Prehistoric Socio-Political Structure on Pohnpei: Perspectives from Mortuary Contexts

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Declaration

Except where otherwise acknowledged,

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Abstract

The traditional Pohnpeian socio-political system has been classified as a complex stratified chiefdom (e.g. Ayres 1990; Cordy 1985; Petersen 1992) and was arguably a state for a few hundred years of the island's prehistory. Oral tradition documents a period when the island was unified by a dynasty based at the site of Nan Madol, followed by a decentralization of power after the dynasty was overthrown (Bernart 1977; Hambruch 1936a; Hanlon 1988a). Archaeological data support the identification of Nan Madol as a major socio-political center in prehistory, but little is known archaeologically about how power was centralized at Nan Madol and the strategies used to maintain the state prior to its overthrow. The primary questions of this thesis surround the mechanisms of social change in Pohnpeian prehistory, particularly the use of coercion and cooperation as a means of developing and/or maintaining a state-level society.

Monumental architecture is often associated with the presence of complex stratified societies and states, and is often referenced in discussions of socio-political development (e.g. Joyce 2004; Kirch 2010; Kolb 1994). Monumental constructions on Pohnpei, particularly those at Nan Madol, have been a point of interest to visitors and researchers since the mid-1800s. Surprisingly, with the numbers of drawings and maps produced of these monuments, little detailed analysis of these structures as a unit has been completed. This thesis addresses questions related to the socio-political development of Pohnpei through the analysis of mortuary monuments and structures.

Detailed comparisons of architectural features performing similar functions can produce invaluable information relating to social hierarchy and change. Examinations of architectural change over time may indicate major shifts in a society's developmental trajectory. This thesis examines monumental mortuary structures in order to examine social strategies in the state period and factors which may have played a role in the maintenance and dissolution the centralized socio-political system. These structures were constructed

across the island, including at Nan Madol. The inclusion of burial platforms with the *lolong* in this analysis will allow for an examination of hierarchical relations between burial types, and identification of potential indicators of socio-political change.

This thesis examines architectural styles, scale of architecture, permanent features associated with each structure, and labor invested into the construction process. The analyses of this data will provide information on relative status of architectural features, the management required to construct these structures, differences between sites, and change over time. The results will then be used to discuss the probability of the use of coercive labor mobilization strategies in building construction, and the wider social implications of the use of coercion in architectural projects. This study will examine the incidence of coercive labor mobilization in contrast to cooperative projects as a means of examining the use of coercion and cooperation in prehistoric socio-political dynamics and state politics on Pohnpei. Finally, the results of this thesis will be discussed in relation the application of cooperative and coercive theories of socio-political development in instances where there is little to no archaeological evidence of interpersonal conflict and warfare.

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Chapter 1: Introduction and Thesis Structure

Complex societies and states have long been a focus of archaeological research. In part this is due to the visibility of some permanent structures and monuments associated with these societies (e.g. Egyptian pyramids, Mayan temples, Mississippian earth-mounds), and is also a function of their historical significance to understanding the rise of hierarchy, social inequality and the development of urban centers. This thesis contributes to this research by examining the development of state-level society on the island of Pohnpei in Micronesia (Figure 1.1). The mechanisms (e.g. warfare, economics, ideology, etc.) that drove prehistoric social change (i.e. complexity and centralization) are not well understood archaeologically on Pohnpei. Evidence regarding the role of specific mechanisms, namely cooperation and coercion, is discussed in relation to archaeological data from architectural features. By identifying possible instances of coercive versus cooperative labor mobilization in managing building projects it will be possible to posit whether these mechanisms played a significant role in socio-political development on Pohnpei.

In recent times new research questions have examined the differences between states and chiefdoms, how complex societies and states develop, and why complex societies and states form in some locations and not in others (e.g. Earle 1991a, b, 1997; Kirch 1984; Paynter 1989; Tainter 1977; Van Buren and Richards 2000; Wenke 1981). In the 1960s and 1970s there was a major push to develop theoretical models that explained how complex societies developed into states, which could be applied to socio-political systems around the world (e.g. Binford 1977; Carneiro 1970; Cherry and Renfrew 1986a). Though some theoretical perspectives have gained more support than others (e.g. circumscription theory) many studies have found that existing models or factors such as trade and exchange, coercion and intensification of production only account for part of the developmental history of complex societies. Through this engagement with model building, archaeologists have clarified differences between socio-political systems and defined the components which distinguish

complex societies and states from chiefdoms and other kin-based social systems. Yet, the examination of social change at its core is based upon the restructuring of inter-personal relationships through the manipulation of material and cultural resources (Barrett 1990), and understanding the dynamics of change and what drives them is now a more fruitful avenue of investigation.

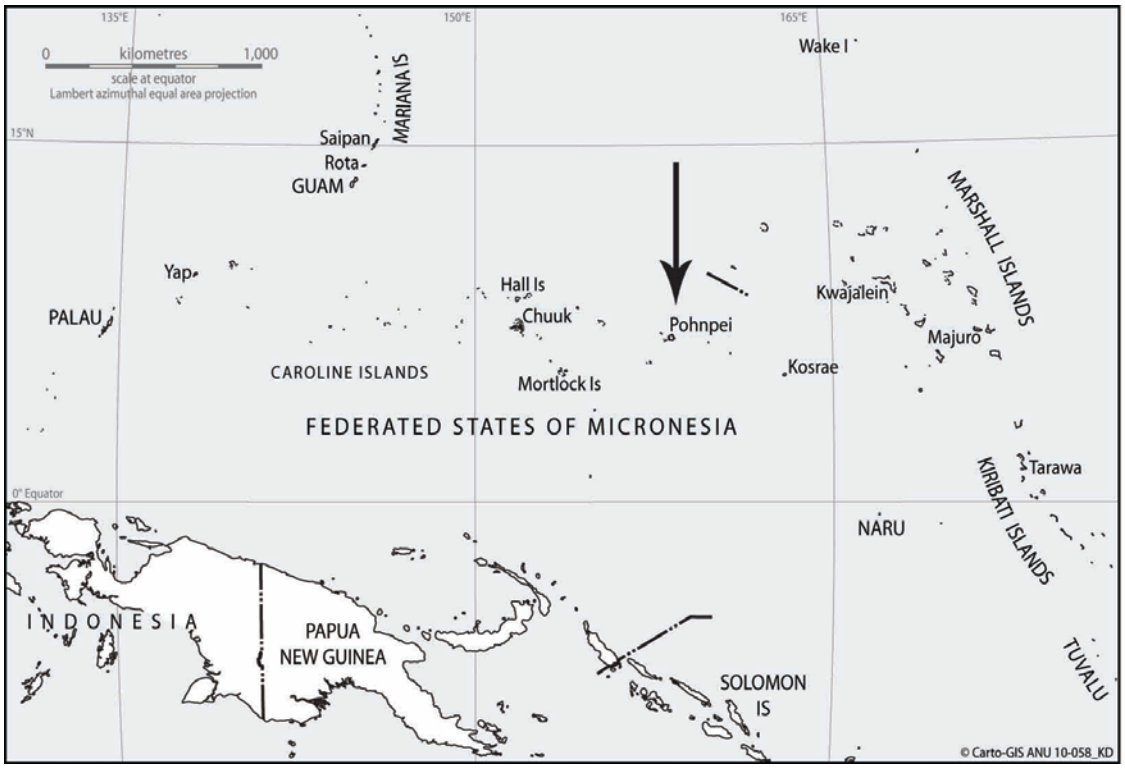


Figure 1.1 Context Map of Micronesia showing the location of Pohnpei.

Though states are defined by the centralization of socio-political power and class endogamy that is lacking in other less complex societies such social systems are also argued to have a number of specific archaeological markers. These include evidence for subsistence intensification to support a growing population and the production of a surplus, settlement hierarchy, the designation of ritual or functional spaces within settlements, and apparent social hierarchy demarcated by distribution patterns of prestige goods or foodstuffs (e.g. Kirch 1984, 2010; Smith 2012). Complex societies and states are also identified by the presence of monuments, public architecture and other public works (e.g. Kirch 2010; Kolb 2012). The Pacific region is known for its large stone monuments (e.g. *ahu*, *moai*, *marae* and *heiau*),

which are the primary feature that identifies many Pacific societies as complex chiefdoms or, in some instances, archaic states. Of the thousands of islands in the Pacific there are only a few which have been identified as states for at least a portion of their history, and even fewer which maintained a state-level society into the historic period. The most archaeologically well documented states include Hawai'i and Tonga. Based on its monuments and other archaeological evidence (see Chapter 3) the island of Pohnpei can be classified as a complex society by at least AD 1000. Some have argued that the island housed a state-level society centered at the site of Nan Madol between AD 1200 and 1600 (Ayres pers. comm.; Cordy 1985), which is supported by archaeological evidence.

Pohnpei is the largest volcanic island in the Caroline Islands of Micronesia with a land mass of approximately 334 square kilometers (Figure 1.1). In addition to the main island, there are numerous small islets within the lagoon and scattered along the fringing reef. Pohnpei also had frequent contact with Mwokilloa (153 km East) and And Atoll (14.5 km Southwest) into the historic period. And Atoll was integrated into the Pohnpeian socio-political system at some point since it was the property of one of the title holders in Kiti during the Contact Period (Bernart 1977; Hambruch 1936b).

Mortuary monuments are significant prehistoric features in the Pohnpeian landscape. These monuments, called *lolong*, are enclosures containing a burial platform(s) surrounded by a large enclosing wall. *Lolong* are most commonly associated with Nan Madol, a site composed of approximately 100 artificial islets occupying 80 hectares of Pohnpei's southeastern reef flats (Bath and Athens 1990). Nan Madol contains dozens of monumental architectural features, including *lolong*, some of which have walls reaching heights of eight meters. In oral traditions, Nan Madol is connected to the Saudeleur Dynasty, which is reputed to have unified the whole island under their rule until they were overthrown (Bernart 1977; Hambruch 1936a). Thus, *lolong* are linked through local tradition to the period when socio-political power was first centralized on Pohnpei.

Lolong have been explored by archaeologists and visitors since western contact in the 1820s, but there has been little discussion of how these architectural features might reflect Pohnpeian socio-political structure and the processes of political centralization. Monumental architecture has long been integral to discussions of socio-political development and stratification around the world (e.g. Alcock 2002; Bradley 1998; Clark 2010; Dietler 1998; Joyce 2004; Kirch 1984, 1990; Kolb 1994; Richards 2004; Sand 1996; Wallin and Solsvik 2010), so it is surprising that *lolong* have not been utilized in the study of socio-political change on Pohnpei. This thesis examines *lolong* to address Petersen's (1990a:150) critique that more time should be devoted to studying the pre-Contact development of social complexity on Pohnpei.

1.1 Current Research Gaps

Studies of complex societies are historically focused on identifying states and chiefdoms. When discussing how and why states form, perspectives tend to divide between warfare/conflict-based or cooperative explanations (e.g. Carballo et al. 2014 vs. Carneiro 1970, 1988, 2012). Though they recognize other factors which may influence the pace of increasing complexity, arguments often boil down to an either/or explanation. What is overlooked in these approaches is how coercion and cooperation were key drivers of social development and complexity. Focusing on how states and complex societies form is only part of the story, how complexity is maintained is equally important.

Often the conversation is limited to the presence or absence of evidence of warfare and inter-personal conflict (e.g. fortifications, weapons, skeletal material with trauma). Yet, the lack of evidence of conflict or warfare is not enough to prove an argument based on cooperation as the primary mechanism of socio-political development, since there are other forms of coercion that are more difficult to track in the archaeological record (e.g. threat of violence, labor conscription, social duties, etc.). The question here is where else to look for indicators of coercion and cooperation, and how these mechanisms can be identified in the

archaeological record. Possible markers of coercion include evidence for slavery in mortuary behavior and skeletal health and disease, the presence of standing armies and conflict, and the presence of large structures, monuments and earthworks into which significant labor was invested, at times, using conscripted labor or slaves (e.g. Brunt 1980; Dai 2001; Janssen 1978; Kiser and Cai 2003; Lorton 1977; Martinon-Torres et al. 2014; Scheidel 2008, 2012). Indicators of cooperation include public architecture, communal monuments and evidence for integrative social events or ritual practices (e.g. Albarracin-Jordan 1996; Aldenderfer 1993; Hegmon 1989). Monuments in particular should be able to provide some evidence to contribute to this discussion, since they are a common feature of complex and state societies which have multiple meanings and are built for a range of reasons (see Section 2.5 in Chapter 2). The Pacific is one location where this approach to non-violent forms of coercion may prove useful, since many islands have oral traditions that recount conflicts and wars in prehistory and there is often little to no archaeological evidence of violent conflict.

Pacific islands are often put forth as model locations to examine issues related to the origin and expansion of socio-political structures. However, many questions related to the influence of specific factors and mechanisms on the development, maintenance, and potential decline in social complexity still remain to be answered. Archaeological discussions of socio-political change in the Pacific relate largely to the rise of stratified chiefdoms and early state development in Polynesia, particularly Hawai'i (e.g. Dye 2010; Kirch 1984, 1990; 2010; Kolb 1994; Ladefoged and Graves 2006). There has been valuable archaeological work done on social change and development in Melanesia (e.g. Sand 1996, 2002; Walter and Sheppard 2001) and Micronesia (e.g. Athens 2007; Ayres 2002; Bath 1984a; Cordy 1986; Ueki 1990). Yet, anthropological and historical studies of social change and the development of chiefdom societies far outnumber archaeological studies in these regions (e.g. for Pohnpei see Coale n.d./1951; Dahlquist 1974; Ehrlich 1978; Fischer 1974; Hanlon 1988a; Hughes 1968, 1982; Petersen 1979, 1982a, 1990a, b; Riesenberg 1968).

The relatively small number of studies relating to socio-political development in Oceania generally is not a reflection of the amount of work done in a given region or island group, but rather is due to research on other major issues. These include settlement, human impacts on the environment, colonization and other questions, and site specific research, which contributes, indirectly, to discussion of social change. Pohnpei is one location where the discussion of social change has largely stagnated even though there is evidence - traditional, archaeological and ethnohistoric - that can contribute to the discussion of what drove social development on the island over time.

The development of new, or more complex, architectural features often indicates significant social and political change (e.g. Abrams and Bolland 1999; Joyce 2004; Wallin and Solsvik 2010). Architectural complexity pertains to architectural construction styles (e.g. header-stretcher or stacked stone) as well as architectural types (e.g. tomb structures or burial platforms). Tracking changes in the type and scale of architecture can identify specific points where hierarchical societal changes occur, either towards or away from centralized systems. The development of elaborate monuments is frequently linked to the development of social hierarchy and, in some cases, socio-political centralization (e.g. Clark et al. 2008; Kirch 1990; Kolb 1994). Ueki (1990:304) notes that studies of social stratification examining burial structures and house sites in Micronesia were just starting 20 years ago, unlike other areas of the world which received attention much earlier (e.g. Egypt, Central America). Though studies have progressed significantly since then, few studies have specifically attempted to explain social structure in relation to architectural features on Pohnpei or other Pacific Islands (e.g. Ayres and Seikel 2014; Kolb 1994, 1997, 2012; Liston 2009; Phear 2007; Seikel 2011).

Petersen (2006:86) notes that the early history of socio-political development on Pohnpei after settlement (c. AD 1) was not particularly distinct from other Micronesian societies or even other Pacific societies. However, later prehistoric developments on the island were unique in Oceania based on the scale and type of monumental architecture that arose. Pohnpei has arguably been identified as an incipient state-level society centered at the

site of Nan Madol during the time-frame (c. AD 1100-1650) with which this thesis is concerned. How and why the Pohnpiean state developed and subsequently dissolved is poorly understood archaeologically, as is the means through which the state was maintained.

1.2 Research Objectives

Centralization of power during state formation is a significant issue in the development of socio-political systems. The overarching goal of this thesis is to determine how coercion and cooperation affected socio-political development on Pohnpei when power was centralized under Saudeleur rule. This information can then be used to discuss why socio-political centralization occurred and how a 'state' government was maintained.

The two primary strategies that group leaders and elites use to create and hold together complex societies are cooperation and coercion. Consideration of coercive strategies is common since conflict often accompanies the reorganization of socio-political structure, as in Rapa Nui or the Maya lowlands (Barrett and Scherer 2005; Kirch 1984; Louwagie et al. 2006; Palka 2001; Scherer and Golden 2009). Yet, there is little to no direct archaeological evidence of warfare or conflict on Pohnpei prior to the historic period (refer to Chapters 3 and 4). In order to find evidence of coercion in prehistory it is necessary to look beyond conflict. This thesis examines possible indicators of the use of cooperative and coercive socio-political strategies through archaeological study of architectural features.

This thesis examines coercion and cooperation from the monumental constructions of Pohnpei, to understand how they influenced the rise and dissolution of social complexity. In the past, as now, Pohnpeians have used permanent constructions, typically of stone, to "define and differentiate social status and political rank differences" (Ayres and Scheller 2002:110). Architectural variation is indicative of social hierarchy as status is often manifested through construction investment in permanent structures (e.g. Abrams and Bolland 1999; Ayres and Scheller 2002; Kirch 1990). The analysis of architectural variability in mortuary

structures, including the organizational management of construction, is used to address social hierarchy and the strategies employed to mobilize labor for construction.

This study primarily examines the period of state formation under the Saudeleur dynasty (c. AD 1200-1600). It focuses on Pohnpei's *lolong*, which are associated with this period in Pohnpei's history. While much of the data discussed in this thesis is derived from Nan Madol, architectural datasets from mortuary structures in other districts are added to examine "Nan Madol as a part of Pohnpei's larger past rather than as its focus" (Hanlon 1990:111).

This thesis examines architectural patterning in mortuary structures to determine whether coercive or cooperative strategies were more influential in constructing mortuary architecture associated with state-level society on Pohnpei. This approach emphasizes the probability that methods for mobilizing labor for major architectural constructions would have been utilized for other purposes as well. Determining when coercive or cooperative strategies may have been used in mobilizing labor for major construction projects provides insight into the roles that coercion and cooperation may have had in state socio-politics. An understanding of these mechanisms of social change can then be used to produce hypotheses about the development of a centralized state-level socio-political system on Pohnpei which was maintained for 300 or 400 years.

A set of criteria that plausibly differentiate between structures built through primarily coercive or cooperative means is developed (see Chapter 2) and applied to an analysis of mortuary structures (*lolong* and burial platforms). How monumental architecture reflects socio-political change, namely the relationship between social status and architectural elaboration, the role of ancillary features (e.g. stone alignments, pavings, platforms, etc.) in the social and ideological system, and how labor mobilization is influenced by social networks and status hierarchy are examined to identify structures which may have been built using coercive rather than cooperative means. Patterning and variation in monuments at Nan Madol and comparison with other sites is then used to examine how cooperation and

coercion may have been employed in the development of a complex socio-political system on Pohnpei, particularly the centralization of power at Nan Madol. The examination of monuments, in this case mortuary monuments, provides a case study exploring the use of coercive and cooperative labor mobilization strategies in prehistoric structures. The identification of coercion and cooperation in architectural construction should provide a new means of examining social complexity in prehistory.

1.3 Thesis Structure

The principles and processes of socio-political change are not unique to a society, but the interplay and strength of different factors gives rise to varying developmental trajectories (Earle 1997:211). Chapter 2 examines the application of coercive and cooperative theories to understanding the development of social complexity elsewhere. It then, outlines how these theoretical perspectives will be applied to mortuary monuments from Pohnpei. A series of hypothetical criteria to distinguish between structures built via coercive or cooperative means are outlined. These criteria are discussed as a means of linking strategies of labor mobilization with the primary mechanisms which drove socio-political change. In order to examine the mechanisms of change it is necessary to understand the development of political complexity on Pohnpei from the emergence of a centralized society to the breakdown of this highly stratified system. Chapter 3 reviews the oral traditions and archaeology of Pohnpei to build a general model of social change over time. Once this context is introduced, Chapter 4 covers what is currently known about the role of specific factors and mechanisms impacting Pohnpeian social development throughout its history using archaeological, geographical, oral traditional, anthropological, and ethnohistorical data. By presenting this information, it should be clearer as to which factors, mechanisms and strategies may have had greater influence on Pohnpeian social change over time.

Pohnpeian mortuary practices and archaeological data, particularly architectural, related to these practices are defined and analyzed in Chapters 5 through 8. Chapter 5 reviews

what is known about Pohnpeian mortuary practices and structures from ethnographic and ethnohistoric accounts, as well as past archaeological research. Chapters 6 through 8 examine mortuary architecture and the organizational management involved in the construction of *lolong*. Chapter 6 includes site descriptions, excavation data, radiocarbon dates, and qualitative analysis of mortuary features examined in this study. Chapter 7 presents the quantitative architectural analyses. Chapter 8 discusses estimates of labor investment and a case study which aims to refine these estimates by providing more accurate transport distances for construction materials through a geochemical analysis of stone used in mortuary features.

Chapter 9 discusses the datasets in relation to one another and the hypotheses posed in Chapter 3, which will contribute to discussion of the influence of coercion and cooperation in Pohnpeian social change. The discussion of these influences will be addressed in relation to the data presented in Chapter 4 as a means of understanding which factors and mechanisms had the greatest influence at various times to produce the model of social development on Pohnpei (see Chapter 2). With this understanding of the driving mechanisms of socio-political change on Pohnpei, the island can be integrated into the discussion of the various developmental trajectories of Pacific island societies.

Chapter 2: Mechanisms of Socio-Political Development in Archaeological Context

Over time the Pohnpeian socio-political system developed a significant degree of complexity and centralization, arguably leading to state formation. The centralized system appeared to have destabilized and broke down after a few hundred years. Previous work has allowed for the construction of a generalized model of socio-political change over time (see Chapter 3). However, the mechanisms (e.g. warfare, ritual, economy) tied to the development of this centralized polity and its demise are not well understood apart from what is recorded in Pohnpeian oral tradition about specific leaders and/or events. It is important to understand how specific mechanisms or strategies (e.g. coercion, ritual) were used to influence socio-political centralization and the subsequent decentralization of power on Pohnpei. This study focuses on the mechanisms which significantly impacted the development of the socio-political system on Pohnpei around the time of state formation and dissolution, particularly coercion and cooperation.

Coercion and cooperation manifest in multiple forms, which may not be obvious in the archaeological record. I believe that in centralized, state societies one avenue to examine potential indicators of coercive and cooperative social strategies is architectural analysis. This thesis examines coercion and cooperation in relation to mortuary architecture including those built on a monumental scale, since the monuments are associated with state-level society on Pohnpei. A second reason for choosing these structures is that they are highly visible with ties to group and individual identity, ideology, status hierarchy, and social differentiation. This provides a means to investigate the social and political facets of Pohnpeian society in the past.

2.1 Social Systems and the Development of States

As important as the processes driving socio-political development and state formation are, it is necessary to define what constitutes a state. States are generally preceded by one or

more of the following types of social organization: kin-based societies, chiefdoms and stratified chiefdoms. The trajectory to state formation, when it occurs, varies from society to society, and once a state is formed leaders must find a means to maintain it. State-level society is not necessarily stable and states have been known to dissolve or be overthrown (e.g. Maya states, Harrapa, and Rome).

Cordy (1985:160) defined a state as a socio-political system with four or more organizational levels, while a complex, stratified chiefdom has three or more levels. This definition leaves much to be desired regarding the boundary between states and complex chiefdoms, since there is potential overlap between states and stratified chiefdoms in regards to levels of hierarchy. By Cordy's definition it is possible for a stratified chiefdom to have the same number of organizational units as a state, which means other components are more important in defining states from stratified chiefdoms. Significant research has gone into further demarcating the line between states and chiefdoms and refining Cordy's definition (e.g. Bath 1984a; Earle 1991a, 1997, 2000; Golden and Scherer 2013; Kirch 1984, 2010; Petersen 1982a). Chiefdoms are characterized as kin-based societies with parallel hierarchies and a wider range of paths towards social advancement (Earle 1997:5, 151), whereas states are large territorial units that dissolve land use rights of the population and have a centralized power structure and some form of class endogamy within the highest ranked groups (e.g. Golden and Scherer 2013; Kirch 2010).

The challenge in arriving at these definitions of the state is that the sources of socio-political power (e.g. land tenure, armies, economic control) around which the processes of social change and development are based do not inherently change once a certain level of social complexity or integration is attained. Cooperation, coercion, and economics are amongst the mechanisms that form a recurring theme in this discourse. The primary goal is to understand the mechanisms of socio-political development on Pohnpei, particularly coercion and cooperation, so does it matter if it is chiefdoms or states which are being discussed?

The interest in states stems from a need to understand why and how they form, especially as state formation is not necessarily beneficial to a population. Golden and Scherer (2013:404) note that it was the job of the leaders of states or complex stratified chiefdoms to provide social incentives (e.g. economic opportunity, protection) to maintain a stable polity with a supportive population. The sources of socio-political power and the inter-relationship of these sources determine the stability of a polity and the scale of its influence (Earle 1997). More stable social systems can develop greater complexity over time, but this is not a given. Social change and the development of centralized social systems and states are far more complex than unidirectional evolutionary models recognize (e.g. Golden and Scherer 2013; Schwarz 2013). Although increasing complexity can be produced in reasonably stable social systems, it is not a prerequisite for social development.

If a stratified chiefdom is stable and thriving, what causes the transition from chiefdom to state? It has been suggested that as chiefdoms increase in organizational complexity kinship ties may become less central to the functioning of society (Earle 1997; Kirch 1984). Is it possible that a lessened influence of kin-ties contributed to the formation of state societies? In the formation of primary states, which develop without the influence of outside groups or polities, it is possible that a lessened importance of kinship created avenues to develop new hierarchical structures within society. This may not be the case in secondary states, which developed in succession from a previous state or through contact with other societies at various stages of development (Parkinson and Galaty 2007:114). The potential impact of outside influence on kinship ties within a society can only be examined on a case by case basis in relation to other factors.

One thing that is clear in studies of the development of state societies is that there is a material change in the physical representations of culture. The sharing of architectural and artifact styles over a geographic area suggests that various polities were integrated into a centralized socio-political system, which was a focus for ideological, economic and/or social practices (Golden and Scherer 2013). Though definitions vary, the development of state-level

society is demarcated by the appearance of settlement hierarchy (i.e. regional socio-political centers associated with smaller settlements and hamlets) and significant changes to social practices, architecture, and modes of production (see Bath 1984a; Golden and Scherer 2013; Smith 2012).

2.2 Theories of Political Development

It is the structuring of social systems which is integral to the understanding of socio-political development beyond the assignment of a society to a typological category (Kristiansen 1991; McGuire 1983; Petersen 2006; Tainter 1977). Over past decades researchers have moved past typologies and unidirectional evolutionary development in favor of looking at social change through frameworks of social interaction, developmental change, shifts in political centralization, and power relations (Cobb 1993; Earle 1997; Golden and Scherer 2013; Kirch 1984; McGuire 1983; Paynter and McGuire 1991; Petersen 2006; Renfrew 1986; Steponaitis 1991; Tainter 1977). Currently, theory is limited in terms of developing predictive models of state formation as causation appears to vary from society to society (Athens 1977).

McGuire (1983) notes that effort would be better invested in thinking of social complexity as a product of a number of inter-related components. “Before we can specify how cultural complexity changes, we must be able to specify the systemic relationships within a society that make it complex and the consequences of change in these interrelationships” (McGuire 1983:95). It is necessary to look at the individual features of a society and how they interact before attempting to reconstruct the system and how it changed (Tainter 1977). It is understanding how society operated over time and the nuances of each situation that allow us to make meaningful conclusions about why trajectories of social development vary from society to society.

The examination of social change at its core is based upon the restructuring of inter-personal relationships through the manipulation of material and cultural resources (Barrett

1990). The mechanisms of change (e.g. cooperation and conflict) and their related factors (e.g. surplus production, technological change) vary with each socio-political shift within a culture or society. These mechanisms are in action long before change actually occurs, and should have spatial and/or temporal components (Cherry and Renfrew 1986b). Mechanisms may be similar across time and geographic space but they tend to be geographically and historically contingent, varying in influence and importance over time (Hirth 1996). This does not negate the value of recognizing trends or patterning identified in cross-cultural or regional studies, but no "single paradigm will ever parsimoniously and sufficiently 'explain' the transformation" of all societies within a geographic region (Kirch 1984:8). It is necessary to review the processes which drove change within a society before productive comparative analysis can be undertaken.

2.2.1 Theories of State Formation

"All societies are composed of diverse groups, each of which has its own internal social structure, and every society must integrate such diverse groups into a whole" (McGuire 1983:117). Therefore, in order to meet their primary goal to maintain societal stability and their own status, political leaders and the social elite must promote social integration (Barnett 1953; Golden and Scherer 2013). The most common practice to this end is the structuring of a culture's collective history, putting forth the current system as legitimate and founded in traditional social values and ideology (Halbwachs 1992; Van Buren and Richards 2000). However, social relations are continually restructured (Earle 1997) which in turn modifies the collective memory of the society (Halbwachs 1992).

It is this continual restructuring of social relations that provides individuals and groups with a means of asserting influence on socio-political development, which in some cases can lead to state formation. Socio-political change provides an opportunity for ideology and collective history to be constructed or restructured (Cannon 1989; Carsten 1995; Coleman 1992; Halbwachs 1992). This practice creates multiple narratives with one adopted as the

'official' historical and ideological perspective (Cobb 1993; Coleman 1992; Confino 1997; Earle 1997; Eves 1996; Halbwachs 1992). Establishing an elite or national history/ideology creates and often reinforces the position of elites and high-status groups, and indirectly establishes inequalities within society (Brumfiel 2000; Earle 1997; Eves 1996; Halbwachs 1992; Henige 1974; LeGoff 1992; Paynter and McGuire 1991). In many cases new social and political developments are built upon past history, legitimacy and ideology rather than negating their influence (Brumfiel 2000). Elites in highly stratified societies often strive to create legitimacy through their claimed connection to the distant past or the system's antiquity (Van Buren and Richards 2000). Those most successful in the practice of ideological and social restructuring build upon past socio-political or religious practices as a means of integration (Halbwachs 1992).

Perceived inequality also plays a major role in social change, as does contact with other polities (Barnett 1953; McGuire 1983; Paynter and McGuire 1991; Renfrew 1986). There are groups and individuals within society who wish to change their standing in society regardless of their initial social status. When presented with options for social change, whether from within or without, it is typically groups who are limited in what they believe to be full participation in their own society (e.g. youths and disenfranchised) that are more willing to adopt new ideas, practices, and resources (Barnett 1953). In some cases a desire for change will result in significant social conflict (e.g. revolutions, coups), and it is during times of social instability and upheaval when the most significant change occurs (Barnett 1953).

The acquisition of social status and prestige, through social competition or conflict, is meaningless unless it is deemed legitimate by society. "In essence legitimacy is the institutionalization of people's acceptance of, involvement in, and contribution towards order" (Baines and Yoffee 2000:15). The challenge for social leaders and elites is creating and maintaining the legitimacy of the social structure and their status (Baines and Yoffee 2000; Brumfiel 2000; Earle 1997; Golden and Scherer 2013; Van Buren and Richards 2000). It is the

continued validity of a socio-political system that allows it to persist, regardless of its age or practical functionality.

Depending on the circumstances, social change and development can occur over a very brief period (see Kirch 1984 for examples). Even considering the rate of change, social development cannot be considered as a by-product of either internal or external forces, but the product of social mechanisms acted upon through various conduits (Earle 1997, 2000; Renfrew 1986; Steponaitis 1991). There are always multiple paths to power and strategies in play that contribute to social change (Earle 1997; Steponaitis 1991:213). Often more than one strategy operates at a given time, so it is important to identify which one takes primacy during periods of significant social change.

One strategy that has been under debate in regards to its role in many societies is the use of warfare or conflict in social change. There has been some question whether warfare is indicative of social instability and a lack of socio-political legitimacy or whether it was a mechanism through which legitimacy was established or both (see Earle 1997). It is possible that warfare, in producing a new social order, could be a legitimizing force, because for a particular system to be accepted the history/ideology supporting it must appeal or apply to a significant cross-section of the population (Brumfiel 2000; Earle 1997).

Many theories of political development favor specific mechanisms or factors of social change. In theories of state formation, the role of conflict and warfare is most pointedly highlighted in circumscription theory. For this reason circumscription theory has been both widely applied and thoroughly debated (e.g. Carballo et al. 2014; Carneiro 1970, 2012; Kirch 1988a; McCoy et al. 2014; Schacht 1988; Varien et al. 2000). The next section briefly reviews the principles of circumscription theory.

2.2.2 Circumscription Theory

Circumscription theory falls under the category of coercive theories of state formation. These theories highlight the role of conquest warfare and coercion in persuading small,

autonomous groups or polities to merge with other groups and form larger political units and/or states. Many coercive theories rely on the logic that there would be no reason why groups would *voluntarily* cede their autonomy in favor of creating a new social order. Circumscription theory goes further to examine additional factors and mechanisms (e.g. subsistence, population pressure) that work in concert with conquest warfare to form states, which is why it has gained significant support in research on social change and state development.

Carneiro proposed circumscription theory in 1970 as a unifying theory which could be used to explain the development of social complexity and state formation. The primary elements outlined by Carneiro (1970, 1988, 2012) in circumscription theory are environmental circumscription, population pressure, resource concentration, and warfare. With all these mechanisms access to land is a primary factor. Carneiro (1988, 2012) argues that within an environmentally circumscribed area population growth will lead to population pressure and restricted access to land. Hence, competition for land increased with the population, which Carneiro (1970, 1988, 2012) posits led to conquest warfare as a means to mitigate population pressure. The primary prerequisite of the development of social complexity and state formation is population pressure (Carneiro 1988:503), though more recently Carneiro (2012) has recognized the influence of resource concentration as more significant than environmental circumscription since it is more difficult to mitigate.

Circumscription theory has particularly been utilized to describe state formation and social complexity in the Americas (e.g. Kuckelman et al. 2002; Nielsen and Walker 2009; Varien et al. 2000) and has been applied to some islands in Polynesia (e.g. Kirch 1988b, 2010; McCoy et al. 2014). Even though circumscription theory has been useful in many cases, there has been criticism of its limited focus (e.g. Dye 2009; Golden and Scherer 2013; Kirch 1988a; Rees 1997; Schacht 1988). The mechanisms identified as crucial in circumscription theory have not been disputed, but the theory has been critiqued for not accounting for other mechanisms or variables. Some elements recognized in the works of others as contributing to

socio-political change within prehistoric societies include cooperation, ritual and ideology, and social competition outside the realms of warfare and conflict (Aldenderfer 1993; Golden and Scherer 2013; Hegmon 1989; Schacht 1998).

2.2.3 Other Perspectives on State Formation

Non-coercive theories of social development and state formation focus on the roles of ritual and ideology, cooperation, and social integration. These theories do not ignore the potential impact of coercion and warfare, but they all agree that it has been given too much primacy (e.g. Albarracin-Jordan 1996; Aldenderfer 1993; Carballo et al. 2014; Golden and Scherer 2013; Hegmon 1989; Schacht 1988). Religion or ritual is a common theme in non-coercive theories since ritual is a means to enact the ideological worldview of a society where social relations are reified and reinforced (e.g. Aldenderfer 1993; Fox et al. 1996; Hegmon 1989; Van Gijseghem and Vaughn 2008). Another theme is integration through cooperation and or social obligation (e.g. Albarracin-Jordan 1996; Carballo et al. 2014; Dye 2009; Golden and Scherer 2013). In particular, Golden and Scherer (2013) argue that integration through whatever means (e.g. religion, kinship relations) may create a more stable polity than warfare or coercion.

This thesis examines both the mechanisms favored by circumscription theory as well as others that have been proposed as vital to the discussion of social development and state formation. By starting with circumscription theory and its framework we should be able to identify times where cooperation or ideology may have had more influence than conflict. It is necessary to define and review these mechanisms before they can be addressed as they relate to my discussion of socio-political development on Pohnpei.

Though the factors and mechanisms of social development are easy enough to pin-point conceptually, it is not as easy to connect them with the material remains left to archaeologists. In order to find clues about specific mechanisms, it is necessary to choose the types of data that may be most beneficial to examining the factor or factors one is interested

in addressing. For example, in order to examine environmental circumscription, it would be more valuable to look at geography, settlement densities, subsistence intensification, and evidence for possible trade connections.

2.3 Factors and Mechanisms of Social Development

Various mechanisms and resources are used to restructure social relations on every level of society (Barrett 1990), and these factors can be introduced from within a society or by another group or community (Braun 1986; Renfrew 1986). It is imperative to understand that "the social practices linking individuals, the household, and larger corporate groups into political structures were cross-cut by lineage and descent groups that were themselves couched in, and sometimes trumped by, territorial and other concerns that created complex networks of social obligations" (Golden and Scherer 2013:403). The actions of individuals are not solely tied to their social status or rank, and changes to social structure may be due to individual choices based on experience or ideology (Bolyanatz 2000; Golden and Scherer 2013). Still, social hierarchy is predicated on the ability of one group to limit the power acquired by another (Earle 1991a), in effect limiting the influence of individual choices in favor of group solidarity. Understanding the underlying processes driving politics will allow for a clearer understanding of socio-political change (Earle 1991a:15).

Social practices (economic or ideological) maintain society as it develops and changes (Barrett 1990). In this way inter-personal relationships are very much based on the structuring of history, ideologies, economics, and politics. Yet, social change and development are not only impacted by community and group dynamics. Components of the processes driving socio-political development include subsistence practices, inter-community or regional interaction, demographic growth, competition, surplus production, craft specialization, and technological development. How much each of these factors impacts upon the mechanisms of social change (e.g. social competition, warfare, cooperation) varies in each instance of change. For example, socio-political change in any given location around the time of settlement may

be more significantly impacted by subsistence and demographic growth than craft specialization or conflict. Understanding how different factors (e.g. land tenure, social competition) operated over time within a society is invaluable in the reconstruction of political development. It may also contribute to the refinement of typological definitions and discussions of how mechanisms (e.g. coercion, cooperation) of change are operationalized.

Before it is possible to address how social practices and environments influence the processes of social change, the mechanisms driving change need to be defined and discussed. The following section outlines the mechanisms of change as highlighted by circumscription theory as well as non-coercive theories.

2.3.1 Environmental Circumscription and Population Pressure

Environmental circumscription is the limiting of a population to a specific area based primarily on natural geographic boundaries. Groups can be circumscribed by the presence of other groups around their territorial boundaries, but this type of circumscription is more easily mitigated than geography. Population pressure occurs as the population grows and the group's territory does not expand with the population, which, in turn, limits the amount of available land per person.

Often limited access to land forms inequalities upon which social hierarchy develops (Earle 1991b, 2000). By controlling property and/or land-use rights high-status individuals significantly impact upon the lives of others and control many aspects of surplus production, in effect controlling the livelihood of the population (Earle 1991b, 1997, 2000; Hirth 1996). As differential control of resources is integral to the development of social stratification, it is necessary to consider all forms of resource control, not just production and exchange (Hirth 1996). "Regional chiefdoms would have established a regional peace and regularized rules of property and, thus, allowed for the development of large-scale specialized production with corresponding increased efficiencies" (Earle 2000:42). In addition, constructions (e.g. walls,

ditches, terraces) or structures (e.g. buildings, monuments) may act as territorial markers (Earle 1991b).

Internal and/or external influences do not institute change in a vacuum, but rather impact a society in concert with varying degrees of input at any given time (Renfrew 1986; Steponaitis 1991). Even if a geographic area becomes isolated from outsiders, there are multiple localized interest groups which influence each other (see Kirch 1984, 2010). But isolation from foreign inputs can significantly impact upon social and technological change (Kirch 1984). In cases where isolation is not a factor, significant social change in one community may trigger changes on a local or regional scale (Renfrew 1986; Steponaitis 1991). Social systems of all scales change in response to interaction with other systems regardless of intention (Renfrew 1986; Steponaitis 1991). Even though a study may focus on change within a specific region, it is imprudent to detach that system from foreign influence (Steponaitis 1991). Even brief encounters between groups or societies can trigger significant social and/or technological changes.

The potential for foreign influence is significant to the discussion of circumscription because contact between groups and the possible migration of group members is one way which population pressure or limited access to land may be mitigated. States that form with this type of inter-group interaction at various stages in their development are considered secondary states (Parkinson and Galaty 2007:114). This type of state tends to be more common since complete isolation from other polities is rare (Parkinson and Galaty 2007; Renfrew 1986). Even in cases where inter-group contact is intermittent the development of a state in one society can influence state development in neighboring societies. In the case where states form in true isolation, often geographic, they are considered primary states (Parkinson and Galaty 2007). This distinction is particularly important because their archaeological signatures should be distinctive (e.g. evidence for external contact based on exotic goods in secondary states).

2.3.2 Conflict, Warfare and Coercion

Inter-personal conflict occurs in all societies and conflict can be manifested through social competition, inter-personal violence, or warfare. Of these social competition and warfare are the most likely to cause social change, and of the two warfare causes the most impact in the shortest time. Warfare takes a number of forms including raiding, skirmishes, and conquest warfare.

Warfare is planned violent conflict between groups of people or factions, which can be from different communities or from opposing groups within a society (Thorpe 2003). Typically warfare occurs as a means for one group to gain power and/or territory. In the archaeological record evidence of violence and warfare consists of human remains with violent traumatic injuries, weapons, defensive structures or fortifications (e.g. palisades, ditches, walls, etc.), and artwork depicting battles or violent confrontations. These types of material remains, when recovered, provide a fairly clear indication that conflict and/or conquest warfare played a significant part in social development at some point in a society's history.

Early evidence for violent conflict and warfare occurs around 8500 BC in Europe and by 5000 BC in the Americas (Dye 2009; Thorpe 2003), though there may be earlier evidence that may have been obscured by taphonomic processes (e.g. Milner 1999). This includes evidence of points impacted in skeletal remains. It has been suggested that early conflict may have constituted spontaneous raids related to resources (Dye 2009:40; Maschner and Reedy-Maschner 1998). Conquest warfare and other forms of conflict developed along with societies. Conflict and wars over land, status and resources had significant influence on socio-politics, economics and ideology (Kolb and Dixon 2002; Nielson and Walker 2009; Snead 2008; Thorpe 2003). Yet, in many cases the threat of conflict is more prevalent than warfare itself (Topic and Topic 2009).

Often before conflict ensues there tends to be a period in which individuals and groups negotiate their positions. A common feature in these negotiations is the use of

coercion as a means of winning the fight without having to go to battle. Coercion is the practice of attempting to obtain a goal through threats of violence or social sanctions. Some examples of coercive threats include exile, the seizing of land or possessions, the destruction of crops or property, and war. Evidence of coercion in the archaeological record is ephemeral though it is more common throughout history than warfare (Maschner and Reedy-Maschner 1998; Milner 1999). The use of coercion may be inferred in some cases (e.g. where a major building project would seem to mobilize a significant labor force over an extended period of time), but it is often overlooked in archaeological discussions of social change (e.g. Webster 1990).

2.3.3 Social Integration

Cooperation and coercion are both tools which social elites integrate various groups within a polity. Coercion has been covered in the previous section (Section 2.3.2), but cooperation has yet to be addressed. Group cooperation is built upon reciprocity, reputation, redistribution, and rewards (Carballo et al. 2014:106-107). In order for cooperation to be an integrative force elites and community members must create a way of coping with potential conflicts of interest (Carballo et al. 2014). This negotiation places constraints on elite strategies of power consolidation (Stein 1998), and requires the group/s to create a balance of political, economic, and religious priorities to form a cohesive society (Albarracin-Jordan 1996).

In order to maintain social integration on a broad scale the leadership must be seen as legitimate by their elite counterparts and society as a whole. “In essence legitimacy is the institutionalization of people’s acceptance of, involvement in, and contribution towards order” (Baines and Yoffee 2000: 15). Legitimacy is upheld by cultural practices and ideologies that form cultural symbols which emphasize the unifying elements of the polity and common history (Earle 1997; Van Buren and Richards 2000). However, some practices relate to elite ideologies are more effective as a way to gain the support of the elite or dominant members

of society (e.g. conferring titles, monument building, etc.) rather than garnering the support and submission of the masses (Brumfiel 2000; Paynter and McGuire 1991).

The social integration of disparate groups within a society is necessary to build a stable polity, but it must be maintained once it is achieved. Conflict, warfare, the introduction of new ideas or beliefs, resource stress, and abuses of power are amongst the factors which may threaten the stability of a polity or state. The development of socio-political systems incorporates failure as well as growth (Golden and Scherer 2013). Failure, unlike the collapse of a society, does not leave a power vacuum at all levels but reorganizes society (Golden and Scherer 2013). The failure of socio-political systems was likely more common than complete societal collapses.

Golden and Scherer (2013:400) suggest that the use of coercion was potentially less integral to the development of complex state-level social systems than has been suggested in the past. Trust in the socio-political system is as important as social networks in maintaining the legitimacy of the system itself (Golden and Scherer 2013). Socio-political systems which fail tend to do so because of long-term issues with governance than short-term social and/or environmental impacts (Golden and Scherer 2013). “The poles of political integration and disintegration are not starting and ending points, but instead represent dialectical potentials resolved in political practice as states teeter over the decades and centuries between strong centralization, failure, collapse, and potential recovery” (Golden and Scherer 2013:413).

2.3.4 Resource Concentration and Economy

Economics is predicated on the availability of specific resources, whether those resources are land or material goods. Resources tend to be concentrated in clusters rather than being evenly distributed throughout a territory. Individuals and groups attain power or influence based on their control of productive land, mineral resources, and other natural resources which can be used to produce agricultural surpluses or goods that can be traded. Durable goods are part of the surplus economy, as are excess food-stuffs (Kolb 1994). Surplus

is not a static variable; the nature of surplus changes as society and technology develop (Kirch 1984). Subsistence development may have been important early on while durable exchange materials may increase in importance later.

Competition for control of or access to highly concentrated resources contributes to the development of social complexity through the negotiation of power structures within and between groups or communities. The control of durable goods and prestige items is a reliable way for leaders to underpin their authority (Kirch 1984; Kolb 1994). Often the control of these goods was manifested in systems of exchange and redistribution. “Exchange and political power are linked to one another in creating and reproducing local and regional power structures” (Kristiansen 1991:26).

Prestige competition is one way in which surplus and other material goods are utilized for individuals and groups to gain social status (Cobb 1993; Earle 1997; Hirth 1996). In some kin-based societies redistribution of goods may be more important than the accumulation of surplus and wealth items in acquiring status (Cobb 1993). Cultural traditions and ideology impact the ways in which local surplus and materials, and exotic trade goods are used to create power structures and social differentiation (Brown 1981; Cobb 1993; Wiessner 1996).

Resources can be mobilized in a wide range of practices stemming, at least in part, from prestige competition (Barnett 1953; Hirth 1996). Some of these practices include participation in redistributive feasts, the use of edible surplus to mobilize labor for building projects, the utilization of available resources in support of innovations in technology or engineering, or the display of wealth items in a given setting to indicate relative prosperity. Individuals and groups that successfully participate in these types of activities gain status and power (Earle 1997). In essence prestige competition materializes the fitness of leaders within the social hierarchy. The competition for prestige occurs not only between groups, but also between members of the same group (Athens 1977). There are social conventions related to what types of activities may constitute socio-political competition and at what level an individual or group might participate (Wiessner 1996). “There were … social, religious, and

moral sanctions for not participating in such activities and benefits yielded through participation" (Golden and Scherer 2013:405).

2.3.5 Religion, Ritual and Ideology

Social ideologies are manifested in ritual behaviors and religious practice. Rituals are essential to social integration as they regulate the social system and may sanctify or legitimize decisions (Aldenderfer 1993; Hegmon 1989). Elites and leaders seek to control ritual/religious practice as a means to maintain and expand their political and social standing and power (Aldenderfer 1993; Earle 1997). Often this wish to control ritual is exhibited in the formalizing of sacred and ritual spaces through the construction of monuments and other religious structures. Though spaces or structures used in ritual and religious practices are often built using communal labor (Hegmon 1989: 7), elites claim direct or indirect ownership of the space and control of ceremonies through the sponsoring of these projects (Earle 1997).

Rituals typically are categorized as religious or communal. Both have significant influence on the construction and maintenance of group identity and can be used to reinforce the social hierarchy. Amongst the most universal rituals and ceremonies are feasts and mortuary practices. While feasts are commonly used to underpin existing social relations and provide a means for social competition through contributions made to the feast (e.g. Hayden 1996, 2001; Junker 2001), mortuary practices focus on the restructuring and renegotiation of social ties and status in the wake of the loss of a community member.

2.4 Socio-Political Development in the Pacific

What is significant enough to induce social change in a society, excluding contact with foreign entities, is specific to the society and its environment. In the case of the Pacific Islands, the period following the settlement of an island shows significant social development with peoples adapting to their surroundings (Kirch 1984). Part of this adaptation included the modification or cessation of traditional behaviors (e.g. pottery production, horticultural

practices, and settlement organization), exploitation of previously unknown plant or animal species, and the development of new practices. This type of social change has also been suggested for migrant communities elsewhere (e.g. Carsten 1995). But, often the most significant socio-political change that can occur is the shift from kin-based systems to those based on other social or political networks, which often happens after contact with foreign groups (e.g. European contact in the Pacific). This type of shift can impact resource acquisition and exchange, and power dynamics (e.g. increased coercion) (Cobb 1993; Kirch 1984).

The Pacific islands are often considered model systems with which to examine the development of social complexity and state formation (see Kirch 1984). Archaic states have only been identified in Tonga and Hawai'i, though Pohnpei should arguably be added to this list since it formed an incipient state-level society for approximately 200 to 400 years. In the case of both Tonga and Hawai'i conflict and warfare played a major role in the development of the state, but the evidence is provided primarily by traditional history rather than physical remains. There was a marked increase in warfare after European contact in both societies which shows that culture contact included significant social upheaval (Kirch 1984, 2010). The question is what were the primary mechanisms of social change on Pohnpei? Was warfare and conflict a driving mechanism of social change as it was elsewhere in the Pacific, or was the Pohnpeian state built and maintained through other more cooperative means?

The current model of prehistoric socio-political development on Pohnpei does not directly account for the potential role of warfare or coercion in state formation, though it plays a major role in the decentralization of the state in traditional history (see Chapter 3). There is a lack of direct evidence of conflict in the archaeological record, but there are gaps in current survey data for the island. So if there is not clear evidence of warfare or the use of coercion by way of fortifications or skeletal trauma, what other archaeological data may provide indicators of these mechanisms? The mortuary monuments and structures associated with the development of the state center of Nan Madol may provide evidence as to whether coercion played a significant role in labor mobilization and monument building.

2.5 Architecture and Power Relations

Monuments and other large-scale constructions (e.g. roads, irrigation systems, etc.) are often linked to the development of state societies primarily based on the resources and labor required to complete these projects (e.g. Kirch 2010; Kolb 2012). The monuments of Pohnpei and the architectural investment at the site of Nan Madol indicate that the island was at least partially unified as a state in prehistory, which places it in discussions of state formation in the Pacific. Yet, it is not clear how the new elite of the Saudeleur Dynasty obtained their socio-political dominance or how they controlled resources and labor during their reign. This thesis focuses on what the analysis of architectural remains might say about coercion and cooperation in periods of social change on Pohnpei. How is labor for architectural construction mobilized, and how might the mechanisms of state formation be reflected in the built environment? Before this question can be addressed it is necessary to review the relationship between architecture and society.

2.5.1 Architecture and Society

Architecture is important in nearly every society, regardless of how temporary (e.g. tents or seasonal shelters) or permanent (e.g. stone foundations or monuments) structures are. Societies organize and divide space using various constructions and buildings, separating the public from the private, sacred from secular and elites from commoners. This section discusses the relationship between architecture and society as built space provides a context for individual and group action to occur (Ashmore and Knapp 1999; Bahloul 1996; Bender 1993; Darvill 1999; Paynter 1989; Tilley 1994; Van Dyke 2003). Understanding how architectural space is organized is crucial to interpretations of socio-political structure and development.

Architectural constructions create markers for social memory in the landscape, and as such act as symbols of group identity (Bahloul 1996; Bender 1993; Connerton 1989; Clark and Martinsson-Wallin 2007; Tilley 1994; Van Dyke 2003). Structures built in specific locations will

tie the structure to the history and/or ideologies associated with the space, or purposefully modify the meaning associated with the space (Bradley 1993; Van Dyke 2003). In this way architecture co-opts meaning, memory, and history. Interaction with built space not only created individual and group identities, but it also structured society (Bender 1993; Bradley 1993; Tilley 1994). Architectural space is not passive since it is imbued with meaning, though that meaning may be modified over time. The structure of settlements holds as much social meaning as monumental constructions or variations in architectural styles, and may inform on group ideology as it related to the organization of activity areas (Abrams 1989; Abrams and Bolland 1999; Blier 2006; Connerton 1989; Tilley 1994; Van Dyke 2003).

Large buildings convey social, political, and cultural values and messages (Abrams and Bolland 1999; Blier 2006; Wallin and Solsvik 2010). The inbuilt durability of architectural constructions, particularly those of stone, allows them to be continually reinterpreted (Alcock 2002; Bradley 1993, 1998; Tilley 1994). These interpretations are built upon individual and group memory and the history of events tied to a site or structure (Bahloul 1996; Joyce 2003; Tilley 1994). Over time the meaning associated with a specific space may change or be lost, whether or not the space maintains its original form (Bahloul 1996; Barrett 1999; Bradley 1998; Fentress and Wickham 1992; Tilley 1994). By attaching memory to space, groups and individuals are able to recall a variety of associations related to specific sites, which rely on familiarity with and experience related to a location (Alcock 2002; Bradley 1998; Tilley 1994).

Architecture holds both practical and symbolic functions (Bahloul 1996). State architecture promotes dominance, power, and social stability due to their scale and permanence (Blier 2006; Bradley 1993). Though monuments were built as a way to control a message or signal societal stability through amplifying the meaning of a space, there are many simultaneous, potentially conflicting, meanings or memories tied to these structures (Alcock 2002; Bradley 1993; Tilley 1994).

Architectural space can be understood only by considering those who built it and interacted with it (Richards 1993; Thomas 1993). Elites and other high-status individuals were

typically involved in large architectural projects and settlement planning (Paynter and McGuire 1991). Though elites intended for a structure or complex to invoke a specific message or influence behavior, the message was not always read as intended (Abrams and Bolland 1999; Alcock 2002; Blier 2006; Paynter and McGuire 1991; Tilley 1994). In many cases this practice did more to unify the upper echelons of society, than to control and influence the masses (Paynter and McGuire 1991). Social agency, in terms of built space and architectural forms, is not limited to high-ranking individuals and leaders. In some cases communities attempt to maintain autonomy via challenging and competing with strategies implemented by regional bureaucrats to encourage or project socio-political integration (Kolb and Snead 1997:614). Architectural features, particularly monuments, were often used as territorial markers or indicators of social rights of specific groups (Kinnes 1981).

Monument building is one way in which individuals or groups attempted to gain prestige (Bradley 1993). Often the purpose and meanings of the earliest monuments are different from later constructions of the same or similar type (Barrett 1999; Bradley 1993, 1998; Fentress and Wickham 1992; Joyce 2004). Joyce (2004) suggests that early monuments changed how communities perceived and interacted with space, and potentially created an emphasis on permanent structures. The elaboration of architecture indicates an intentional manipulation of space and meaning (Bradley 1993, 1998).

Within communities or regional centers leaders may have constructed large structures or monuments to legitimize their rule in relation to past rulers or contemporary rivals (Abrams and Bolland 1999; Blier 2006; Kirch 1990; Kolb 1994). Often monuments and new architectural forms are associated with periods of significant socio-political change and are meant to unify specific groups (Abrams and Bolland 1999; Kolb 1994). Various researchers (Herdrich and Clark 1993; McGuire 1983) note that prehistoric architecture is not necessarily the product of clan groups or dominant social institutions, but is potentially tied to other marginalized institutions or groups. It is not possible to understand social change without considering all the possible actors and the symbolism of architecture (Herdrich and Clark 1993). Even with

these considerations archaeological sites “consist of hierarchically related architectural units” (McGuire 1983:125). The scale and complexity of the form of architectural features should match that of their newly formed institutions (Abrams and Bolland 1999). Though increasing social complexity is correlated with architectural complexity, it is not directly related to socio-political centralization in all cases (Ayres 2002). Some structures, particularly burial features, can be indicative of relative status rather than social rank (Kirch 1980).

Frequently, monuments tend to act as visual representations of chiefly status and rank (Blier 2006; Graves 1986; Kirch 1990). The development of architectural variation indicative of social differentiation probably occurs later in a society’s history, but this needs to be assessed on a case by case basis (Abrams 1989).

Large structures display not only cultural information and political symbolism, they also are indicative of labor expenditure and technological demands involved in planning and building a structure (Abrams and Bolland 1999; Kolb 1997). In non-egalitarian societies there is a direct link between labor costs of residential structures and household status or power (Abrams and Bolland 1999). It has been suggested that households or clans with greater wealth or power produce agricultural surplus, which in turn is used to mobilize workers for major projects via feasts and to feed workers once they were recruited (Carmean 1991; Kolb 1997). Comparisons of labor investment within and between architectural types and other cooperative projects are valuable for understanding management and organization of architectural projects (Kolb 1997; Kolb and Snead 1997). “What the stone structure labor assessments do demonstrate is how chiefs utilized architecture, relying on its ability to impart durable and real social messages that physically altered the community landscape in a way that reproduced the social order” (Kolb 1997:280). Shifts in labor investment from monuments to a wider range of structures and vice versa may be indicative of social change (Abrams 1989). For example, in cases of decentralization of socio-political power architectural investment focused on elite structures (e.g. tombs, monuments, and residences) shifted towards integrative ‘public’ structures (e.g. plazas, spaces for feasting and ceremonies).

Analysis of architectural variation shows significant flexibility in socio-political systems at the chiefdom level (Kirch 1990). The forms of specific types of structures such as feast structures (e.g. *nahs*) or ceremonial spaces (e.g. *marae*, *heiau*) varied over time, but structures with a particular function are comprised of specific features and tend to display patterns in spatial composition (Clark and Martinsson-Wallin 2007; Wallin and Solsvik 2010). As societies become more centralized architecture changes from simple forms to complex types or monuments (Joyce 2004; Kolb 1994). Therefore, over time many societies develop a wide range of architectural types, which impacts upon how space is organized (Abrams 1989). The chronology of the architectural construction sequence is invaluable to understanding the development of society. Over time monuments, administrative buildings, formal burial grounds, and new types of ritual structures may develop in addition to pre-existing settlement components (e.g. cook houses, dwellings, agricultural/horticultural areas, religious sites). As new architectural types are introduced it is necessary for a community and, particularly, its leaders to make decisions on how these structures fit into existing settlement areas (e.g. administrative buildings in populated areas or burial grounds on the periphery), thus reorganizing space to include these structures. This continual reorganization of space involves the creation of monuments and the development of local and regional centers (Joyce 2004:23-25). Public architecture and monuments reflect group identity and status (Abrams 1989; Abrams and Bolland 1999; Seikel 2011). There is a direct link between the energy invested in private or group structures and social status, and investment in public architecture should reflect the degree to which an entire community is unified ideologically (Abrams and Bolland 1999; Kolb 1994; Seikel 2011). As societies develop the emphasis shifts from large ritual structures (e.g. mortuary and religious sites) to economic structures (e.g. feast houses) (see Abrams 1989; McGuire 1983). In the shift towards the development of social complexity there may be a link between architectural scale and complexity, with larger structures of a specific type being associated with higher degrees of complexity (e.g. stratified hierarchies) and smaller ones with lesser degrees (Seikel 2011). The shift towards complexity may also

produce an emphasis on the permanence of structures (residential, political, and ritual) (Joyce 2004).

The analysis of specific types of structures (e.g. feast houses, ritual structures) within a geographically bounded area or territory should reflect the relative or perceived status of a group or leader (Ayres and Scheller 2002; Rolett 2010), because architecture is tied to identity and social authority through memory and collective history (Van Dyke 2003). The primary function of architecture is to structure social space. Paynter and McGuire (1991) discuss space as providing structure for acceptable social behavior as defined by elites and social ideology. Town and site planning are geared towards structuring everyday activities, though this structuring may impact elites more than the general populace (McGuire and Paynter 1991). It is necessary to understand the relationships between and within architectural types to examine architecture and monuments in terms of the broader cultural context (e.g. settlement, subsistence, etc.) (Ayres 2002; Kirch 1990). Once we understand how structures relate to one another spatially and chronologically we can begin to discuss how various members of society might have related to architectural space. Beyond a spatial understanding of how society is structured, it is imperative to consider how people utilized and experienced this built space (Bender 1993; Darvill 1999:116; Richards 1993; Thomas 1993). The use of space, particularly for ritual purposes, brings disparate groups together and creates an "illusion of a common past" (Van Dyke 2003:194). It is this common past that groups and leaders employ to justify their position and status, and the construction of monuments is one means by which socio-political leaders reinforce their legitimacy.

2.5.2 Pohnpeian Monuments in the Context of Social Change

Architecture and the mechanisms of social development are interconnected. In particular, monuments and other large-scale constructions are tied to a number of factors and mechanisms of social change. As outlined previously, architecture is at the center of spatial circumscription, economy, ideology, and sometimes ritual. Architecture, as a materialization

of space, is both constructed by and structures a society. An examination of specific types of structures (e.g. houses, ritual spaces, etc.) should provide insight into the structuring of their associated society.

The mortuary monuments of Pohnpei are the focus of this thesis. These monumental tombs structures (*lolong*) have been identified as family and/or clan burial structures that were constructed and used during the Saudeleur Period. The timing of the use of these structures is particularly relevant since they are a by-product social unification on the island. By examining mortuary structures, questions related to resource acquisition, labor investment, and labor mobilization can be answered. These questions include how much coercion played a part in architectural construction. Hence the data provided through architectural analysis will provide evidence as to whether coercion or cooperation was the dominant mechanism of social change during the state period on Pohnpei.

The mortuary function of these monuments (*lolong*) provides an added layer of complexity to this discussion. These structures are not only relevant to the development of state-level society, but they are also linked to group, clan and individual identity, social and political ideologies, and religious belief and ritual. The modifications made to mortuary practice that often accompany major socio-political changes are often an attempt to signal the legitimacy of the new social order (Barrett 1990; Carr 1995; Foster 1995; Kuijt 2001; Parker Pearson 1993, 2003). Chapter 5 deals more directly with mortuary practices and Pohnpeian traditions, but what is notable here is that the structures discussed in this thesis are not solely public or political projects. They are the materialization of a confluence of the social, political, and ritual ideologies on Pohnpei during the time in which they were built and used. This convergence of meaning is why these structures were chosen to examine questions about the driving mechanisms of social change on Pohnpei during the pre-contact period. Primarily, how do elites use mortuary structures to further their political ambitions? Secondarily, which structures were built by elites and by what means were they built (e.g. social obligation,

coercion)? By examining these questions, a more complete picture of social dynamics in Pohnpeian prehistory around the time of state formation can be achieved.

2.6 Thesis Framework

In socio-political systems with a centralized government there are significant increases in wealth expenditure (e.g. feasts, architecture, communal projects), which operate as a way to legitimize the new system of government (Cherry and Renfrew 1986b). New architectural features produced during major shifts in socio-political organization further constrain how groups and individuals interacted with one another (Earle 1997, 2000). The labor invested in the construction of these structures is indicative of the control of labor and resources available to the elites and when compared with contemporaneous structures may be revealing in terms of socio-political competition through construction (Earle 1991b).

Public architecture and monuments are particular features that can provide information about the mechanisms (e.g. cooperation and coercion) driving socio-political development. The analysis of *lolong* and burial platforms will allow for a discussion of ritual, ideology, economics, social status, and power as it relates to architectural construction during the state period on Pohnpei. This thesis examines the roles of coercion and cooperation in social change through the analysis of a set of criteria regarding archaeological remnants of mortuary monuments combined with supporting lines of ethnographic and ethnohistoric evidence.

By looking at monuments that are associated with mortuary practices it is possible to explore differences in social status, labor investment required for construction, architectural variation, resource access, and ideology. The investigation of these components using the hypotheses posed here (see Section 2.6.2) will provide a means by which to identify possible instances of coercion used in the construction of Pohnpei's mortuary monuments. If instances of coercion can be identified in prehistoric architectural remains, the evidence can be used to

make an argument for the use of coercive strategies in instances of socio-political change where direct evidence for conflict and warfare is lacking.

2.6.1 Types of Labor Mobilization in Historical Context

The most crucial factors in building an argument for the potential influence or lack of influence of coercive socio-political strategies using architectural remains are identifying what types of data are most useful. The hypotheses developed to determine how to archaeologically differentiate structures built through cooperative strategies from those constructed using coercion should be directly linked to relevant datasets.

There are three ways by which labor was likely mobilized in prehistory: familial obligation, alliances, and conscription of labor. One or more of these strategies may be used depending on who is attempting to mobilize labor. Families, clans, local chiefs and rulers do not have the same access to these strategies. Mobilization via familial obligation would most likely have been used for family-use structures (e.g. houses, cook houses) that the whole family would use or benefit from. Local chiefs would have been able to draw from their clans and alliances for assistance, but conscription of labor may not have been a viable option. Providing a feast is one way in which labor is organized. Feasts can be used to mobilize a social network including family or clans, neighbors and allies, since the providing and exchange of food and goods creates reciprocal relationships. Elites and paramount chiefs have the ability to mobilize labor through every available means including conscription, and the utilization of these strategies may be simultaneous (e.g. Brunt 1980; Janssen 1978; Lorton 1977; Padgug 1976; Rathbone 2002 on ancient Rome and Egypt). Labor conscription is used by elites and paramount leaders as a form of taxation for access to land or in exchange for protection (see Dai 2001; Janssen 1978; Kiser and Cai 2003). Though, in some cases conscription becomes an entirely coercive force (i.e. slavery in Imperial Rome). But how do these activities reflect socio-political strategies driving social change? This thesis argues that the first two types of labor

mobilization are primarily cooperative strategies founded on some level of mutual benefit, while the third is considered coercive.

Ancient Egypt, Imperial China and Ancient Rome are amongst the most well documented social systems that provide explicit evidence of labor mobilization strategies through written accounts. Each of these societies utilized significant labor forces to construct monumental structures and infrastructure projects. Each society used varying levels of cooperative and coercive labor mobilization strategies.

Ancient Egypt utilized a number of labor strategies including wage labor, slavery, labor conscription, and penal servitude (Janssen 1978; Lorton 1977; Rathbone 2002; Warburton 2007). This mix of strategies supported the commercial economy as well as the state (Eyre 1997; Warburton 2007). It has been noted that taxed labor and conscription were used to staff state projects (i.e. irrigation works and the pyramids) and expeditions to resource procurement sites (Janssen 1978), in addition to the use of penal and/or slave laborers (Lorton 1977). Lorton (1977) and Janssen (1978) both note that many of the laborers involved in the construction of Egypt's monuments were not legally or socially slaves, even if they may not have been entirely free, as was the case with those sentenced to hard labor. For the most part craftsmen, project managers and others involved in the skilled components of projects were wage laborers or were paid for items they produced (Warburton 2007).

As in Egypt, labor strategies in Ancient Rome were diverse and utilized cooperative and coercive tactics (Brunt 1980). This being said, slavery was an integral feature of Roman society (Bradley 1994; Harris 1999; Jongman 2003; Padgug 1976; Scheidel 2008, 2012; Yavetz 1988). Slaves were utilized as skilled and unskilled laborers, domestic servants, and clerks, amongst other things (Brunt 1980; Scheidel 2012). The prevalence of slaves in historic Roman writings does not mean that wage labor, conscription, convict labor, and other forms of labor were not commonly used. Brunt (1980:89) suggests that slaves were written about primarily because they were more likely to be involved in law cases, since they were considered

property. Public projects within the Roman Empire were built utilizing a combination of unskilled laborers, convict labor and slaves (Brunt 1980; Scheidel 2008).

Corvée labor was particularly important to the development of the Qin State (c. 897-222 BC) and the Qin Dynasty (221-206 BC) during and after the Warring States Period in China (Dai 2001; Kiser and Cai 2003). The most notable construction projects with which corvée labor is credited include the road networks, the Great Wall, and the mausoleum of the first emperor (Dai 2001; Kiser and Cai 2003; Martinon-Torres et al. 2014). The increasing use of labor as a means of taxation (corvée) and liberal use of military conscription are two factors which contributed to the failure of the Qin Dynasty (Kiser and Cai 2003). Even though the over use of these strategies contributed to the decline of one Dynasty, it did not prevent successive dynasties from relying on corvée labor. It was not until commercialism expanded in the 18th century that corvée labor declined in favor of wage labor in Imperial China (Dai 2001). Taxed labor ceased in favor of monetary taxes to support the economy as it adjusted to internal and international commercial trade, though conscription was not completely abolished (Dai 2001). It is notable that throughout most of its history that China relied heavily on coercive labor mobilization strategies to build monuments and protect its borders.

While Rome and Egypt relied on all types of labor categories (i.e. wage labor, conscription/corvée, slavery), Imperial China primarily utilized corvée labor for its projects. What is particularly relevant to this thesis is that each of the historically documented states discussed here utilized coercive labor mobilization practices to construct monuments and build infrastructure as a means of supporting the state government and the legitimacy of its elite.

2.6.2 Hypotheses to Be Tested

Identifying different types of labor mobilization is relatively simple using modern and historic references. The challenge is how the use of particular methods of mobilization can be determined using archaeological data. The objective of this thesis is to test whether structures

were built using coercive labor mobilization or were constructed using cooperative labor. This thesis is predicated on the idea that the use of coercive labor mobilization strategies is limited to elites and/or socio-political leaders because such individuals/groups hold a monopoly on force, control land and extract levies. The following are the hypothesized criteria which this thesis uses to identify structures associated with elites and others with high status. These structures are further examined in terms of coercive labor practices. In order to meet the burden of evidence for potential use of coercion in labor mobilization at a minimum Criteria 4 must be met, though a strong case would meet at least three of the criteria.

Criteria 1: Structures incorporating the highest quantity of columnar stone and the largest stones are associated with the highest ranking members of society.

Access to specific types of materials used in construction on Pohnpei, such as columnar basalt, was limited and may have been controlled by individual groups or clans. Coral rubble and basalt boulders are not limited in their distribution and, therefore, would not have been associated with resource restrictions. Networks tied to clan affiliations and hierarchical social relations would have provided some groups with access to specific columnar basalt quarries. Therefore, access to columnar basalt sources may be associated with relative status, and large amounts of columnar stone might reflect greater status compared to individuals buried in tombs where columns were few or were absent.

Variability within architectural structures is indicative of relative social relations. Architectural elaboration within a specific type of architecture is linked to investment by individuals or groups (Abrams and Bolland 1999; Kolb 1997). More elaborate constructions signal relatively higher status (e.g. Kirch 1980; Rolett 2010). Therefore, burial platforms or *lolong* constructed using the distinctive header-stretcher style of construction (see Chapter 5 for description) would be more highly ranked than those constructed of stacked basalt boulders or coral rubble.

Stylistic variation within individual structures can also relate to relative status and construction choices. Inconsistency in construction style across a single structure may be indicative of multiple building phases or an emphasis on a specific feature. For example placing a header-stretcher style burial platform inside a basalt-boulder enclosing wall pulls the visual focus toward the burial platform. This type of variation can also signal intermediary status levels, where those associated with a structure invest more in key features while not having the resources to complete the entire structure in a specific style. Stylistic variation on this scale may also indicate the need for multiple building phases, where challenges to accessing labor or materials can lead to delays and several construction phases. Thus, construction of a structure utilizing one unified style that is smaller in scale may be of similar status to a large structure built in multiple phases with a variety of construction styles. Large, multi-phase projects could be indicative of attempts to legitimize status ranking during periods of socio-political change (e.g. title acquisitions or death of a high-status individual).

In addition to the link between the use of columnar stone and high-status structures, such constructions are also likely to contain larger stones. The quarrying and transport of large stones would require greater labor. The labor-force required to move each stone may limit the number of large stones utilized by lower status clans or families, which suggests that structures with a higher incidence of large stones were probably constructed by elites and other high-status individuals and groups.

Criteria 2: Elite structures should incorporate stone from a wider variety of stone sources than other structures.

Stylistic variability is primarily related to the materials and the time a group or individual can invest in a specific structure. Since socio-political centers operate as sites where multiple groups and individuals interact and compete for prestige and status, it is hypothesized that competition would extend to architectural constructions sponsored by

specific groups and individuals. Competition should produce a wide range of stylistic variation based on the materials each group or individual has access to.

Restricted access to columnar stone quarries would likely be consistent over time even if ownership of a quarry territory changed, particularly within small territorial units. During socio-political centralization the highest ranking individuals (e.g. the Saudeleur) would be able to access any quarry within their unified territory through their network of allies and underlings, but others would still have limited access to columnar building material. As a result, the socio-political center should contain more structures with large amounts of columnar stone, and individual structures may contain stone from a number of geographically dispersed quarries. Chiefs and high-ranking individuals outside the paramount line would have access to fewer quarries, because they would depend solely on trade connections and clan members for access to stone quarries. It is inferred that there should be a smaller number of quarries used in structures constructed by low ranked individuals.

Criteria 3: Structures with a greater number of ancillary components and higher enclosing walls are associated with high ranking members of society.

Ancillary features are structural components or items associated with a structure that are not defined as standard features of an architectural type. For example, it is not necessary for a burial platform to be associated with stone paving to serve its purpose. Some ancillary features do have a clear functional purpose, like foundational support structures that buttress walls. Other features may have a purpose not associated with architectural stability or as direct indicators of relative social status (e.g. alignments around a burial platform). Ancillary features, such as *sakau* stones, stone alignments, and stone pavings that have no clear architectural purpose, probably functioned as components of ritual or feasting activities associated with a site (see Section 4.6.2), since they cannot be categorized as decorative architectural elements.

Structures with a higher number of ancillary features would also suggest a higher status due to the additional time invested in the construction. The formalizing of ritual spaces within mortuary architecture provides one way with which one group may define or limit the role of others in mortuary rites. This formalization of space may be more important to those of higher status since the death of a leader, chief or king causes some level of restructuring within the social hierarchy, so the delineation of ritual space and the prescribed roles in mortuary practice may mitigate some uncertainties during leadership transitions.

Scale and visibility also often play significant roles in marking social status in architecture. Large, highly visible structures draw the attention of those in proximity to them. For this reason these variables have long been used to address questions relating to relative status. Generally, larger structures and higher walls are associated with greater status and the potential exclusion of some groups from designated spaces.

In the case of mortuary structures enclosing walls limit access (physical or visual) to the burial platform. This division of space would create a hierarchy of access based on relationship to the deceased, social status, and what role an individual might play in burial rites. Thus, the further division of architecture space creates a relative hierarchy within the group of mourners. The level of exclusivity can be modified based on the height or size of the enclosing wall, which ties back into the amount of labor needed to construct the walls. Therefore the high of the enclosing wall is directly associated with the status of those who sponsor the construction of a structure and those who utilize the space.

Criteria 4: Structures requiring over approximately 100,000 cumulative labor hours to build were most likely built using coercive labor mobilization strategies.

Labor may be mobilized using coercive or cooperative means, as discussed above. Building projects are typically organized by families/clans, local chiefs or elites and paramount leaders. All three of these groups can mobilize family members and allies to assist with building projects, but labor conscription is limited to the elite and paramount chiefs of the

island. Therefore, there should be a limit to the amount of labor that can be managed by local chiefs and clans, and any structure built above this limit is likely to have been constructed by a work force that, at least in part, involved coercion.

The time, resources, and man-power required to build a structure for a small family unit, clan or local chief would likely be able to be managed through cooperative means based on reciprocal social obligation and potential future use of the structure itself. Individuals or groups sponsoring a project would not likely wish to impose on the time volunteered by family or clan members and allies out of familial or reciprocal obligation beyond which they might be able to spare themselves in the future. The smaller network used to manage projects of this scale may also limit the resources available for use (e.g. amounts of columnar stone). Therefore, the limits on the time and the potential limit to access of specific types of building materials would produce smaller, less labor intensive structures.

Elites and rulers use architecture as a means of signaling their status and legitimacy, which means they may invest in larger and more elaborate structures than their lower-status counterparts. Due to their station, elites and high status groups are able to manage larger, more time consuming projects through their access to a wider network of materials and their potential to mobilize a significant work-force. Cooperative and coercive means of labor and resource mobilization would be utilized to assemble clans and allies in addition to laborers from other sources (e.g. other clans, commoners). The mobilization of kin or close allies would mostly likely rely upon cooperative means, since it would be unwise to alienate clan members and allies upon which their elite status was dependent. While mobilizing subordinates or less well-integrated social groups could possibly occur through coercive means (e.g. conscripted labor, slavery). Labor conscription is one means of mobilizing commoners or dependents, and has often been used as a potential form of taxation in societies where land tenure is not controlled by those who cultivate it (e.g. feudal systems).

Structures built via cooperative means of labor mobilization would not likely require more than 50 workers to complete the work within a year for a family or 75 workers in the

same time frame for a clan or local chief. The maximum labor hour estimate comes to roughly 144,000 hours if a 40 hour work week is assumed and 108,000 at 30 hours a week. An approximate estimated value of 100,000 hours is considered for the purpose of this thesis, since the available work-force would have responsibilities other than construction (e.g. cultivation, maintenance of existing structures, fishing, canoe construction, production of chiefly tribute, etc.). Investment calculations for structures built through cooperative means should take 100,000 or less cumulative hours to build. If 100,000 hours is the upper limit of structures built entirely through cooperative means, anything over this limit is hypothesized to require some level of coercive labor mobilization.

Based on these proposed criteria, the largest and most stylistically elaborate structures should be found at centers of socio-political power to project the legitimacy of the political order (Earle 1991b; Van Buren and Richards 2000). Questions of scale are fairly straightforward, but stylistic development is more difficult to address. If *lolong* developed contemporaneously with the centralization of Pohnpeian socio-politics, all variations and developmental forms of this type of architecture should be present at Nan Madol.

The primary question for the analysis of Pohnpei's mortuary monuments is whether there is evidence of the use of coercion by elites in mobilizing labor. By looking for evidence of coercion versus cooperation we should gain a better understanding of the mechanisms used to build and maintain power during the Saudeleur Period. This information, when paired with lines of evidence from traditional history and other archaeological and ethnographic datasets (presented in Chapters 3 and 4), should provide a clearer picture of socio-political development on the island and the mechanisms driving social change and state formation.

2.7 Conclusions

This chapter has outlined a theoretical framework for a discussion of the mechanisms and factors integral to socio-political development on Pohnpei, and how specific questions

related to cooperation and coercion can begin to be addressed through the analysis of mortuary architecture. Of particular interest is identifying how prevalent the use of coercive labor mobilization practices may have been in the construction of mortuary structures, and the implications of the prevalence of coercive social strategies upon the socio-political system as a whole.

The following chapters present background information contributing to the current model of socio-political development (Chapter 3) and what is currently known about how factors and mechanisms influence social change in the Pohnpeian context (Chapter 4). This foundation will provide the broader context in which to fit the discussion of monumental mortuary constructions as they relate to state-level society on Pohnpei. Chapter 5 presents information on Pohnpeian burial practices based on archaeological data, ethnohistory, and oral tradition. By reviewing this information, it should be possible to recognize potential patterns or signatures in the sites and structures discussed later that may be attributed to socio-political and ritual functions of these sites. Chapters 6 through 8 deal specifically with the architectural analysis of Pohnpei's mortuary structures and monuments, and examines them in relation to the hypothesized criteria for distinguishing structures potentially constructed via coercive strategies formulated here. The evidence for coercion will be thoroughly reviewed and the implications for the model of social change on Pohnpei (see Chapter 3) will be discussed in detail in Chapter 9.

Chapter 3: Pohnpeian Socio-Politics – Context and Chronology

This chapter reviews traditional histories regarding the prehistoric and early historic periods on the island, and archaeological data relating to socio-politics on Pohnpei. The information presented provides a basis to build a model of socio-political development for the island based on existing data (see Section 3.4). This model acts as a preliminary explanatory aid of how and why socio-political centralization occurred on Pohnpei, which will be critically examined in Chapters 4 to 9 through discussions of coercion and cooperation in social interaction.

3.1 Historic Context

The contact/historic period on Pohnpei is shorter than other islands in the Pacific, since sustained contact with Westerners did not occur until the 1820s. This is important because some oral historians began to write down or share their knowledge of traditional history with outsiders in the mid to late 1800s (e.g. Christian 1899a, b; Hambruch 1911, 1936a; Kubary 1874), and the events of the time had an influence on which histories were shared and how they were told (Mauricio 1992, 1993; Vansina 1985). This section briefly reviews the major events of the historic period to provide a social context for the traditional history presented in the following section.

De Quiros was the first European to sight Pohnpei in December 1595, though he did not make landfall (Hambruch 1936b; Hanlon 1988a; Hezel 1983). It was another 230 years before the island was noted again by Europeans despite the fact that a series of explorers and Catholic missionaries made contact with other islands in the Carolines (Hanlon 1988a; Hezel 1983; Riesenberg 1968). According to oral tradition, sometime between Pohnpei's first sighting in 1595 and 1820 a Spanish ship anchored in Ron Kiti Harbor to acquire provisions, but the Spanish were driven off after negotiations disintegrated into violence (Hanlon 1988a:28-29).

In 1828, the Russian navigator and explorer, Lutke, 'rediscovered' Pohnpei during a scientific expedition, although he did not make landfall (Bascom 1950a; Hambruch 1936b; Hanlon 1988a; Hezel 1983). American whaling ships that stopped at Pohnpei for provisions in 1833 noted that beachcombers were living on the island, though it is probable that there were foreign residents on the island prior to Lutke's visit (Coale n.d./1951; Hambruch 1936b; Hezel 1983; Langdon 1992). In the 1840s provisioning stops by whalers were common and contributed to an increase in the beachcomber population (Fischer and Fischer 1957; Hambruch 1936b; Hanlon 1988a; Riesenberg 1968; Shineberg 1971). In 1850, beachcombers had increased the population of foreigners living on Pohnpei to nearly 150 (Hanlon 1988a).

Pohnpei was not subjected to colonial rule until 1886 when Spain claimed sovereignty over Micronesia (Bascom 1950a; Ehrlich 1978; Hambruch 1936b; Hanlon 1988a; Hezel 1983, 1995). The Spanish wished to build their capital at Mesenieng (now Kolonia) due to its proximity to Sokehs harbor, and the Lepen Net allowed the Spanish to establish the administrative center there for a monthly rent (Ehrlich 1978; Hambruch 1936b; Hanlon 1981, 1988a). The Spanish were only the first of a series of colonial powers that ruled central Micronesia from the colonial capital established on Pohnpei. Each colonial power on Pohnpei left its own imprint on Pohnpeian history and socio-politics.

The Spanish ruled Micronesia from 1886 until their loss in the Spanish-American War of 1898. Spain's Pacific holdings were either ceded to the United States in the Treaty of Paris or sold off to Germany (Bascom 1950a, b; Hambruch 1936b; Hanlon 1988a). German colonial rule of central Micronesia started in 1899 and ended during World War I (Hanlon 1988a; Hezel 1995). Japan took control of Pohnpei and the rest of Germany's Micronesian holdings in October 1914 on behalf of the Allies, but the Mandate Period ended in 1945 with Japan's defeat by the Allies in World War II (Fischer and Fischer 1957; Hanlon 1988a; Hezel 1995). Micronesia was occupied by the American Navy until it was declared a Trust Territory by the United Nations in 1947 (Hezel 1995). The US Trusteeship was dissolved in 1986 when the Federated States of Micronesia (FSM) established a Compact of Free Association with the US

(Pinsker 1997). The FSM was accepted into the United Nations as a sovereign nation in 1991 (Pinsker 1997). This succession of colonial influences had a significant impact on Pohnpeian traditions of land ownership, religious practices, politics, and economics.

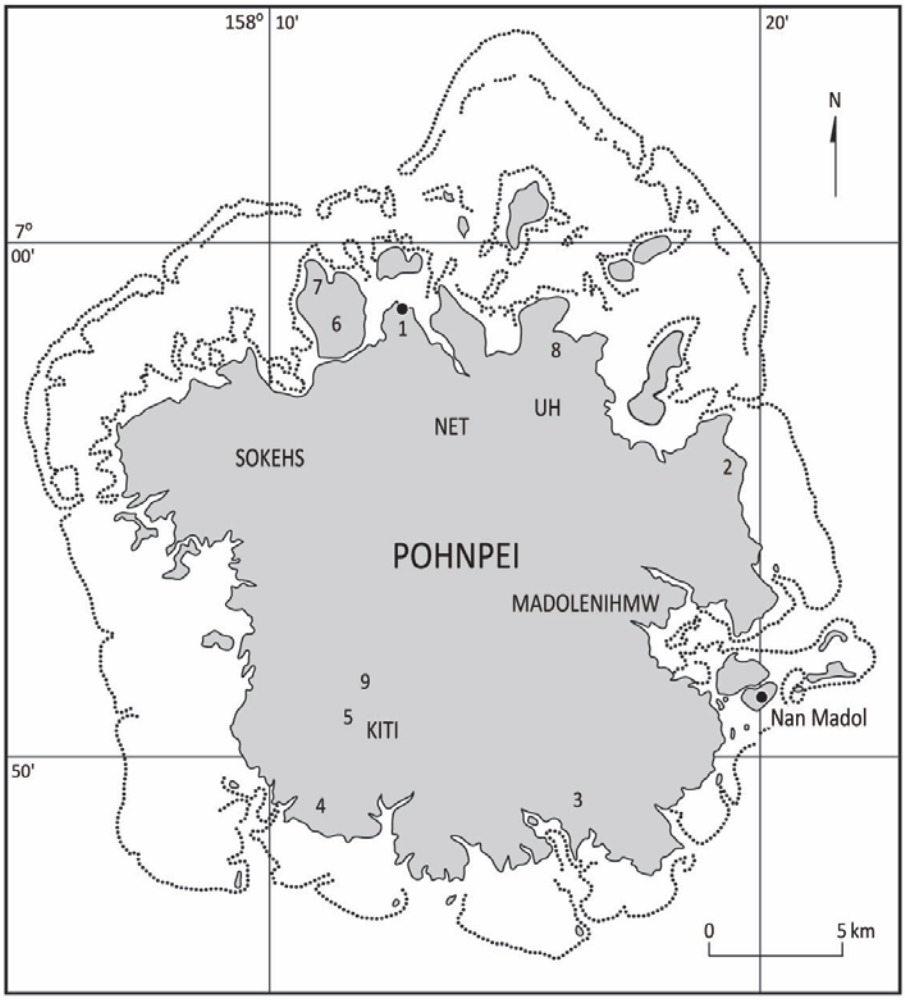


Figure 3.1 Context map showing important historic locations: Kolonia (1), Ohwa (2), Wene (3), Rohnkiti (4), Sapwtakai (5), Sokehs Island (6), Ipwal (7), Awak (8), and Salapwuk (9).

3.2 Social Change in Pohnpeian Oral Tradition

Major socio-political changes are recorded in the oral traditions and traditional histories of Pohnpei. Historic records and oral traditions demonstrate how Pohnpeians reacted to attempts by foreigners to force change in local practices, dealt with conflicts related to land tenure, or selectively accepted new traditions or changes to religious practice. These records provide valuable information about how economics, politics, religion, and

ideology intersected in the past, and how the links between them changed over time. Understanding mechanisms of socio-political change from traditional history has the potential to produce insight into factors which were significant to past socio-political development.

3.2.1 Pohnpeian Traditional History

The traditional history of Pohnpei is marked by multiple in-migrations and significant shifts in power. Oral traditions divide Pohnpeian history into four periods: the Building Period, the Saudeleur Period, the Nahnmwarki Period, and the Contact Period (Hanlon 1988a; Mauricio 1993). Interestingly, each period prior to the Contact Period begins with the arrival of a canoe (Dobbin 2011; Hanlon 1988a). This either highlights the consistency of contact with nearby islands and the potential for these external ties to influence Pohnpeian culture and society (Petersen 1984:352), or reflects a trope in Pohnpeian oral history. The reoccurrence of foreigners in traditions, which features in discussions of the accuracy of oral tradition (see Henige 1974; Vansina 1985), is that the arrival of outsiders operates as a typical paradigm to explain and legitimize culture change.

The first period, Building, is characterized by the creation of the island and the establishment of matrilineages, which are the basis of the Pohnpeian clan system (Bernart 1977; Fischer et al. 1977; Hanlon 1988a). The first canoe to arrive carried 16 people and made landfall on a submerged reef, upon which the people constructed an altar, the foundation of Pohnpei; they are said to have brought soil and plants from their homeland in the south to construct the island (Hanlon 1988a:4). Seven subsequent settlement voyages brought new groups and resources to Pohnpei (Bernart 1977; Hanlon 1988a; Mauricio 1993:27). As noted by Falgout (1984:123), “each of the clans on Ponape has an origin myth which discusses their ultimate place of origin, details of persons and events in their voyage to Ponape, their incorporation into Ponapean culture and the creation of various subclans.”

Though the Mehn Pohnpei (the People of Pohnpei) realized that their tie to the land united them, they were just as aware of the differences that divided them (Hanlon 1988a:7-8).

The early settlers of Pohnpei linked their identity to their clan to the point that later settlers had to compete for status amongst the established clan groups (Hanlon 1988a:8). Conflict amongst the clans characterized this early period as there was nothing to unify them (Hanlon 1988a:7-8). There was no single socio-political unit that brought order to any given district, though local chiefs and priest-leaders established themselves during this period (Mauricio 1993:145-46). Based on traditional accounts of the Period of Building Pohnpeian society consisted of independent clans who were engaged in status rivalry both within the clan and competed with other clans using knowledge and violent conflict.

"As had everything else in this early period, that order came from beyond Pohnpei's shores" (Hanlon 1988a:8). The second period, the Saudeleur Period, began with the arrival of two foreign brothers, Ohlosihpa and Ohlosohpa, from the west. These brothers are traditionally attributed with building the megalithic constructions at Nan Madol and founding the Saudeleur dynasty, which significantly modified the socio-political system of Pohnpei (Bernart 1977; Hadley 1987; Hambruch 1936a; Hanlon 1988a). Though there were a number of attempts to construct similar sites on other locations along the Pohnpeian coastline, the brothers did not succeed until they started work on the southeastern reef flats at Nan Madol and gained the assistance of the community (Bernart 1977; Hadley 1987).

Nan Madol was constructed as the site of a new religion upon which the Saudeleur Dynasty was founded (Mauricio 1993; Petersen 1995). This religion was centered on the worship of the sea and introduced a number of new rituals, the most notable of which was the turtle ceremony (Hadley 1987; Hanlon 1988a:14-15; Mauricio 1993:15). The turtle ceremony developed as a significant ritual after Nan Madol was established and had political as well as religious meaning (Mauricio 1993:151-152). The turtle represented the land, while the moray eel, to which a portion of the turtle was fed, represented the sea (Hanlon 1988a; Mauricio 1993:152-154). This ritual had political meaning in that the turtle was divided into three sections, and during centralization established territories were incorporated into three districts (*wehi*) which operated as fiefdoms under the Saudeleur (Bernart 1977; Hanlon

1988a:14; Mauricio 1993:156). Thus the turtle was symbolic of these three districts, and the eel was likely symbolic of the Saudeleur dynasty as the unifier of the island (Hanlon 1988a:14; Mauricio 1993:154). The ceremony may also have been symbolic of the tribute system instituted under the Saudeleurs. The unification of the island under centralized rule was a significant event in Pohnpeian history, and is commonly referenced in discussions about traditional politics.

> In organizing the island under a single political system, the Saudeleurs confirmed the existing territorial divisions on the island … The Saudeleurs also recognized the claims of the leading clans in the different areas of the island. Titles were bestowed upon the different sectional chiefs, thereby reconstituting their previously existing authority under the new order of Nan Madol (Hanlon 1988a:13).

Saudeleur rule was initially accepted by the Pohnpeians, and the first two or three Saudeleurs are well regarded in oral traditions (Bernart 1977:37, 73; Hadley 1987; Mauricio 1993). However by the time of the last Saudeleur (the 12th or 13th) there was discontent with the increasing amount of tribute they were required to provide (Bernart 1977; Hadley 1987; Hanlon 1988a:16; Mauricio 1993:159-160). According to Hanlon (1988a:16) the Saudeleur failed to redistribute a reasonable share of this tribute to the people, which "threatened the people's very existence." As discontent spread, some individuals and sections defied Saudeleur rule and began to assert their individual autonomy once more (Bernart 1977; Hanlon 1988a:17; Mauricio 1993). "Indeed, Nan Madol's hold over the island had become in many ways more symbolic than real" (Hanlon 1988a:17).

The arrival of Isohkelekel and the subsequent overthrow of the Saudeleur dynasty via armed conflict marked the beginning of the Third Period, the Nahnmwarki Period (Bernart 1977:77; Hadley 1987; Hanlon 1988a:18-21). After Isohkelekel's defeat of the Saudeleur the Nahnmwarki system was established, which created a hierarchy of chiefly titles for each district of the island. The Nahnmwarki Period marked the decentralization of socio-political power with a shift away from Nan Madol, although some islets continued to be occupied by some leaders, priests, and families during this time (Bernart 1977; Hadley 1987; Hambruch

1936a). The Nahnmwarki of Madolenihmw moved his primary residence from Nan Madol to a nearby location in the district well before 1800, possibly as the result of disease or a typhoon (Bernart 1977; Davidson 1967) and/or in order to distance himself from past regimes (i.e. the Saudeleur). After the Nahnmwarki relocated, the site ceased to function as a political center, however, ethnohistoric accounts suggest that Nan Madol continued to be used as a religious center into the 1800s (Gulick 1859; Hanlon 1988a; Mauricio 1993). The lessened but continued habitation at Nan Madol was probably linked to its continued importance in the turtle ceremony into the 19th century; also some occupants may not have had land tenure elsewhere on Pohnpei which prevented them from relocating.

Isohkelekel was the son of Nahn Sapwe, the thunder god, who was captured by the Saudeleur before escaping and settling on another island (Bernart 1977:73; Hadley 1987; Hanlon 1988a:18). He traveled to Pohnpei with 333 companions to retaliate against the Saudeleur, first making a stop at And Atoll following an invitation from the local chief (Bernart 1977:73-76; Hanlon 1988a:18). Isohkelekel's protracted stay at And was strategic as he and his companions learned the customs of Pohnpei and became members of the community (Hanlon 1988a:18-19). Eventually, they relocated to Nan Madol, though Isohkelekel concealed his position as the group's leader (Bernart 1977). After a number of seemingly minor events, conflict between the Saudeleur's and Isohkelekel's followers turned into war (Hanlon 1988a:20). An initial skirmish quickly took the form of more formal conflict with distinct battle-lines (Bernart 1977). Warriors on both sides were armed with javelins, spears tipped with stingray spines, and sling-stones (Bernart 1977). The Saudeleur's force initially had the advantage but the tide turned and Isohkelekel's side was victorious (Bernart 1977). Isohkelekel returned to Nan Madol and proceeded to rule over Deleur, the territory closest to the site which includes Temwen (Bernart 1977:77; Hadley 1987; Hanlon 1988a:20; Mauricio 1993:165).

The subsequent change in socio-political organization on Pohnpei has been linked to a discussion between gods, sacred and secular leaders (Bernart 1977:80-81; Hadley 1987;

Hanlon 1988a:20-21). The Nahnmwarki chiefly system was the product of this event in oral tradition, and Isohkelekel became the first Nahnmwarki (paramount chief) of Madolenihmw. "Claiming the eastern portion of the island as his own domain, Pohnpei's first Nahnmwarki had restored the rest of the island to its many people; over time, most of these other areas would copy the political system established for Madolenihmw" (Hanlon 1988a:24). Some districts did not adopt the Nahnmwarki system until well into the historic period, rather choosing to revert to systems similar to the chiefly organizational structures in place prior to Saudeleur rule (Dobbin 2011; Mauricio 1993; Petersen 1990a).

Traditional histories also reference details about changes to the socio-political systems of other districts after the decentralization of power associated with the overthrow of the Saudeleur. Traditions note that there was an increase in inter-personal and territorial conflicts during the Nahnmwarki Period primarily aimed at unifying territories and restructuring power dynamics (Bernart 1977; Hanlon 1988a:29-30). The most notable of these conflicts was the Battle of Sapwtakai, which unified the current district of Kiti under its first Nahnmwarki sometime shortly before the Historic Period (Bernart 1977:101-103; Hanlon 1988a:30). There are also traditional and ethnohistoric accounts of conflict between Madolenihmw and Kiti into the 1840s (Bernart 1977:115-117; Hanlon 1988a:44-45), and internal clan rivalries in Madolenihmw leading to conflict between clans and a visiting crew which significantly impacted the district's social hierarchy in the 1830s (see the 'Falcon Incident' and the 'Lambton Affair' in Ehrlich 1978; Hambruch 1936b; Hanlon 1988a; Hezel 1983).

In addition to internal conflicts fueled by Western contact and access to new trade goods, the Contact Period also sparked significant changes to the ideology and religion of Pohnpei. A combination of the influence of missionary teaching, the devastating impact of new diseases, and introduced ideas regarding social structure significantly diminished the influence of traditional religion and was seen by Pohnpeian chiefs to undermine their status (see Chapter 4). Within 50 years of the Christian mission's arrival most of the population of

Pohnpei had converted (Bernart 1977; Hambruch 1936b; Hanlon 1988a; Hezel 1983). Though initially resistant, the district leaders and chiefs eventually converted probably partly due to changed beliefs and to maintain their status with the commoners. Traditions and ethnohistoric accounts from the early Historic Period demonstrate that when presented with new ideas and groups Pohnpeian society adapted to its new circumstances often with the hierarchy attempting to maintain the status quo while individuals attempted to find a means to better their status. It was not until colonial land reform in the early 1900s that land tenure was removed from the control of the chiefs seriously threatening the Pohnpeian chiefdom system (Bascom 1948; Bernart 1977; Ehrlich 1978; Fischer 1958; Hambruch 1936b; Hanlon 1988a; Petersen 1982a; Pinsker 1997; Riesenberg 1968; Sudo 1987). Instead of collapsing, Pohnpeian society adjusted and the socio-political system changed yet again to cope with new circumstances.

3.3 Archaeological Context for Social Change

Archaeological work on Pohnpei has taken place since the 19th century, though the largest volume of work has occurred since the mid-1970s. Most of the work prior to 1975 (e.g. Christian 1899a; Hambruch 1936a; Intoh 1998) was focused on the site of Nan Madol due to its early designation as the largest socio-political complex on the island and indeed in the Pacific. Even with more recent work done elsewhere on Pohnpei (e.g. Ayres and Haun 1980; Ayres and Mauricio 1997; Ayres et al. 1981; Bath 1984a, b; Falgout 1987; Hanlon 1981; Haun 1984), “archaeological research on Pohnpei is still in a nascent stage” (Petersen 1990a:150). Although there are significant gaps in Pohnpei’s archaeological record, the review presented here is used to construct a temporal framework to model Pohnpeian socio-political development prior to western contact. The archaeological model of socio-political change on the island provides information on the prehistoric period which is not necessarily recognized in the traditional histories of Pohnpei.

3.3.1 Past Research

Before reviewing the archaeological data, it is important to review the history of antiquarian and archaeological work on the island. This context provides answers as to why some aspects of the archaeological record on Pohnpei are better understood than others. Refer to Figure 3.1 for sites referenced in this section.

Early accounts of Pohnpei incorporating descriptions of Nan Madol and musings about its builders were written by travelers and missionaries in the 19th century (e.g. Campbell 1967; Christian 1899a, b; Gulick 1859; Hobart Town Courier 1967; Kubary 1874; Moss 1889; O'Connell 1972; Shineberg 1971; Wood 1875). Though many visitors' accounts incorporate Nan Madol, a few also include information about other sites (Christian 1899a, b; Hobart Town Courier 1967; Kubary 1874; Shineberg 1971; Wood 1875). Wood (1875) made note of a long, winding earthwork in the Kiti hills, which may correspond to earthworks visited in the Kipar section of Kiti by Christian in 1896 and Cheyne in 1842 (Christian 1899a; Shineberg 1971). A brief article submitted to the *Hobart Town Courier* (1967) included notes on petroglyphs inland from Nan Madol and a mention of the site of Sapwtakai. Kubary (1874) makes brief references to sites in Kiti and on Temwen Island. In most cases these notes are brief and not particularly detailed, as was the case for much of the rest of the Pacific. These early accounts are notable because they provided a list of sites that became the focus for future antiquarian and early archaeological studies. They also produced a number of assertions which later, more academically minded individuals addressed in their work.

In 1873 J.S. Kubary, a Polish naturalist and ethnographer, arrived on Pohnpei to collect materials for the Godeffroy Museum in Hamburg (Spoehr 1963). Kubary was one of the first antiquarians to survey and collect materials from Nan Madol. His primary focus was the islet of Nahndauwas, which he thoroughly documented and mapped (Kubary 1874). Kubary also completed a rough map of the site, excavated 10 additional tombs/graves, and examined the construction of the islets and their associated structures (Kubary 1874). He was the first to dismiss suggestions that the site was built by Spanish pirates and present evidence that Nan

Madol was purposely built on the reef flats. Kubary posited that the site was built over a long period of time in multiple phases by the ancestors of the local population, and he suggested that the large stone tombs (*lolong*) were probably family burial places (Kubary 1874). Kubary's examination of Nan Madol was thorough and his observations were insightful. Many of his original hypotheses have since been supported by recent archaeological work.

F.W. Christian, an amateur philologist and archaeologist from Britain, arrived on Pohnpei early in 1896 as part of his travels through the Caroline Islands. He consulted with Kubary on various topics including his views on Nan Madol (Christian 1899a, b). During his stay on the island Christian and his team completed excavations at Nan Madol and at least two sites elsewhere on the island (Christian 1899a, b). Christian spent his time at Nan Madol primarily on the islet of Nahndauwas, taking photographs and excavating, but he also investigated Pahn Kadira (Christian 1899a, b). Although Christian produced his own map of Nan Madol, it was no better than Kubary's in accuracy or drafting. "Christian supplemented his description of *Nan Madol* with lengthy accounts of Pohnpeian traditions concerning the history of the site" (Hanlon 1990:104). He also reviewed some of the previously written theories about the site (Christian 1899a:81-85), and disagreed particularly with an opinion that the site had sunk rather than being purposely built with channels between the islets. In addition to his work at Nan Madol, Christian excavated two tombs in Kiti and Wene, and visited a number of other sites including those at Kipar, Awak, Palikir, Sapwtakai, and Ponial (Christian 1899a, b). He was also told of constructions in Salapwuk and of the petroglyphs on the Dewen Sapwalap (Christian 1899a).

In their many conversations, Christian and Kubary agreed on the construction techniques used at Nan Madol and how construction materials were transported. They hypothesized that inclined planes, ropes and poles were used during construction and that, based on basalt columns sunk in the lagoon, the basalt was rafted from wherever it was quarried (Christian 1899a, b; Kubary 1874).

In 1907, the German Governor, Berg, conducted excavations at Nan Madol for the Museum of Ethnology in Leipzig (Sarfert 1911/12). Unfortunately, his excavations of burial sites on 11 different islets were unsystematic and his report to the museum was never completed (Sarfert 1911/12). Berg died of sunstroke shortly after conducting excavations in a tomb on the islet of Pein Kitel, though the Pohnpeians believed he was killed by spirits (*eni* in Pohnpeian) for tampering with the tombs of their ancestors (Ehrlich 1978; Fischer and Fischer 1957; Hezel 1995; Sarfert 1911/12). A record of what Berg excavated from each burial context was later published by Sarfert (1911/12) in the *Yearbook of the Municipal Museum of Ethnology in Leipzig* (see Chapter 5).

Paul Hambruch was the next individual to undertake research on Pohnpei. He was a member of the German South Seas Expedition, which carried out ethnological and archaeological research throughout the Pacific between 1908 and 1910. Though he only spent two weeks at Nan Madol, Hambruch undertook the most complete survey and produced a fairly accurate map of the site, in addition to completing excavations at Nahndauwas, and recording local traditions about the site (Hanlon 1990; Hambruch 1911, 1936a, b, c). While Hambruch repeated much of the work that had been undertaken by Christian and Kubary, he also undertook to gather as much information about the site and other similar sites on Pohnpei. His research was particularly thorough, in that he gathered all the information about various sites on Pohnpei from available traveler's tales and published accounts of previous researchers, and noted that much had been removed from Nahndauwas and other islets over the years (Hambruch 1911, 1936a). Hambruch also visited a number of sites, including Sapwtakai and the petroglyphs in Madolenihmw, investigated traditions about the basalt quarries and building methods, and recorded a significant number of traditions about specific sites and Pohnpeian history (Hambruch 1911, 1936a). His work, which was published posthumously in three edited volumes, is commonly referenced.

Though the majority of research done on Pohnpei by the Japanese took place in the 1920s and 1930s, the earliest Japanese excavations were undertaken in 1915 (Intoh 1998;

Muranushi 1942; Yawata 1932). Like many of their predecessors, the Japanese focused their excavations on Nan Madol (Intoh 1998; Yawata 1932), though Muranushi (1942) did explore tomb structures elsewhere on Pohnpei. Unfortunately, much of this research is not readily accessible. Even though some of this work has been published or reported in Japanese, the funding limitations of this project prevented the acquisition and translation of this material, which limits detailed discussion of it here.

The majority of archaeological work completed in the early days of the Trust Territory was undertaken by American visitors or the anthropologists attached to the Naval administration (e.g. Richards n.d./1948). Much of this work has never been published and it is likely that some of it was never fully reported. As with prior researchers and visitors, early Trust Territory excavations were focused on the monumental tombs of Pohnpei with a particular interest in Nan Madol (e.g. Richards n.d./1948). The Smithsonian Institution undertook excavations at Nan Madol in 1963. The expedition excavated at Nahndauwas and Ideht, and was the first to obtain radiocarbon dates anywhere on Pohnpei (see Long 1965). Unfortunately, the only published records from this work are three radiocarbon dates from Ideht. The project notes and a brief letter report are held in the museum's collections.

After the establishment of the State Historic Preservation Offices in the FSM through the National Historic Preservation Act of 1966, research and contract projects were more completely reported, if not published. In the late 1970s projects began to focus on other sites in addition to Nan Madol (e.g. Athens 1980a, Ayres and Haun 1980; Bath 1984a, b; Falgout 1987), but there was also a significant push to complete projects geared towards an understanding of the chronology and construction of Nan Madol (e.g. Athens n.d., 1980a, 1984, 1985; Ayres n.d.a., 1983; Ayres et al. 1981). Many of these projects were combined research and contract projects, partly or entirely funded through the Historic Preservation Office of the Trust Territory.

During the Trust Territory Period survey work in Palikir (Sokehs District) and Kiti was contracted as part of proposed construction projects in both locations (Athens 1980a; Streck

1980). Generally, other research projects from this period were focused on sites or locations that feature significantly in Pohnpeian oral tradition, such as Wene, Sapwtakai, and Awak (see Ayres and Haun 1980; Ayres et al. 1981; Bath 1984a, b; Falgout 1987; Hanlon 1981; Haun 1984). These projects variously recorded, mapped and documented a significant number of site complexes, agricultural features, and architecture. This foundational work produced important information on Pohnpeian prehistory as a whole, and provides useful comparative data to track the mechanisms of social change on the island.

Research and contract projects around Nan Madol during the Trust Territory Period greatly expanded upon the prior effort expended on the site. Saxe and colleagues (1980) resurveyed the site and visited a number of other sites in the area. Ayres, Athens and their teams (e.g. Athens n.d., 1980a, 1984, 1985; Ayres n.d.a., n.d.b., 1983) spent multiple seasons at Nan Madol focusing on establishing the chronology of the site and completing detailed maps for nearly half of the 100 artificial islets that comprise the site. Data from these projects is continuing to be analyzed and published (e.g. Athens 2007; McCoy and Athens 2012; Seikel 2011).

The status of archaeology on Pohnpei has not changed significantly since the Compact of Free Association came into effect in 1986 as US legislation on historic sites is still in place, though the frequency of projects has fluctuated to some degree. Contracted projects on major construction endeavors are intermittent (e.g. Brulotte n.d.), and research projects, some of which are under contract to the Historic Preservation Office, tend to be more common (e.g. Ayres and Mauricio 1997; Ayres n.d.b., Ayres et al. n.d.a.). These projects have included surveys in Salapwuk (Kiti District) and Temwen (Madolenihmw District), documentation of coastal sites, and further documentation at Nan Madol.

3.3.2 Review of Pohnpeian Prehistory

Ayres (1990) proposed a cultural-historical sequence for Pohnpei based on existing archaeological data (Figure 3.2). The sequence is divided along similar lines to Pohnpeian oral

tradition, and relies heavily on the archaeological record from Nan Madol. This framework provides a valuable foundation, but will need to be refined over time as more work is completed on the island. This review of Pohnpeian prehistory from an archaeological standpoint follows this sequence, though suggestions on how the sequence may need to be modified are made in the next section.

Pohnpei Culture-Historical Sequence
(From Ayres 1990)

Settlement and Adaptive Integration Phase inland forest clearance, Awak; calcareous tempered pottery in use	pre-500 BC - AD 1
Peinais Phase stone house foundations, breadfruit storage pits, pottery with rim notching, rare punctate and incised line designs; Nan Madol islets with some columnar basalt costruction as early as AD 500-600	AD 1 - 1000
Nan Madol Phase expansion and formalization of Nan Madol complex and associated sociopolitical aspects (Deleur "Empire"), chiefly residential architecture, stylized tombs (*lolong*), pottery declining in use --- increasingly plainware --- or absent	AD 1000 - 1500
Isohkelekel Phase disintegration of the Deleur polity, Nahnmwarki title in use, chiefly complexes and new style meeting house (*nahs*), post-pottery phase	AD 1500 - 1826
Early Contact Phase Western contact; Nan Madol occupation continues but in a non-center role	AD 1826 - 1885
Historic Phase Western contact and colonial governments	AD 1885 - present

Figure 3.2 Current sequence of Pohnpeian history based on archaeology and oral traditions.

3.3.2.1 Settlement (c. 500 BC-AD 1)

The initial settlement of Micronesia as a region is still unclear, even with considerable effort put into questions about regional or island settlement (e.g. Clark 2010; Petersen 2006, 2009). Part of this uncertainty is based on gaps in early records for many islands. But "there is little reason to think that eastern Micronesia was settled from a single island or locale, or even a single circumscribed area, by a single group of people, or at a single point in time" (Petersen 2009:41). There is evidence, archaeological, linguistic and anthropological, that supports multiple settlement phases (Athens 1990; Mauricio 1987; Petersen 2006, 2009).

The earliest dated evidence of human activity on Pohnpei comes from swamp cores from the Awak valley (Ayres and Haun 1985; Haun 1984). The core dates suggest that human-induced land clearing began between 40 BC and AD 440 (Ayres and Haun 1985). But the settlement record for Pohnpei suffers from the same paucity of early settlement sites as the rest of Micronesia. Initial settlement of Pohnpei is estimated between 2,000 and 3,000 years ago (Ayres 1990; Mauricio 1987, 1993), but the most reliable dates range between 100 BC and AD 100. Pottery from a few sites has been argued to have an affinity to the late Lapita Plain-ware tradition, which suggests ties to central Melanesia and/or western Polynesia (Athens 1990; Ayres 1990). Early ties to these regions are supported by the presence of kava varieties originating from Vanuatu or the Bismarcks on Pohnpei (Lebot et al. 1992).

3.3.2.2 Peinais Phase (AD 1-1000)

There is significantly more information available for the Peinais Phase, mostly due to its chronological length. This phase accounts for a significant amount of social development and socio-political change in the Pohnpeian sequence. Between AD 1 and 1000 there is evidence for population growth, development of horticultural and agroforestry practices, continued but declining pottery use, and architectural elaboration.

The expansion of agricultural production has been argued to be linked to developing social complexity in the Pacific (e.g. Ayres and Haun 1985; Kirch 1984, 2010). Ayres and Haun (1990:223) propose that the "elaboration of intensified tree-root intercropping in permanent field or 'managed forest' systems, and increasingly intensive yam cultivation" on Pohnpei is linked to the development of prestige feasting. Turtle, dog, and certain species of fish have been identified as prestige foods ethnographically (Riesenberg 1968). Faunal analysis completed on materials excavated at Nan Madol note that dog, turtle and many prestige fish (e.g.*Epinephelus sp*., *Gymnothorax sp*., *Bolbometopon muricatus*) were consumed by AD 750, and possibly as early as AD 600 (Athens 1990; Kataoka n.d., 1991). The possibility that prestige foods were being designated in the middle of the Peinais Phase and the evidence of

agricultural intensification around the same time support Ayres' and Haun's (1985, 1990) hypothesis.

Subsistence practices are not the only potential indicators of socio-political change on Pohnpei. Technological change also plays a significant role in social change (see Barnett 1953; Braun 1986; Joyce 2004; Pauketat 2001). Technological innovation and shifts away from use of specific artifacts are particularly obvious in Pohnpeian ceramics. Pottery likely dates back to the early settlement of the island, but reliable evidence for ceramic use and production only occurs between AD 1 and 1000 (Athens 1981, 1990; Ayres 1990). Pohnpeian ceramics were made using the paddle and anvil method with a wide variety of tempers (e.g. grog, calcareous sand, volcanic sand) and in some cases untempered clay (Athens 1990; Ayres 1990). Typically, there is little decoration on pottery sherds, but rim edge-notching, incising, punctuated lines or marks, and fingernail impression represent the corpus of decoration (Athens 1990; Ayres 1990). Based on their analysis of Nan Madol pottery Athens (1990) and Bryson (1989) suggest that calcareous sand tempered ceramics (CST pottery) were abandoned around AD 500, but other types of tempered ceramic were still in use until around AD 1000 (Athens 1990; Bryson 1989). Grog temper, for example, is common in non-CST wares and is more prevalent later in the sequence (Athens 1990). Athens (1990:22) notes that pottery was likely used for cooking due to soot coating a significant number of sherds. Ceramics seem to go out of use before the establishment of specialized ritual structures (e.g. feast houses) or tombs on Pohnpei (Ayres 2002), suggesting a shift away from pottery manufacture due to modifications of daily schedules related to changes in cooking techniques. The changes in scheduling are likely tied to an intensification of horticultural practices, which may be linked to the development of more elaborate architecture (e.g. feast houses or *lolong*).

Investment in architecture is exemplified by the site of Nan Madol. Nan Madol is located on the reef flats off Temwen Island on southeast Pohnpei, and is central to discussions of architectural elaboration. It comprises approximately 100 artificial islets spanning approximately 80 hectares (Bath and Athens 1990). Islets were built on a foundation of coral

and basalt boulders with coral rubble islet fill. Columnar basalt was used in the construction of architectural features and islet walls. There is evidence for occupation on the reef flats as early as 2,000 years ago, but early construction of artificial islets did not commence until c. AD 600 (Athens 1990; Ayres n.d.b.). Two charcoal dates from below Dapahu islet date the usage of the reef flats to AD 25-530 (Athens 1984; Leach et al. 1996). The reef flats were likely used as fishing grounds prior to islet construction. Evidence for the development of the mangrove forests on the coastal margin and the slow rate of subsidence (less than 0.7 m per 2,000 years) (Bloom 1970a; Spengler 1990; Spengler et al. 1992, 1994) generally support this interpretation of the presence of charcoal on the reef flats.

Dates from the islet fill from Dapahu, Wasau and Usendau place the start of islet construction between AD 600 and 900 (Ayres et al. n.d.b.; Bryson 1989; Leach et al. 1996), though it is likely that most of this construction took place in the latter part of this range. It is possible that some islets in the mangrove swamp nearer Temwen may date to an earlier period (Ayres pers. comm.). Bryson (1989:334) suggests that the religious precinct of Nan Madol, as designated by oral tradition, was built up prior to the secular precinct based on ceramic seriation and radiocarbon dating. This supports oral traditions (see Bernart 1977; Hambruch 1936a) which establish the site as a religious domain before its use as a political center. Nan Madol likely functioned as a local/district center and religious site prior to the establishment of the centralized socio-political system under the Saudeleur.

Settlement and architectural data from elsewhere on Pohnpei support the proposed shift towards increasing socio-political complexity in the latter half of the first century AD. A series of radiocarbon dates from Sokehs Island, in the Ipwal Quarry area, place the settlement and early occupation of the area around AD 150. Current evidence from test-pitting at a small paved feature (PoS4-5) suggests that it was constructed at or after AD 400 (Brulotte n.d.). Other test excavations have yielded radiocarbon results that show that Ipwal was consistently occupied throughout the Peinais Phase. Even though there is some evidence for stone architectural features (e.g. PoS4-5) prior to the Nan Madol Phase, elaboration of architectural

styles (e.g. use of columnar stone and new architectural types) does not occur until later in the record (AD 1000-1300) at Ipwal.

The pattern of architectural elaboration at the end or after the Peinais Phase is supported by radiocarbon dates associated with various types of architecture in the Awak Valley, Uh District. House platforms and cookhouse/dwellings compose part of the early architectural record for Awak. Three dates from these types of features (sites PoB7-41, B7-29 and B7-62) place early stone architectural construction in the valley between AD 430 and 1160 (Ayres and Haun 1980; Ayres et al. 1981; Bath 1984a). Elaborated or ritual architecture occur later in the Awak sequence.

Archaeological surveys of the sections of Salapwuk and Wene in Kiti have yielded a significant number of non-agricultural sites. Many of these sites have associated oral traditions or histories linked to priest-leaders or have religious associations (Ayres and Mauricio 1997; Falgout 1987; Mauricio 1993). Unfortunately, there are few radiocarbon dates associated with sites earlier than the Nan Madol phase, mostly due to sampling bias. It is possible that many of the earthworks, pavings, house platforms, and other structures date to the Peinais Phase, but more chronological work is necessary.

3.3.2.3 Nan Madol Phase (AD 1000-1500)

The Nan Madol Phase (AD 1000-1500) marks a period in Pohnpeian prehistory where there is a major elaboration of architecture and the appearance of monumental constructions. Architectural elaboration has been noted as indicative of significant socio-political change, and possibly large-scale political centralization on Pohnpei (Athens 2007; Ayres 1990, 2002; Bath and Athens 1990). Pohnpeian monuments are primarily comprised of large tomb structures (*lolong*), which include a burial platform and substantial enclosing wall, and mortuary complexes which incorporate multiple tomb structures. Many of the monumental mortuary structures were constructed using very large columnar basalt stones using header-stretcher style construction (see Chapter 5).

Radiocarbon dates suggest that the majority of islet building and occupation at Nan Madol occurred from approximately AD 1000 into the mid-to-late 1600s (Athens 1990, 2007; Ayres 2002; Bath and Athens 1990; Mauricio 1993). It has been suggested that columnar basalt walls may be a later feature of the sequence based on islet chronologies and construction sequences (Ayres pers. comm.; Bath and Athens 1990). Though various dates for islets (e.g. Pohndauwas, Sapwenpwe, and Pahnwi) have been reported for this period, only a few dates have been discussed in direct relation to their depositional context which limits this interpretation.

Pahn Kadira islet test excavations (n=3) have yielded seven radiocarbon dates (Ayres et al. n.d.b.). These dates taken in conjunction with stratigraphy show that the islet was built up in stages in the 700 years between AD 900 and 1620 (calibrated range) (Ayres et al. n.d.b.). Most of the dates lie within the range between AD 1200 and 1620, suggesting that the majority of islet construction at PahnKadira took place during the major building period at Nan Madol. This is significant as the islet was identified in oral tradition as the Saudeleur's administrative seat, and was abandoned after the overthrow of the Saudeleur (Bernart 1977; Mauricio 1993:165).

The primary construction phases at Pahnwi and Nahndauwas date to between AD 1000 and 1400 (Bryson 1989; Mauricio 1993), and demonstrate variation in building phases and construction completion. Nahndauwas and its architecture were built between AD 1100 and 1600. An examination of individual architectural features shows that the central platform and *lolong* was built prior to the smaller tombs on the islet. While Nahndauwas shows every indication of being completed, Pahnwi was largely abandoned before construction on the islet was completed (Mauricio 1993). The functioning of Nahndauwas as the burial complex of the Saudeleur may explain why it was completed when Pahnwi, which is not tied to oral traditions, was not. It is reasonable to suggest that socio-economic and political changes linked to those responsible for islet building caused them to shift their focus away from building projects at Nan Madol towards other projects or activities. Over time, construction at Nan Madol

"became too costly both in economic, manpower, and political terms" (Mauricio 1993:160), particularly after the centralized system broke down and resources were likely allocated elsewhere.

AD 1200 is the estimated time when major building projects begin to be undertaken at other sites on Pohnpei. Radiocarbon dates from Sokehs, Temwen and Awak provide the chronological framework for an increase in architectural building, the construction of settlement complexes, and new types of architecture (e.g. *lolong*) during the middle of the Nan Madol Phase.

The widest typological range of dated sites from the Nan Madol Phase is located in the Awak Valley due to extensive survey in the area (see Ayres and Haun 1980; Ayres et al. 1981). As noted previously, dates for some of the domestic areas in Awak place their construction and/or use in both the Peinais Phase and the Nan Madol phase, but what have been identified as high-status dwellings or *lolong* are firmly situated within the Nan Madol Phase (Ayres 1979; Haun 1984). PoB7-116 is a high-status dwelling which has been dated to AD 1030-1385, and is indicative of status differentiation becoming more marked over time as shown by the size of house platforms and the architectural complexity of settlement areas (Ayres pers. comm.).

The pattern at Awak also appears elsewhere. Architectural sites in Ipwal display an elaboration in form and an increase in number after AD 1100. Radiocarbon dates from a paved feature (PoS4-5) place its use to at least AD 1030-1280 (Brulotte n.d.). A multi-component platform (PoS4-1) is located nearby and radiocarbon determinations place its use and construction at AD 1290-1450 (Brulotte n.d.). It is probable that this pattern of architectural development exists elsewhere on Pohnpei around the same time.

Tomb complexes (*lolong*) appear during the Nan Madol Phase across Pohnpei. They are prevalent at Nan Madol, itself, as well as other locations across the island. None of the Nan Madol *lolong* have been directly dated, but relative dates from islet construction layers place their construction between AD 1100 and 1700. These relative dates are derived from

excavations in the islet fill which underlies these structures. They provide an estimate for the earliest construction of these *lolong*, but the dates also present some issues. These include the possibility that the charcoal was brought from another site with the construction fill and that they have potentially have filtered into the construction fill from the surface of the islet. Three *lolong* from other sites on Pohnpei have been directly dated. PoB7-44, a *lolong* in Awak, dates to 650 +/- 100 BP (AD 1178-1445) (Ayres 1979). The two *lolong* from Temwen date to between AD 1200-1400 (PoC3-5) and AD 1400-1600 (PoC3-8) respectively. The date from PoB7-44 was the only date derived from burial remains rather than construction fill. Thus, dated materials are primarily associated with the construction of this type of structure rather than their use-life, which may extend into the early Contact Period. The relative dates from Nan Madol produce a similar age range to those from other sites which suggests they are accurate. These *lolong* dates support the hypothesis that status differentiation increased after AD 1000, since there is no evidence of monumental construction prior to AD 1100.

Both the Peinais and Nan Madol Phases saw significant development in subsistence strategies (e.g. breadfruit fermentation pits and terracing) and architectural styles (e.g. *lolong*). This progression is indicative of increasing socio-political complexity, but developments in the later phases of Pohnpeian prehistory may suggest a shift in focus away from monuments towards community structures (e.g. feast houses).

3.3.2.4 Isohkelekel Phase (AD 1500-1820)

The Isohkelekel Phase, otherwise known as the Nahnmwarki Period, marks a period of socio-political decentralization on Pohnpei in oral tradition (e.g. Bernart 1977; Mauricio 1993). The archaeological record shows that major building projects decline in frequency, especially at Nan Madol, and there is a shift away from centralized seats of power (Bath 1984a). Construction of monumental scale structures ceases by the 18th century if not earlier (Bath and Athens 1990).

Late in the Nan Madol Phase and early in the Isohkelekel Phase other population centers were being constructed outside of Madolenihmw (i.e. Sapwtakai). Sapwtakai (PoD35-1) has three associated dates that securely place the construction and use of the site at AD 1300-1650 (Bath 1984a, b). The slightly later construction dates from Sapwtakai indicate that the site may have acted as a satellite center to Nan Madol; it might also represent a visual statement of local autonomy from Saudeleur rule. Three additional dates from a rock oven suggest that there was residual use of the site until the historic period. A paved terrace located a short distance from Sapwtakai dates AD 1650-modern (Bath 1984 a, b). This supports the continued occupation of the Sapwtakai area up to and beyond the early Contact period.

Faunal remains from marine fish and shellfish were uncovered at Sapwtakai (Bath and Athens 1990; Bath 1984b), which prompted Bath and Athens (1990:285) to posit that "access to subsistence resources was not a factor in the location of either Nan Madol or Sapwtakai." The development of satellite centers away from Nan Madol, as well as the development of Nan Madol itself, was based on factors beyond, but still including, subsistence capabilities.

The U-shaped *nahs* (feast house) was introduced in the Nahnmwarki Period to replace the rectangular meetinghouses of the Saudeleur Period (Falgout 1990; Hanlon 1988a). The change in design according to traditional history was to provide shelter for more people (commoners and nobility) and to accommodate a sheltered activity area (Hanlon 1988a:22). In some locations the Nahnmwarki title system was not adopted until late in prehistory or the historic period (Mauricio 1993), so the *nahs* was not necessarily a standard architectural feature across Pohnpei until recent times. Additional dates will be needed to confirm the dates of *nahs* construction and use.

During the Nahnmwarki Period, "the effect on the settlement pattern has been a gradual phasing out of local and regional centers" (Bath 1984a:152). Evidence from Sapwtakai shows that though it was constructed over 200 or 300 years, its peak in occupation and use was significantly shorter than that of Nan Madol. At this time evidence for the decline of Nan

Madol and Sapwtakai around AD 1600 support oral traditions, in that the Nahnmwarki Period was a time of significant social change on Pohnpei, particularly the return to semi-autonomous territorial rule and/or the adoption of the Nahnmwarki system (see Section 3.2.1).

3.3.2.5 Early Contact Phase (AD 1820-1885)

Archaeological remains from the Early Contact period are not always readily distinguishable from those of previous stages in Pohnpeian history. Historic sites utilizing foreign materials are readily recognizable in the archaeological record from this period. However, other sites using more traditional materials continued to be used and/or built. The establishment of stone pig fences and brick and mortar foundations are reliably associated with this phase.

Dogs and rats were used as food in pre-Contact Pohnpei (Ayres and Haun 1985; Kataoka n.d., 1991), but alternate protein sources were introduced during the Contact Period. Chickens and pigs were introduced by Westerners during the early Contact Period, yet pigs had a much larger environmental and structural impact on Pohnpei than chickens or the commensal species introduced in prehistory. Pig walls and yam enclosures were built during the Contact period to limit foraging by pigs and, later, to cope with introduced cattle and other livestock (Ayres and Haun 1990; Levin and Ayres In Press). Often, Pohnpeians would recycle materials from older structures to construct these historic period features (Ayres pers. comm.). It is likely that structures with oral traditions attached to them were more likely to survive untouched over time.

3.3.3 Chronological Limitations to Archaeological Interpretation

The greatest challenge to understanding Pohnpei's chronological sequence is incomplete reporting of radiocarbon dates in reports and academic literature. In most cases conventional radiocarbon ages are reported, but a number of dates have been reported as

District	Site	Site #	NM Islet	Provenance	Lab Code	Conventional	IntCal13	Source	Reference/s
Uh	Awak	B7-41		Layer 3	Beta 1811	1335 +/- 140	AD 425-984	charcoal	Bath 1984b
Uh	Awak	B7-29		cookhouse/dwelling	Isotopes10, 170	1075 +/- 80	AD 769-1154	charcoal	Ayres & Haun 1980
Uh	Awak	B7-62		house platform	Gak 7643	1110 +/- 120	AD 673-1155	charcoal	Ayres et al 1981
Uh	Awak	B7-44		lolong	Gak 7641	650 +/- 100	AD 1170-1445	bone collagen	Ayres et al 1981
Uh	Awak	B7-116		high status dwelling	Beta 1806	795 +/- 85	AD 1032-1385	charcoal	Bath 1984b
Kiti	Wene	D5-10		below paving	Beta 1810	1085 +/- 105	AD 690-1160	charcoal	Bath 1984b
Kiti	Wene	D5-11		breadfruit pit	Beta-1808	1650+/- 125	AD 125-642	charcoal	Bath 1984b
Kiti		D31-8		paved terrace: TP1 Level 7	Beta-3476	90 +/- 70	AD 1669-1945	charcoal	Bath 1984a
Kiti		D31-8		paved terrace: TP1 Level 4	Beta-3477	180 +/- 50	AD 1647-1954	charcoal	Bath 1984a
Kiti		D31-8		paved terrace: TP1 Level 1	Beta-3478	lt.170		charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		Feat. 15 - depression	Beta-3474	390 +/- 70	AD 1421-1646	wood	Bath 1984a
Kiti	Sapwtakai	D35-1		Edge Feat. 1	Beta-3475	470 +/- 80	AD 1302-1635	charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		Feat.26 - rock oven Level 2	Beta-3479	80 +/- 50	AD 1679-1940	charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		Feat.26 - rock oven Level 3	Beta-3480	200 +/- 70	AD 1522-1954	charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		Feat.26 - rock oven Level 4	Beta-3481	130 +/- 70	AD 1665-1952	charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		midden near Feat 15; 10-20 cm bs	Beta-3482	440 +/- 80	AD 1318-1644	charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		Feat. 7 - depression	Beta-3483	lt.130		charcoal	Bath 1984a
Kiti	Sapwtakai	D35-1		midden near Feat 15	Beta-5145	190 +/- 60		marine shell	Bath 1984a
Kiti		D35-3		lolong	Beta-5146	280+/- 60		marine shell	Bath 1984a
Madolenihmw	NM	C3-1	Dapahu	basal/beach layer	Beta 6107	1770 +/- 90	AD 33-529	charcoal/wood	Athens 1984
Madolenihmw	NM	C3-1	Dapahu	Grid 2 Spit 12		1870 +/- 50	AD 25-311	charcoal	Leach et al 1996
Madolenihmw	NM	C3-1	Dapahu	Grid 2 Spit 1		1010 +/- 60		shell	Leach et al 1996
Madolenihmw	NM	C3-1	Dapahu	Grid 2 Spit 7		1170 +/- 65	AD 689-990	charcoal	Leach et al 1996
Madolenihmw	NM	C3-1	Ideht	Midden mound	SI-90	520 +/- 65	AD 1291-1482	charcoal	Long 1965
Madolenihmw	NM	C3-1	Ideht	Midden mound	SI-91	690 +/- 50	AD 1228-1398	charcoal	Long 1965
Madolenihmw	NM	C3-1	Ideht	Midden mound	SI-92	770 +/- 60	AD 1053-1387	charcoal	Long 1965
Madolenihmw	NM	C3-1	Ideht	Midden mound		350 +/- 50	AD 1452-1642	charcoal	Athens 2007
Madolenihmw	NM	C3-1	Ideht	Midden mound		600 +/- 65	AD 1281-1429	charcoal	Athens 2007
Madolenihmw	NM	C3-1	Ideht	Midden mound		700 +/- 30	AD 1261-1387	charcoal	Athens 2007
Madolenihmw	NM	C3-1	PahnKadira	Test 1, Unit A Layer 3B	Beta-3715	970 +/- 80	AD 894-1224	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	PahnKadira	Test 1, Unit B Layer 3A	Beta-4077	470 +/- 50	AD 1320-1619	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	PahnKadira	Test 1, Unit B Layer 2B	Beta-3714	1000 +/- 60	AD 895-1168	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	PahnKadira	Test 2 Layer 2A/B	Beta-3713	470 +/- 50	AD 1320-1619	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	PahnKadira	Test 2 Layer 2C	Beta-4078	490 +/- 60	AD 1301-1618	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	PahnKadira	Test 3	Beta-4079	660 +/- 50	AD 1270-1401	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	PahnKadira	Test 4	Beta-3711	700 +/- 70	AD 1192-1410	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	Usendau	Test 1	Beta-3712	1190 +/- 50	AD 691-970	charcoal	Ayres et al. n.d./1983
Madolenihmw	NM	C3-1	Wasau	TP-1, Level 5	Beta-10757	1120 +/- 80	AD 688-1036	charcoal	Bryson 1989
Madolenihmw	NM	C3-1	Wasau	TP-1, Level 13	Beta-10758	1360 +/- 50	AD 595-770	charcoal	Bryson 1989
Madolenihmw	Temwen	C3-10		Area 3	UCIAMS 76153	385 +/- 20	AD 1445-1620	charcoal	M. Levin pers. comm.
Madolenihmw	Temwen	C3-11		TP-1: 30 cm	D-AMS #005998	198 +/- 26	AD 1652-1954	charcoal	Levin and Ayres 2015
Madolenihmw	Temwen	C3-11		TP-1: 74 cm	D-AMS #005375	750 +/- 34	AD 1219-1290	charcoal	Levin and Ayres 2015
Madolenihmw	Temwen	C3-9		TP-1: 45 cm	D-AMS 005376	1477 +/- 31	AD 540-645	charcoal	Levin and Ayres 2015
Madolenihmw	Temwen	C3-9		TP-1: 53 cm	D-AMS 005999	293 +/- 25	AD 1498-1656	charcoal	Levin and Ayres 2015
Madolenihmw	Temwen	C3-8		33 cm bs	ANU 29904-8669	405 +/- 30	AD 1433-1624	charcoal	K. Seikel
Madolenihmw	Temwen	C3-8		51 cm bs	ANU 29905-8700	600 +/- 25	AD 1299-1407	charcoal	K. Seikel
Madolenihmw	Temwen	C3-5		Feat 1 - bark, 27-33 cm bs	ANU 29906-8701	695 +/- 25	AD 1266-1385	charcoal	K. Seikel
Madolenihmw	Temwen	C3-5		Unit A, 82 cm bs	ANU 29907-8702	725 +/- 40	AD 1220-1385	charcoal	K. Seikel
Madolenihmw	Temwen	C3-5		Unit B, 63 cm bs (1)	ANU 29909-8703	995 +/- 30	AD 986-1153	charcoal	K. Seikel
Madolenihmw	Temwen	C3-5		Unit B, 63 cm bs (1) - duplicate	ANU 29910-8705	1025 +/- 30	AD 903-1146	charcoal	K. Seikel
Madolenihmw	Temwen	C3-5		Unit A, 46 cm	ANU 29910-8704	980 +/- 35	AD 993-1155	charcoal	K. Seikel
Sokehs	Ipwal	S4-1		Feature 1	Beta-63386	550 +/- 70	AD 1286-1451	charcoal	Ayres et al. n.d./2008
Sokehs	Ipwal	S4-5		120-140 cm	Beta-63389	1800 +/- 60	AD 82-380	charcoal	Ayres et al. n.d./2008
Sokehs	Ipwal	S4-5		100-120 cm	Beta-63388	850 +/- 80	AD 1028-1278	charcoal	Ayres et al. n.d./2008
Sokehs	Ipwal			inland S4-1 (TP 3): 30 cm	Beta-135130	960 +/- 110	AD 779-1275	charcoal	Ayres et al. n.d./2008
Sokehs	Ipwal			inland S4-1 (TP 3): 95 cm	Beta-135131	1150 +/- 40	AD 774-978	charcoal	Ayres et al. n.d./2008
Sokehs	Ipwal			inland S4-1 (TP 3): 130 cm	Beta-135132	1720 +/- 70	AD 129-531	charcoal	Ayres et al. n.d./2008

Table 3.1 Recalibration of available radiocarbon dates. All dates have been calibrated using the IntCal13 calibration curve (Reimer et al. 2009) in Ox Cal 4.2 (Bronk Ramsey 2009).

age ranges without further information printed about material types, lab codes and/or conventional dates (e.g. dates from eight Nan Madol islets). This limits the interpretation of the chronological data, as date ranges cannot be recalibrated in the absence of conventional radiocarbon ages (CRAs) (see Table 3.1 for recalibrated dates).

Calibration of marine shell from Pohnpei also remains a concern. The only data currently available on marine correction values near Pohnpei come from Eniwetok Atoll, New Ireland, the Solomon Islands, or Guam (between 672 and 1,648 kilometers away). The published ΔR values for these locations vary considerably (Marine Reservoir Correction Database), which means more work needs to be done on ΔR correction values in central Micronesia before ages from marine shell samples can be used to build a chronological sequence for Pohnpei (e.g. shell dates Bath 1984 a, b).

Another necessary consideration is whether dates produced from samples processed at the Gakushuin laboratory in Japan are valid, since issues have been raised with the methods used to process some of the samples submitted to the laboratory. All of the Gakushuin dates from Pohnpei but one, which was on unpurified bone collagen, were on charcoal samples, which are more reliable. The dates produced at the Gakushuin laboratory do not represent a significant departure from age results produced at other laboratories, so they are provisionally considered accurate in the absence of additional radiocarbon results from the same sites.

At this stage, the available calibrated radiocarbon dates support Ayres' (1990) cultural-historic sequence for Pohnpei (see Figure 3.2). One possibility to consider is whether or not to subdivide the Peinais Phase based on the increase in the construction of stone structures and settlement complexes, and their associated socio-political developments after AD 600. It is clear that settlements expand during this time, though major shifts in architectural development are not associated with the marking of major hierarchical status differences until the Nan Madol Phase. The fluorescence of stone construction, particularly that utilizing columnar basalt, happens around AD 1200. The acquisition of additional dates

from unexcavated sites recorded during surveys may clarify the current chronology and assist in the revision of the current cultural-historical model for Pohnpei.

Many sites identified by surveys in the Wene and Salapwuk sections of Kiti have been documented and associated oral traditions have been recorded for these sites, but few have been excavated and no radiocarbon dates are available at this time. The chronological data from these sites would be particularly valuable as many are related to various priestly groups, priest-leaders, and periods of socio-political development (Ayres and Mauricio 1997; Bernart 1977; Falgout 1987; Mauricio 1993).

3.3.4 Archaeology of Socio-Political Change

> Ayres (1979:9) points out that Pohnpei offers an excellent situation in which to study an elaborate chiefdom-level social organization and the factors contributing to its development because new ethnographic, oral tradition, and archaeological data can be acquired to supplement the historically documented character and operation of the system (Mauricio 1993:10-11).

Although the culture-historic sequence is informative of general cultural shifts over time, what is specifically known about socio-political development is limited to a small number of locations or sites. The link established between Nan Madol and major socio-political shifts in Pohnpeian prehistory has contributed to a significant amount of archaeological work being focused on the site (e.g. Athens 1980b, 1984, 1990, 2007; Ayres n.d.a, n.d.b; Bath and Athens 1990; Bryson 1989; Christian 1899a, b; Hambruch 1911, 1936; Intoh 1998; Kataoka n.d., 1991; Kubary 1874; McCoy and Athens 2012; Muranushi 1942; Sarfert 1911/12; Saxe et al. 1980; Seikel 2011; Yawata 1932). Although Nan Madol is associated with socio-political shifts after AD 1000, the previous 1,000 years of Pohnpeian socio-political history is poorly understood archaeologically.

Nan Madol was the center of Pohnpeian socio-politics for approximately 500 years (c. AD 1100-1600). What is understood about the development of socio-political complexity elsewhere on Pohnpei before and after the florescence of Nan Madol is limited apart from traditional knowledge. Oral traditions identify Salapwuk and Wene as places of religious and

political importance prior to the establishment of Nan Madol (Ayres and Mauricio 1997; Bernart 1977; Dobbin 2011; Falgout 1987; Mauricio 1993). Wene and Sapwtakai occupy similar roles at the beginning of the Nahnmwarki Period (Bath 1984 a, b; Bernart 1977; Mauricio 1993). Of the 50 plus sites identified during survey in Salapwuk and Wene many built sites and modified natural features have associated oral traditions (Ayres and Mauricio 1997; Falgout 1987; Mauricio 1993). Though the traditions provide a broad temporal framework for these sites, most have not been excavated. This makes an attempt at incorporating these sites in Pohnpei's prehistoric sequence difficult.

What can be determined from the information available in oral tradition is that there were priests or priest-leaders before the establishment of local secular chiefs in Kiti. These religious leaders continued to have influence up until and sometimes past the Saudeleur Period (Bernart 1977; Mauricio 1993). Often priests worked alongside secular chiefs and leaders, though their status was not necessarily tied to the title system until the Nahnmwarki Period (Bernart 1977; Dobbin 2011; Mauricio 1993). Priests were associated with specific sites or locations (Bernart 1977; Dobbin 2011; Falgout 1987; Mauricio 1993). It is probable that individuals with similar ritual or religious positions may have operated in other districts over the course of Pohnpei's history alongside or within the chiefly system.

Both ideological and ecological factors are significant in socio-political development on Pohnpei. Some (e.g. Mauricio 1993) argue that exploitation of ecological zones was as much ideological as practical. The land is central to the ideological values of Pohnpeians, as oral traditions describe how the ancestors built it up, introduced plant species, and populated it (Bernart 1977; Mauricio 1993). It is possible that "a period of political and ideological instability and tension possibly spanned the three centuries between AD 1200 and 1500 culminating in the overthrow of the Saudeleur political regime and the abandonment of the major structures of Nan Madol" (Mauricio 1993:159). It is likely that ideology and the social distancing of Nan Madol from the rest of the island was a factor in the decentralization of power later in Pohnpeian prehistory.

There are a series of possible indicators of status present in the archaeological record. As Mauricio (1993) notes *sakau* (kava) stones and shell ornaments are signals of prestige in Pohnpeian prehistory. Artifacts procured over long distances likely also fall under this category.

Evidence for cultural or exchange contacts between Pohnpei and the rest of the Pacific in prehistory have been suggested for some time. In 1932, Yawata noted possible cultural affinities between Pohnpei and Polynesia, and possibly Melanesia, based on comparisons of architectural constructions and monuments. More recently, Petersen (2009:22) has noted that "there were well-established and commonly used channels of interaction among the islands" of Micronesia. Various archaeological finds from Pohnpei support connections with other islands, within or outside Micronesia.

Four basalt adzes were discovered at sites during the 1980s (Athens 1981; Ayres and Mauricio 1987). The adzes were all identified as Western Polynesian in style, and preliminary geochemical analyses confirm that they are not made from Pohnpeian basalt (see Ayres and Mauricio 1987; Seikel et al. In Prep.). The most probable explanation for their existence on Pohnpei are that they were brought to the island from Western Polynesia (~ 4,100 km away) by Polynesian travelers or that they were items used in down-the-line exchange between Pohnpei and Western Polynesia.

Ayres and Mauricio (1987) also note three adzes collected by a German missionary during the early 20th century. Though these artifacts were lost during the bombings of Germany during WW II, sketches of the adzes exist in the museum's archives. Based on these sketches, the adzes have been identified as having probable affinities with Melanesian adzes based on the form and cross-section drawings (Ayres and Mauricio 1987:28).

Other items recovered that do not occur naturally on Pohnpei include obsidian fragments and quartz crystal. It has been suggested that obsidian recovered from excavations at Nan Madol may be linked to sources from the Bismarcks or elsewhere in Western Melanesia (Ayres pers. comm., Ayres et al. n.d.b.; Nagaoka pers. comm.). Unfortunately, most

of these pieces have since been misplaced or lost, so geochemical characterization is not currently possible. The quartz crystal was excavated from Sapwenpwe at Nan Madol, and is not local based on the absence of quartz in Pohnpei's geology (Athens 1990).

Aside from the quartz, there are few radiocarbon dates associated with these artifacts. The quartz piece was introduced to Pohnpei sometime prior to AD 1100 (Athens 1990). The adzes were typically surface finds or the context of the find is not specifically known. The Nan Madol adzes were probably introduced during the Nan Madol Phase since they were surface finds, unless they were curated for a significant period of time. This indicates that Pohnpei maintained contact with other islands in Micronesia and possibly further afield.

3.3.5 Discussion

Pohnpei's archaeological record has much to contribute to the understanding of pre-Contact socio-political development on the island. The trajectory based on the archaeological data presented here offers a much more complex picture of this period than that available through oral traditions and early historic records. The archaeological record does not contradict Pohnpeian traditions, but it does suggest differences in the timing and impact of events.

The trajectory developed from the archaeological data reviewed in this chapter indicates that at the time of settlement (500 BC-AD 1) Pohnpeian socio-politics were not particularly integrated, though there was likely some form of clan or kinship-based hierarchy that accompanied the settlers. The development of subsistence practices and the elaboration of stone architecture around AD 500-600 reflect a shift in socio-politics and potentially the establishment of priest-leaders or other local chiefs just preceding this time. Architectural changes in the centuries around AD 1100 mark another shift. The appearance of monuments shortly after significant islet construction began at Nan Madol is indicative of a move towards centralized power structures. A discontinuation of islet building and the construction of monuments between AD 1600 and 1700 provides the primary evidence for the

decentralization of Pohnpei socio-political power recorded in oral tradition. Currently there is no archaeological evidence for or against resource stress or inter-personal conflict to add further weight to the argument for decentralization. One potential indicator might be found in the construction of the site of Sapwtakai in the Kiti hills. Sapwtakai is identified as a major center for Kiti and its slightly later date of construction may indicate that the power centered at Nan Madol may not have been able to maintain a unified Pohnpei for more than a couple hundred years at most.

The archaeological record shows that the centralization and decentralization of Pohnpeian socio-political power may not have been particularly straightforward. Even though Nan Madol has been long assumed to have been, and operated as, the socio-political center in local tradition, it is not clear how centralized or unified the island became. Other issues that remain include the role of prestige goods in the development and maintenance of centralization, and the mechanisms driving the eventual decentralization of socio-political power structures. It should be possible to start answering these questions through the examination of mortuary monuments from a number of locations, including Nan Madol. The next section presents a refined model of socio-political development on Pohnpei combining the archaeological, oral traditional and historical data.

3.4 Model of Pohnpeian Socio-Political Development

The information presented in the previous sections produced two different models of socio-political development on Pohnpei (see Figures 3.3 and 3.4). Both models show similar trends in the development of socio-political centralization, but there are significant gaps in the explanatory powers of each. This section reviews both these models and presents a model which integrates traditional and archaeological data. This thesis uses the integrated model (Figure 2.5) as its foundation.

3.4.1 Traditional Model of Social Change

The traditional model (Figure 3.3), which includes traditional history, ethnohistory and historic accounts, provides a general chronology of significant events since there are no dates recorded in the history of the island until the 1800s. This model divides Pohnpeian history into five periods based on accounts of major socio-political developments.

Oral tradition regarding the settlement of the island documents a number of distinct settlement events and the arrival of the clans. Individual clans probably held the majority of socio-political power during the early period of Pohnpei's history (Hanlon 1988a). Individual status within the clan was determined by genealogy, age, and knowledge. The status of a clan was determined based on settlement precedence (Falgout 1984; Marshall 1999; Mauricio 1987; Petersen 2009; Riesenberg 1968), which would place members of long-established clans in the position to control and maintain much of the knowledge and traditional history of a settlement area. They would also have access to the most productive zones within a territory. Clans new to an area would not maintain the same time depth of knowledge related to the countryside which meant the community knowledge-base was directly linked to the clan settlement histories in any given location. However, knowledge was not the only way to gain and preserve one's status; clans could also use military prowess to change or maintain their status (see Chapter 4).

Traditions note the presence of priest-leaders throughout much of the island's history spanning from sometime after settlement into the period following the overthrow of the Saudeleur Dynasty. It is probable that priest-leaders were initially members of high-status clans, as access to and control over sacred and historical knowledge would be integral to justify their elevated positions within the community. The dispersed, hierarchical systems centered on clan territory were the norm on Pohnpei until the Saudeleur Period, when socio-political centralization occurred.

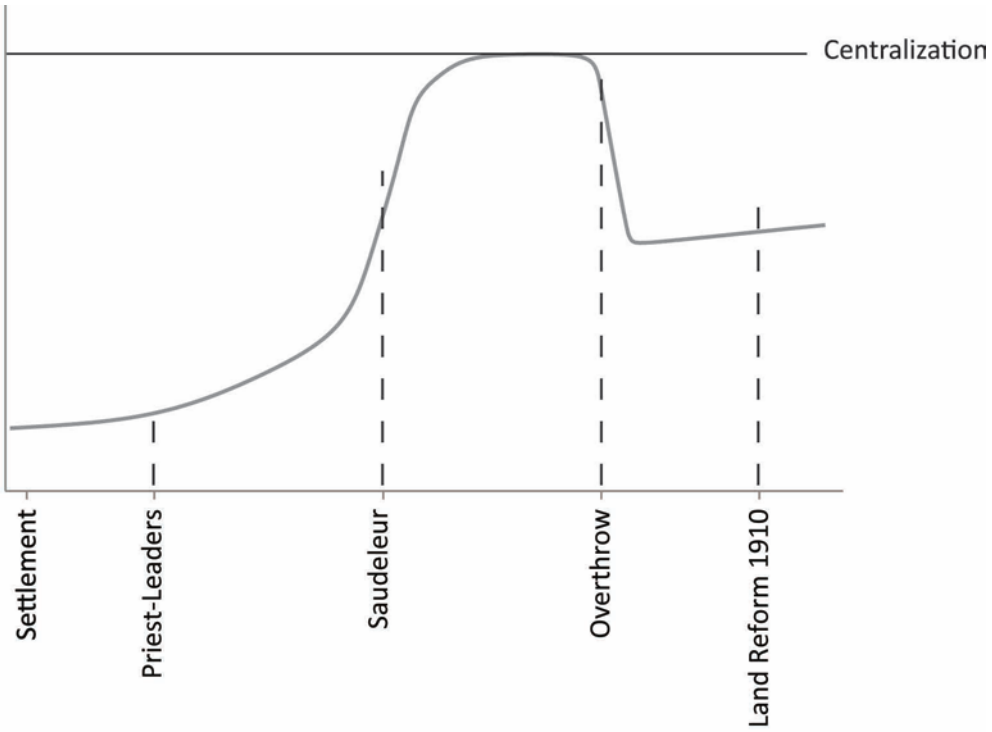


Figure 3.3 Diagram showing socio-political change over time based on oral tradition and historic accounts.

It is likely that the Saudeleur initially based their power on religious or ideological authority rather than coercion, though there are accounts of abuses of power and coercive practices by later Saudeleur rulers. In many districts, geographically distant from Nan Madol, this centralization of power was potentially seen as adding another level of stratification to the already established system of regional chiefdoms. Prestige competition during this period may have functioned primarily as a way to continually reinforce the status quo within the socio-political hierarchy and to legitimize the centralization of power under the Saudeleur. It is suggested that over time Saudeleur rulers began to create divisions between sacred and secular aspects of society to some degree (Dobbin 2011; Mauricio 1993). This separation probably occurred between the rules of the 4th and 12th Saudeleur, but oral tradition is not clear on this point (see Bernart 1977). Priests maintained their status throughout this period, even though the distinction between the political leadership and religious roles was becoming more prevalent.

The downfall of the Saudeleur initiated the process of socio-political decentralization on Pohnpei, where power reverted to the chiefs of each territorial unit, although in a different configuration than in the pre-Saudeleur Period. After the Saudeleur regime was deposed by Isohkelekel and his comrades, the Nahnmwarki system was established and some priestly titles were subsumed into the secular title system (Bernart 1977; Dobbin 2011; Falgout 1990; Riesenberg 1968). Individuals with sacred knowledge would have been important within the socio-political system (Ehrlich 1978; Falgout 1984; Fischer and Fischer 1957; Keating 1994; Mauricio 1993), but they were required to participate in the secular prestige system to gain further power or status.

Contact with western visitors became a regular aspect of Pohnpeian life after 1830, and prolonged exposure to foreigners had a more significant impact on Pohnpeian religious beliefs than the traditional political system until the early 20th century (see Section 3.2). During the ethnohistoric and colonial periods the Nahnmwarki system did not change as much as what was important to maintain it (e.g. feasting, ideology, clan relationships) and the means through which an individual could gain prestige (e.g. commerce, participation in feasts, horticultural skill). Chapter 4 further reviews historic material associated with ideological and political changes during the Historic Period.

The benefit of the traditional model is that it provides information on how Pohnpeian society operated in the past and discusses what drove socio-political change (e.g. ideological change, conflict). There are gaps in the traditions upon which the model is founded, but it does provide a timeline of significant events. By highlighting some events and not recognizing others Pohnpeian tradition and the model based on it outlines the accepted narrative of social change on the island. Solely relying on this model is complicated by the fact that traditional histories may be modified over time to suit the ambitions of some groups or individuals and/or to maintain a specific narrative (Vansina 1985). Though this model presents a plausible sequence of events based on historical events there is no means through historical research that can verify which events prior to the Contact Period were modified in oral traditions.

3.4.2 Archaeological Model of Social Change

The archaeological model (Figure 3.4) primarily identifies benchmarks related to significant changes in the material record of Pohnpei. It provides material indicators of socio-political change in Pohnpeian prehistory attached to fixed periods in the past. These changes are identified by dating changes in the landscape, changes in architectural patterning and changes in ceramic production/use.

Initial settlement of Pohnpei occurred sometime between 500 BC and AD 1. Dated contexts from this period are from sites with evidence for land clearing for agricultural and settlement purposes, and coastal sites with ceramics. The intensification of horticultural and agricultural practice began around AD 400 as demonstrated by changes to the landscape. Settlement organization and the elaboration of residential architecture followed soon after. This evidence shows that the population increased significantly and that some degree of social hierarchy was established.

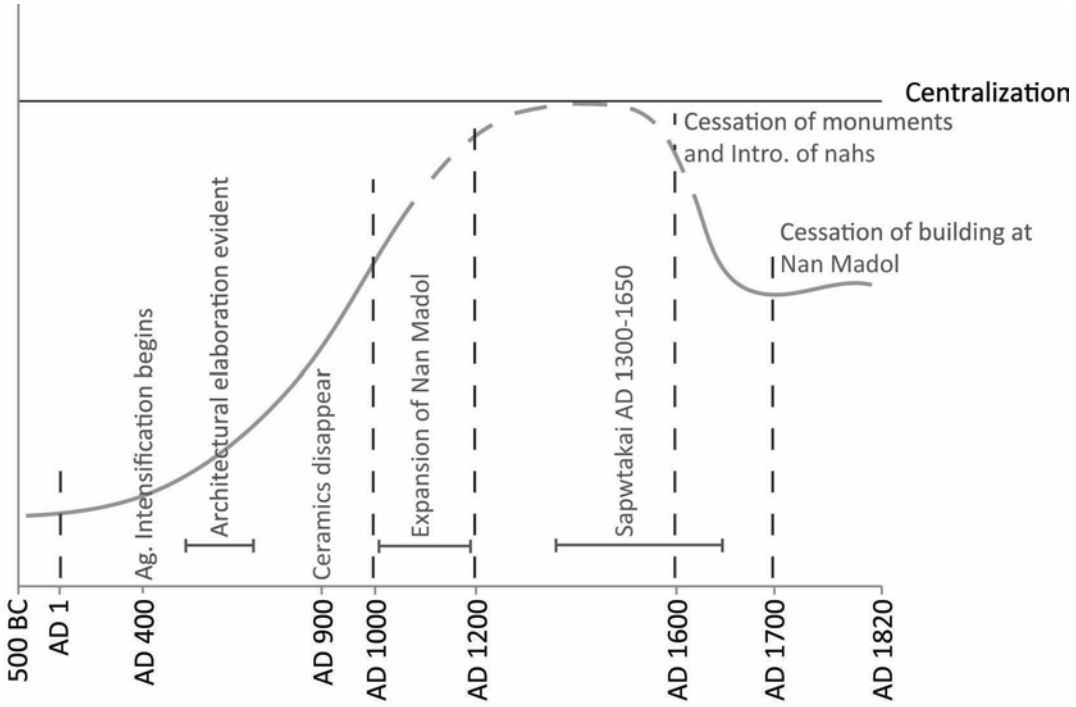


Figure 3.4 Diagram of trajectory of socio-political change on Pohnpei based on current archaeological knowledge.

Islet construction at Nan Madol began at a small scale c. AD 900-1000, though construction expanded and was built on a much larger scale between AD 1000 and 1200. The development of monumental-scale tomb complexes also occurred during this expansion period. These monuments and the construction of Nan Madol form much of the archaeological evidence in support of the development of a state-level society on Pohnpei. Nan Madol was also the center of ritual practice. The islet of Ideht contains a significant midden accumulation in close association with stone enclosures and pavings. Dates from the midden place its use between AD 1100 and AD 1750 (Long 1965).

The site of Sapwtakai was constructed in Kiti between AD 1400 and AD 1650. This site potentially acted as a either a satellite political center of Nan Madol or was constructed in opposition to Nan Madol. There is no indication that Nan Madol lost precedence as Pohnpei's socio-political center until around AD 1600-1700 when construction declined to the point where some construction projects were never completed. Incomplete structures are suggestive of shifts in labor investment and/or social hardship. The occurrence of a new architectural type, the U-shaped feast house or *nahs*, during this period would suggest a change in investment.

Archaeological data shows at least four distinct changes in the social structure of Pohnpei. Even though this model is fairly straightforward there are significant gaps in the record, primarily due to the lack of dates from many sites in Kiti and the need for archaeological survey on the western side of the island. There are also concerns that some of the available dates are problematic, but the questionable dates are consistent with others. With these concerns in mind, the archaeological model is still valuable as it provides approximate dates of social development on Pohnpei. The trend-line of this model is similar to that of the traditional model, which lends support to the traditional model. There has been little work on the archaeological signatures of the mechanisms of social change (e.g. ideology, conflict, coercion) aside from population growth. By integrating the traditional and archaeological models it is possible to create a model of social development with both

chronological shifts in society with further understanding of the potential mechanisms driving this change. It is this integrated hypothetical model which will be addressed in this thesis.

3.4.3 Integrated Model of Socio-Political Development

The integrated model of Pohnpeian socio-political development discussed here combines the data presented separately in Figures 3.3 and 3.4. The model has been divided into periods which are distinguished by hypothetical changes in socio-political organization (see Figure 3.5). The dates presented in this discussion are primarily based on available archaeological data and historical records, with some estimated dates based on cultural sequences in oral tradition. Pohnpei has long been identified as a stratified chiefdom society (e.g. Ayres 1990; Cordy 1985; Petersen 1992). This model does not challenge this determination, but it does attempt to define how and why the Pohnpeian socio-political system developed a centralized power structure, how this level of complexity was maintained, and the factors that led to its failure.

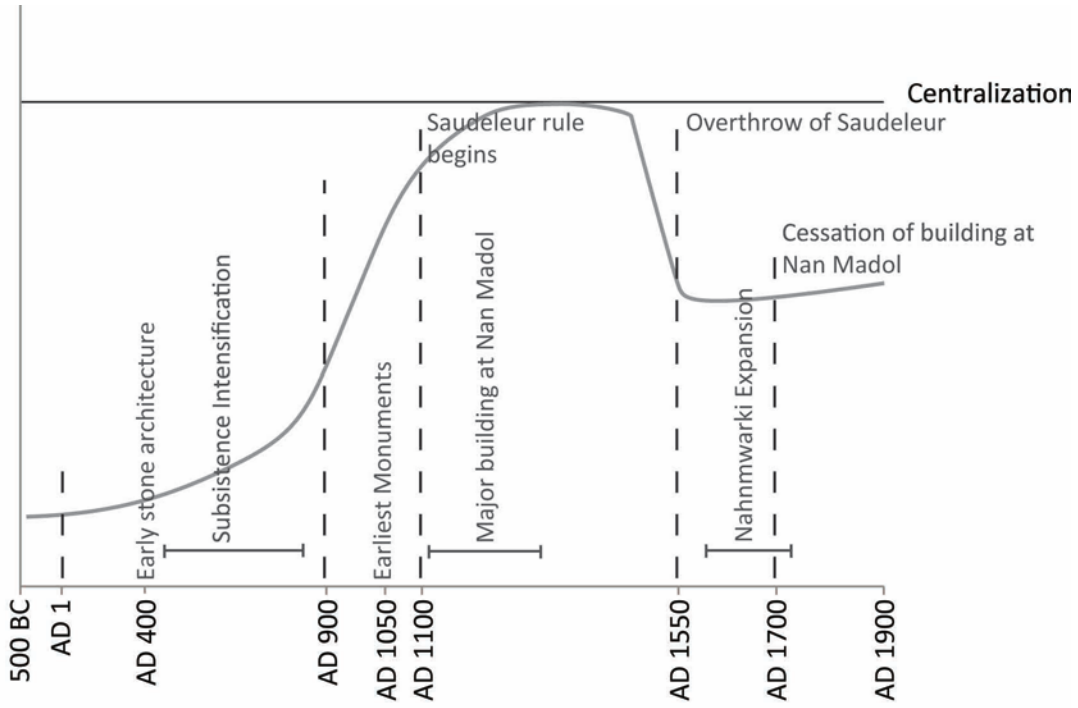


Figure 3.5 Diagram of socio-political change combining both archaeological data and historic information.

The first period demarcated in the integrated model of socio-political development on Pohnpei is the settlement period (500 BC-AD 1). This period is primarily concerned with the settlement of the island and the establishment of clans on the island. The time after each subsequent settlement event (6 according to oral traditions) would have required a renegotiation of social relations, which over time created the basis for clan and social hierarchy on Pohnpei.

The second period, AD 1 to approximately AD 900, is characterized by the development of stone architecture (e.g. house platforms, foundations) around and following AD 600 and expansion of subsistence practices (c. AD 400). It is during this period that priest-leaders are hypothesized to have become important and territorial chiefdoms with some degree of hierarchy emerge.

The period between AD 900 and 1100 is of particular note because it precedes the proposed development of a centralized state on Pohnpeian around AD 1200-1300. Ceramics were no longer in use by this time, but this period is notable for early elaboration of stone architecture (starting c. AD 1000), which includes the start of small-scale islet construction at Nan Madol. This may correlate with traditional history in which the brothers (Olisihpa and Olisohpa), who are credited with the construction of Nan Madol, introduced a new belief system to the island. This 200 year period is particularly important because it is when new leaders established a base for themselves at Nan Madol and began building a foundation for further socio-political development. This period represents the incipient phase of centralization on Pohnpei. At this time socio-political organization is assumed to have been characterized by priest-leaders and powerful clans based on oral traditions, which could be supported if additional dates were acquired from sites associated with oral traditions. This period may be characterized by an increase in prestige competition (feasting, displays of affluence, inter-personal competition) between social groups and clans as a means to establish or maintain their status on a local and potentially regional level. Archaeological

correlates of this likely consist of evidence for feasting, large breadfruit fermentation pits, and evidence for the cultivation of large yams and other root crops.

The period between AD 1100 and 1600 is believed to be the period in which socio-political power was centralized at Nan Madol, under the Saudeleur Dynasty. There is a significant increase in stone construction and monument building starting between AD 1100 and AD 1200 at Nan Madol and elsewhere, which is suggestive of the accompanying social and ideological changes. There is abundant evidence for religious, ritual and political activity centered at Nan Madol at this time (e.g. turtle ceremony at Ideht). There is no obvious archaeological evidence of inter-personal conflict or warfare (e.g. fortification, refuges, etc.) during the centralization of socio-political power on Pohnpei, which means violent conflict may not have been a significant strategy in gaining or maintaining socio-political power. The lack of evidence for violence does not preclude the use of coercion to maintain the Saudeleur Dynasty, which is supported by oral tradition.

Ideological shifts may have contributed to the populace questioning the legitimacy of the centralized system as the Saudeleur began to abuse their position of power. The overthrow of Saudeleur rule by Isohkelekel and his allies recounted in oral tradition likely occurred around AD 1600 based on a decline in building projects at Nan Madol in the 1600s and 1700s. The battles which led to the replacement of the Saudeleur do not appear in the available archaeological data from Pohnpei, but evidence for warfare can be ephemeral (see Milner 1999) and may yet be discovered.

The Nahnmwarki system was probably established around AD 1600 in Madolenihmw (Mauricio 1993) to replace the organizational gap left by the removal of the Saudeleur. The U-shaped feast house (*nahs*) is associated with this time period, and monumental constructions (e.g. *lolong*) were no longer built. Construction at Nan Madol continued on a small scale until c. AD 1750, since the Nahnmwarki of Madolenihmw probably used the site as their base of power until the 18th century. The Nahnmwarki system was adopted in some of the other districts between AD 1600 and 1800.

The integrated model identifies a number of important factors related to socio-political development and change on Pohnpei. Throughout these socio-political shifts kinship and clan hierarchy continued to play significant roles in Pohnpeian power relations, and they still play an integral role. Another important aspect of the proposed model is that ideological and religious beliefs were as important to the development of socio-political hierarchy as demographic increase and surplus production. Though power was centralized under the Saudeleur based on introduced ideological and religious views, it is not clear how this centralization impacted upon areas far from the center of power. The largest effects of this centralization may have been on horticultural production systems and architectural innovation, along with the integration of new levels of hierarchy in the socio-political system.

A significant underlying theme in this proposed model is the trend from a focus on the sacred to the secular over the course of Pohnpeian prehistory (see Mauricio 1993). Oral tradition provides much of the evidence for this shift, but radiocarbon dates from Nan Madol show that the supposed sacred precinct of the site was built prior to the political precinct (see Bryson 1989). Based on the dates from Nan Madol, the probable development of purely secular leadership roles on Pohnpei took place over 500 to 700 years. Secular leaders founded their power upon control of land tenure and surplus production used in prestige competition (Bascom 1948; Fischer 1958; Petersen 1982a; Riesenberg 1968). Power and status are tied to prowess in social competition and knowledge, which has a somewhat sacred character (Ehrlich 1978; Falgout 1984; Fischer and Fischer 1957; Keating 1994; Mauricio 1993).

This study does not plan to address the full scope of the developmental trajectory presented above, but focuses on socio-political development on Pohnpei between AD 1000 and 1700. To answer questions relating to the processes of centralization and decentralization of socio-political power during this period, this study examines architectural development and change. Mortuary structures comprise a significant component of the architectural elaboration on Pohnpei with the development of monumental tomb structures (*lolong*) concurrent with the centralization of power at Nan Madol. The next section is concerned with

how this study will address questions of socio-political change through the analysis of mortuary structures.

3.5 Conclusions

The model of socio-political development presented above still needs significant refinement in regards to the chronology of events and would benefit from the inclusion of additional archaeological data. Yet, it does provide significant information about the period of socio-political centralization on the island to allow for a discussion of the factors and mechanisms that played a significant role in state formation on Pohnpei. The model emphasizes the role of social cooperation and ideology in socio-political centralization and discusses the role of conflict and coercion primarily in the decentralization of the political system. The thesis examines the possibility that conflict and coercion may have had a more significant role in socio-political centralization than currently recognized by this model (see Chapter 2). The next chapter focuses on how specific factors contributed to socio-political development on Pohnpei as a means of understanding how coercion and cooperation may have had an impact on the socio-political system.

Chapter 4: Current Evidence Relating to the Factors and Mechanisms Linked to Pohnpeian Socio-Political Development

To understand the mechanisms driving socio-political change on Pohnpei, it is necessary to discuss the context of socio-political development in the island's past. Several researchers have spent considerable effort examining socio-politics on the island at different times (e.g. Fischer 1974; Hughes 1968; Petersen 1982a, 1990b; Riesenberg 1968), which provides important information about how Pohnpeians react to internal and external influences on the social system. This information provides useful context which can be used to discuss the factors and mechanisms that played a significant role in social development at different times in the island's history. This context reviewed in this chapter provides a framework of Pohnpeian social relations and dynamics in which to place the evidence for coercion and/or cooperation provided by the architectural analysis presented in the following chapters.

4.1 Environment and Resource Distribution

The geographic context of Pohnpei is reviewed prior to the presentation of cultural and political information because environmental constraints are often defined as major factors which influence societal development (e.g. Anderson 2002; Earle 1991a, 1997; Haun 1984; Kirch 1984, 2010; Louwagie et al. 2006; Tainter 2006). Pohnpei is located at seven degrees North latitude with average temperatures around 80 degrees F or 26 degrees C (range 72-89 degrees F or 22-31 C). The island is approximately 344 square kilometers (133 square miles).

The highest point on Pohnpei is Mount Nahna Laud at 798 meters. The island receives 4,000-5,000 millimeters of rain yearly. The high rainfall and climate promote rapid vegetation growth and erosion, which has contributed to the development of the mangrove swamp which encircles the entire island. Mangroves were present for at least the last 5,000 to 6,000

years on Pohnpei (Bloom 1970b; Fujimoto et al. 1996). The mangroves expanded considerably around 2,000 years ago, when rapid submergence of the island slowed and intertidal flats developed (Bloom 1970a:149-150, 1970b:1898; Fujimoto and Miyagi 1993:144). Human settlement of Pohnpei approximately 2,000-2,500 years ago (Ayres 1990; Mauricio 1987, 1993) also potentially contributed to the development of the mangroves due to increased sedimentation on the coast from inland gardening. The majority of Pohnpei's population today (34,500 individuals) lives in valleys or on the flat-lands at the lower elevations near the coast, which was likely true for prehistoric populations as well.

4.2 Settlement and Population Growth

Pohnpei was initially settled approximately 2,000 years ago (see Chapter 3). Linguistic evidence suggests the early settlers were Austronesian speakers (Mauricio 1993), which is supported by ceramic evidence (see Chapter 3). Most likely the settlers of Pohnpei originated from central Melanesia or western Polynesia. Early ties to these regions are supported by the presence of kava varieties originating from Vanuatu or the Bismarcks on Pohnpei (Lebot et al. 1992).

Oral tradition recounts multiple settlement events on the island by different groups (Bernart 1977; Hanlon 1988a; Mauricio 1993). Settlers arrived on the island from multiple locations over an unspecified period of time (Falgout 1984; Mauricio 1987, 1993). Anthropological study of Micronesia identifies clans that established themselves on numerous islands in Micronesia, which supports the possibility of multiple settlement events in the region and continued contact between islands (e.g. Petersen 2009). The initial settlement of Pohnpei at least 2,000 years ago and the subsequent immigration of other groups suggests that population growth on the island had the potential to increase dramatically on this relatively small island in a matter of centuries.

4.3 Subsistence

Subsistence practices are universal contributors to social change and development (e.g. Earle 1991b, 1997, 2000; Erasmus 1965; Kirch 1984, 2010). In the case of less stratified societies, leaders depend on kinship and personal networks to produce surplus food and goods (Cobb 1993). Pohnpeian agricultural subsistence was based on breadfruit, taro, banana, and yam cultivation (Ayres 1990; Ayres and Haun 1985, 1990; Haun 1984), while fish and wild birds comprised the majority of the protein component of the diet prior to Western contact (Kataoka 1991). Evidence for subsistence practices includes gardening terraces, fermentation pits, cookhouses, and faunal remains. Faunal remains from Nan Madol show that the lagoon was the primary source of marine foodstuffs (Ayres 1990; Kataoka 1991; Leach et al. 1996).

Survey data shows that "prehistoric Ponapean agriculture was spatially extensive and agronomically diverse" (Ayres and Haun 1990:219). Dating these contexts has been useful to understanding the development of agricultural practices. Charcoal samples taken from under the pavement of a platform feature (PoD5-10) and a nearby breadfruit fermentation pit (PoD5-11) dated to 1085 +/- 105 BP (AD 689-1160 cal.) and 1650 +/- 125 BP (AD 126-642 cal.) respectively (Bath 1984a:173; Haun 1984:183). These dates are the earliest from Kiti and suggest that settlements associated with breadfruit storage and processing were established well before monumental constructions. Terrace complexes in Awak date to c. AD 875 (Ayres and Haun 1980, 1990) and there is evidence for swidden gardening on Temwen starting at least 700 years ago (Levin and Ayres In Press). Levin (2015) posits that a shift to permanent cultivation plots occurred between AD 400 and 1000, which when paired with other data point to an intensification of subsistence practices within this timeframe.

There are few dated contexts from the Nahnmwarki Period, but dates from subsistence features on Temwen Island (e.g. PoC3-10, AD 1445-1620) indicate that additional areas were being utilized for subsistence practices. Part of this expansion is likely tied to increasing population, but one would expect more subsistence sites on Temwen prior to the

Nahnmwarki Period due to the area's proximity to Nan Madol. The expansion of land use is most likely related to socio-political developments and changing social practices in the transition between the Nan Madol and Nahnmwarki Periods.

4.4 Kinship, Clans and Traditional Hierarchy

Historians and anthropologists have long recognized the complexity and flexibility of Pohnpeian socio-politics (Ehrlich 1978; Hanlon 1984, 1988b; Hughes 1982; McGarry n.d.; Petersen 1982a, 1990a, b; Rainbird 2006; Riesenberg 1968; Ward 1989; Zelenietz and Kravitz 1974). There were multiple types of political entities and numerous titles throughout Pohnpeian history; even during colonial times Pohnpeian districts used different systems of titles (Dobbin 2011; Ehrlich 1978; Hanlon 1988a; Petersen 1982a, 1990a, b, 2009; Riesenberg 1968). Pohnpei can be categorized as a complex chiefly society, though further categorization is far from straightforward when discussing the island as a whole since it is the product of a complex socio-political history. This section reviews various aspects of the traditional socio-political system as a means of understanding how the system may have operated in the distant past.

4.4.1 Kinship and Clans

Familial and kinship relations are integral to any discussion of socio-political change in traditional societies since these relationships form the first main social group with which individuals interact, and it forms a template for how groups operate and interact generally. Familial relations also provide an individual with a social identity. Collective memory is integral to forming clan, group, and social identity (Confino 1997; Halbwachs 1992). The choice to not pass some knowledge on allows "other images of shared identity in the present and the future to come to the fore" (Carsten 1995:318). The presentation of a unified, collective history creates a shared group identity (Carsten 1995; Coleman 1992; Halbwachs 1992). Controlling what is remembered and what is forgotten is paramount to controlling the structure of group

history, and those with that power tend to have higher social standing (Carsten 1995; Coleman 1992; Eves 1996; LeGoff 1992). Often the creation of this identity establishes and reinforces power relationships and inequalities within society (Coleman 1992; Eves 1996). Kinship ties are also particularly important to the political economy of a given society as it forms one network through which goods and support can be mobilized (Cobb 1993).

The foundation of the socio-political system on Pohnpei is the matrilineal clan. The status of a clan is ascribed to each individual born into it, and clan membership determines which titles an individual might be able to earn in the political hierarchy (Petersen 2009:176). The development of the traditional socio-political system is comprised of the "history of its clans as socio-political units and as largely independent polities" (Bryson 1989:33-34).

The origin story of each clan and the subsequent formation of sub-clans established a chronology for each section. This chronology was used as the foundation for the ranking of each clan and sub-clan (Falgout 1984; Marshall 1999; Petersen 2009; Riesenberg 1968). Clan ranking is based on when the clan settled in a location, not when it arrived on Pohnpei (see Mauricio 1987). A clan holding the highest rank in one district could hold a significantly lower rank in another. Many clans are found in more than one section of Pohnpei and all have connections to other islands in Micronesia (e.g. Kosrae, And, Mwokilloa, Pingelap), creating a vast network of contacts across the island and the region (Petersen 1982a; 1989a, 2009).

Tradition notes that sub-clans tend to be local off-shoots of larger clan groups that developed as a result of population growth and migration. Often sub-clan members are not recognized as separate from the larger clan until genealogies become important to the process of assigning high ranking titles (Petersen 2009:78).

In each section, clan membership determined the range of titles an individual could achieve in their lifetime, but participation in feasts, rituals and community activities were important to advancement in the title system (Fischer and Fischer 1957; Petersen 1982a, 2009; Riesenberg 1968). Individual merit gained through participation in social gatherings allowed for advancement in status, but ascribed status from clan affiliation determined one's starting

place in the title system. High-ranking clans will only put forward the most skilled or competent individuals to hold the highest positions in the title system in order for the legitimacy of the clan, as a ruling clan, to persist (Petersen 1989a, 1999, 2009; Riesenberg 1968). Though some aspects of the traditional hierarchy resemble a meritocracy, individuals from high-ranking clans tend to hold the highest titles since they are not eligible to hold titles that are lower status than their clan affiliation.

Often ruling clans of a section or district would intermarry to ensure their continued status and maintain the political cohesion of the district (Fischer and Fischer 1957; Petersen 1982b; Riesenberg 1968). It was at marriages and funerals that ties between clans were most often recognized, though major construction projects or other activities did occasionally bring clans together (Coale n.d./1951; Petersen 1982b).

4.4.2 Traditional Socio-Political System

On Pohnpei, dual lines of paramount titles operate on a district level. The Nahnmwarki is the head of the primary line (A line), the paramount chief, and the Nahnken is the head of the secondary line (B line) and acts as the Nahnmwarki's primary advisor/talking chief (Hanlon 1988a; Riesenberg 1968). The Nahnken title was established to act as the intercessor between the people and the Nahnmwarki (Hanlon 1988a:23). Clan affiliation determines whether an individual can obtain a title in the A or B lines. Once an individual accepts a high-ranking title in one line, they can only advance through that line (Riesenberg 1968:14). The A and B lines comprise the court of the Nahnmwarki. "The paramount chief and his court were principally occupied with certain public works - feast houses, canoe houses, boat channels, religious structures - and with administering the flow of tribute from the people" (Fischer 1974:167). Any major building project, festival or feast in a district was organized by title holders in the paramount lines.

There are section titles in addition to the paramount titles. Each of the five districts on the island is divided into sections, each of which has its own series of titles. In some cases, an

individual may have a section title and a title in the paramount lines, though they are addressed by the one which has the highest overall rank (Riesenberg 1968). Section titles were originally a means of organizing a section and a way for commoners to participate in the broader socio-political system (Riesenberg 1968). The section chief is expected to bind the section together as a productive unit, regardless of any issues that might arise (Petersen 1982a). Section leaders are tasked with organizing first fruits to the Nahnmwarki and Nahnken, mobilizing labor for community and district building projects, and organizing section feasts amongst other things.

Food contributions at district-wide feasts and other occasions are made as service to the Nahnmwarki (Riesenberg 1968). Aside from feasts, the most common form of service is first fruits offerings. First fruits are presentations of food to the Nahnmwarki, Nahnken and section chiefs at designated times in the growing season (Riesenberg 1968:78-83). Breadfruit, yams (cultivated and wild), kava, bananas, mango, pandanus, sugar cane, taro and Polynesian chestnut were traditional first fruits offerings, though other foods were included in this list after western contact (Riesenberg 1968:78-82). These offerings were originally made to specific deities, then to the Saudeleur as tribute, and were used to demonstrate allegiance to the chiefs in the Nahnmwarki Period as well as functioning as rent (Hanlon 1988a:21; Mauricio 1993:159). Modern first fruits are not considered taxes as land tenure is no longer controlled by chiefs, but are related to respect for and the legitimacy of the social hierarchy (Hanlon 1988a; Petersen 2009).

Kinship and clans form the foundation of the title system, but advancement in the system is not assured by clan membership alone. Outside the clan, rank and status in the title system are based on traditional knowledge, cultivation of land, participation in first fruits and feasts, clashes of personalities, age, and accomplishments (Bascom 1948; Bath 1984a; Mauricio 1993; Petersen 1992, 1999; Riesenberg 1968). Often advancements in rank and title are far from what might be expected.

Advancement in the title system is discussed and decided by the Nahnmwarki and the Nahnken when titles are vacated, except when the vacant titles are Nahnmwarki or Nahnken (Riesenberg 1968). In the case of these titles other members of the title system, not eligible for the title, choose the next title holder from the list of candidates. On Pohnpei one does not campaign for traditional titles as modesty is a highly prized quality in traditional leaders (Bascom 1948; Keating 1994; Petersen 1989a; Riesenberg 1968). One's actions and personal acumen are meant to speak to an individual's merit (Keating 1994; Petersen 1992; Riesenberg 1968). "Achievement of Pohnpeian titles may be viewed as a means by which an individual's accomplishments, conduct, and loyalty to the leaders are publicly recognized, praised, and applied in the administrative activities of the chiefdom" (Mauricio 1993:68). Typically only males hold titles, but each title has a female counterpart for their spouses (Kihleng 1992; Mauricio 1993; Riesenberg 1968).

"Though Pohnpei can be included among the more hierarchically-organized Pacific island societies, with a multiplicity of chiefly titles, individual people on Pohnpei place a high value on personal autonomy" (Petersen 1992:210). An individual's autonomy is generally not infringed upon unless they are not fulfilling commitments to the chiefs or their clans. Habitual failure to contribute first fruits and fulfill honor obligations to the chiefs may result in the stripping of one's title (Mauricio 1993). Other ways to lose a title include change in residency, violence towards the paramount chief, and disloyalty or conspiracy (Mauricio 1993).

4.4.3 Social Change and Traditional Socio-Politics

> Pohnpeians view their island's modern political system as simply the most recent in a series of historically evolving political formats (Petersen 2009:143).

Pohnpeians understand the present as a product of history, and as such the current form of socio-political organization and political boundaries are the product of long-term development and change (Falgout 1984; Mauricio 1993). The history of this development is complex and variable from district to district. Therefore, this overview focuses on general island-wide trends rather than localized specifics.

"Pohnpeian oral traditions report that the formation of small dispersed polities and their eventual unification and disintegration were accompanied by a transition from religious/ideological to secular means of control" (Mauricio 1993:2). Petersen (1990a) notes that linguistic evidence suggests that the original settlers of Pohnpei may have had relatively little hierarchy, but they likely had a set of values and/or beliefs to guide their behavior. Local chiefdoms developed from matrilineal clans; these chiefdoms were headed by priest-leaders in many locations (Bernart 1977; Dobbin 2011; Falgout 1990; Fischer et al. 1977; Hambruch 1936c; Kubary 1874; Mauricio 1993; Petersen 1990a).

Secularization of the Pohnpeian socio-political system occurred during the Saudeleur Period, though the process was not complete until the early Nahnmwarki period (Dobbin 2011; Mauricio 1993). Initially, the Saudeleur rulers were seen as religious and secular leaders, but over time the Saudeleur ceased direct participation in many religious events (e.g. turtle ceremony) allowing the priesthood to develop autonomy outside the political hierarchy. This created a division between sacred and secular roles. Some of the old priestly titles were subsumed into the secular title system over time, particularly after the introduction of Christianity (Bernart 1977; Dobbin 2011; Falgout 1990; Riesenberg 1968).

In spite of the information available about traditional socio-political organization, it is not clear how much power chiefs had over individuals (Petersen 1982a, 1989b). It is clear that the priest-leaders established at least some centralized control over communities through simultaneous ritual and economic endeavors prior to the Saudeleur (Mauricio 1993). According to Mauricio (1993:345), "religious beliefs and ideologies transgressed into the secular experiences of the people and became political instruments in the form of sanctified power and authority." This co-opting of religious authority opened the socio-political system up to further centralization, which culminated with the Saudeleur Dynasty (Mauricio 1993). Even though the religion and ideology were used by the Saudeleur to gain legitimacy, later rulers of the Dynasty distanced themselves from the religion their early counterparts introduced.

The degree of centralization that the Saudeleur Dynasty actually achieved is unclear, though the chiefs of the other polities were given new titles by the Saudeleur and were expected to pay tribute (Bryson 1989; Mauricio 1993). There is no definitive evidence that the Saudeleur attempted to influence the hierarchical structure or the daily functioning of these smaller chiefdoms (Bernart 1977; Bryson 1989). Over time the demands of the Saudeleur for tribute and service increased to the point where they were affecting daily life on Pohnpei (e.g. limiting food available to families due to quantities required for tribute) (Bernart 1977; Hanlon 1988a). The decentralization of socio-political power occurred after the Nahnmwarki system replaced the Saudeleur in Madolenihmw. Based on genealogical information of the Madolenihmw chiefs, this decentralization process probably occurred between AD 1600 and AD 1700 (Mauricio 1993:163).

After the Saudeleur was deposed most of the polities reverted to their traditional leadership systems. One example of this is Kiti, which reverted to its previous leadership system until the Battle of Sapwtakai after which the district was unified and the Nahnmwarki system was adopted (see Bernart 1977). On the other hand, in Madolenihmw a new system of leadership, the Nahnmwarki system, developed, which was designed to limit potential abuses of chiefly authority by establishing two series of titles (Bath and Athens 1990; Bernart 1977; Hanlon 1988a; Mauricio 1993). These leadership positions of Nahnmwarki and Nahnken were ascribed to two separate clans, effectively permitting "the formation of an internally decentralized socio-political structure in the form of paralleling leadership positions" (Mauricio 1993:62). What was novel about this system was the creation of two secular series of titles, which eventually incorporated priestly titles as well. The Nahnmwarki system is built on the foundations of previous socio-political entities, and was not entirely divergent from past hierarchies (Ehrlich 1978). The Nahnmwarki performed the same duties as other chiefs and had the same requirements for his subjects. What is unique about this social system is that any potential abuse of power was kept in check by the Nahnken, who could intercede on

the behalf of the people or in their best interest. The presence of two lines of titles meant that there was also more opportunity for social advancement.

Over time the Nahnmwarki system spread from Madolenihmw to other polities through both adoption and conflict (Bernart 1977; Mauricio 1993). This transition was slow, as there were several polities with different hierarchical title systems in place in the 1800s and into the 1900s (Dobbin 2011; Ehrlich 1978; Hanlon 1988a; Petersen 1982a, 1990a, 2009; Riesenberg 1968). Colonial influences did much to progress the adoption of the Nahnmwarki system, especially German colonial reforms in the early 20th century. Now that the Nahnmwarki system is the only remaining traditional socio-political system, place-names and oral traditions are the living remnants of these previous socio-political units (Petersen 1982a; see Ayres and Mauricio 1997 and Panholzer and Mauricio 2003 for specific examples).

Although more than a century of western contact has taken place on Pohnpei, the socio-political system on the island has adapted without abandoning its basic structure or principles (Hanlon 1988a; Hughes 1968; Petersen 1984, 1989b). “Resistance to foreign intrusion became part” of Pohnpeian culture, while they continued to incorporate selected foreign material culture and ideas (Hanlon 1988a:206). The traditional socio-political system was never particularly static and continually adapted over the course of Pohnpeian history without significantly impacting on what it meant to be Pohnpeian.

4.5 Land Tenure

The title system is predicated on the control and cultivation of land. “Micronesian conceptions of land tenure ensure that under normal circumstances everyone has access to land” (Petersen 2009:117). Early geographic section and district boundaries were likely defined by established clan territories, though chiefs took control of land tenure at some point (Coale n.d./1951; Fischer and Fischer 1957; Petersen 1990a). Modern section boundaries are not indicative of early prehistoric land divisions as boundaries would have shifted over time as a result of socio-political change (Petersen 1979, 2009:29). Prior to the colonial period access

to land and tenure was controlled by chiefs (Bascom 1948; Fischer 1958; Petersen 1982a; Riesenberg 1968). The people inhabiting a section or polity were tenants of the paramount chief. First fruits offerings and feast contributions were part of maintaining land tenure in a polity; without participation in the prestige economy the chief could revoke an individual's tenure on a plot of land in addition to their titles (Riesenberg 1968). Access to land and the products cultivated on the property are directly linked to the prestige economy and advancement in the title system (see Sections 4.4 and 4.7).

Colonial land reforms took land out of the direct control of paramount chiefs and deeded it to individuals (Bascom 1948; Ehrlich 1978; Fischer 1958; Hanlon 1988a). This change in land tenure significantly impacted on the socio-economic and political systems. The chiefs no longer had the power to banish an individual or family from the polity as they no longer owned all the property (Riesenberg 1968). It is probable that the creation of new honorary titles and the use of title deprivation by chiefs became more common than before as chiefs used these methods to compensate for their loss of control over land tenure (Fischer 1958; Petersen 1982a; Pinsker 1997; Riesenberg 1968). Although the chiefs no longer dictate land tenure, they maintain "their importance as the leaders of the feast and title system" (Fischer and Fischer 1957:159).

Land tenure was taken out of chiefly control in 1907 by the German colonial government and land was deeded to those who worked it (Bascom 1950b; Ehrlich 1978; Fischer 1958; Hambruch 1936b; Hanlon 1988a; Sudo 1987). In 1908, Governor Fritz amended land tenure rules further and all land became private property and tribute to the chiefs (e.g. feasts and first fruits) was to cease (Ehrlich 1978). After a series of disputes, he relented on the immediate implementation of the land reforms. In most municipalities the reforms took effect in 1909, but they were deferred in Sokehs until 1910; the land reforms were not finalized until Governor Kersting (1911-1914) began to register land holdings and issue title papers (Ehrlich 1978; Fischer 1958; Fischer and Fischer 1957).

The 1908 land reforms included provisions for 15 days of work for the District Office in support of public works (Ehrlich 1978; Hambruch 1936b). The public works scheme was meant to provide infrastructure for the economic development of Pohnpei, primarily through the construction of roads. The first road building project began in April 1908 with limited success and multiple complications; a second attempt was made in 1909 (Ehrlich 1978; Hambruch 1936b). Confusion and conflicts over labor were common on German colonial projects (Fischer and Fischer 1957). These conflicts, in addition to other incidents, led to the Sokehs Rebellion (refer to Section 4.8).

After the Sokehs Rebellion, Kersting completed the land reforms (Ehrlich 1978; Fischer 1958). He registered land holdings, formally established the municipalities, and appointed the Nahnmwarkis of each municipality to the position of chief magistrate (Ehrlich 1978). The district of Net, which did not have a Nahnmwarki previously, adopted the Nahnmwarki system as part of the reforms. Kersting commissioned local teams to help in the surveying necessary to establish property boundaries for the deed paperwork (Ehrlich 1978). All deeds issued from 1912 onward included the new land reform law, which included a provision that land was to be inherited patrilineally, changing the traditional pattern of inheritance (Ehrlich 1978; Fischer 1958; Fischer and Fischer 1957; Mauricio 1993). Other provisions under the land reform law made most tribute feasts to the Nahnmwarki voluntary, and required each land owner to plant 10 coconuts per month on each farmstead owned along with other crops (Ehrlich 1978).

Regardless of all attempts to prevent excessive feasting via land reforms, the Pohnpeians continued their traditional practices as a point of pride (Ehrlich 1978). They followed the letter of the law but persisted with traditional socio-economic competition (Ehrlich 1978). “It is as if the Ponapeans wanted to prove to themselves (at least) that they could continue despite their private grief over Sokehs” (Ehrlich 1978:214). The Japanese and Trust Territory administrations did not continue the restrictions placed on feasting and first fruits to the Nahnmwarki that had been instituted in the German Period (Fischer 1958; Hughes 1968).

The Japanese administration also did not enforce the patrilineal inheritance provision instituted under the German administration, and early on they prohibited the sale of native-owned land on Pohnpei and restricted leases to no more than 10 years (Fischer 1958; Hezel 1995; Hughes 1968). But the Japanese "had claimed all unoccupied land for the colonial government, in accordance with the National Resources Law that had gone into effect in Japan in 1921" (Hezel 1995:191). This move is what opened land to immigrant farming and development. The influx of immigrants forced the administration to re-evaluate its protectionist stance towards native-owned lands, and allowed Japanese citizens to purchase land in 1931 (Bascom 1950b; Hezel 1995). At this point the time for forcible change had ended.

Colonial reforms in the early 20th century significantly impacted the traditional socio-political system. The land reforms in particular affected the Pohnpeian world-view. The severing of chiefly control of land meant that the entire social system had to adjust, particularly the social ideology. Some traditional practices (e.g. feasting) became even more important in reifying Pohnpeian society.

4.6 Ideology and Ritual

Ritual and ideology are significant components of Pohnpeian socio-politics, which contribute to the structuring and restructuring of society. The two primary outlets for ritual practice and the maintenance and manipulation of socio-religious ideologies on the island are religious practice and feasting. This section reviews ideological and religious views and the role of feasting in Pohnpeian society.

4.6.1 Pohnpeian Ideology and Religion

Ideological viewpoints change over time, yet oral tradition and ethnographic data suggest that some segments of Pohnpeian social ideology stretch back to the initial settlement of the island. The term Pohnpei translates as upon a stone altar or platform (Hanlon 1988a). This name is directly related to oral traditions which recount the construction of a

platform/altar upon a submerged reef by the initial wave of settlers (Bernart 1977; Hadley 1987; Hanlon 1988a) (see Section 3.2.1 in Chapter 3). When the matriarch of the founding clan died she transformed into a bird (Bernart 1977), which became the totem of the clan. On Pohnpei, clan totems are taboo and if a clan member harms or kills a totem animal the *eni* (spirits) will punish them, sometimes with death (Fischer 1957; Fischer et al. 1959).

Details regarding religious practice prior to the foundation of the Saudeleur Dynasty exist in some local traditions though it is likely that many have been lost. Salapwuk and Wene are two areas in the district of Kiti which traditions still exist regarding religious practice (see Ayres and Mauricio 1997; Bernart 1977; Falgout 1984, 1987). A priestly class developed in each location and there are existing sites associated in traditions with both groups (Ayres and Mauricio 1997; Falgout 1984, 1987). Priest-leaders play a significant role in the traditions of Wene up to the early Contact Period (Bernart 1977; Falgout 1984, 1987). Religious practice was integral to early social development on Pohnpei even if there is little evidence of what those practices were.

Others have noted that early religious practice was focused on the land while the religion introduced by the Saudeleurs was primarily centered on the sea (Mauricio 1993). Oral traditions regarding the religious rituals introduced by the founders of the Saudeleur Dynasty are significantly more detailed (see Section 3.2.1 in Chapter 3). This detail is likely attributed to the continuation of the turtle ceremony into the early Contact Period (Gulick 1967). As in many Western societies, religion and socio-political change were interconnected throughout Pohnpei's history.

The intertwined nature of religious ideology and socio-politics continued well into the Historic Period. Although the colonial era did not officially start until the Spanish Period, the missions acted as a colonizing force in the mid-19th century. Accounts of the influence of the beachcomber population and activities related to visiting ships provided 'moral' grounds for missionary activity on Pohnpei, as on other Pacific islands (Gulick 1967; Hambruch 1936b;

Hanlon 1988a; Zelenietz and Kravitz 1974). The primary challenge to missionary progress was not foreign influence on Pohnpei, but local traditions and religious practices.

"In a concerted attack upon the social system, the missionaries, understanding no more than any other group of outsiders about life on the island, found themselves confronted by a complex culture that, as it had in the past, proved strongly resilient" (Hanlon 1988a:86). In 1837, a Catholic mission was established on Pohnpei, only to close after six months (Hambruch 1936b; Hanlon 1988a; Hezel 1983:123-124; Riesenberg 1968). The Protestant missions met with more success. The American Board of Commissioners established a Protestant mission in Kiti in 1852 and by 1865 the missions expanded to include mission stations in Madolenihmw and Mesenieng, and six churches (Bascom 1950a; Hanlon 1981, 1988a; Hezel 1983). Although the Protestant missions made some progress in their first 10 years, much of this progress was marked by continual need for the missions to restate their independence from the local chiefs (Hanlon 1988a). Local chiefs, as in the past, treated the newcomers as nearly equivalent to other members of their communities. The missionaries leasing land from individual chiefs were considered to be under the rule of that chief and not independent from the local socio-political system. The frustrations felt by the missionaries early on stemmed from maintaining lifestyles separate from their Pohnpeian neighbors (Coale n.d./1951; Hanlon 1988a:103).

The missions did not have to wait long before outside influence caused a major shift in Pohnpeian socio-politics. A whaling vessel, the *Delta*, put ashore infected crew members to quell an outbreak of smallpox in 1854, which caused an epidemic on the island (Bascom 1950a; Coale n.d./1951; Ehrlich 1978; Gulick 1967; Hambruch 1936b; Hanlon 1988a; Hezel 1983; Spoehr 1963). The epidemic killed an estimated third of Pohnpei's population and significantly changed the traditional structure of the districts, modifying clan hierarchies and seriously impacting the title system and traditional religious practices (Dobbin 2011; Hambruch 1936b; Hanlon 1988a; Hezel 1983). Pohnpeians believed the epidemic was sent by the Christian god, partly because their priests could not prevent it (Bascom 1950a; Dobbin 2011; Hanlon 1988a).

The missionaries vaccinated many of the locals and as a result the Pohnpeians began to take the lessons of the missions seriously (Bascom 1950a; Hanlon 1988a:111). "Christianity, the *lamalam kapw* 'new way of thinking' as the Pohnpeians of the time referred to it, placed more intense strains upon the always fragile relationship between the chiefs and their people" (Hanlon 1988a:113). The expansion of Christianity after the epidemic was deemed a threat to local traditions and traditional leaders began to act [out] against the church and their members in the 1860s (Coale n.d./1951; Hambruch 1936b; Hanlon 1988a; Hezel 1983).

Regardless of the backlash against the missions, many Pohnpeians converted by 1872 (Hambruch 1936b; Hanlon 1988a; Hezel 1983). Christianity was more popular amongst commoners and lower ranking individuals, while traditional religious practices were still important to chiefs and higher ranking members of society well into the 1870s (Kubary 1874). "Christianity … began to take root on Pohnpei because of its appeal to lesser chiefs seeking political leverage and to common men and women who saw in this new system of beliefs an alternative to the oppression in their lives under the existing system of chiefly rule" (Hanlon 1988a:129). Initially, the acceptance of Christianity was a reaction to introduced disease and was seen as a new avenue for social advancement outside the title system, but true belief did develop within the community over time (Hanlon 1988a).

Catholic missions were established on Pohnpei late in the 19th century. During Spanish colonial rule there were numerous conflicts on Pohnpei, which were linked to religious factions. The 1890 uprising was directly linked to the Spanish administration pushing the presence of additional Catholic churches on land leased to the Protestant mission, regardless of opposition from their own priests (Ehrlich 1978; Hanlon 1988a; Hezel 1995). In other cases, membership in one church or the other was tied to traditional clan or kinship ties. In most cases these alliances or rivalries were not amplified by religious differences, though the 1898 uprising did (Ehrlich 1978; Fischer and Fischer 1957; Hanlon 1988a). The Spanish banished the Protestant missionaries from Pohnpei, because they suspected them of promoting dissidence against Spanish rule (Ehrlich 1978; Fischer and Fischer 1957; Hanlon

1988a). Though this may have been the case, the conflict on the island did not cease and Protestant church services were still held under the direction of local deacons. These conflicts were based on perceived political differences, not on religious ones.

Christianity appealed to those who saw the institution as a means of manipulating their position within the community. It gave low status individuals a means to obtain standing through other means, which made religious change about socio-politics as well as ideology. Traditional religion and ideology played a significant role in the early aversion towards the mission's teachings, but eventually Christianity influenced the socio-political system by modifying the views of what qualities chiefs should have and what was considered acceptable behavior.

4.6.2 Feasting

Social ties are curated through activities related to food or food sharing (Gumerman 1997:106). Hunting, planting and gathering of food comprise one social facet of food, while food sharing and feasting comprise another. "By analysing structure and symbolism we see that food is vital in defining everyday social relations" (Gumerman 1997:109). By their nature feasts embody the social nature of food. Feasts reify kinship ties and social hierarchy, while also acting as stages for other social interaction (Bolyanatz 2000; Dietler and Hayden 2001; Eves 1996; Gumerman 1997; Hayden 1996, 2001; Junker 2001; Wiessner 1996). Along with their social implications, feasts also have in-built ritual and ideological components (Bolyanatz 2000; Dietler and Hayden 2001; Eves 1996; Gumerman 1997; Junker 2001).

There are many types of feasts (e.g. mortuary or feasts for visitors), but in general feasts are directly linked to social relations and socio-political change (e.g. title conferral feasts) (Bolyanatz 2000; Dietler and Hayden 2001; Dietler and Herbich 2001; Eves 1996; Gumerman 1997; Hayden 1996, 2001; Junker 2001; Wiessner 1996). It has been suggested that feasts provide a forum for the mechanisms of social change to be enacted (Dietler and Hayden 2001; Hayden 1996). Often the ability to host or contribute to a feast signals the

relative status of an individual or kin-group (Bolyanatz 2000; Hayden 1996; Junker 2001; Wiessner 1996). Food and other material goods are produced as surplus, which in turn is used at feasts to establish reciprocal debts (Dietler and Hayden 2001; Hayden 1996). Social relations structured by feast participation establish status hierarchy and relationships that become important during times of social change. Feasts also tend to be held in many societies as part of funerary practices or title conferral ceremonies (e.g. Battaglia 1990; Bolyanatz 2000; Eves 1996; Riesenberg 1968). Feasts at these transitional times serve to reify and re-establish social relations (see Bolyanatz 2000).

Feasts, particularly mortuary feasts, are also significant to the construction of group identity. "People are remembered through their acts of sociality, and feasts are a central arena for the remembrance of these acts and the point of departure for the creation of new memories" (Eves 1996:271). Kin-groups host mortuary feasts in order to remember the deceased, re-establish kin and social ties, to pass on descent ideology, and to create new memories and relationships which may be called on in the future (Bolyanatz 2000; Eves 1996). This body of theory is supported by the ethnohistoric and ethnographic record on Pohnpei.

"The everyday use of foods, their use in rituals, feasts, language, and myths provides interpretable evidence for food symbolism" (Gumerman 1997:111). This symbolism is utilized in specific social contexts, primarily feasts, to mark social distinctions. Oral traditions on Pohnpei identify a number of prestige foods used in feasting and rituals in the past (Bernart 1977; Riesenberg 1968), some of which retain their status. These staples include yams, breadfruit (in various forms), *sakau* (kava), pigs (or dogs in prehistory), and some species of fish. These foods are redistributed to feast attendees based on hierarchical rank (see Keating 1994; Riesenberg 1968; see Section 4.7). Food contributed towards feasts also impacts on an individual's status in the community and will be remembered (Bolyanatz 2000; Hayden 1996; Junker 2001; Riesenberg 1968; Wiessner 1996). Thus feasting, as a type of ritual practice, plays an influential role in the reification of social structure and social competition.

Sakau drinking comprised a ceremonial aspect of Pohnpeian feasts and community gatherings. The preparation and drinking of *sakau* takes place prior to the division and redistribution of foods at feasts. The root is macerated on a flat basalt slab using water-worn basalt pounding stones, which produce a ringing sound when striking the stone slab (Riesenberg 1968). The pattern of pounding changes when the *sakau* is nearly ready in order to call those not present to join the feast, and another beat is used when the *sakau* is ready (Riesenberg 1968:105). The order of drinking is strict during the first round: two highest ranking males, usually the Nahnmwarki and Nahnken, the highest ranking female, the third highest ranking male, and then other participants (Riesenberg 1968:108). The last cup in the *sakau* session is given to the highest ranking male (Riesenberg 1968:108). *Sakau* drinking reified the social structure of Pohnpeian society, while providing a forum for discussion of community affairs.

Ayres (2002:65) notes that status foods have been found in association with ritual areas and architecture. This is particularly relevant to Ideht islet at Nan Madol, which was utilized for the turtle ceremony (Bernart 1977; Hanlon 1988a; Mauricio 1993). The ceremony began during the Saudeleur dynasty according to oral tradition and continued into the early Contact period (see Section 3.2.1 in Chapter 3). Radiocarbon dates from the midden mound on Ideht suggest that the turtle ceremony took place from AD 1100-1200 to at least 1500-1600 (Athens 2007; Bath and Athens 1990; Long 1965). These dates place the ceremonial use of Ideht during the fluorescence of monumental stone construction of the site, though use was continued past this construction phase.

Though, aspects of feasting and its influence may not be obvious in the archaeological record. Direct evidence for feasting may include midden remains, and feast-related features and structures (e.g. *nahs* and *sakau* stones for Pohnpei). Formal feast structures may be closely associated with cooking areas, but midden remains may not be present because the area was maintained and/or some foods were taken home by participants (as in redistributive feasts). Feasts also may not always take place within these designated areas (e.g. mortuary

feasts at gravesites). On Pohnpei, it would be expected to find *sakau* stones in close proximity to burial sites and structures if mortuary feasts took place at burial sites, since *sakau* drinking is ubiquitous at feasts.

4.7 Economics and Social Competition

"Hierarchy and rank are fundamental to Micronesian political life but exist within a participatory context, recognizing that every individual and group possesses legitimate interests in the community's continued success" (Petersen 2009:158). This participatory context in Pohnpei is the prestige economy, where individuals attempt to gain status and honor through competition (Fischer and Fischer 1957; Keating 1994; Petersen 2009). Successful participation in prestige competition results in upward mobility in the title system in addition to gaining respect and honor from other members of the community. Political maneuvering is a constant preoccupation on Pohnpei mitigated through the prestige economy (Bath 1984a).

The feast is the most visible manifestation of the prestige economy (Bascom 1948; Keating 1994; Mauricio 1993; Petersen 1989b, 2009; Riesenberg 1968). Although there are many facets to the prestige economy, "food is at the core of all transactions which ultimately involve a change in status during competitive exchanges" (Keating 1994:164). Feasts, where the redistribution of food and various goods occurred, were not the only components of the prestige economy. Knowledge of traditional history, rituals, medicines, and other types of information was "valuable for the prestige and political influence which its possession gives" (Fischer and Fischer 1957:141). The management of this knowledge was a significant source of power and can impact upon one's status within Pohnpeian society (Falgout 1984; Keating 1994; Mauricio 1993). The individuals who controlled the knowledge and history could control the story (Mauricio 1993).

4.7.1 Prestige Competition and Feasting

Feasts act as a stage for social competition aimed at gaining and maintaining individual and group status (Dietler and Hayden 2001; Hayden 1996, 2001; Junker 2001; Wiessner 1996). Feast hosts, who are often social leaders, organize feasts to demonstrate their status through their ability to gather and feed large groups through the redistribution of food surplus. "Feasts are techniques for *transforming surpluses* into socially, economically, and politically useful currencies that can be used to further individual and group self-interest and survival" (Hayden 2001:58). Status achieved through this type of competition allows for additional wealth to be acquired and networks through which labor can be mobilized (Hayden 1996; Junker 2001). "In 'competitive' feasts, there is an escalation of labor mobilization and surplus needed to finance future feasts and the aim of translating feasting success into long-term political power and economic profit (e.g. Friedman 1979)" (Junker 2001:280). Feasts are among social practices which mobilize voluntary labor (Dietler and Herbich 2001). Social obligations established through feasting allow for labor to be mobilized for large subsistence or architectural projects, which in turn produces status for an individual or group.

There are six major feasts each year (three related to yam growing season, one for fermented breadfruit, one tied to cookhouses, and one for twine production; see Riesenberg 1968:83-86), which are accompanied by first fruits offerings and other small feasts (Mauricio 1993; Petersen 1982b; Riesenberg 1968). Small feasts include death feasts (*uhmw en mwirilik* or *mwiririk*), apology feasts, family feasts and feasts for visitors (Riesenberg 1968; Ward 1989). All feasts include the presentation of food and goods brought by the participants, the sharing of kava (Latin: *Piper mythisticum*; Pohnpeian: *sakau*), and redistribution of the food and goods contributed by all. "The share of food a man receives at a feast is partly in proportion to the rank of his title, but in the long run the rank of his title is also partly in proportion to the amount of food he has contributed to feasts" (Fischer and Fischer 1957:159). In this way the contribution and redistribution of food and goods reifies and institutionalizes the relationship

between the title system and feasts (Keating 1994). Therefore, the redistribution of food and goods is a core activity in Pohnpeian social hierarchy.

Petersen (1989b, 1995) has noted that competitive feasting within the prestige economy also has the capability to mobilize a significant labor force. The mobilization of labor can take place on the clan, section or district level. This type of labor is often utilized for major construction projects (e.g. feast houses, religious structures, canoe channels) (Fischer 1974; Petersen 1995). It is likely that the monumental site of Nan Madol was constructed at least in part by labor mobilized or paid for through feasting (Petersen 1995).

In 1901, Governor Berg began his tenure with hopes of disarmament of the islands and discontinuing feasting on Pohnpei (Ehrlich 1978; Hambruch 1936b; Hezel 1995). The reasoning behind disarmament is more self-evident (see Section 4.8) than the reasons for ending feasting, which included the assumption that fewer feasts would increase time invested in the production of commercial goods (e.g. copra). The typhoon that devastated Pohnpei in 1905 aided Berg in his move towards disarmament. He traded food or money for any guns or ammunition turned in to the German administration, though most of the arms turned over did not work properly and others were hidden away for future use (Ehrlich 1978; Hambruch 1936b). Even with the limited success of disarmament, Berg had no impact on traditional feasting. “Despite a century of foreign contact and two regimes of colonial rule, the title system, tribute, feasts, and so on, remained strong” (Ehrlich 1978:115).

4.7.2 Economics and Social Competition in the Historic Period

Commercial interests drew foreigners into Micronesia in the early 19th Century, whether it was to provision whaling vessels or to find new sources for marketable materials (e.g. copra, *beche de mer*, etc.). These visitors were the first to interact with Pohnpeians on a regular basis, and some remained on the island.

Beachcombers on Pohnpei included deserters from whaling or trading vessels, stranded sailors, and escaped convicts. “Having broken with European or American society,

beachcombers were prepared to teach Pohnpeians something of the ways of the world from which they had fled" (Hanlon 1988a:60). The beachcombers acted as intermediaries between the Pohnpeian chiefs and the ships that stopped at the island for provisions and trade (Hambruch 1936b; Zelenietz and Kravitz 1974). Even though most of the beachcomber population never fully integrated into Pohnpeian society, they had a significant impact on the prestige economy by negotiating access to new goods on behalf of the chiefs. When traders began to establish trading stations on Pohnpei they undermined "the remnants of the beachcomber presence on Pohnpei" (Hanlon 1988a:134). The Pohnpeians quickly adapted to this change in the structure of trade on the island.

Commerce provided Pohnpeians of all ranks with new goods and means to gain status within or outside the traditional socio-political system. Foreign trade goods and introduced foods were quickly incorporated into the prestige economy, while learned skills were used in multiple contexts. Education in particular provided Pohnpeians with a new path towards prestige outside of the traditional system.

4.8 Conflict and Warfare

The model of social change on Pohnpei (see Chapter 3) only recognizes the influence of coercion, conflict, and warfare as the cause of decentralization of socio-political power during the Saudeleur Period. Yet, traditional history contains more information which can contribute to a more thorough discussion of the role of conflict in Pohnpeian prehistory.

Various clans and chiefdoms struggled with their neighbors and alliances and boundaries shifted regularly (Petersen 1979:27). Battles between communities or clans are present in oral tradition, but only a fraction of these were conflicts over political leadership or titles (Petersen 2009; Riesenberg 1968). More often than not, these battles were over resources or territory.

> When the object of a war was to replace one ruling clan by another there would be a wholesale shift in the holders of titles, but the only immediate economic effect was that the new Nahnmwarki or Nahnken and such section chiefs as were replaced

> received offerings instead of the old ones; the greater number of families remained on their farmsteads. Occasional shifts of a section from one tribe to another are recorded, but these were more often through peaceful means than by conquest … (Riesenberg 1968:61-62).

As battles took the form of raids or ritualized skirmishes, there was no need for organized armies on Pohnpei (Petersen 2009). The socio-political hierarchy was a major factor in these conflicts, since individuals only fought against their social equals according to societal rules (Hanlon 1988a:44-45). Oral traditions include additional details about specific conflicts.

Bernart (1977) includes accounts of inter-group conflict during the period after the settlement of Pohnpei. These traditions are primarily concerned with territorial conflicts and the extirpation of a cannibalistic group who are said to have lived in the interior of the island (Bernart 1977:25-26). These somewhat anecdotal traditions demonstrate that conflict and warfare were features of Pohnpeian social relations prior to Saudeleur rule.

Most traditions related to the construction of Nan Madol and the foundation of the Saudeleur Dynasty depict this process as a cooperative effort by Ohlosihpa and Ohlosohpa and the people of Madolenihmw (Bernart 1977; Hadley 1987; Hanlon 1988a). The often overshadowed part of this tradition is that there were two or three other locations where the brothers attempted to settle prior to Nan Madol (Bernart 1977; Hadley 1987). The primary reason given for their lack of success is that the sites were not suitable for their purpose (Bernart 1977; Hadley 1987), though Hanlon (1988:9) notes that the groups living around these areas were not hospitable to the brothers. It is likely that social or ideological differences played a role in the failure of the brothers to settle in those locations. It is known from early historic accounts of missionaries and other Westerners that Pohnpeian political and religious leaders were slow to adopt new beliefs and ideas unless that could see the benefit to their social position or to the economy of their district (see Hambruch 1936b; Hanlon 1988a; Hezel 1995). I find it probable that this type of conservative position was also held by their pre-Contact counterparts.

Eventually, Ohlosihpa and Ohlosohpa were welcomed in Madolenihmw and the people assisted with the construction of Nan Madol (Bernart 1977; Hadley 1987). These brothers were highly respected in Madolenihmw, so when one brother died the other was given the position of Saudeleur, thus founding the Saudeleur Dynasty (Bernart 1977; Hadley 1987). The rituals the brothers introduced, namely the turtle ceremony, were integral to the social cohesion of society (Bernart 1977:51), though it is not clear in traditions how the Saudeleur united the districts under their centralized rule. It is noted that the Saudeleur rulers utilized existing hierarchies in their restructuring of social relations (Hanlon 1988a:15), but there is nothing in traditional history to suggest that unification and centralization was anything but peaceful. It is not until later in traditional history that coercion and abuses of power are discussed in detail.

There are many accounts of the later Saudeleur rulers using coercive methods to attain specific items or additional tribute, restricting people's access to specific foods, and other abuses against people or gods (Bernart 1977; Hadley 1987). Bernart (1977) and Hadley (1987) recount stories of individual attempts at assassination of or undermining of the Saudeleur prior to the arrival of Isohkelekel. Where these attempts failed, Isohkelekel succeeded because he had support from his friends and some Pohnpeian subjects (Bernart 1977; Hadley 1987).

As with the first Saudeleur, Isohkelekel was given the title Nahnmwarki of Madolenihmw instead of taking it. This title conferral was part of the canoe charter during which socio-religious leaders and gods decided the socio-political future of Pohnpei (Bernart 1977; Falgout 1987).After the decentralization of the socio-political system instances of conflict and conquest warfare were primarily geared toward merging territories and restructuring the social hierarchy (Hanlon 1988a:29-30). The most notable of these conflicts is the Battle of Sapwtakai, which unified the current territory of Kiti under its first Nahnmwarki sometime prior to 1820 (Bath 1984a, b; Bernart 1977; Falgout 1987).

Conflict and warfare did not cease with the arrival of Western ships, though it was more thoroughly documented and recounted by Pohnpeians and foreign visitors alike. Throughout their history Pohnpeians have been wary of foreign claims to their islands and were often critical of what they perceived as an abuse of power by foreigners (Falgout 1989; Fischer and Fischer 1957; Hezel 1995). Like people of other colonized islands, Pohnpeians had mechanisms of resistance against colonial mandates and foreign influence. They "worked out ways to satisfy, at least to a minimal degree, the expectations of their current colonial ruler, while using the system to achieve their own aims and minimizing damage to their societies" (Hezel 1992:64). In most cases cultural differences linked to concepts of authority and/or power were the source of disagreements and clashes between Pohnpeians and their colonizers (Falgout 1989:293).

Soon after regular visits by foreign ships began local politics complicated provisioning stops from visiting ships due to clan or district rivalries in the acquisition of foreign goods. The most notorious exchanges linked to foreign visitors' unwitting involvement in local politics are the 'Falcon Incident' and the 'Lambton Affair.' In 1836, a group of Pohnpeians attempted to plunder the *Falcon's* cargo after the ship was blown into the reef, and the conflict resulted in the death of the captain and five crew members (Ehrlich 1978; Hambruch 1936b; Hanlon 1988a; Hezel 1983). At this time Madolenihmw was divided by tense clan rivalries, which played out significantly during the 'Lambton Affair' (Hanlon 1988a). The *Lambton* along with two other vessels carried out a punitive expedition against the Pohnpeians involved in the 'Falcon Incident' with the assistance of a rival clan, during which the Nahnmwarki of Madolenihmw was killed and the supposed ringleader behind the 'Falcon Incident' was hanged aboard the *Lambton* (Ehrlich 1978; Hambruch 1936b; Hanlon 1988a; Hezel 1983). The deaths of two of the three highest title holders in Madolenihmw during these events significantly changed the socio-political order in the district and on Pohnpei, with some families relocating to other districts (Hanlon 1988a). These events were amongst the most notable conflicts of the Early Contact Period on Pohnpei based on their socio-political impact,

but there are accounts of a number of clashes and conflicts between local clans/groups prior to the advent of colonial government on the island (Bath 1984a, b; Bernart 1977; Falgout 1987).

The first conflict between the Spanish and the Pohnpeians occurred in 1887 over issues with labor and treatment during the construction of the Spanish settlement (Santiago, originally Mesenieng, now Kolonia) (Bascom 1950a; Bernart 1977; Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b; Hanlon 1988a). The conflict culminated in the sacking of Santiago and the death of the governor at the hands of warriors from Net and Sokehs (Bascom 1950a; Bernart 1977; Ehrlich 1978; Hambruch 1936b; Hanlon 1981, 1988a). The standoff following the uprising lasted for two months (Hanlon 1988a). The only Pohnpeians punished as a result of the uprising were three men supposedly involved in the death of the governor, even though the Lepen Net and Wasai Sokehs, who were ultimately to blame for the murder, were spared (Bernart 1977; Ehrlich 1978; Hanlon 1988a). After the uprising, the fort at Santiago was completed using stone from Pohnpeian shrines (Hanlon 1981, 1988a). “The struggle for Mesenieng was but the first in a series of violent encounters that allowed the people of the island to successfully resist Spanish domination” (Hanlon 1988a:165).

After the 1887 rebellion peace was maintained until 1890 (Ehrlich 1978:73). In 1887 the Spanish were given permission to build a church in Wene, but over-stepped their influence in 1890 when they chose to build another church and barracks on land held by the Protestant church and school at Ohwa in Madolenihmw (Ehrlich 1978; Hambruch 1936b; Hanlon 1988a). The Capuchin priests argued against the move to Ohwa as they were “aware that the project in Madolenihmw lacked any real endorsement from either the Nahnmwarki or the lesser chiefs of the area,” but the governor ignored their concerns (Hanlon 1988a:183-185). Warriors from Madolenihmw attacked the Spanish and several skirmishes ensued, which the Spanish lost; before the troops returned to Santiago, they set fire to the mission station (Bascom 1950a; Ehrlich 1978; Hambruch 1936b; Hanlon 1988a). A punitive expedition into Madolenihmw was launched that November, and significant Spanish losses (200 soldiers killed

or wounded) were taken at a small hill-fort and the half-completed fortress at Kitamw (Fischer and Fischer 1957; Hambruch 1936b; Hanlon 1988a). After the conflicts at Ohwa and Kitamw the Spanish withdrew from their footholds in Madolenihmw and Kiti (Hambruch 1936b; Hanlon 1988a; Hezel 1995). “In the end, the conflict over Ohwa in 1890 shredded the last pretense of Spanish dominance over the island” (Hanlon 1988a:166-167).

Regardless of Spanish efforts, the Protestant church continued to operate in Kiti and Madolenihmw (Ehrlich 1978). In 1898 there was an uprising of native Protestants (southern municipalities) against their Catholic neighbors (northern municipalities) over a court case tried by the Spanish administration; the split between the religious factions also fell along the lines of traditional alliances and rivalries (Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b; Hanlon 1988a). When the Spanish attempted to intervene in the battle, the factions united against them (Ehrlich 1978). “The Spanish never realized that the conversion of Net and Sokehs after the 1887 battle did not make their converts into allies” (Ehrlich 1978:84).

When the Spanish gave up their holdings in Micronesia late in 1898, they never successfully managed to suppress any of the Pohnpeian uprisings against the colonial administration (Ehrlich 1978; Hezel 1995). The administration tried to stop the sale of guns, but the Pohnpeians acquired them through trade in exchange for copra and were so well armed “as to keep their ‘rulers’ within the walls of Colonia” (Ehrlich 1978:83). The Spanish were particularly inept at using the local socio-political system to their benefit, and their refusal and/or failure to work within that framework caused a plethora of problems for the administration (Hezel 1995:92).

German administration of the Carolines began in 1899 and was based in Mesenieng, which had been called Santiago by the Spanish (Ehrlich 1978; Fischer and Fischer 1957; Hanlon 1981). Dr. Hahl, the first German colonial administrator, knew of the issues the Pohnpeians had with the Spanish administration and chose to be cautious in dealing with the local population (Ehrlich 1978; Hambruch 1936b). Therefore, in an effort to promote friendly relations, the German colonial administration began by demolishing many of the Spanish

buildings and most of the fortifications, effectively rebuilding the settlement (Ehrlich 1978; Hanlon 1981). “As long as the Germans did not tamper with the status quo, the Ponapeans” were willing to tolerate their presence (Ehrlich 1978:102).

The German administration instituted a public works scheme in 1908 as part of the land tenure reforms, which triggered significant conflict between Pohnpeian workers and the foreign foremen (Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b). Many of these clashes were minor and were handled well on both sides, but Governor Fritz was transferred to Yap late in 1909 and was replaced by Gustav Boeder (Ehrlich 1978). By all accounts Boeder was contemptuous of both the previous administration and the Pohnpeians (Ehrlich 1978). It was under Boeder’s administration that “all the conflicts and tensions beneath the surface were about to explode into rebellion” (Ehrlich 1978:150).

The Sokehs Rebellion in 1910 is the most infamous conflict related to the road building projects, which resulted in the death of Governor Boeder and the exile of most of the population residing in Sokehs (Bascom 1950a; Bernart 1977; Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b; Hanlon 1988a; Hezel 1995). Talk of rebellion took root over a misunderstanding between Boeder and the Sokehs chiefs over the 15 days of additional work the colonial administration required due to the deferment of the land reforms in 1909, and poor treatment of traditional leaders from Sokehs and others by Boeder increased tensions (Bascom 1950a; Ehrlich 1978; Hambruch 1936b). The situation exploded due to the unjust punishment of a worker from Sokehs on the word of the German overseer, Otto Hollborn (Bernart 1977; Erhlich 1978; Fischer and Fischer 1957; Hambruch 1936b). On October 18, the workers showed up ready to retaliate against Hollborn; when Boeder was told of the situation at the mission he went to Sokehs against council (Ehrlich 1978; Hambruch 1936b). The Sokehs warriors proceeded to kill Boeder and his companion, and when Hollborn and his assistant fled they were also killed (Ehrlich 1978; Hambruch 1936b).

The ensuing conflict ranged over the northern half of the island involving the entire population of Sokehs, some members of other municipalities and soldiers from Germany and

New Guinea (Bernart 1977; Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b). Eventually, the leaders of the Sokehs warriors turned themselves in after realizing that the support from their allies was waning (Ehrlich 1978; Hambruch 1936b). In February 1911, 17 men from Sokehs were executed and most of the Sokehs population was exiled to Palau (Bascom 1950a; Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b; Hanlon 1988a; Hezel 1995). "The executions and exile of the Sokehs warriors and their families seemed unduly harsh sentences to the Ponapeans in Madolenihmw, Uh, Kiti, and Net" (Ehrlich 1978:191). In 1911 and 1912, Governor Kersting resettled Sokehs with atoll immigrants who were displaced after the typhoon of 1905 (Ehrlich 1978; Fischer and Fischer 1957; Hambruch 1936b). This resulted in a major vacuum in the traditional socio-political hierarchy of Sokehs. The Japanese allowed those exiled to return between 1917 and 1927 (Ehrlich 1978).

Open rebellion against the colonial administration ceased before the Japanese took control of the island in October 1914 (Fischer and Fischer 1957; Hanlon 1988a; Hezel 1995). By the end of the German Period "the part of Mesenieng known as 'the colony' had, through occupation and conflict, become almost totally estranged from Ponape" (Hanlon 1981:81). There were three primary causes of conflict during the historic period: the mistreatment of Pohnpeians by outsiders, infringement on property or traditional practices, and misunderstandings relating to cultural differences. These trends in conflict were also likely to be significant in the prehistoric period, though any significant or prolonged abuse of power may have acted as a trigger.

4.9 Discussion and Conclusions

The decentralized nature and adaptability of the traditional socio-political system has been beneficial to its continued relevance on Pohnpei, yet it provides challenges to historians and other researchers who aim to comprehensively describe it. It is more than likely that the documented variability and complexity reviewed in this chapter and Chapter 3 extend into the

distant past, a feature which needs to be recognized in archaeological studies as it has been in historical and anthropological research.

The current model of socio-political development on Pohnpei (see Chapter 3) cannot currently recognize the individual developmental trajectories of each district due to significant gaps in available archaeological data. It does account for the roles of cooperation, coercion, and ideology at different times in prehistory, but it is hardly a comprehensive view. The reviews of the factors and mechanisms presented in this chapter indicate how each is interconnected, so there should be evidence of the impact of each in the archaeological record. The challenge is to identify how their influence might manifest within the archaeological record beyond the most obvious contexts.

Ideology and community cooperation are highlighted in the current model of socio-political development on Pohnpei, though cooperation is primarily inferred through oral traditions. Cooperative community activities are difficult to identify in the archaeological record, and clear evidence may not exist in material form. This review highlights how ideology and ritual/religious practice were integrated into many components of traditional Pohnpeian society, including the structuring of inter-personal conflict.

This chapter has shown that conflict and warfare had a more significant role in socio-political development that typically acknowledged on Pohnpei regardless of the lack of physical evidence. An approach based on violence alone is flawed since it fails to recognize other coercive forces within society (e.g. threat of violence or retribution, blackmail, etc.). Coercion is probably more commonly deployed by socio-political leaders than warfare but, as with cooperation, it is more difficult to prove using archaeological data.

The information presented in this chapter has not provided overwhelming support for either cooperative or coercive models of social change on Pohnpei. There is data to support both arguments, and it is likely that primary mechanisms of socio-political development changed over time. In the following chapters, this thesis focuses on the period associated with state-level society on the island with the intention to develop a means to differentiate

between cooperative versus coercive socio-political strategies that does not rely on negative evidence for one driving mechanism acting as evidence for another. Monumental architectural features associated with this period are analyzed as a means of testing criteria developed to differentiate between structures that might have been managed using cooperative strategies and those more likely to have been built via coercion (see Section 2.6 in Chapter 2). If differentiation between cooperatively or coercively built structures is possible, this method would provide a new means through which to examine cooperation and coercion using architectural datasets.

The following chapters examine the criteria outlined in Chapter 2 to determine their viability in distinguishing between strategies used to mobilize materials and labor for monument construction. The results are used to further examine whether the application of coercive or cooperative models of social change is more appropriate on Pohnpei while power structures were centralized at Nan Madol (see Chapter 9).

Chapter 5: Mortuary Practices and Pohnpei

As Goldstein (1981:57) has stated, "the task in mortuary analysis is to identify the rules a society used and the cultural elements (e.g. kinship, wealth, etc.) represented." The challenge is that mortuary structures only comprise part of a society's mortuary activity, and within those other contexts social, economic, religious, and political dimensions have significant roles (Carr 1995; Goldstein 1981; O'Shea 1981; Pader 1982). Multi-dimensional and comparative approaches are particularly useful in addressing how the range of factors involved in funerary events can manifest archaeologically (Goldstein 1981:67; Pader 1982). Such an approach also allows for comparisons between different sites and site types. This chapter examines several components of Pohnpeian mortuary practices that are not covered in the study of architectural mortuary features made in the following chapters.

Although, mortuary contexts have been a major focus of archaeological work on Pohnpei since its very beginning (see Chapter 3), sites and features have not been studied comparatively until recently (e.g. Seikel 2011). This chapter reviews what is known about past mortuary practices based on ethnographic and ethnohistoric accounts, oral traditions, artifact distributions and burial demographics. This information is crucial to build an understanding of how burial sites were used as ritual spaces on Pohnpei and how mortuary practices changed over time. The context presented in this chapter provides information with which to directly link the architectural analyses discussed in Chapters 6 through 8 to the prehistoric socio-political system of Pohnpei.

5.1 Mortuary Practices and Social Structure

The mortuary context and its variability are directly linked to a society's socio-cultural complex (i.e. ideology, hierarchy, economy, etc.) (Barrett 1990; Carr 1995; Chapman 1981; Chesson 2001; Goldstein 1981; Huntington and Metcalf 1979; Kuijt 2001; Pader 1982; O'Shea 1984; Parker Pearson 1993, 2003; Saxe 1970). Tombs and mortuary sites are sites of

symbolism, ideology and politics (Ashmore and Geller 2005; Bloch and Parry 1982; Chapman and Randsborg 1981; Kuijt 2001; Parker Pearson 1993, 2003). Ideology often manifests in the placement of burials in relation to settlement areas and other socially meaningful places (Chapman and Randsborg 1981; Kuijt 2001; Pader 1982; Parker Pearson 1993).

The appearance of cemeteries and communal burial sites has been associated with the establishment of communities comprised of multiple kin-groups with access to surplus goods (Chapman 1981; Meskell 1999). Often it is modifications to the form of human disposal that are early indicators of socio-political and economic shifts (Chapman 1981). Cemeteries and burial structures occasionally act as territorial markers, which might contribute to a site's location on a hill or prominence and on the periphery of settlements, or the construction of monuments (O'Shea 1984:287). The location of burial sites on the periphery of settlements could also suggest a societal need to separate the dead from the living. Hence, it is necessary to consider mortuary sites in relation to the entire social context (Chapman and Randsborg 1981; Kuijt 2001; Pader 1982; Parker Pearson 1993). There is also social meaning encoded within mortuary space (see Ashmore and Geller 2005 for example). Single interments tend to inform on the identity and perception of the deceased, while communal sites are more indicative of group identity and status. The communal crypt as a symbol of group solidarity and status can only be maintained if individual identities are de-emphasized in burial (Bloch and Parry 1982).

Changes within a society are often reflected in modifications to mortuary practices (Cannon 1989; Chapman 1981; Meskell 1999). Burial practices and variations within or between interment types vary due to changes in views related to hierarchical social development or changing ideology about kinship ties (Meskell 1999). Specific mortuary practices are meaningful through their comparison with contemporaneous and past practices (Cannon 1989:446). Social and ideological change is most apparent in variation in burial types and/or structures over time and space. The challenge of interpreting mortuary contexts in the archaeological record is that what remains represents a fraction of the associated mortuary

ritual (O'Shea 1984). Change from family tombs or crypts towards community cemeteries or burial grounds could suggest a shift in ideology from kinship toward other relationships (e.g. Byrd and Monahan 1995). Rank differentiation is more apparent in the comparative context once affiliated burial systems are identified (Brown 1981:37). Factors impacting on burial types over time and space include status, kinship, economics, and ideology (Carr 1995; Meskell 1999; O'Shea 1984; Pader 1982; Saxe 1970).

"Tombs are not simply symbolic markers but are real components of political actuality, forming a principal means of acquiring and demonstrating power" (Parker Pearson 2003:193). Morris (1991:152) suggests that mortuary customs often develop directly following subsistence intensification, which is regularly linked to the development of socio-political complexity. Often mortuary rituals and architecture are used to legitimize the socio-political system and status reflected in social hierarchy (Barrett 1990; Carr 1995; Foster 1995; Kuijt 2001; Parker Pearson 1993, 2003). Identity, both individual and group, is intertwined in mortuary practices and ritual partly due to the link between burial practice and memory (Chesson 2001; Foster 1995; Kuijt 2001; Van Dyke and Alcock 2003). Identities associated with burial sites tend to be modified and reworked over time based on the significance of the site or individuals affiliated with the site (Barrett 1990; Parker Pearson 1993, 2003). Memories associated with mortuary sites are often linked to individual or kin-group status, and survivors enact their own status and kin affiliations by their participation in mortuary rites (Barrett 1990; Foster 1995; Parker Pearson 1993). Mortuary architecture on a monumental scale constitutes social markers in the landscape, which are indicative of group identity throughout time (Earle 2000).

Ritual feasting and mortuary offerings tend to be linked to memory (Chesson 2001; Foster 1995; Van Dyke and Alcock 2003). Mortuary events act as a stage to express group solidarity and status, alongside individual status (Barrett 1990; Chesson 2001; Kuijt 2001; Mandelbaum 1965). Mortuary archaeology is particularly situated to address social change and development over time as it addresses economic, ideological, and political issues (Meskell

1999; Parker Pearson 1993; Saxe 1970; Tainter 1977). This change may include decentralization, not just increasing complexity (O'Shea 1984). Often mortuary practices also "present situations where the lack of solidarity is dramatically highlighted" (Mandelbaum 1965:357).

The death of a socio-political leader raises additional considerations in relation to mortuary practices. In the case of the deaths of high-ranking leaders it is necessary for the mortuary ritual to reaffirm the legitimacy of the socio-political structure and demonstrate that the death has not destabilized society (Hertz 1960; Saxe 1970). The mortuary rituals associated with high-status burials reflect the position of the deceased in form and offering (Huntington and Metcalf 1979; Saxe 1970), and act to legitimize social hierarchy. In many chiefly societies the death of a leader was kept secret until a new leader was chosen, at which time the funeral would be held (Hertz 1960). According to Hertz (1960:72) in complex societies mortuary practices operate as attempts for the society to reconstitute itself, and often social structure is reflected in burial practice.

The development of socio-political hierarchies and heterarchies with ties beyond the kinship-level often manifest with increased investment in practices (Brown 1981; Carr 1995; Chesson 2001). Change in society is typically reflected in changing perspectives on burial rites and other practices (Barrett 1990; Carr 1995; Chesson 2001; O'Shea 1984; Parker Pearson 1993, 2003; Tainter 1977). By addressing as many components of a society's mortuary complex as possible over time and geographic space, interpretations of social structure and change can be developed (Chesson 2001; Goldstein 1981; Pader 1982). The location of burial sites in a settlement is often indicative of a society's perception of death and the ancestors (Binford 1971; Parker Pearson 2003). There is also some differentiation between individuals buried in a specific fashion or place and individuals located in other areas. There is typically a small cross-section of society that is treated differently in death based on status or behavior (Brown 1981; Goldstein 1981; O'Shea 1984; Parker Pearson 2003; Saxe 1970). High status is often indicated by an elaboration of mortuary practices typically used by a society at a given

time, but there are individuals that may be treated so differently in death as to be invisible within a society (Brown 1981; Chesson 2001; O'Shea 1984; Parker Pearson 2003). In some societies social distinctions may be underplayed by levelling mechanisms, which indicates a non-linear relationship between status and burial treatment (Barrett 1990; Carr 1995; Chapman and Randsborg 1981). Mortuary ritual also allows for the redefinition of status for the living as well (Barrett 1990). The loss of an individual opens a gap in the social hierarchy and funeral participants often compete for social advancement through ritual participation. Another challenge to archaeological interpretation of social distinctions in mortuary sites is variation between contexts based on personal and social choices relating to each mortuary site (Carr 1995; Pader 1982). Identifying regularly occurring attributes (e.g. specific types of artifacts, architectural components, and burial orientations) is integral to discussion of status distinctions or anomalous occurrences (O'Shea 1984).

Some mortuary behaviors (e.g. secondary burial, ritual bone breaking, etc.) also provide challenges to the interpretation of depositional processes (O'Shea 1984). In particular, secondary burial shows continued mortuary activity within burial sites connecting individuals with their ancestors, which indicates a complex of ritual activities which may not be recovered archaeologically. Non-human taphonomic processes must also be accounted for in burial contexts. Differential preservation is an issue for artifact types and skeletal material (O'Shea 1984; Roksandic 2002). Consideration of possible human or natural impacts on mortuary sites will aid in the interpretation of these sites (e.g. Chapman 1981; Haglund and Sorg 2002; Ubelaker 1999; Valentin et al. 2010).

As outlined here, existing archaeological remains may represent only part of a society's mortuary practices. It is valuable to examine ethnographic, ethnohistoric, and traditional history as a means of understanding the social context of burial practices within a society. Even though these lines of evidence may not provide a glimpse into the distant past, they do provide information on how a culture approached death. The next section reviews mortuary practices on Pohnpei.

5.2 Pohnpeian Mortuary Practices

Mortuary practices on Pohnpei tend to be highly variable, based on the time period and the relative status of the individuals involved. Visitors, missionaries, and anthropologists documented sub-surface burial, canoe burial, burial in platforms or tombs, burial in mounds, and secondary burial (Ayres and Mauricio 1997; Frazer 1924; Hambruch 1936c; O'Connell 1972; Mauricio 1993; Shineberg 1971; Riesenberg 1968). Little is known of the chronological patterning in burial practices, though it has been suggested that sub-surface burial was introduced later in Pohnpeian history or was reserved for low-status individuals (Mauricio 1993; Riesenberg 1968; Shineberg 1971). According to Hambruch (1936c:92) some individuals were buried in house floors, while other less important family members were interred near the house in the 19th and early 20th centuries. There is also evidence of prehistoric community and/or family cemeteries in Wene and a few other locations, which according to Hambruch (1936c:95) resembled organized palm groves within a stone enclosing wall. The trees are of particular note because a tree or shrub was planted at the head of graves into the last century (Hambruch 1936c). Regardless of final burial context, feasts were a major component of funerary rituals on Pohnpei (Christian 1899a; Frazer 1924; Hambruch 1936c; McGarry n.d.; Riesenberg 1968). Unfortunately, sub-surface burials and feasting are not particularly visible in the archaeological record of Pohnpei due to poor preservation in acidic soils, though the presence of *sakau* stones near some mortuary sites is indicative of formal mortuary feasting (see Section 4.6 in Chapter 4).

Ayres and Mauricio (1997) developed a mortuary site typology based on visible sites and structures (Figure 5.1). Though these are clearly not the only types of burial sites, the typology covers most site types. Although there is little available by way of direct accounts of mortuary structures in use, some general information exists in the ethnographic and ethnohistoric records (e.g. McGarry n.d.; Riesenberg 1986; Shineberg 1972).

Pohnpeian Mortuary Site Typology
(Based on Ayres and Mauricio 1997)

Type	Descriptive Attributes
Lolong tombs	
	A. Stone Vaults:
	1. Single isolated vaults
	2. Vault(s) enclosed by a single stone wall
	a. Single detached Vault
	b. Single vault attached to wall
	c. Double detached vaults
	d. Double vaults attached to wall
	B. Tomb with two enclosing walls (all sub-types)
	C. Tomb complex with vaults in multiple sections
Stone Platforms (*Pwukoar-takai, Ketipar, Koasoksok Takai*)	
	A. Burial *Pehi* - Rectangular platform with a central stone vault
	1. Single narrow rectangular vault
	2. Double narrow rectangular vaults
	B. *Mwohnihm* - sub-floor burial in house platform
Mounds - *Uluhl*	
	A.Truncated rectangular burial mounds with stone facing on four sides (Historic)
	B. Mounds (rounded in cross-section) with no stone facing (occasionally graves)

Figure 5.1 Site typology for known mortuary sites on Pohnpei.

Sources suggest that in the past high-ranking title holders and priests were buried in secret, and later moved to a burial structure for secondary burial to mitigate the power vacuum created by death (Hambruch 1936c; Mauricio 1993; Riesenberg 1968). The death was kept secret until a replacement was determined. Unless there was a tomb or burial structure with space available, a new structure was constructed (Mauricio 1993). It has been suggested that tomb structures were used by clans or local groups, and not just by chiefs (Ayres and Haun 1980; Kubary 1874; Mauricio 1993; Seikel 2011). According to Mauricio (1993:300) tomb complexes (*lolong*) were no longer in use in the early 20th century, but burial within structures continued (e.g. house platforms). There were also two documented instances in the early historic period where Nahnmwarki insisted that they should be buried in their *nahs* (feast house) and eventually were (Mauricio 1993:358-359).

Oral traditions record some information about clan or group associations and links to burial sites. Hambruch (1911, 1936a), Kubary (1874) and Bernart (1977) documented specific individuals or groups associated with three islets at Nan Madol. Isohkelekel, the man who led the overthrow of the Saudeleur, is associated with the largest tomb on Pein Kitel, the

Saudeleurs are buried on Nahndauwas, and Karian is linked to the priesthood affiliated with the Saudeleur religion. Outside of Nan Madol, most of what is known is linked to priests or priest-leaders in Kiti. The Soukise priests are said to be buried under the Paler burial cairns in Wene (Riesenberg 1968). The priest-leaders of Salapwuk are associated with the burial sites at Doleni and Nanlikop (Ayres and Mauricio 1997; Mauricio 1993). These records suggest a strong association of high status elites with formal burial structures and monuments. However most of the mortuary sites on Pohnpei have no known associations in oral tradition, even though their distribution outside socio-political centers indicates that there was a common set of mortuary practices used across the island.

5.3 Typological Variation in Mortuary Sites

This thesis focuses on two types of burial structures: stone platforms and *lolong* tombs (see Figure 5.1 for Typology). These burial structures are particularly important to archaeological signatures of mortuary practices on Pohnpei as they are documented in all five districts of the island. Artifact preservation tends to be better at Nan Madol due to the coral used to build the islets, providing a recoverable artifactual burial signature. Isolated burial platforms and *lolong* are highly visible, but are also highly variable in scale and architectural style.

Burial platforms exist in two primary emic types: *pehi* and *mwohnihm*, but these classifications may have changed over time as Pohnpeian culture developed. A *pehi* is a rectangular platform with one or two central burial chambers. *Mwohnihm* are house platforms with associated burials in the floor and/or the central hearth. Often platforms are not functionally distinguishable as *pehi* or *mwohnihm* unless human remains or specific artifact classes are visibly present or uncovered during excavation. Ayres (pers. comm.) suggests that columnar basalt is associated with ritual, political or mortuary sites, and not typically residential sites. Therefore the use of columnar basalt in some *mwohnihm* may separate these platforms from house platforms with no associated burials.

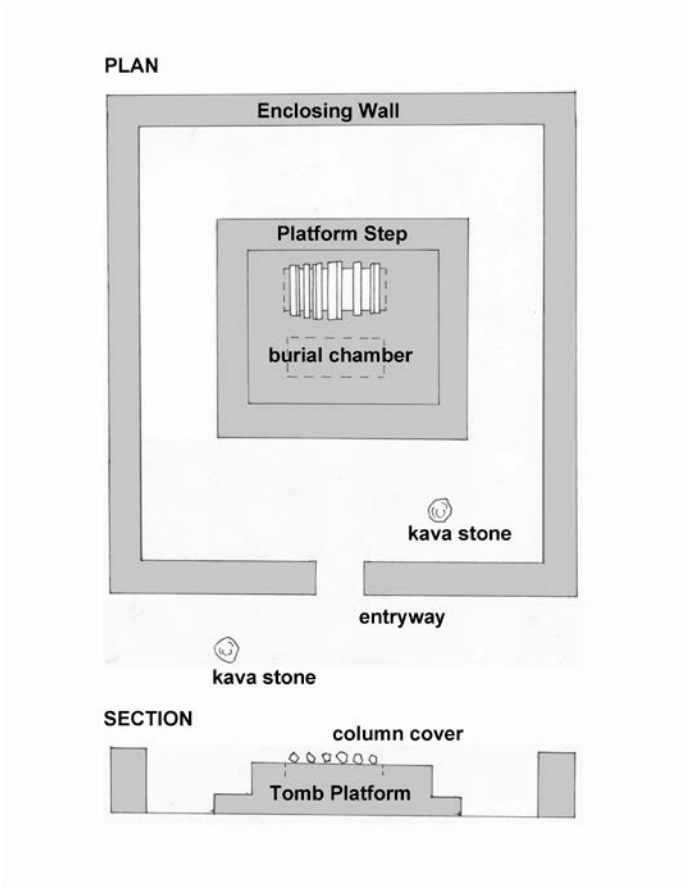


Figure 5.2 Basic *lolong* plan (From Ayres and Seikel 2014).

There are multiple types of *lolong*, though they are all variations on a basic plan. The basic template of *lolong* incorporates a burial platform surrounded by an enclosing wall (Figure 5.2). Often there is a single burial platform located centrally within the enclosure (Type A2a). The enclosing wall typically will have at least one entryway, though in some cases the entry is not apparent due to structural collapse and disturbance, or it was never constructed. Variations on this layout include single platforms built into the corner of the enclosure or against the enclosing wall (Type A2b- Angeir Feat. 1), and multiple platforms located within the enclosure suggesting prolonged use of the site (Type A2c and d- Karian). Compound *lolong* complexes are uncommon, but incorporate multiple *lolong* within a larger enclosure (Type C- Nahndauwas and Pein Kitel).

Other features associated primarily with *lolong*, and occasionally with burial platforms, include stone alignments, *sakau* stones, pavings, and small ancillary platforms. The most

common of these features are stone alignments. Often burial platforms, regardless of their association with *lolong*, have stone alignments around the base of the platform or are built on a paved step or low platform (e.g. Nahndauwas Feat. 1). *Sakau* stones are commonly associated with burial structures at Nan Madol (e.g. Lemenkau), and were likely associated with similar structures elsewhere even though some have been moved for reuse. *Sakau* stones are primarily associated with sites where feasts are held (see Section 4.6 in Chapter 4) and were likely also used in rituals and ceremonies. Their close proximity to mortuary structures indicates that mortuary feasts may have taken place at the gravesite in prehistory. Large *sakau* stones were likely left in place because they were too difficult to move, and though smaller stones could be moved from site to site mortuary sites are associated with stones of varying sizes. This suggests that stones associated with ritual spaces may have been left in place permanently. Basalt-lined cysts or caches of artifacts and secondary deposits of skeletal material are associated with some structures. Other ancillary features, such as pavings or platforms, have a ritual function or meaning that is difficult to determine from archaeological data alone.

The variation in architectural layout and the presence or absence of additional features associated with mortuary structures accounts for only a fraction of the overall variability in mortuary structures. There is also significant variation in construction style and material (see also Ayres and Seikel 2014). Construction materials for burial platforms and *lolong* include columnar basalt, coral rubble, and basalt boulders/rubble. Construction styles include header-stretcher, rubble/boulder construction, boulder construction with columnar basalt facing, and permutations of these styles. Header-stretcher construction is comprised of stacking basalt columns atop each other alternating lengths and widths, and filling the gaps with coral and basalt rubble (Figure 5.3).



Figure 5.3 Image of header-stretcher style construction at Nahndauwas (Photo by A. Craib).

Variation in the materials used and construction style are significant factors to consider in addition to typological variation in architectural plan. Detailed architectural analysis, such as that undertaken in this study (see Chapters 6 through 8), can narrow the factors responsible for architectural variability. It is necessary to address as many types of variation within these burial structures as possible in order to begin to understand how architecture represents the Pohnpeian socio-political system at different points in time.

Although mortuary architecture is the focus of this thesis, it is important to examine associated mortuary information to build a more complete understanding of prehistoric mortuary practices. The following section reviews artifacts recovered from mortuary sites and burial demographics as a means of examining how mortuary structures and sites functioned, and providing integral clues about social structure.

5.4 Mortuary Datasets: Artifacts and Burial Demographics

In this section I review and synthesize available datasets from excavations associated with burial structures from Nan Madol and elsewhere on Pohnpei. Most of the archaeological data related to burial practices is directly linked to architectural features (e.g. burial platforms and *lolong* at Nan Madol). But there is still much to glean from demographic profiles and artifactual data recovered from burial sites, or as Ayres (2002:59) stated, "to assess the significance of architectural variation as a measure of socio-political complexity, it is necessary to consider monuments and monumental architecture in the broader context of settlement, subsistence, and demographic data." Preliminary statements relating to settlement are possible, particularly those relating the Nan Madol structures to other mortuary features in other settlement areas, but it is not yet possible to incorporate much information related to subsistence or feasting beyond that presented in Chapter 4 at present. This section focuses on the excavations of mortuary structures, associated artifacts recovered from these contexts, and the demographic profiles of the burials.

Detailed excavation reports of mortuary contexts on Pohnpei are rare, as excavation results were often either not reported or only mentioned in passing (see Chapter 3). Most mortuary structures which have been excavated are located within the Nan Madol complex, and were explored prior to 1985. These early excavations, particularly those prior to 1950, were not always excavated stratigraphically (e.g. Christian 1899a, b; Hambruch 1911, 1936a; Intoh 1998; Kubary 1874; Sarfert 1911/12; Yawata 1932) (see Chapter 3). Most excavations on mortuary sites undertaken from the mid-1970s onward have been noted in accessible reports (e.g. Athens n.d.; Ayres et al. 1981), though full accounts of all excavations are not yet available. The few excavations undertaken on mortuary sites elsewhere on Pohnpei have been reported on in varying detail (e.g. brief notations to full detailed reports; see Ayres et al. 1981; Christian 1899a, b; Richards n.d./1948).

Architectural and artifactual data from Nan Madol provides the majority of what is known about burial contexts and their associated material goods. This is partly due to the coral matrix of the islets providing favorable conditions for preservation. Therefore, the foundation of data collected from Nan Madol is vital to the understanding of mortuary practices at this stage.

5.4.1 Artifacts Associated with Mortuary Contexts

Thousands of artifacts have been recovered from mortuary contexts on Pohnpei, primarily at Nan Madol. Artifacts associated with these contexts include shell beads (*Conus* and *Spondylus*), *Conus* rings, *Spondylus* pendants, *Conus* armbands, pearl shell fishing-lure shanks, and shell adzes (*Tridacna* and *Terebra*) amongst other items. Most of the recovered artifacts were uncovered in excavations undertaken at Nan Madol in the 19th and early 20th centuries for museums and collectors in Europe. Many of the artifacts recovered during this period did not complete the trip back to Europe (Spoehr 1963) or were lost in the bombing of Germany in World War II. F.W. Christian's collection is one of the few to survive. Even though relatively few of the artifacts can be located today, some sketches and documentation of these early collections gives an idea of what was recovered. This information will be outlined below.

Collections from two expeditions exist in various museums in the United Kingdom and the Smithsonian. The F.W. Christian collection is divided between a number of museums and private collections in the United Kingdom, although most of the items are now held in the Pitt Rivers Museum, the British Museum, and the National Museum of Scotland. Museum records provide a listing of the items which can be compared to Christian's published accounts. The Smithsonian collection is the only intact collection from Nan Madol, but a full report of the 1963 expedition was never completed (Ayres pers. comm.). A listing of artifacts recovered from the Nahndauwas burial structures is not currently available in the museum catalogs. The information in the accessible museum records and publications is reviewed here in order of

collection date. Where collections were lost I am required rely on artifact identifications made by the collectors.

Kubary travelled to Micronesia under the auspices of the Goddefroy Museum in the 1870s (Spoehr 1963). His hypotheses regarding the use and construction of Nan Madol laid the foundations for more recent research, and were progressive compared to some of his contemporaries (see Section 3.3 in Chapter 3). Most of Kubary's collections from Nan Madol did not survive the trip to the Godeffroy Museum (Spoehr 1963) or World War II, but he published his observations about the site and some notes relating to items he recovered from several of the tombs (Kubary 1874). Little of Kubary's published material has been translated from the original German, which means details cannot be included in this discussion, but pertinent information was published in his 1874 article. Kubary (1874) noted 13 burial platforms at Nan Madol with stone cysts demarcating individual bone groupings. He excavated an unknown number of tombs, but he identifies Nahndauwas, Karian, Sapwuhtik B, Lukepenkarian, and Angeir in the list of islets where he located mortuary structures. Each crypt he excavated was filled with coral rubble, fragmentary human remains, and other artifacts, of which stone and shell discs and shell pendants were common (Kubary 1874). Kubary (1874) claimed that the stone discs associated with the burial contexts were used as currency as well as ornamentation and he was the first to suggest that grave goods at Nan Madol were indicative of status differentiation.

The benefit of F.W. Christian's collection is that it survived nearly intact although spread among four museums in the United Kingdom and the material is also documented in his publications (Table 5.1). Christian also recounted his discussions with Kubary about the site and the collection once he returned from Micronesia (Christian 1899a, b). Accession records show that on his return to Britain in 1899, Christian divided his collection and sold pieces off to different museums and private collections. By cross-referencing museum records and notes from Christian's publications (1899a, b) it is possible to reconstruct how much of the

Artifact Type	Nahndauwas	Ronkiti	Total
Conus armlet/ring	24	0	24
Tridacna Bracelet frag	5	0	5
Shell discs/beads	100+	0	100+
Cassis pendant	9	0	9
Shell pendants	1+	0	1+
Shell Ornaments	7	0	7
Shell ornament frag	9+	0	9+
Carved tridacna	2	0	2
Pearl Shell fishing lure shanks	80	0	80
Tridacna Adze	3	0	3
Tridacna Adze frag	1	0	1
Shell adze	2	1	3
Cassis chisel	2	0	2
Shell chisel	1	0	1
Stone implement	1	1	2
Obsidian Frag	1	0	1
Shell needles	12	0	12
Basalt 'gong' Stone	0	1	1
Conus shell	1	0	1
Cassis shell	1	0	1
	262+	3	265+

Table 5.1 Estimate of the artifacts recovered by F.W. Christian based on his published accounts.

collection resides in these institutions. It also allows the provenance information to be confirmed. Christian excavated all three *lolong* on Nahndauwas, and shifted his interest to the "Chokalai" burial ground in Kiti when the Nahnmwarki of Madolenihmw forced him to cease work at Nan Madol (Christian 1899a, b). Christian's exploration of the Kiti site was the first documented excavation to take place outside Nan Madol. In his accounts (1899a, b), Christian did not publish the exact number or in some cases the type of artifacts he recovered from Nan Madol. Though he recorded most of what he excavated from the central and northern *lolong* in general terms, Christian only noted that he found a few artifacts of unspecified type in the

southern *lolong* (1899a). There are inconsistencies between Christian's publications and the museum accession records. Some of these discrepancies are accounted for by Christian's gift of some items from Nahndauwas to the captain of the *Quiros*, who docked in Madolenihmw Harbor while Christian was working at Nan Madol (Christian 1899a). Museum records do not contain the 12 shell needles nor the single obsidian fragment listed in Christian's accounts from Nan Madol, which means they either were part of the gift to the captain, were part of a private collection, or were confused with other specimens. The numbers of each type of artifact are not consistent across both sets of records, which is not surprising since Christian was not diligent in recording them. For example, Christian (1899a, b) notes 80 pearl shell fishing-lure shanks were recovered from the central tomb at Nahndauwas, but only 51 are listed in museum records. As with the other missing artifacts, these items were likely gifted or sold to private collectors or acquaintances. The only other artifacts from Christian's excavations that have not been accounted for are a stone knife and shell chisel from the Kiti excavations. Christian (1899a) noted that there was very little at the site, but attributed the lack of artifacts to the character of the deceased's relatives. In fact, the Kiti excavations demonstrate the same preservation concerns as those noted in relation to the PoB7-44 excavations in Awak (see Chapter 6). All the archaeological material from Christian has been provenanced to Nan Madol by the UK museums. It is possible that the Kiti artifacts never made it into the museum collections, but it is also possible that these items were given an incorrect provenance. Regardless of the issues with the history of the collection, Christian's finds are overall representative of burial deposits at Nan Madol. The obsidian item uncovered in the central *lolong* at Nahndauwas is of particular interest because it does not naturally occur on Pohnpei and it is a rare find, as noted by Ayres *et al*. (n.d.b.) regarding a similar find on Usendau. The presence of exotic material in mortuary contexts suggests that it may have been a prestige material rather than a functional item as obsidian does not occur on Pohnpei and the nearest sources are the Admiralty Islands and Fergusson Island several thousand km away (International Assoc. for Obsidian Studies).

Berg's Name	Nan Tauaj	Panui	Peintam	Peijapanaj	Likinianair	Lukopkerien	Kerien	Peimok	Japutik	Ponmant	Panmajanap	Unknown	Total
Islet Name	Nahndauwas	Pahnwi	?	?	Lemenkau?	Lukepenkarian	Karian	?	Sapwuhtik	Mand?	Angeir?		
Conus rings	1	38	15	6	3	0	4	0	0	0	0	7	74
Conus ring frag	1	2	0	3	41	0	0	0	0	0	0	1	48
Spondylus ornament	0	19	1	2	5	0	5	0	0	0	0	8	40
Pearl shell frag	0	0	5	0	0	0	0	0	0	0	0	1	6
Tridacna adze	0	9	1	1	0	0	2	0	0	1	0	7	21
Spondylus pendant	0	0	0	0	18	0	8	0	0	0	0	0	26
Pearl shell fishing lure shanks	0	0	0	0	23	0	0	0	0	0	0	0	23
Conus base	0	0	0	0	1	0	0	0	0	0	0	0	1
Perforated shark tooth (?)	0	0	0	0	1	0	0	0	0	0	0	0	1
Unworked tridacna	0	1	0	1	0	0	0	0	0	0	0	0	2
Unworked spondylus	0	5	0	0	5	0	3	0	0	0	0	0	13
Worked basalt	0	0	0	0	0	0	0	0	0	0	0	1	1
Stone	0	0	1	0	0	0	0	0	0	0	0	1	2
Iron Frag	0	3	0	0	1	0	0	0	0	0	0	0	4
Frag Human remains	17	154	156	90	3	60	95	58	61	75	57	1	827
Artifact Totals:	2	77	23	13	98	0	22	0	0	1	0	26	262

Note: One of these islet names should correspond with Pein Kitel, where Berg is reputed to have gotten sunstroke while digging in a tomb.

Table 5.2 Listing of artifacts recovered by Gov. Berg. One islet listed is Pein Kitel but it cannot be determined at this time due to discrepancies in placenames.

The majority of the other artifacts excavated by Christian in 1896 can also be classified as personal ornaments or prestige items.

The collection from Nan Madol posthumously donated to the Leipzig Museum by German Governor Berg was lost or destroyed during WWII. Sarfert (1911/12), an associate at the Leipzig Museum, published a list of the artifacts received along with what little provenance information was attached to the shipping crates. Berg's excavations were not systematic and all his notes relating to Nan Madol and his collections were lost (Sarfert 1911/12). The loss of his notes means confusion remains regarding some of the place-names he listed on the shipping crates. Hambruch (1936a:56) was the first to attempt to rectify artifact provenance during the German South Seas Expedition, and additional discussion on the topic has occurred more recently (Ayres pers. comm.). What are likely to be the proper names for the islets he visited are presented alongside his identifications (see Table 5.2). It is apparent, from Sarfert (1911/12) that Berg visited at least 11 different islets and excavated 15 tombs or burial structures. Unlike his predecessors, he collected all fragmentary skeletal material and crania in addition to artifacts. Overall, he recovered 822 bone fragments, three molars, at least two human skulls, and 266 artifacts. The types of artifacts he uncovered include *Tridacna* shell adzes, shell pendants, pearl shell fishhooks, *Conus* rings, unworked shell, and the occasional worked basalt stone (see Figure 5.4 for examples). In his concluding notes, Sarfert (1911/12) suggests many of the ornaments and fishhooks may have been used as currency, and he notes that much of Berg's material is comparable to that reported by Christian and Kubary.

Hambruch managed to accomplish an astonishing amount of work at Nan Madol in the 12 days he spent at the site. In addition to completing the first site survey and mapping project for the entirety of Nan Madol, he also conducted a number of excavations. These excavations (n=21) on 18 separate islets produced approximately 2,000 artifacts (Hambruch 1911). The majority of items recovered were interpreted as feast or grave goods, with only 40 from non-burial contexts (Hambruch 1936a:39).

Artifact Type	Nahndauwas	Pahnwi	Pein Kitel	Pohndauwas	14 Non-Burial Islets	Total
Bone fish hook	1	0	0	0	0	1
Terebra adze	1	1	0	0	2	4
Tridacna adze	3	0	0	1	14	18
Tridacna adze frag	1	0	1	0	12	14
Tridacna Armband	3+	0	0	0	0	3+
Conus armlet/ring	12+	4	0	0	0	16+
Tridacna armband frag	many	0	0	0	0	many
Conus armlet/ring frag	6+	10	0	0	0	16+
Shell armlet/ring frag	many	0	0	0	1	many
Shell discs/beads	hundreds	hundreds	0	0	0	hundreds
Spondylus pendant	many	0	1	0	0	many
Conus pendant	1	1	0	0	1	3
Cassis pendant	3+	0	0	0	0	3+
Shell Fishing Lure shank	very many	multiple	0	0	0	very many
Frag sperm-whale teeth	multiple	0	0	0	0	multiple
Triton horns	0	0	0	0	2	2
Coral breadfruit pounder	0	0	0	0	1	1
Pestle-like grinder	0	0	0	0	1	1
Sling stone	0	0	0	0	1	1
Stone knife	1	0	0	0	0	1
Basalt adze frag	1	0	0	0	0	1
Basalt pendant	0	1	0	0	0	1
Unworked spondylus	many	0	0	0	0	many
Unworked conus	multiple	0	0	0	0	multiple
Total:	many hundreds	hundreds	2	1	35	Many hundreds

Note:The non-burial islets include Dapahu, Dauahdpeidi, Ideht, Nihmokemok, PahnKadira, Peilapalap, Pohndake, Pwilel, Sapwolos, Sapwreirei, Sapwuhdir, Sapwuhtor, Usendau, and Usenpei.

Table 5.3 Listing of Hambruch's published finds.

Hambruch's (1936a) records do not list specific artifact counts from many islets (see Table 5.3). Seven burial contexts on four islets yielded hundreds of shell beads, pendants, rings, and bracelets. Other items collected from these contexts include shell adzes, pearl shell fishing-lure shanks, and unworked shell. A few uncommon artifacts identified by Hambruch include a *Tridacna* canoe adze from Pohndauwas, and from Nahndauwas, fragments of a sperm whale tooth, a "nepheline" basalt knife, and a fishhook made of human bone (Hambruch 1936a). The majority of these artifacts were from mortuary sites, and were thought to be personal ornaments and valuables. These grave goods probably reflected the status of those interred within a specific tomb or platform (e.g. Binford 1971; Carr 1995; Saxe 1970). The absence of these valued artifact types in Hambruch's non-burial excavations supports the use of ornaments and other types of items as distinguishing social status at death.

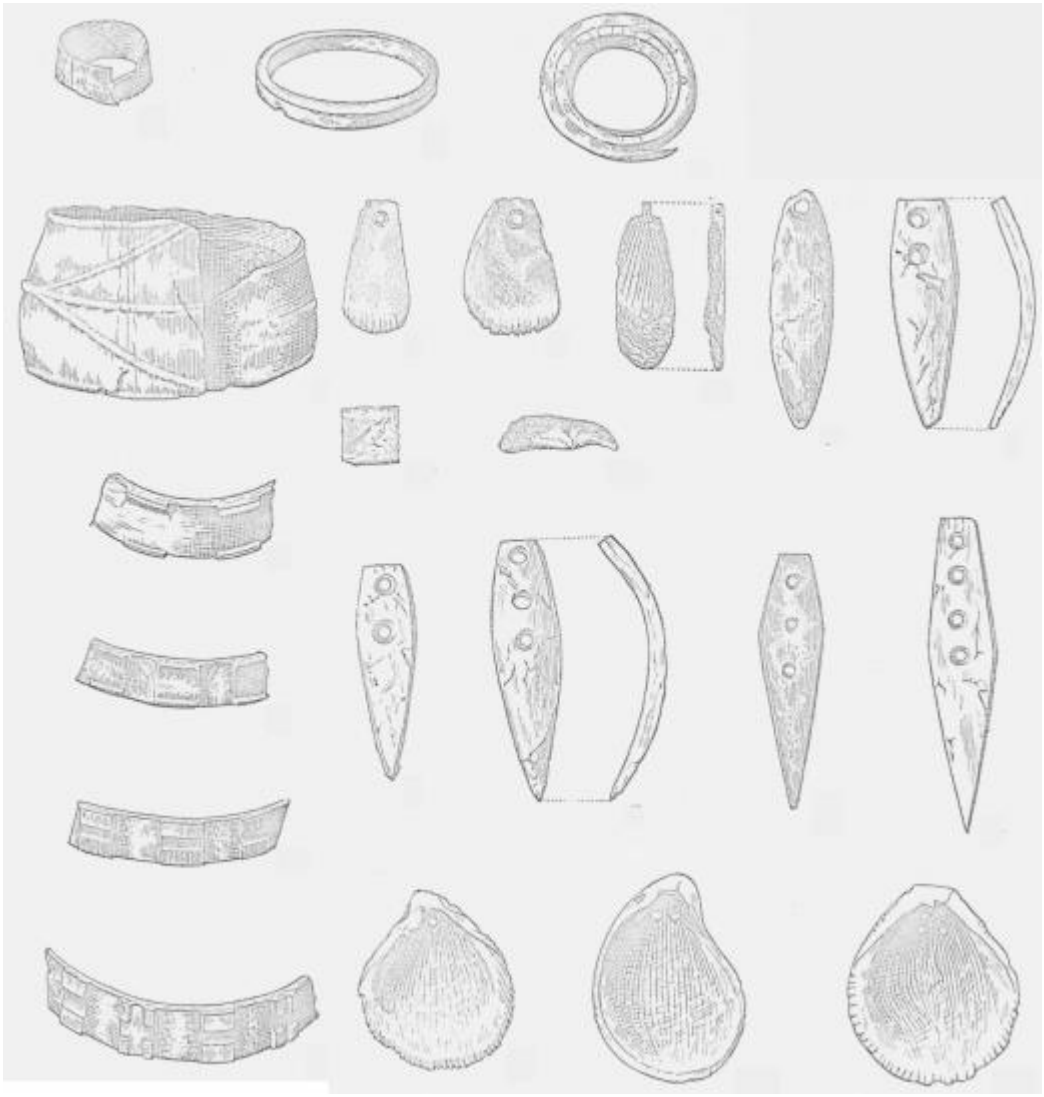


Figure 5.4 Sketches of shell bracelet fragments, shell pendants, shell beads, and shell rings recovered from mortuary contexts from Sarfert 1911/12.

Published records from the Japanese excavations at Nan Madol are typically published in Japanese (see Chapter 3), which limits access to excavation details. The primary source of items recovered from Pohnpei by the Japanese archaeological expeditions during the Mandate Period is Intoh's (1998) inventory of museum holdings in Japan. Between 1915 and 1932, the Japanese collected items from the tombs of Nan Madol (Intoh 1998). The surviving collections are held in the Tokyo University Museum and the National Museum of Ethnology (see Table 5.4). Though the majority of these artifacts were collected by Hasebe or Yawata (ethnologists/archaeologists) others were collected by members of the Japanese Navy (Intoh 1998). These collections are provenanced to two of the tombs at Nahndauwas (Central and

Northern), the tomb on Sapwuhtik, and one of the tombs on Pahnwi. Intoh (1998) also notes various unprovenanced surface finds, likely from one of the islets listed above. The artifacts are all consistent with items recovered by previous collectors. The majority of items are personal ornaments or artifacts that may have been used as currency (e.g. pearl shell fishing-lure shanks). *Conus* shell ornaments and pearl shell fishing-lure shanks are the most common items in the Japanese collections. One of the more unusual artifacts recovered is a fragment of a *Tridacna* shell ring, because *Tridacna* shell tends to be more commonly associated with adze manufacture than ornaments on Pohnpei.

Artifact Type	Nahndauwas	Pahnwi	Sapwuhtik	Surface Collection	Total
Pearl shell fishing lure shanks	16	0	0	0	16
Worked spondylus shell	3	0	0	0	3
Trolling lure shank (bone?)	0	0	0	3	3
Tridacna adze	1	1	0	1	3
Tridacna ring	0	0	0	1	1
Conus bracelets	0	0	0	22	22
Conus ring	0	1	1	8	10
Spondylus ornament	0	1	0	0	1
Shell beads and ornaments	4	0	6	0	10
					69

Table 5.4 Listing of artifacts recovered from Nan Madol during the Japanese Mandate (see Intoh 1998).

Stratigraphic excavations became the standard on Pohnpei by the 1960s. A number of burial excavations have produced artifacts, though only a few can be discussed due to gaps in reporting. In general the artifacts recovered from these excavations are consistent with those discussed above. What follows is a brief review and interpretation of the artifactual evidence from a set of mortuary sites at Nan Madol that were stratigraphically excavated.

In 1984, Ayres and colleagues mapped Pahnwi islet and completed six excavations (Seikel 2011). A recent analysis of the material recovered from these excavations was undertaken for comparative purposes. This analysis (Seikel 2011) of the artifacts recovered from the Pahnwi excavations (Table 5.5) demonstrates that there is a significant difference

between non-burial, *lolong*, platform burial, and sub-surface burial artifacts. The largest difference occurred between the burial and non-burial contexts, which is partly due to differences in the overall numbers of artifacts recovered from each context. Excavated burial contexts not associated with architectural features tend to have smaller artifact counts than burial platforms or *lolong*. Taphonomic processes cannot account for the discrepancies in artifact numbers, so variations in artifact frequencies can be attributed to status differences in burial types. The inclusion of more individuals in *lolong* or isolated platforms might also contribute to artifact number, since the Pahnwi *lolong* (Feature 30) excavation recovered more individuals than all the other burial contexts on the islet combined. *Lolong* were associated with greater numbers of prestige pieces (i.e. shell beads and ornaments) than isolated platform and sub-surface burials. Sub-surface burials typically have more utilitarian artifacts (e.g. shell adze fragments and stone flakes) than their architectural counterparts. Even with the potential impact of larger numbers of occupants in mortuary structures, the results of the artifact analysis indicate hierarchical differences within burial types (Seikel 2011).

Artifact Catagories	F16	F32	F1	F18	F23	F30	
Ceramics	0	0	0	0	2.7%	0	3
Stone Tools and Implements	28.6%	30%	43.3%	21.9%	11.6%	<0.1%	44
Shell Tools and Implements	7.1%	10%	3.3%	18.8%	5.4%	<0.1%	17
Fishing Gear	0	0	0	0	0	0.1%	5
Jewelry	0	40%	3.3%	3.1%	34.8%	99.8%	10,504
Worked Shell	64.3%	20%	50%	56.3%	45.5%	0.1%	103
Total Artifacts	14	10	30	32	112	10,478	10,676

Note: F16 and F32 are non-burial features, F1 and F18 are non-structural burials, and F23 and F30 are structural burials.

Table 5.5 Overview of artifacts recovered from Pahnwi by Ayres in the 1980s.

All the artifact collections reviewed in this section originated from Nan Madol. Three of the collections are no longer extant, but the records and publications of the collections and their recovery provide information on mortuary goods. The expeditions to Nan Madol tended to focus on a few burial sites (e.g. Nahndauwas) and provide us with listing of a wide range of

burial goods and estimates of the quantity of specific classes of artifacts deposited in these structures over their use-life.

The incorporation of ornaments and personal items within burials is ubiquitous at Nan Madol and was likely a standard component of mortuary practices on Pohnpei. The data discussed here demonstrates the extraordinary quantity of material deposited in *lolong*, and the smaller quantities of items deposited in other burial contexts at Nan Madol. The Pahnwi data collected by Ayres demonstrates the added investment in artifacts accompanying *lolong* burials when compared to platform or sub-surface burials. Variables which potentially impacted upon artifact quantity include the duration a burial site was in use, the number of individuals interred, and the status associated with the individuals or group interred. This will be examined further in relation to burial demographics later in this chapter. Based on the wide distribution of *lolong* and other burial architecture on the island, it would be logical to hypothesize that other burial contexts have similar artifact signatures (i.e. type, quantity, etc.) to their cohorts at Nan Madol.

The majority of the artifacts found in association with burials and/or mortuary structures are not utilitarian items. The high proportion of shell ornaments and worked shell pieces suggest that mortuary practices were one arena where individual and group status manifested through the conspicuous display and sacrificial offering of prestige goods during the funerary ritual. Many of the artifacts recovered would have been personal items worn by the deceased or prestige items deposited as offerings. The pendants, rings and bracelets were likely placed on the deceased as jewelry while the beads were probably incorporated into jewelry or fastened to clothing or other textiles (e.g. woven belts, capes, etc.). Items like the pearl shell fishing lure shanks, shell and stone tools, and faunal remains were more likely to have been cached as offerings or grave goods. Even though some artifacts took the form of a utilitarian artifact type they may not have functioned like their counter-parts (e.g. fishing lure shanks), and rather held symbolic meaning beyond their function as prestige goods. Regardless, the artifacts associated with Pohnpeian burial contexts not only indicate the

relative status of the deceased, but also are indicative of the wealth and status of the clan or group associated with a burial structure.

5.4.2 Burial Demography

There are only small demographic datasets for burial sites on Pohnpei, the majority of which were excavated from Nan Madol in the 1980s. The human remains recovered from each burial context were highly fragmentary and often comingled with a total of 61 individuals identified (Pietrusewsky and Douglas n.d.; Pietrusewsky and Willacker 1997; Tasa n.d.). The goal of this section is to address social relationships as indicated by burial context rather than attempting to estimate prehistoric population size or discussing group composition in relation to demographic profiles (see Buikstra 1981; Kinnes 1981 for discussion of sample size limitations).

Pietrusewsky and Douglas (n.d.) and Tasa (n.d.) examined the remains excavated by Athens, Ayres and colleagues from 11 islets across Nan Madol. There were some sites that were listed as mortuary structures instead of being identified as *lolong* or burial platforms in Athens' data (see Pietrusewsky and Douglas n.d.), and determining the specific type of structure in these cases was a goal of my 2011 fieldwork. The five islets where structure classifications were not defined in the report (Pietrusewsky and Douglas n.d.) were visited and the structures in question were examined and classified. Four of the five structures examined were reclassified as burial platforms while the other was listed as a *lolong*. At least 51 individuals were identified in the examination of the Nan Madol skeletal material (see Table 5.6). Age estimates ranged from 18 months to elderly adults (Seikel 2011:455-456). The first statistical analysis of these datasets (see Seikel 2011) show that there is no significant difference in burial type based on age or sex, and the statistics on the reclassified data confirmed the results. This is indicative of inherited or ascribed status, since infants and adolescents will be buried separately from adults in societies where status is solely earned

based on merit (Binford 1971; Saxe 1970). Specific burial structures were most likely used as family or clan burial locations.

		Adult M	Adult F	Adult U	Subadult	Infant	Total
Lemenkau (LMK)							
	Lolong -	1	2	0	0	0	3
Sapwohng (SOE)							
	Platform -	0	2	0	2	1	5
Nandauwas (NDA)							
	Bone Cache -	0	1	0	0	0	1
Pahndauwas (PDA)							
	Platform 4 -	0	2	1	0	0	3
	Platform 9 -	0	2	3	0	0	5
Peinering (PEE)							
	Platform -	0	0	2	0	0	2
Peinioar (PEO)							
	Platform -	2	3	2	2	0	9
Pohndauwas (POA)							
	Bone Cache 1 -	1	0	0	0	0	1
	Bone Cache 2 -	0	1	0	0	0	1
	Bone Cache 3 -	0	0	0	1	0	1
Sapwenpwe (SPW)							
	Platform -	1	0	1	1	0	3
Sapwuhdir (SWD)							
	Platform -	0	0	0	1	0	1
Pahnwi A (PWIA)							
	Lolong M -	0	0	6	2	0	8
	Burial Cyst M -	0	0	0	2	0	2
	House Platform 18 -	0	0	2	1	0	3
	Feature 1 -	0	0	1	0	0	1
	Excavation 3-	1	0	0	0	0	1
Wasau (WAS)							
	Platform -	0	0	0	1	0	1

Table 5.6 Available demographic data from burial contexts at Nan Madol.

The only other burial site that yielded demographic data was found on Na Island, which is located in the lagoon not far from Nan Madol. In 1977, the Catholic Church sent two priests to Pohnpei in an attempt to recover the remains of Father Bachelot who was buried on Na in 1838 (Pietrusewsky and Willacker 1997). The exhumations were not stratigraphically controlled, but six sets of comingled human remains were recovered from a 4.6 meter area (Pietrusewsky and Willacker 1997). Pietrusewsky and Willacker (1997) reexamined the remains to determine the minimum number of individuals and whether one may have been Father Bachelot. They determined that there were 10 individuals of varying ages buried on Na (see Table 5.7). All the individuals exhibited characteristics consistent with Micronesians, so Father Bachelot was probably buried elsewhere (Pietrusewsky and Willacker 1997). The

demographic variation present in the Na sample is similar to that for any individual burial feature at Nan Madol, and the proximity of these burials to one another suggests that the burial location may have been a family or clan burial site. The lack of architectural features or burial markers indicates that this burial site is likely of lower status than those associated with permanent features. A small number of shell beads were associated with Burial Concentration 3, but no other artifacts were identified (Pietrusewsky and Willacker 1997), which supports the identification of this site as of lower status. It is not possible to discuss chronological distinctions between the burials on Na Islet and the Nan Madol burials at this time, since datable material was not collected in 1977 or from the human remains during the 1997 study.

	Adult M	Adult F	Subadult	Infant	Total
Burial 1	1	0	0	0	1
Burial 2	1	0	0	0	1
Burial 3	2	1	0	0	3
Burial 4	1	0	1	0	2
Burial 5	1	0	0	0	1
Burial 6	0	1	1	0	2

Table 5.7 Na Islet burial demographics.

The presence of comingled, fragmentary human remains in nearly every burial site and the use of bone caches at Nan Madol are suggestive of secondary burial practice and repeated use of burial sites. The interment of a single individual in a burial structure (platform or *lolong*) is rare (2 of 10 or 20%), while it is more common in sub-surface burials or bone caches (6 of 8 or 75%). Bone caches often contain a single individual, which may not be surprising since they are often secondary burial locations where an individual is moved out of one structure to make room for others or they are moved from further afield to be in closer proximity with their ancestors. The reuse of burial structures and the presence of secondary burial contexts suggest that secondary burial was a common feature of Pohnpeian mortuary practices.

The Nan Madol and Na Island burial demographics show that Pohnpeians tended to bury individuals in or near structures or locations where their kin or clan members were also buried. This is supported by the presence of sub-adults in every type of burial context, showing that group membership begins at birth. The burial of multiple individuals in a site or structure associated with their kin-group de-emphasizes the identity of the individual (Bloch and Parry 1982). This indicates that hierarchical differences apparent in burial practices more likely reflect the position of the clan or family group rather than the status of a single individual. A variety of burial types in close association with one another may indicate the hierarchical social relationships of the groups who occupied an area in the past. For example, a group buried in a platform with a *lolong* nearby is likely to be of somewhat lower status than those buried in the *lolong*.

5.5 Discussion and Conclusions

The ethnographic and ethnohistoric data paired with oral traditions presented in this chapter shows that mortuary practices did change over time on Pohnpei. There are several constants that appear to be relevant to prehistoric mortuary practices as well as more recent practices. First, burial sites and structures tend to be utilized by a group or clan over a period of years or decades. Second, the death of a leader, political and/or religious, is treated differently, partly to mitigate power vacuums created by their loss. These points are important to keep in mind during the examination of the archaeological data.

The archaeological material presented in this chapter has provided one significant challenge for interpretation. Nan Madol has been disproportionately sampled when compared with the number of burial sites located elsewhere on Pohnpei. The sampling bias can be credited to Nan Madol's visibility in the Pohnpeian landscape. Smaller or more remote sites tended to be overlooked by short-term visitors for reasons, which include issues of scale and access. The wealth of data from Nan Madol's mortuary contexts is invaluable for comparative purposes. The taphonomic processes at the site have had less of a detrimental impact on

burial deposits, artifacts and human remains, because the coral rubble buffered the effects of any acidic sediments deposited at the site after islet construction. The recovery of perishable artifacts from excavations in acidic soils on the main island (e.g. PoB7-44) and the somewhat better preservation from the Na Island exhumations, illustrates that artifact preservation relates to depositional context.

Comparing the contents of burial sites of the same type and scale across Pohnpei is valuable in comprehending local and regional patterns in burial practice. Based on the PoB7-44 excavations (see Chapter 6) and Christian's (1899a, b) notes on the Kiti burial sites, mortuary structures on Pohnpei likely had deposits of similar artifact types as those at Nan Madol. It is not known at this time whether mortuary deposits on the main island were comparable in size to those of similar age at Nan Madol due to the small comparative dataset and potential taphonomic effects on these sites. Since the best way to understand individual mortuary sites is in relation to the whole range of practice in a region over time (Chesson 2001; Goldstein 1981; Pader 1982), additional surveys and excavation of mortuary sites from a broader geographic distribution across Pohnpei will allow for a refinement of the results presented in this chapter.

The primary result of the discussion of the archaeological data is that comparisons of burial contexts show status distinctions. Burial demographics support the hypothesis posited by Kubary and many others (see Ayres and Haun 1980; Kubary 1874; Mauricio 1993; Seikel 2011) that burial structures are used as clan or family burial sites. Comparisons of artifact type distributions and overall frequencies of material deposited in burial and non-burial contexts and within mortuary sites show that these deposits are indicative of social hierarchy and differentiation in burial sites. *Lolong* contexts are associated with higher status than isolated platforms, which are likely higher status than sub-surface burials and bone caches. It is necessary to recognize that factors such as duration of use and status are difficult to separate as they can be conflated with the number of individuals interred in a location and the amount of associated artifacts recovered from each context. Examining artifact distributions in

relation to burial demographics should shed some light on the issue of the relative status of burial contexts.

Discussion of artifact frequencies in relation to burial demographics for individual burial sites may provide an approximate estimate of how long a particular structure may have been used. For example, the sheer quantity of materials recovered from the tombs at Nahndauwas and the notes referencing the hundreds of bone fragments present in each burial crypt is suggestive of continual reuse of this elite site for a relatively long period of time, while the house platform burials from Pahnwi might represent a shorter use-life since three individuals of varying ages were recovered with 105 artifacts (some of which may be related to non-burial use of the site). One factor affecting artifact counts and site reuse is status. Clans which invest in high-status burial architecture (e.g. *lolong*) probably used these sites for a considerable time as they display the status of the group within local society.

The interpretations of artifact distributions and burial demographics provided by over 100 years of research and exploration show that there were status distinctions in mortuary practices based on lineage status or kin ties. The archaeological data supports information provided by ethnohistoric and historic accounts as well as oral traditions regarding serial use of mortuary sites and the association of elites with large burial structures. This evidence of status differentiation in burial practice makes the examination of cooperative versus coercive labor mobilization practices in the construction of mortuary structures feasible. In Chapters 6 to 9, I examine mortuary architecture as a means of further illuminating status distinctions in funerary practice and explore how aspects of cooperation and coercion might be represented in the archaeological record of Pohnpei through architectural analysis.

Chapter 6: Site Descriptions and Qualitative Analysis

This chapter presents descriptive data on mortuary structures at Nan Madol and elsewhere on Pohnpei. It also provides an overview of the chronology and variation in construction styles and techniques. The descriptive data will be discussed in depth, and the conclusions will address whether the structures meet the criteria presented in Chapter 2.

It is necessary to describe and discuss architectural features that exemplify a wide range of variability in order to address questions related to architecture and social systems. The following structures were chosen to provide comparative data about construction methods, variation in structural morphology, and potential change of practices over time. They are from four different areas of Pohnpei, including Nan Madol, to provide geographic diversity to the dataset and begin to answer questions relating to Nan Madol's relationship with the rest of the island.

6.1 Site Descriptions

The following sites are from three areas of Pohnpei, Madolenihmw in the southeast (Nan Madol and Temwen: PoC3 series), Kiti in the southwest (Salapwuk: PoD24 series), and Uh in the north (Awak: PoB7 series) (Figure 6.1). They are identified as mortuary structures based on architectural configuration and/or excavation. Mapping and documentation at Nan Madol took place over the last 30 years and involved Ayres, Athens, myself, and others (Athens n.d., 1980b; Ayres n.d.a., n.d.b.; Ayres et al. n.d.a., n.d.b.). My contribution included site survey, documentation and mapping on Lukepenkarian, Sapwuhtik B and Angeir, and preservation status surveys of selected islets mapped by Ayres and Athens in the 1980s. Ayres and colleagues documented the sites in Awak and Salapwuk (see Ayres and Haun 1980; Ayres and Mauricio 1997; Ayres et al. 1981), and I documented the Temwen structures in 2011.

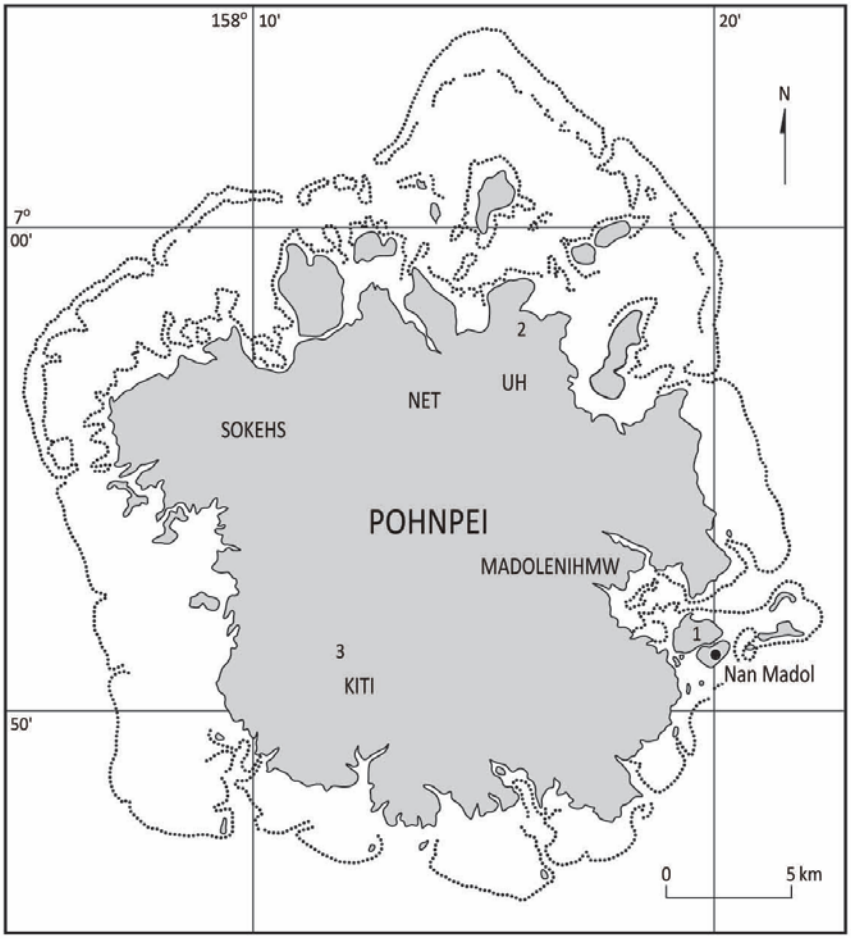


Figure 6.1 Map of Pohnpei showing sites discussed in this thesis: Temwen (1), Awak (2) and Salapwuk (3).

6.1.1 Nan Madol (PoC3-1)

The majority of what is known of tombs (*lolong*) and burial structures, including demographic profiles of the burials and artifact inclusions, is based on information from structures at Nan Madol (refer to Chapter 5). It is hypothesized that *lolong* burial structures were initially constructed at Nan Madol and were built in other locations on Pohnpei later. The structural descriptions for these mortuary contexts at Nan Madol are divided by islet name. These are only a portion of the overall dataset as architectural maps only exist for just under half of the islets at Nan Madol (46 of 102 or 45%).

6.1.1.1 Angeir

Angeir has three mortuary structures. The structures are designated as Features 1, 2 and 7. Features 1 and 7 are *lolong* and Feature 2 is a burial platform. Architectural maps have

been made for Features 1 and 2, but Feature 7 has yet to be mapped in detail, and therefore will only be included in the qualitative comparison of these structures.

Feature 1 is a rather unusual *lolong*, as the burial platform occupies one half of the enclosure and extends to the nearby enclosing walls (Type A2b) (Figure 6.2). This structure was constructed using a combination of header-stretcher, basalt rubble, and coral rubble construction techniques (Figure 6.3). The burial platform occupies the northern half of the enclosure, and measures 4.2 meters by 4.9 meters. It is primarily constructed of coral rubble with a basalt retaining wall on the southwestern side. The burial chamber is centrally located in the platform and the corners have collapsed due to coral degradation. The burial chamber contained three small circular disc beads made of shell at the time of mapping. The enclosing wall is header-stretcher construction at and adjacent to the northern corner and near the east and west corners, but is constructed primarily of coral rubble with basalt facing elsewhere. The enclosure measures 7.8 meters by 11.3 meters. The center of the northeast wall has partially collapsed. A gap in the southwest side of the enclosing wall may have acted as an entryway. There is a long, flat basalt stone inside the enclosure north of the proposed entryway; it possibly fell off the top of the enclosing wall or, due to its position, may have had another function (e.g. someplace to place ritual items or food offerings). The coral rubble platform forming the southern corner extends partway along the southeast wall and has a central pit or cyst; it is not clear what the purpose of this sub-feature was, though it may have been a secondary repository of some type. The length of the columnar stones used in Feature 1 range between 0.4 and 1.5 meters with an average of 0.6 meters. The longer stones are primarily used in the enclosing wall construction.



Figure 6.2 Plan map of Angeir Feature 1 at Nan Madol.



Figure 6.3 View of Angeir 1 from the Northeast.



Figure 6.4 View of Angeir 2 from the East.

Feature 2 is a burial platform (Type A1) adjacent to Feature 1, and measures 5.5 meters by 6.6 meters (Figure 6.4). The platform is built of coral rubble with small-to-medium sized basalt boulders and cobbles added for wall support and facing. The burial chamber is located in the northwestern half of the platform and the southeastern half is partially deflated. There are fragmentary human remains and shellfish food remains or offerings inside the burial chamber.

Features 1 and 2 are located approximately 15 meters from the southwestern wall of Sapwuhtik B (described below). A large *sakau* stone is located between Sapwuhtik B and Angeir Feature 2, though it is now trapped in the roots of a large tree.



Figure 6.5 View of Angeir Feature 7 from the East.

Feature 7 is located at the opposite end of Angeir from Features 1 and 2. It is a *lolong* primarily constructed of coral rubble (Type A2a) (Figure 6.5). The burial platform is located in the center of the enclosure and does incorporate some basalt rubble in its construction. There is a tree growing out of the burial chamber and some of the coral construction material has fallen into the chamber. Some shellfish remains are present at the base of the chamber. Two square stone alignments, cysts, are situated northwest of the burial platform, which have an undetermined purpose. The enclosing wall is constructed entirely of coral rubble. A highly disturbed area in the southwest wall may have been the entryway at one time, though it is uncertain. There is a basalt stone paving to the northeast, which may incorporate *sakau* stones.

6.1.1.2 Karian

Karian is noteworthy as it is a *lolong* (Type A2c) that occupies an entire islet (Figure 6.6) and it may be the only *lolong* with a covered entryway. The enclosing wall is built in the header-stretcher style, incorporating a number of very large basalt columns (Figure 6.7). The

entryway is located in the southwest wall and the wall structure measures 28.8 by 39.6 meters. There is only one enclosure wall which is larger (Lemenkau Feature 1), but the wall of this *lolong* is significantly shorter. Otherwise, Karian is at least five meters longer and wider than the other *lolong* incorporated in this study. There are two burial platforms located within the enclosure. The first is centrally located within the enclosure and is constructed in the header-stretcher style with incorporation of small basalt cobbles. This central platform measures 5.1 by 6.5 meters, and is surrounded by a series of columnar stone alignments. The second platform is significantly shorter and is located just southeast of the central platform. It measures 4.3 by 5.5 meters, and is constructed of coral rubble with columnar basalt facing and supports. The average length for columnar stones used at Karian is 1.2 meters, though stones in the enclosing wall are up to 4 or 5 meters long.

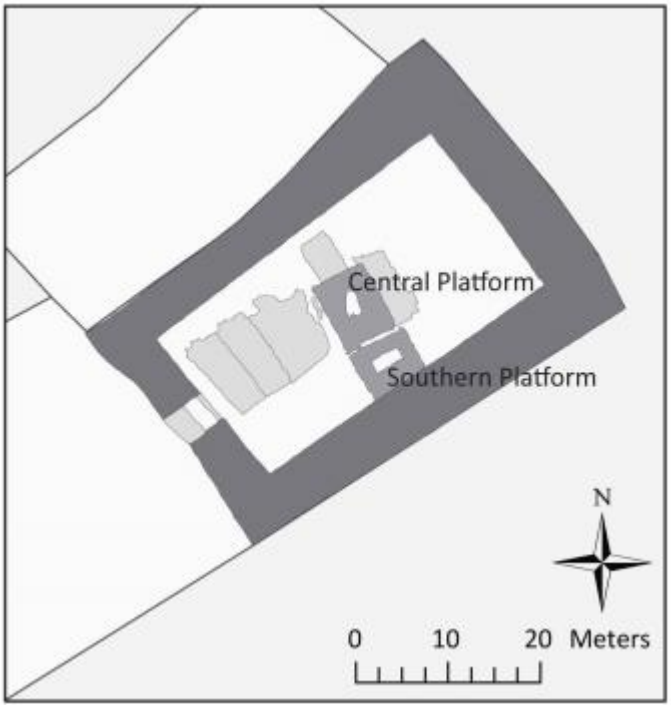


Figure 6.6 Digitized plan map of Karian (Based on Athens n.d.).

There are a number of ancillary features at Karian. The first is a small stepped area to the northwest of the central burial platform. Between the entryway and the central burial platform there are a series of three basalt cobble pavings. There are two small *sakau* stones

associated with these pavings. Outside the entryway there is a step with two paved areas on either side. *Sakau* stones are found in association with both areas.



Figure 6.7 View of the Karian entryway from the Southwest.

6.1.1.3 Lemenkau

There are two *lolong* present on Lemenkau, Features 1 and 18. There may be a third *lolong* on the islet, but further survey is necessary to make that distinction. In addition to the *lolong*, there are also enclosures, low platforms, rectangular depressions, and numerous paved areas on Lemenkau, including two occupied by significant concentrations of *sakau* stones (more than 15 in each concentration). It is clear that Lemenkau was a ritual area, though it is not clear if these rituals were always linked to mortuary practices or if there were ceremonies linked to other socio-political activities in proximity to tombs.

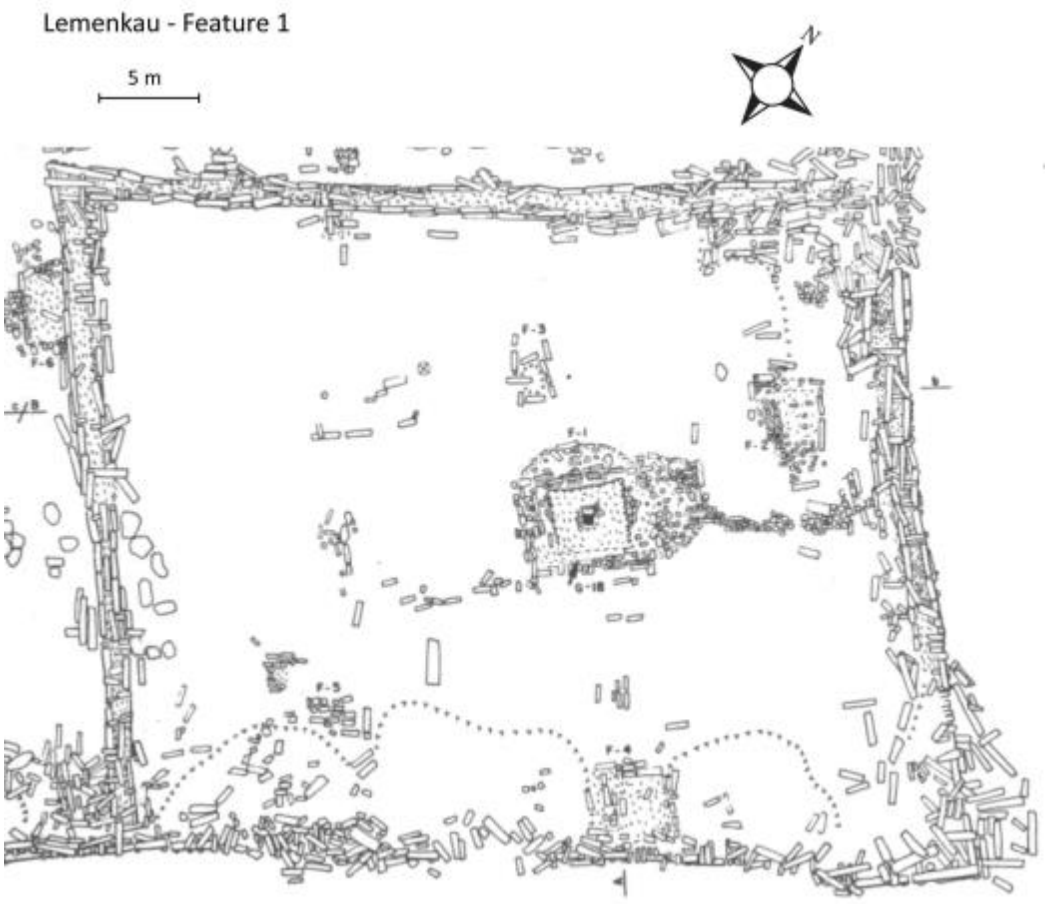


Figure 6.8 Detail of Lemenkau 1 from Athens n.d.

Feature 1 is a *lolong* on the eastern corner of Lemenkau (Type A2a) (Figure 6.8). The enclosing wall is constructed in the header-stretcher style. No entryway has been identified, but the enclosure measures 34.6 by 42.9 meters. Sections of the enclosing wall along the southeast side and the east corner have collapsed due to wave action over time. The average length of columnar stone in the wall is 1.8 meters. The burial platform is slightly northeast of the center of the enclosure and is constructed of columnar basalt and basalt cobbles in the header-stretcher style. The burial platform measures 5.3 by 6.7 meters and the columnar stones used in the platform tend to be 0.8 meters in length. The northeast and northwest sides of the burial platform are bordered by two stone pavings, and there is a columnar basalt stone alignment extending from the southern corner of the platform to the southwest. There are at least four other small platforms and stone pavings scattered throughout the enclosure.



Figure 6.9 Detail of Lemenkau 18 from Athens n.d.

The Feature 18 *lolong* is located on the southern corner of Lemenkau (Type A2a) (Figure 6.9). The southern corner of the enclosing wall and the enclosure has been washed out due to wave action and storms. If there was an entryway, it is no longer detectable. The original enclosure size is estimated at 14.4 by 17.6 meters. The enclosing wall is built in the header-stretcher style, as is the burial platform. The lengths of the columnar stones used in Feature 18 are between 0.7 and 3.8 meters with the largest stones being utilized in the enclosing wall. The burial platform is located near the center of the enclosure, and measures 5.7 by 5.7 meters. There are two *sakau* stones in direct association with two *sakau* pounders near the enclosing wall just northwest of the burial platform (Figure 6.10), which is in close proximity to an area paved with small basalt cobbles.



Figure 6.10 Interior view of Lemenkau Feature 18 sakau stone adjacent to the northwest wall (Photograph taken from the south).

6.1.1.4 Lukepenkarian

Feature 2 is the only mortuary structure, in this case a *lolong* (Type A2a), identified on Lukepenkarian, which extends from Karian to Sapwuhtik B. The *lolong* is comprised of a coral rubble enclosing wall with some supporting basalt construction, a burial platform that is partly built of coral with basalt facing and foundations, and a secondary enclosure attached to the northeast side of the wall enclosing the burial platform (Figures 6.11 and 6.12). The average length of the columnar basalt used in the structure is 1 meter. The burial platform is located in the center of its enclosure, and measures 3.6 by 6.5 meters. There are small stones bisecting the burial chamber. Shellfish remains are scattered across the burial chamber, and fragmentary human remains were identified in the southwestern side of the chamber. There is a step built of basalt columns and stones in the southwestern side of the enclosing wall, which likely functioned as the original entryway. A portion of this southwest wall has been demolished.

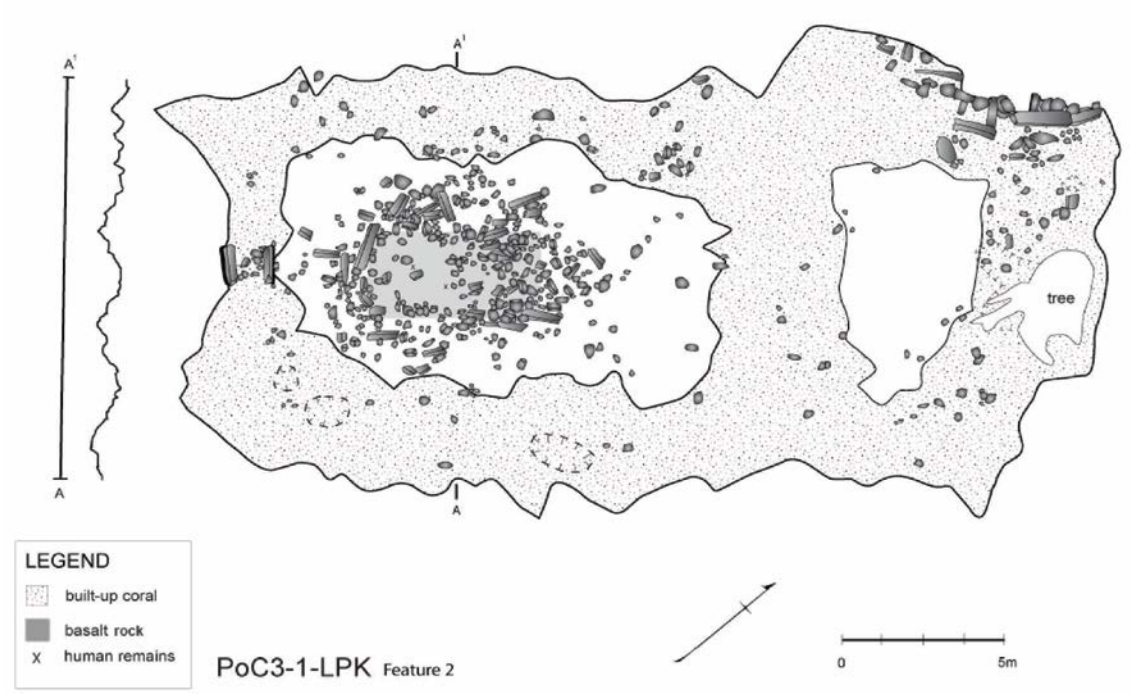


Figure 6.11 Plan map of Lukepenkarian Feature 2.



Figure 6.12 View of Lukepenkarian Feature 2 from the enclosing wall south of the burial platform.

The secondary enclosure wall is also built of coral rubble and contains a *sakau* stone; it is half the size of the primary enclosure. There is not an identifiable entry in this enclosure, possibly due to the tree growing through a section of the northeast enclosing wall. It is suggested that the secondary enclosure was in some way directly linked to mortuary ritual, possibly feasting. Shellfish remains are scattered throughout both enclosures. The overall measurement for both enclosures is 14.1 by 27.1 meters.

6.1.1.5 Nahndauwas

Nahndauwas can be classified as a mortuary complex in itself (Type C), since the islet wall encloses three *lolong*. Nahndauwas exemplifies header-stretcher construction, as all the major islet features are constructed in this style. Aside from the *lolong*, the islet houses *sakau* stones just outside the entryway of the islet enclosing wall, and a number of stone alignments, pavings, cysts, and walkways that are not directly associated with the *lolong*. The stone-lined paths on the islet are credited to the Japanese, who occupied Pohnpei from the 1910s into 1940s, but it is not clear when these paths were actually constructed. The primary entrance to the central area of the islet is in the western wall, though there are two small, covered entries, one in the northern wall and one in the southern. There are a few places where the interior side of the islet enclosing wall has collapsed.

The central *lolong* (Feature 1) is built on its own platform in the center of the islet enclosure (Type A2a) (Figure 6.13). The enclosure does not occupy the whole of the platform upon which it sits; the enclosure measures 22.2 by 29.2 meters. Feature 1's enclosing wall has an interior support wall (or shelf wall), which mirrors the construction of the islet enclosing wall. The entryway is located in the western wall and is in alignment with the entry in the islet enclosing wall. There is a small covered entry in the southern enclosing wall, which leads to Feature 4. The burial platform is located just east of the center of the *lolong* enclosure, and is built in the header-stretcher style with columnar stone covering the top of the burial chamber. The burial platform itself measures 6.9 by 7.3 meters, though it is encompassed by low,

stepped stone platform-like features. The stones utilized in Feature 1 range in length between 1 and 6 meters. No artifactual remains are present in the burial chamber due to extensive excavations between 1860 and the 1980s. There is a paved area with a stone alignment in the northwest corner of the enclosure, and a *sakau* stone is located just inside the entryway.



Figure 6.13 The central *lolong* on Nahndauwas (Feature 1) from the West (Photo by A. Craib).

Two smaller *lolong* flank the central *lolong*, one to the north (Feature 5-Type A2a) and the other to the south (Feature 4-Type A2b). The enclosing walls for these *lolong* extend from the interior of the islet enclosing wall to the platform upon which Feature 1 sits. Features 4 and 5 are constructed in the header-stretcher style.

The enclosure of Feature 4 measures 12.5 by 13.6 meters, though the southern portion of the enclosure has been partly covered by a collapse in the southern islet enclosing wall. The covered entry in the southern islet enclosing wall would have come into the western side of the Feature 4 enclosure, if it had not been covered by the wall collapse. The *lolong* entryway, if it existed, may have also been obscured by the islet wall collapse. The burial platform is located in the northeast corner of the enclosure, attached to the northern wall/central islet platform. It measures 5.1 by 6.1 meters and the burial chamber is partly

covered by columnar basalt stones. Some of the chamber's covering stones were likely moved during excavations in the 19th and 20th centuries. The floor of the burial chamber has been disturbed and there are no visible artifactual remains. There are two stone alignments to the west of the burial platform. The average length of columnar stones is 1.3 meters and the range is 0.7 and 2.3 meters.



Figure 6.14 View across the top of the northern lolong platform on Nahndauwas (Feature 5) from the West.

The enclosure of Feature 5 is larger than that of Feature 4, measuring 10.9 by 31.1 meters. There is an entryway located in the western wall of the enclosure, which is aligned with the eastern side of the covered entryway in the northern islet enclosing wall. The burial platform is located in the center of the enclosure and measures 6.3 by 7.6 meters (Figure 6.14). Like Features 1 and 4, the burial chamber of Feature 5 is also partly covered by columnar basalt stones and has been disturbed by excavations. There is a short

platform/paving around the base of the burial platform. The stones used in the structure average at 1.8 meters in length with a range of 1.1 to 2.8 meters.

6.1.1.6 Pahndauwas

Platform Features 4 and 9 on Pahndauwas are burial platforms (Figure 6.15). Feature 4 (Type A1) is built in the header-stretcher style with basalt and coral rubble fill. The platform measures 4.4 by 4.6 meters, and the burial chamber is partly covered with basalt cobbles. The average length of columnar basalt stones used in Feature 4 is 0.8 meters. Feature 4 is flanked by two lower lying platforms (or pavings) to the east and west, and is built in the center of a square columnar stone alignment.

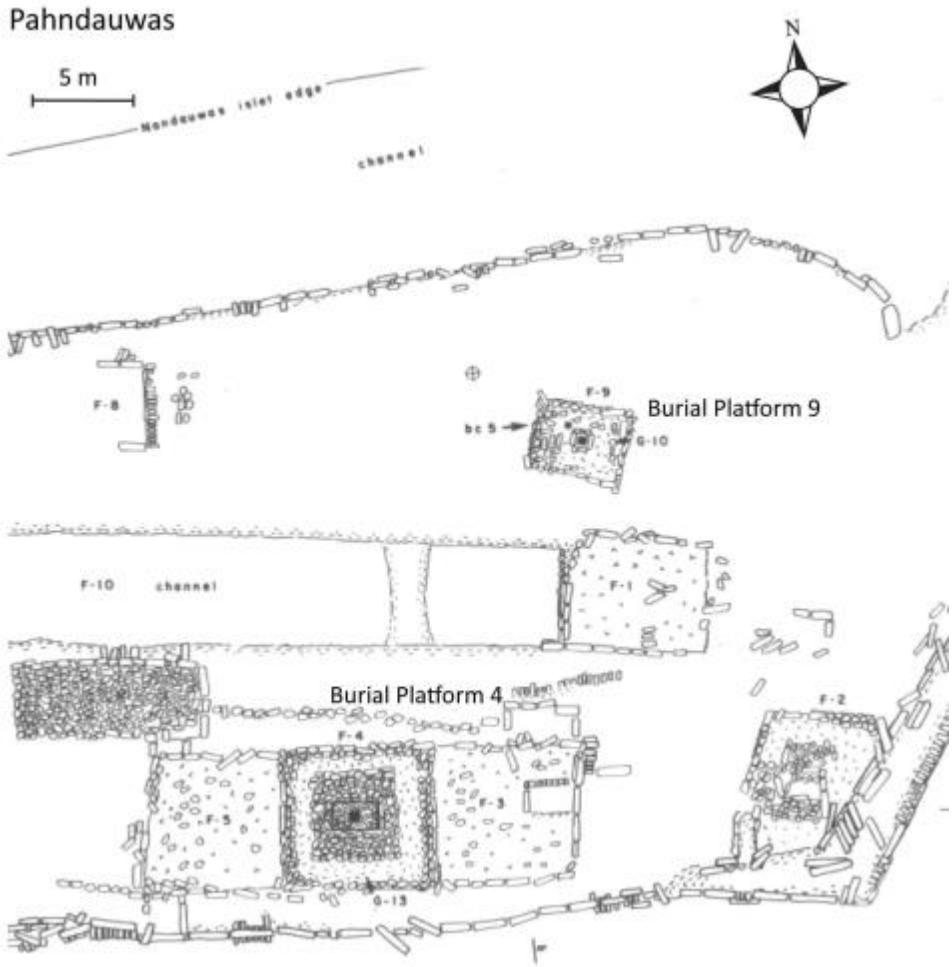


Figure 6.15 Detail of Pahndauwas from Athens (n.d.) with burial platforms labelled.

The Feature 9 burial platform (Type A1) is constructed of basalt cobbles, incorporating some columnar basalt around the edges of the burial chamber and the platform edges. It is located to the northeast of Feature 4 and measures 3.7 by 4.9 meters. The burial chamber is not covered. The columnar stone used in the platform ranges between 0.6 and 1.2 meters in length.

6.1.1.7 Pahndipap

The *lolong* on Pahndipap is located near the center of the islet (Type A2a) (Figure 6.16). The enclosing wall and the burial platform are built of relatively small basalt columns (0.5-1.2 meters long) and basalt cobbles, partly in the header-stretcher style of construction. The entryway is located in the southwest wall of the enclosure. This *lolong* is rather small for Nan Madol as the enclosure measures 11.6 by 11.6 meters, and the burial platform measures 3 by 4.5 meters. It has been suggested that this structure is one of the oldest *lolong* at Nan Madol due to its size and the apparent removal of stone from the edge of the islet for use elsewhere (Ayres pers. comm.).

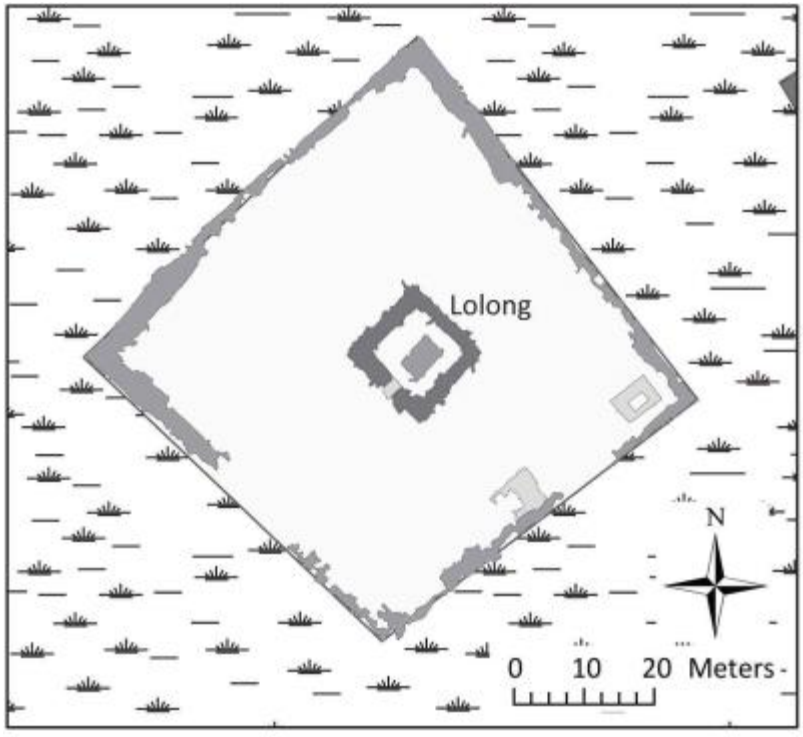


Figure 6.16 Map of Pahndipap with *lolong* in the center of the islet (From Athens n.d.).

6.1.1.8 Pahnwi

Pahnwi hosts a number of structures, including three architectural features used for burial. They are two *lolong* and a house platform that was used secondarily as a burial platform (Figure 6.17). Other architectural features include house platforms, pavings, foundations, enclosures, stone alignments, walls, and the islet walls.

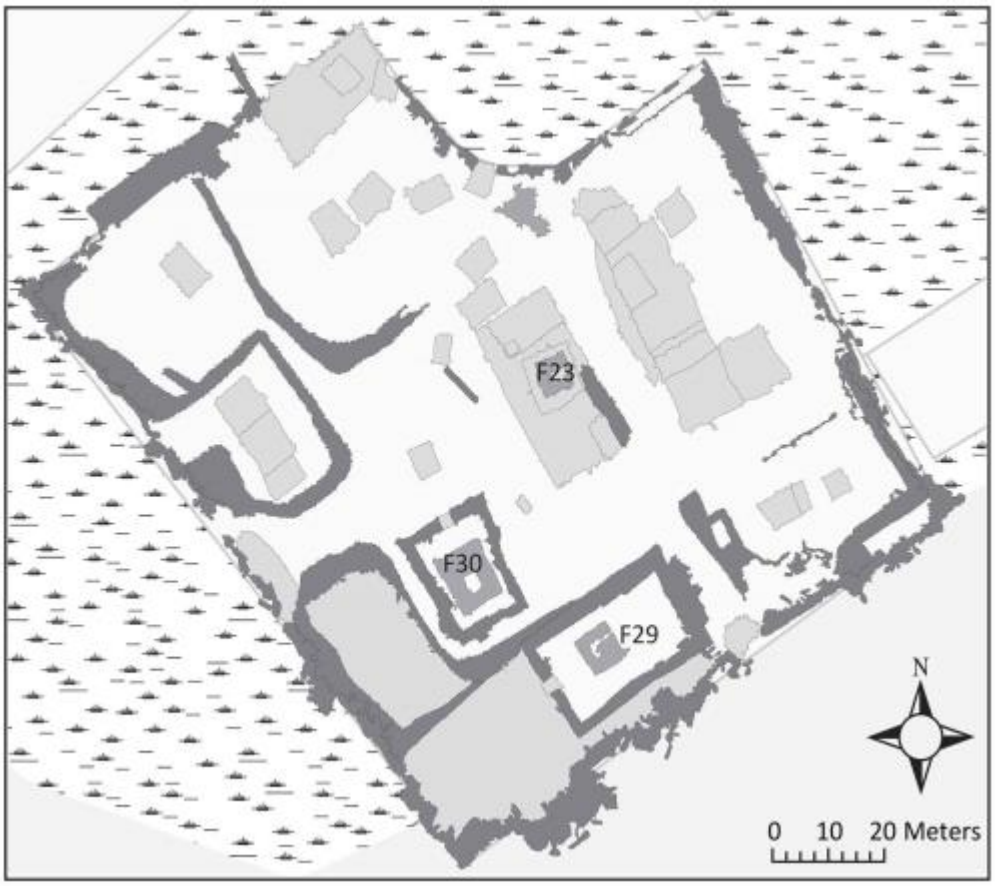


Figure 6.17 Plan of Pahnwi. Feature 23 is the house platform which was used for burial and Features 29 and 30 are *lolong* (Original courtesy of W.S. Ayres).

Feature 23 is a house platform that was later used as a burial platform (*mwohnihm*). It is constructed primarily of coral rubble and basalt cobbles with small basalt columns (0.6 meters in length) used for facing and supports. Feature 23 is built atop a large platform and a paving. The platform measures 5.1 by 5.3 meters, which is consistent with other burial platforms. The burial was located by Ayres in the 1980s during the excavation of the platform's hearth.

Feature 30 is a *lolong* constructed entirely in the header-stretcher style with coral and basalt rubble fill (Type A2a). This structure is located south of Feature 23. There is an entryway in the northwest side of the enclosing wall, and the enclosure measures 13.6 by 17.8 meters. Columns have fallen from the top of the enclosing wall into the enclosure. The burial platform is located just southeast of the center of the enclosure and measures 6.9 by 8.6 meters. There is a stone alignment or step on the northwest side of the burial platform, which occupies the majority of the enclosure. Columnar stone used in the construction of Feature 30 ranges in length between 0.7 and 2.3 meters, and averages at approximately 1.2 and 1.5 meters. There is a small depression between the stone alignment and the northwest enclosing wall, which may have been from previous excavations by Governor Berg or others in the early 20th century. A small *sakau* stone is located between the burial platform and the entryway.

The Feature 29 *lolong* (Type A2a) is located southeast of Feature 30. The enclosing wall is primarily constructed of coral rubble with columnar basalt facing and supports. The enclosure measures 16.1 by 25.7 meters. There is an entryway located in the southwest wall. An area in the southern portion of the southeast wall is somewhat deflated, likely due to weathering during storms, and some of the columns have collapsed out of the northeast wall. The burial platform is located slightly southwest of the center of the enclosure, and is constructed of columnar basalt and basalt cobbles. The burial chamber was entirely covered by basalt columns at some point. It measures 5.5 by 6 meters. The basalt columns used in Feature 29 average around 1 meter in length, though the longest columns are approximately 1.6 meters long.

There are few artifacts associated with the *lolong* on Pahnwi due to extensive excavations undertaken during the German period (Hambruch 1936a; Sarfert 1911/12). Artifacts recovered from some of these structures by Ayres and colleagues are reviewed in Chapter 5.

6.1.1.9 Peinering

Of the three platforms present on Peinering, only Feature 2 has been identified as a burial platform (Type A1). This structure is primarily constructed of basalt cobbles with some coral rubble, though there are some small basalt columns present. The columnar stones are approximately 0.7 meters in length. The burial platform is located in the center of the islet and measures 5.7 by 6.6 meters (Figure 6.18). The burial chamber was not covered (Figure 6.19).

For the purpose of this study Feature 2 is considered on its own, though the entire islet could be considered a *lolong* enclosure due to the large header-stretcher wall that encloses the islet. There is an entryway constructed in the middle of the northwest portion of this enclosing wall.

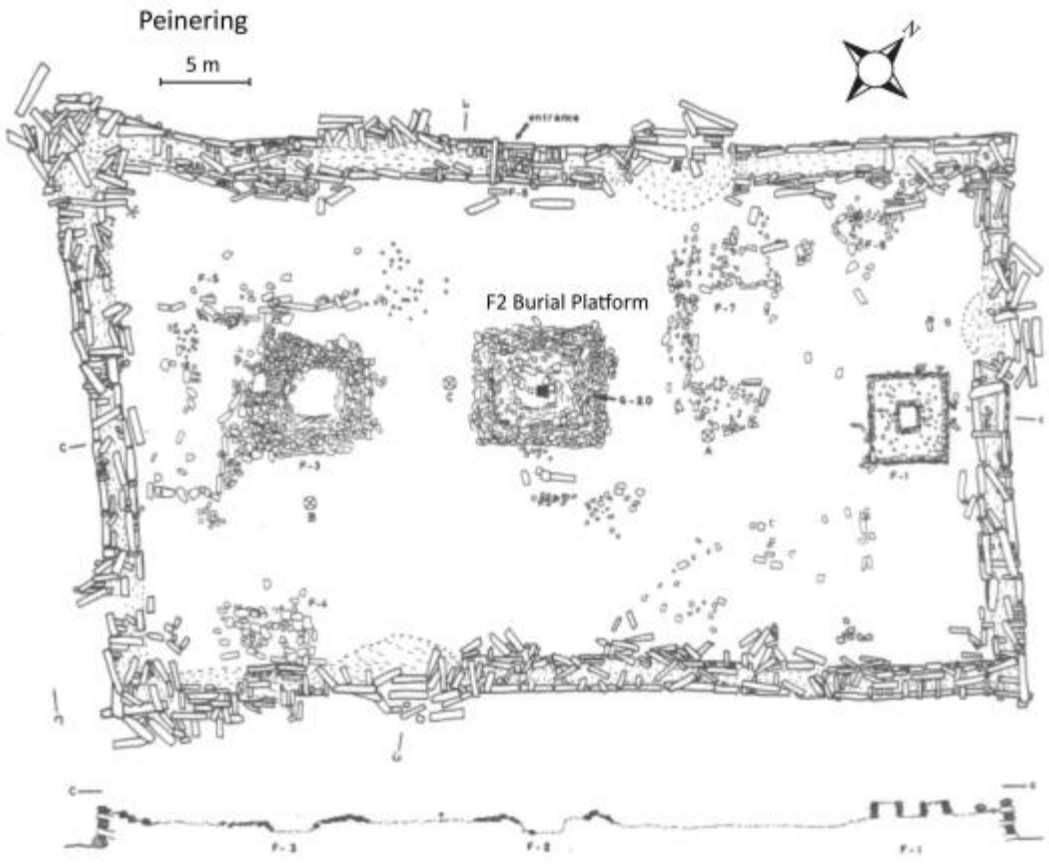


Figure 6.18 Peinering Islet with the burial platform labelled (From Athens n.d.).



Figure 6.19 View across Peinering Feature 2 from the northern corner of the platform. The scale bar marks the edge of the burial chamber.

6.1.1.10 Peinioar

Feature 1 on Peinioar is a low-lying burial platform (Type A1) (Figure 6.20). It is comprised entirely of basalt cobbles and a few small columnar stones. The platform measures 6.1 by 7.2 meters. There is a large *sakau* stone and a scatter of fire-cracked basalt stones, which may have functioned as a hearth or *uhmw*, southwest of the platform.

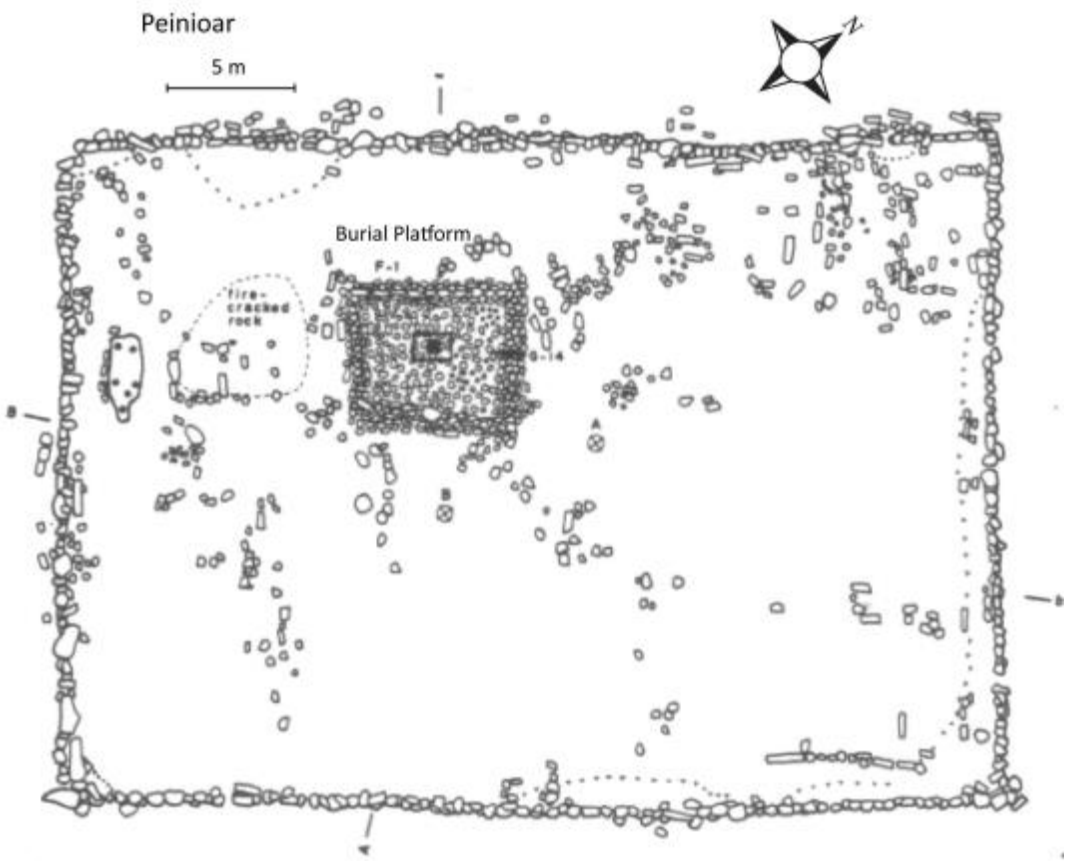


Figure 6.20 Peinioar Islet with the burial platform labelled (From Athens n.d.).

6.1.1.11 Pein Kitel

Like Nahndauwas, Pein Kitel contains three *lolong* surrounded by an islet enclosing wall (Type C), but they are not spatially organized like those at Nahndauwas (see Section 6.2 for a map). These *lolong* (Features 1, 2 and 3) are built entirely in the header-stretcher style.

Feature 1 (Type A2a) is said to be the burial place of Isohkelekel, the individual who overthrew the Saudeleur Dynasty (see Hambruch 1936a), and is larger and more complex than the other *lolong* on the islet. The northwest wall of the *lolong* is built into the islet enclosing wall, and there are supporting wall buttresses built along the interior of the northwest and southwest enclosing walls. The entryway is located in the southwest wall. The enclosure measures 23.2 by 30.5 meters. The burial platform is located just to the northeast of the center of the enclosure, and measures 5.9 by 5.9 meters. The burial chamber is partly covered by columnar basalt stones, but has been disturbed by excavations in the early 20th century (Sarfert 1911/12). There are a number of stone alignments and paved steps surrounding the

burial platform, and a *sakau* stone just inside the entryway to the enclosure. The columnar basalt used in Feature 1 ranges in size between 0.9 and 5 meters long.

Feature 3 is a *lolong* (Type A2a) located southwest of Feature 1. The entryway for Feature 3 is located in the southwest wall and the enclosure measures 10.5 by 14.5 meters. The burial platform measures 5.0 by 6.2 meters and is located in northeast side of the enclosure. There is a stone alignment across the enclosure just to the southwest of the burial platform. Columnar stone used to construct Feature 3 is an average length of 1.6 meters, but stone length ranges from 0.8 to 2.8 meters long.

The Feature 2 *lolong* (Type A2b) is located to the southeast of Feature 3, and is built up against the southeast islet enclosing wall. There is no distinct entryway in the enclosing wall of Feature 2 because of damage to the structure. The enclosure measures 13 and 15.1 meters. The burial platform is located just northwest of the center of the enclosure, and measures 4.2 by 7.2 meters. There is a columnar stone alignment to the northwest of the burial platform that extends to the northeast enclosing wall. The average length of columnar stones used in Feature 3 is 1.6 meters.

6.2.1.12 Sapwenpwe

There are two burial platforms located on Sapwenpwe (Features 2 and 8). Both are constructed of basalt cobbles with basalt columns lining the burial chambers. Feature 2 is located near the middle of the northern half of the islet, while Feature 8 is located near the western side of the southern part of the islet. Feature 2 measures 4.5 by 5.3 meters and the length of the columnar basalt lining the burial chamber is 0.5 meters. There is a *sakau* stone near its southwest corner. Feature 8 is more squared on all sides and measures 4.2 by 5.6 meters. The columnar stone used in Feature 8 is 0.7 meters in length. There is a semi-circular paving of small basalt stones to the north of Feature 8.

6.2.1.13 Sapwohng

Feature 1 is a burial platform (Type A1) located at the center of Sapwohng islet (Figure 6.21). The platform is constructed of basalt cobbles and incorporates a couple of small basalt columns. This structure measures 3.9 by 5 meters. The burial chamber is located in the southeast side of the platform and is lined by small basalt columns approximately 0.8 meters long. There is a scattered paving of small basalt stones surrounding the burial platform.

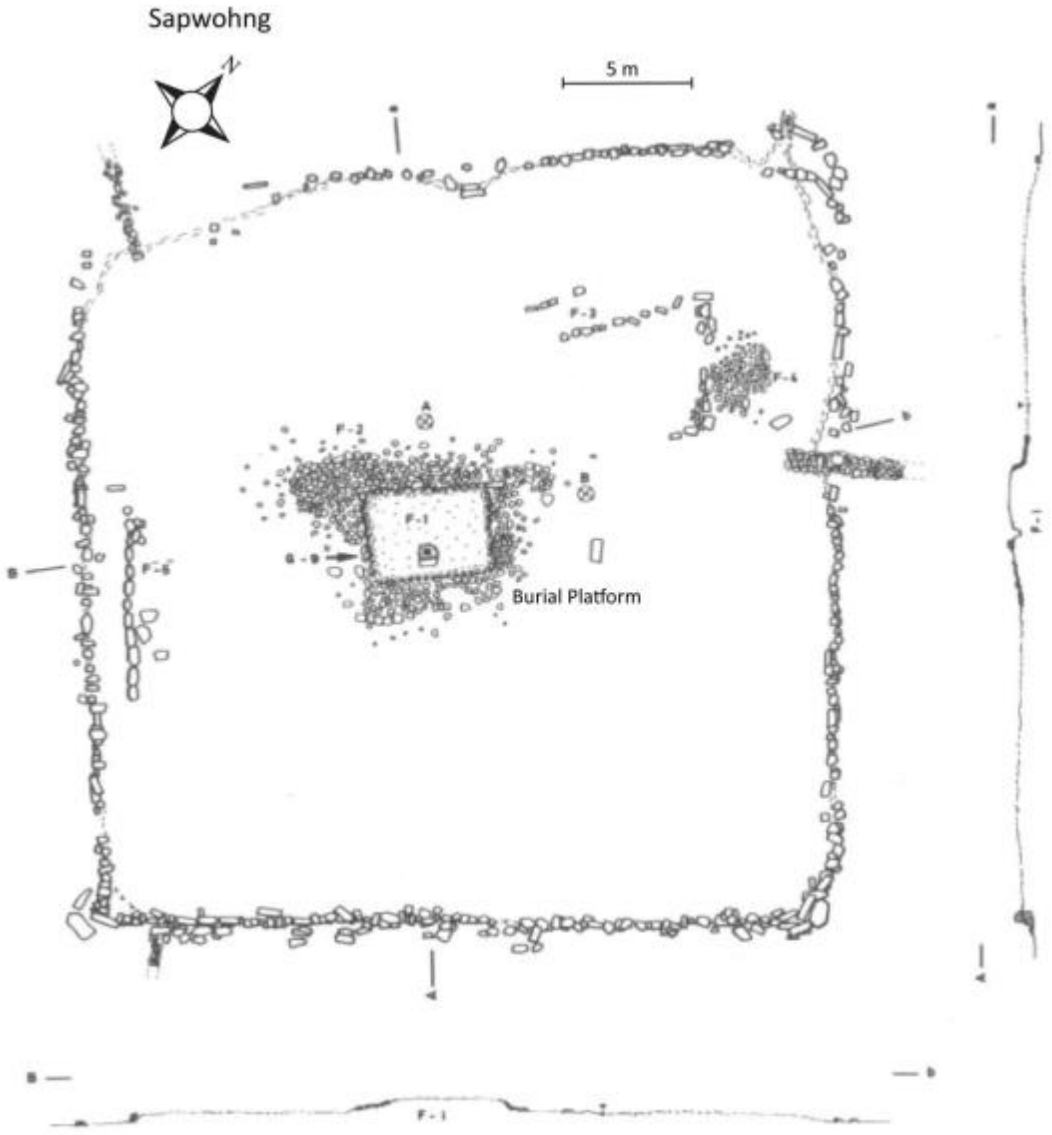


Figure 6.21 Map of Sapwohng with cross-sections (From Athens n.d.).

6.1.1.14 Sapwuhdir

Feature 2 on Sapwuhdir is a burial platform, and is located on the northeast side of the islet. The platform is primarily constructed of basalt cobbles with the incorporation of a few small columnar basalt stones approximately 0.8 meters in length. Feature 2 measures 4.6 by 5.5 meters. There is a small stone alignment or step on the southeast side of the platform, and a paving of scattered basalt stones to the north and northwest of the burial platform (Figure 6.22).

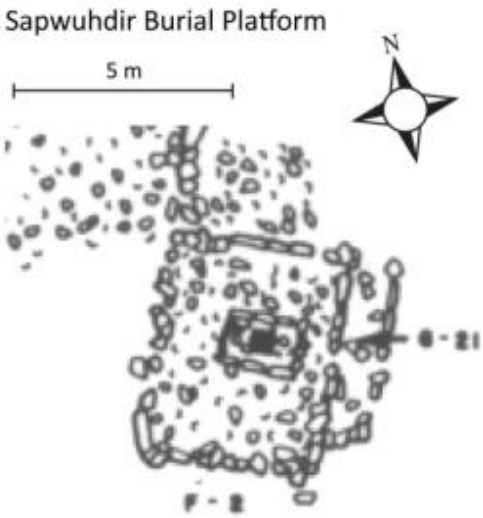


Figure 6.22 Sapwuhdir burial platform from Athens (n.d.) islet map.

6.1.1.15 Sapwuhtik B

The only architectural feature on Sapwuhtik B is a *lolong* (Type A2a) and its accompanying features. Like Feature 7 on Angeir, Sapwuhtik B has yet to be mapped in detail and therefore will only be included in the descriptive analysis of this study. The enclosing wall is built in the header-stretcher style, as is the burial platform. The columnar basalt used in the structure is approximately 0.6 to 4.5 meters in length. The primary entryway is located in the southwest wall, which is approximately 15 meters from Angeir Features 1 and 2. There is another entryway located in the northwest wall near the western corner of the enclosure, and there is another gap in the northwest wall closer to the northern corner of the enclosure. The enclosing wall has partly collapsed in a couple of places along the northeast and northwest

walls. A large tree has disturbed a section of the islet surface on the northeast side of the enclosure. The burial platform is located near the center of the enclosure and a large, flat basalt slab lines the bottom of the burial chamber (Figure 6.23). No human or artifactual remains are present within the burial chamber, though they were present in past surveys of the site (Ayres pers. comm.). Basalt stone alignments extend from the burial platform to the northwest and southwest, and there has been significant disturbance to the islet surface to the south of the platform possibly due to coral degradation or vegetation growth.



Figure 6.23 View of Sapwuhtik B burial platform from the North.

There are two ancillary features of note. The first is a high platform feature built into the interior side of the northwest wall, between the entryway and the collapsed section of the wall Figure 6.24). This platform is constructed of basalt boulders and cobbles, and coral rubble infill. Its height is level with the top of the enclosing wall, and its purpose has yet to be determined. Approximately a meter south of this platform is a concentration of palm-sized water-worn basalt cobbles, which may have been used as sling stones or *sakau* pounding stones.



Figure 6.24 View of the interior of the Sapwuhtik B northwest wall from the East. The in-built platform feature can be seen behind the scale bar.

6.1.2 PoC3-5

PoC3-5 is a *lolong* (Type A2a) located on Temwen Island (Figure 6.25). The enclosing wall is constructed of large basalt boulders with some columnar basalt facing. There is no entryway built into the enclosing wall. There is a support structure built around the foundation of the enclosing wall to buttress the structure, though it turns into a scattered stone alignment or paving along portions of the southern and western sides of the structure. The enclosing wall, excluding the external foundation support (buttresses), measures approximately 19.7 by 26.2 meters. The burial platform is located slightly north of the center of the enclosure, and is constructed in the header-stretcher style with a basalt rubble fill (Figure 6.26). The burial chamber is covered with small basalt stones and some columns. A portion of the eastern side of the burial platform is deflated. The platform measures 4.3 by 4.7 meters. The average length of the columnar stone used in PoC3-5 is 1 meter, though stone lengths range between 0.6 and 1.9 meters. PoC3-5 is constructed on a hill-slope of



Figure 6.25 View of PoC3-5 from the North with the burial platform in the background.



Figure 6.26 View of PoC3-5 burial platform from the southwest with the enclosing wall in the background.

approximately two degrees and sediment was brought in during construction to level off the interior of the enclosure.

There are a few ancillary features associated with PoC3-5. There is a stone alignment just under a meter from the north side of the burial platform that runs the length of the platform. There are small-to-medium sized basalt stones scattered throughout the enclosure with larger concentrations in the northeast and northwest corners. There are two stone alignments that are associated with historic yam planting in the northern half of the enclosure, which are presumed to be associated with modern horticultural use of the enclosure.

A one by two meter excavation one meter deep was located mid-way along the interior of the eastern side of the enclosing wall of PoC3-5. The purpose was to recover charcoal samples for dating and to gain a better understanding of the interior wall foundations. Excavation was necessary to uncover the wall foundations because the structure is located on a hill-slope of approximately two degrees, and the eastern wall is partly buried by sediment that was brought in to create a level surface within the enclosure. There was little fill added to the western side of the enclosure, but the fill depth on the eastern side was approximately 1.5 m based on measurements from the cross-section of the structure. The lack of layering in the excavation profile (Figure 6.27) below the upper 20-30 cm of humic soil suggests that the sediment brought in to level the enclosure was moved in a relatively short amount of time. The excavation confirmed that the buttressing present along the base of the exterior of the eastern enclosing wall was also present on the interior.

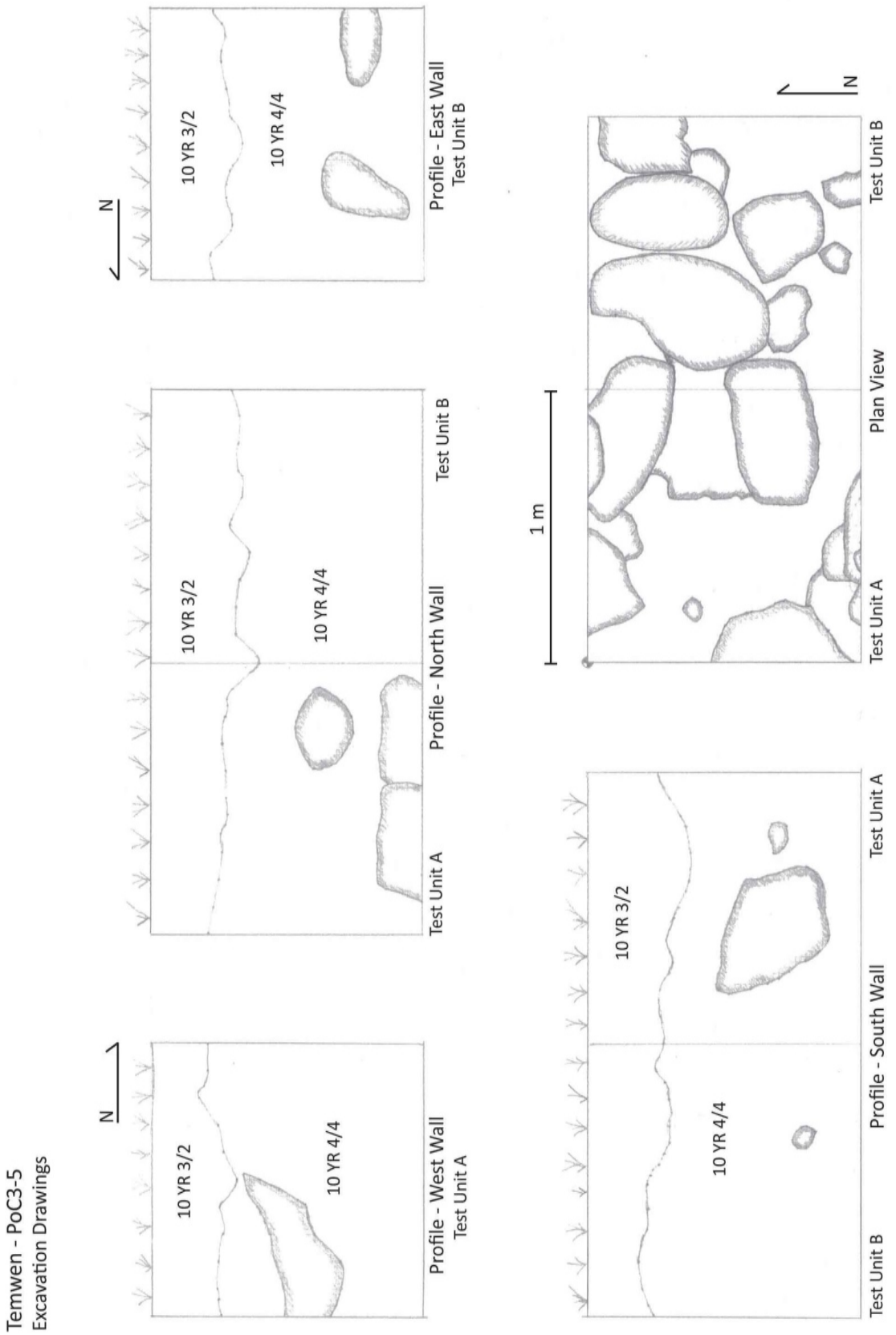


Figure 6.27 PoC3-5 excavation drawings.

No artifacts were recovered, but 76 charcoal samples were collected from the PoC3-5 excavations. Four of the recovered charcoal samples (all dicotyledonous wood derived with 1 branch fragment) were sent to the ANU Radiocarbon Dating Laboratory for AMS dating (see Table 6.1). The construction date for PoC3-5 is based on two samples dating between AD 1220 and 1385, which were obtained from depths of 30 and 82 cm. The other two dated samples, which were collected between the others at 46 and 63 cm, are older (AD 985-1155). This age inversion supports the proposition that fill was brought in, probably from the surrounding landscape, to level off the enclosure. The date from the 82 cm depth may be associated with the ground surface from where the fill was acquired, while the dated material from the Feature 1 concentration (27-33 cm) may be *in situ* since it was located just below the humic soil layer. The ground surface below the fill layer was never reached, which is why three of these dates were derived from fill soil. This interpretation of the available dates is considered accurate.

Site	Context	C 13 Value	Conventional Age	Calibrated Age	Lab Code
PoC3-5	F1, 21-33 cm	-23.5	695 +/- 25	AD 1266-1385	ANU 29906
PoC3-5	46 cm	-27.7	980 +/- 35	AD 993-1155	ANU 29910-8704
PoC3-5	63 cm	-23.1	995 +/- 30	AD 986-1154	ANU 29909
PoC3-5	63 cm**	-22.5	1025 +/- 30	AD 900-1147	ANU 29910-8705
PoC3-5	82 cm	-36.6	725 +/- 40	AD 1219-1385	ANU 29907
PoC3-8	33 cm	-32.1	405 +/- 30	AD 1433-1624	ANU 29904
PoC3-8	51 cm	-19.3	600 +/- 25	AD 1298-1407	ANU 29905

Note: Calibrated using InCal in OxCal online program.
** This sample was run as a duplicate for research purposes at the ANU Radiocarbaon Dating Centre.

Table 6.1 Table of radiocarbon dates from PoC3-5 and PoC3-8.

Twenty-two of the wood charcoal samples were identified using the comparative collections held at ANU. The identified charcoal samples were all derived from dicotyledonous woods. Nearly half of the samples examined are mangrove wood (e.g. *Rhizophora sp*., *Sonneratia sp*.) and cf. *Euphorbiaceae*, a family which includes some mangrove species. Most mangrove woods on Pohnpei are used for construction materials or timber, due to their resistance to termites and other pests (Balick 2009; Fischer and Fischer 1957). Some species in

the *Euphorbiaceae* family are used as fire-starters (Balick 2009). Other woods identified in the charcoal samples include *Casuarina sp*., cf. *Fabaceae*, cf. *Mytaceae* and *Calophyllum sp.*, which are primarily used for construction materials and sometimes for firewood (Balick 2009). The identifications of these types of woods and their recorded uses suggest that there were possibly two wooden structures, one younger than the other (see Table 6.1), that once stood atop the earth that was later moved to level off the PoC3-5 enclosure. These structures may have been razed or dismantled and used for firewood, since charcoal fragments were scattered throughout the excavation fill. Evidence of perishable structures in the area prior to *lolong* construction is of interest because it shows continual use and habitation of Temwen before and during the period of centralization at Nan Madol. Another possibility is that the fill was brought in from the coastal mangrove swamp based on the presence of mangrove wood charcoal.

6.2.3 PoC3-8

PoC3-8 is an unfinished *lolong* (Type A2b) located a short distance uphill from PoC3-5 (Figure 6.28). The enclosing wall lacks an entryway and is constructed of medium-to-large basalt boulders (Figure 6.29). Like PoC3-5, soil was brought in to level the enclosure surface as the *lolong* is constructed on a six degree slope. The enclosure measures 11.6 by 14.5 meters. The burial platform is located in the northeastern half of the enclosure and one corner is attached to the northwest enclosing wall. It is constructed from small-to-medium sized basalt stones, and measures 5.8 by 5.8 meters. The platform, which may only be the foundation for what was to become the burial platform, is not in alignment with the enclosing walls like all the other *lolong* described here.

There are three circular stone alignments within the *lolong* enclosure. These alignments are associated with yam planting, particularly during the historic period. The horticultural feature located in the southwest portion of the enclosure was in use during the mapping of PoC3-8.

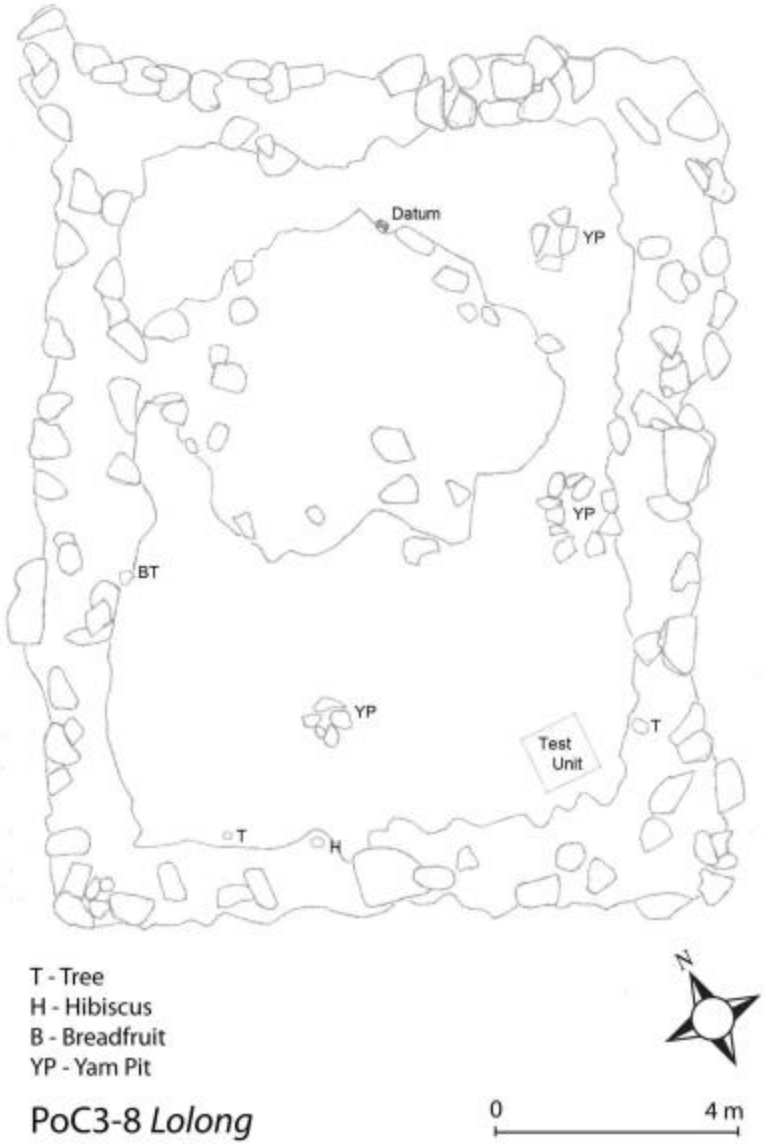


Figure 6.28 Plan map of PoC3-8 showing the location of the excavation square.

A one by one meter excavation was placed near the southern corner of the PoC3-8 enclosure. This excavation was located in an area where it was expected that there would be fewer impediments to finding the original ground surface on which the *lolong* was constructed. The excavation never reached the underlying ground surface as a large basalt boulder prevented excavation below 70 cm (Figure 6.30).



Figure 6.29 Photograph of PoC3-8 from the road to the northeast. The small tree in the center of the image marks the edge of the burial platform.

The only artifact recovered from PoC3-8 was a fragment of a Japanese anti-aircraft shell from the surface of the enclosure where the excavation unit was located. Six charcoal samples were collected from this excavation, and two of these were AMS dated to estimate the age of the structure (see Table 6.1). The sample from 51 cm depth indicates construction around AD 1300-1410, though, as with PoC3-5, based on the surrounding topography and the stratigraphy I suggest that the sample was probably transported with the sediment fill from a nearby location. The AD 1433-1624 date from 33 cm is considered to be a more accurate age estimate for the structure. This later date is also more probable because PoC3-8 has been identified as an unfinished *lolong*, which is based on discussions with local informants and because many of the architectural components were not completed. If the earlier date is accurate, it raises the question of why this project was abandoned when similar structures were actively being constructed elsewhere. There are no known traditions related to PoC3-8 to explain the unfinished status of this structure.

Temwen - PoC3-8
Excavation Drawings

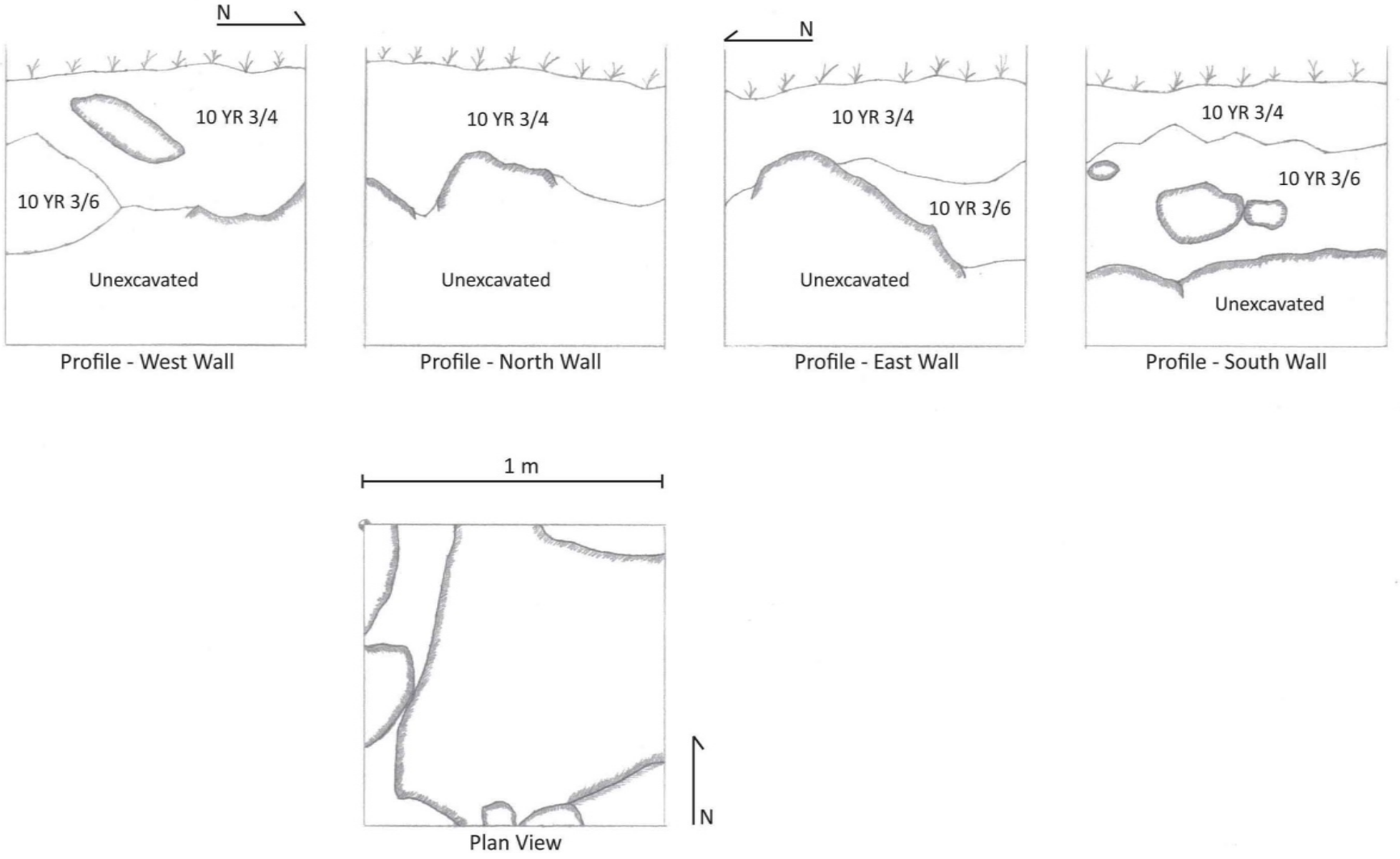


Figure 6.30 PoC3-8 excavation drawings.

Five of the six charcoal samples were identified to taxa. All of the identified woods from the PoC3-8 excavations were dicotyledonous hardwoods. *Sonneratia sp*. and *Casuarina sp*. are the most likely identifications for at least half of the charcoal samples examined. Both of these woods were commonly used as timber or building materials for houses and other structures (Balick 2009). *Garcinia sp*. is another possibility for two of the samples; often used for firewood (Balick 2009). As with PoC3-5 the charcoal identifications suggest the fill sediment was taken from an area where a perishable structure once stood.



Figure 6.31 Plan map of PoB7-10 (Courtesy of W.S. Ayres). Feature 1 is the burial platform and Feature 3 is the tomb chamber.

6.2.4 PoB7-10

PoB7-10 is a *lolong* (Type A2a) located in the Awak Valley in the Uh District (Figure 6.31). The *lolong* enclosing wall is primarily constructed of basalt boulders and cobbles with some incorporation of columnar basalt facing. The average length of the columnar stones utilized in PoB7-10 is 1.1 meters and the range is 0.7 and 1.6 meters. The enclosure measures 10.8 by 11.5 meters. The enclosing wall has been damaged in a few places along the northeast, southeast, and southwest walls. There is a scatter of basalt stones extending from the northwest wall down the hill-slope. The Japanese are credited with the dismantling of part of the structure (Ayres and Haun 1980).

The burial platform is constructed of small basalt cobbles and some columnar material, and is located in the northeast portion of the enclosure. The burial chamber is demarcated and partially covered by basalt columns. The platform measures 5.1 by 6 meters, and has partially collapsed on the southwest side. Portions of the enclosure around the burial platform are paved.

6.2.5 PoB7-39

PoB7-39 (Type A2a) is located approximately 200 meters northwest of PoB7-10. Much of the enclosing wall is constructed of basalt boulders with columnar facing, though some sections are built in the header-stretcher style (Figure 6.32). Some of the columns used as facing have fallen off the enclosing wall. The length of the columns used in PoB7-39 ranges from 0.7 to 1.5 meters, with the largest stones being used in the enclosing wall. The entryway is located in the center of the northwest enclosing wall. There may have been an entryway in the southwest wall, but that area has been significantly disturbed by tree growth (Ayres et al. 1981). The enclosure measures 14.9 by 20.1 meters. The burial platform is located just southeast of the center of the enclosure. It is constructed of basalt cobbles and faced with columnar basalt, and the burial chamber is covered by columnar basalt stones and basalt rubble. The burial platform measures 5.3 by 5.8 meters.

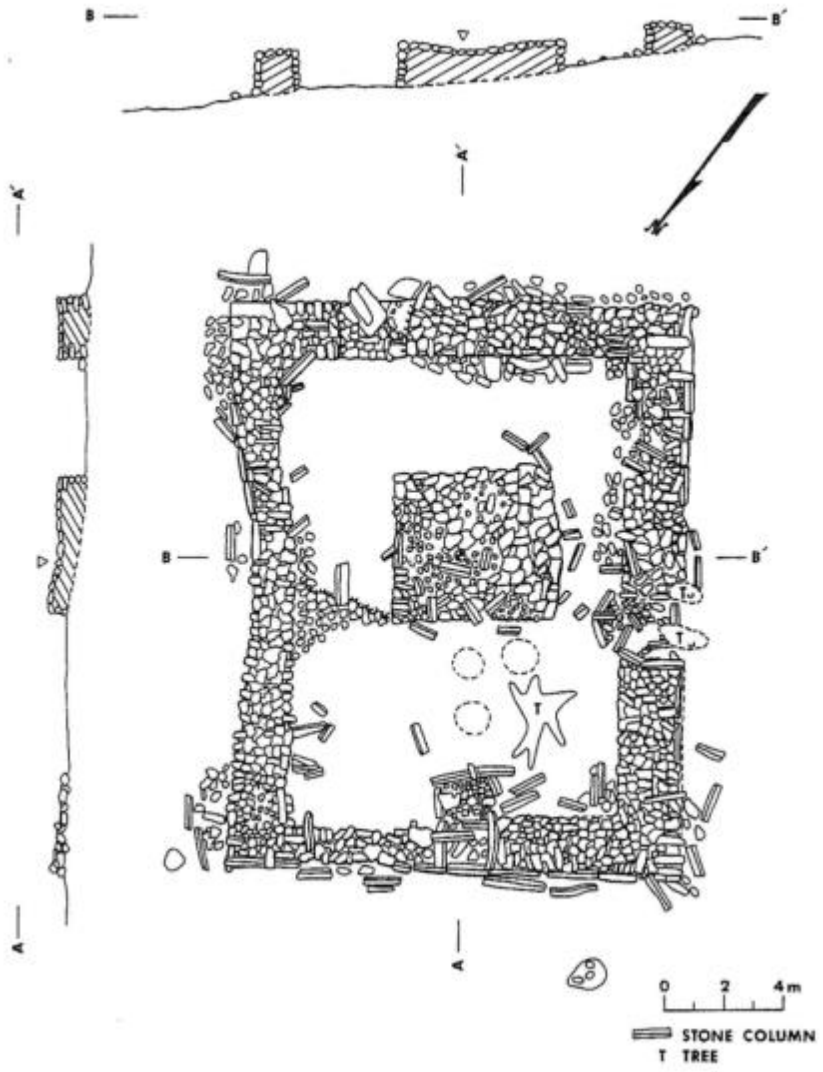


Figure 6.32 PoB7-39 *lolong* map (Courtesy of W.S. Ayres).

There are three small depressions located between the burial platform and the northwest side of the enclosing wall. A *sakau* stone is located just outside of the enclosure to the northwest.

6.2.6 PoB7-44

The PoB7-44 *lolong* (Type A2a) is located approximately 35 meters northwest of PoB7-39. The enclosing wall is comprised primarily of basalt boulders and cobbles and incorporates some columnar basalt facing. The southeast wall has been significantly damaged due to the removal of some of the stonework, as has the southernmost portions of the southwest and northeast walls. There is no apparent entryway, possibly due to this disturbance. The

enclosure measures 21.2 by 23.6 meters. The burial platform is located in the southern half of the enclosure, and it is not in alignment with the enclosing walls. It is constructed from columnar basalt and boulders with basalt cobble fill. The platform is mostly intact and the burial chamber is covered by basalt columns and cobbles. The burial platform measures 5.3 by 6 meters. The columnar basalt used in the construction of PoB7-44 averages 1.5 meters in length.

There are stone walkways attached to the northwest and southwest enclosing walls. They were most likely built later than the *lolong* itself based on architectural construction markers (Ayres pers. comm.). The walkway crossing the southwest wall nearly extends to the edge of the burial platform. The purpose of these alignments is not known.

The burial platform from PoB7-44 was opened and excavated during the Awak survey in 1978 by Ayres and colleagues (Ayres et al. 1981). The burial platform had been disturbed, and some bone fragments and portions of a burial crypt were exposed prior to excavation. Local tradition states that this *lolong* had been used as a residential site as well as a burial site, so excavations were conducted in hopes of finding evidence for both uses (Ayres et al. 1981:53). The burial platform contains two crypts; the exposed crypt was 2.7 by 0.6 m and the second was 1 by 0.6 m in size (Ayres et al. 1981).

Six concentrations of bone fragments, some of which were separated by stone alignments, were identified within the two crypts (see Figure 6.33). The partitioning of the crypts and the demarcation of the bone concentrations are indicative of reuse of PoB7-44 over time (Ayres and Seikel 2014). The reuse of the crypts and the associated shifting of the remains within the structure disturbed and potentially damaged the platform contents. The breakage may have also been a consequence of the purposeful destruction of remains by enemies, which has been noted in oral tradition (Ayres and Seikel 2014; Ayres et al. 1981). The analysis of the remains identified at least seven, possibly eight, individuals buried within the platform (Ayres and Seikel 2014; Ayres et al. 1981). The human remains were not

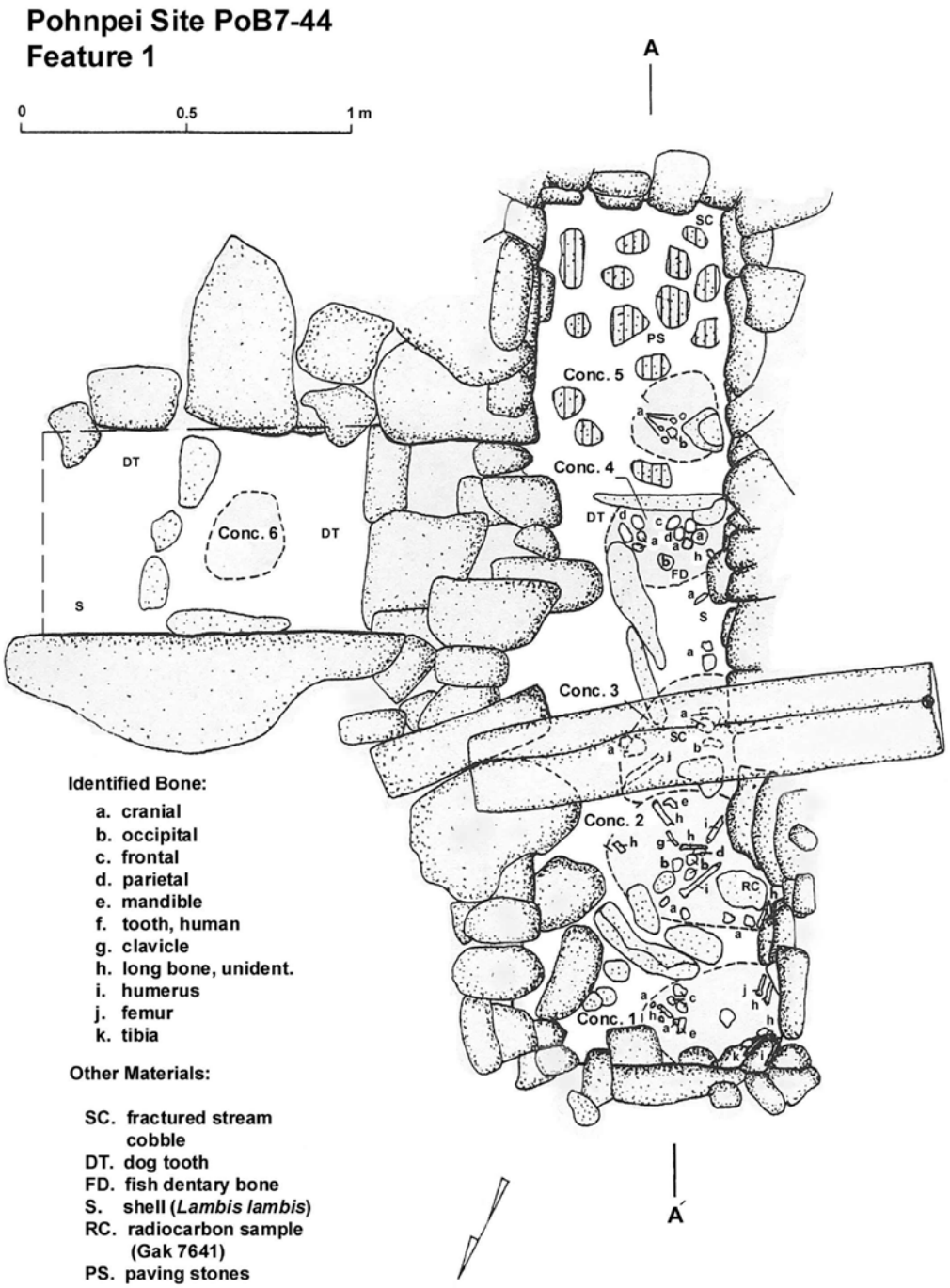


Figure 6.33 Diagram of PoB7-44 burial chambers (Courtesy of W.S. Ayres).

characterized demographically (e.g. age, sex) and were reinterred in their original groupings within the burial platform at the request of the landowner (Ayres et al. 1981:60).

A small number of artifacts were uncovered during the excavations. Ayres *et al.* (1981:58-60) suggest that there may have been other perishable items that have not survived.

The cultural materials recovered during excavations include three dog teeth, one fish dentary, six *Lambis sp.* shell fragments, two stream pebbles, and a single coral fragment (Ayres et al. 1981:59). Not much can be firmly stated regarding this small collection of items, but coral and dog teeth have ritual associations (Ayres pers. comm.). The remains do not confirm or negate the suggestion that the structure may have been used as a residential site.

A single date was obtained from this excavation from bone collagen derived from small human bone fragments located five to 10 cm below the level where the bone clusters were identified (Ayres et al. 1981). The date places the use of PoB7-44 around AD 1178-1445 (650 +/- 100 BP uncal., Gak 7641).

6.2.7 PoD24-17

PoD24-17 is a burial platform (Type A1) located in the Salapwuk section of Kiti. Locally, this platform is referred to as the Nankiahk tomb. It is mostly constructed from basalt boulders and cobbles, though a single columnar stone 0.9 meters long was used to demarcate the open burial chamber. The western side of the platform has been damaged. The platform measures 6.4 by 7.2 meters. There is a *sakau* stone incorporated in the southwest corner of the platform.

6.2.8 PoD24-37

This *lolong* (Type A2c) is located northeast of PoD24-17 on the opposite side of the Salapwuk survey area. The enclosing wall is constructed of basalt boulders, and the enclosure is paved with smaller stones (Figure 6.34). The enclosure measures 8 by 10 meters. The burial platform is located just to the northeast of the center of the enclosure. It is constructed of medium-to-large basalt boulders. There are two burial chambers present in the platform, but their similar size and placement possibly suggests two building phases. Both burial chambers are partly covered by stones; three small basalt columns have fallen into one chamber, over which they were used as covered stones. The burial platform measures 3.3 by 3.4 meters.

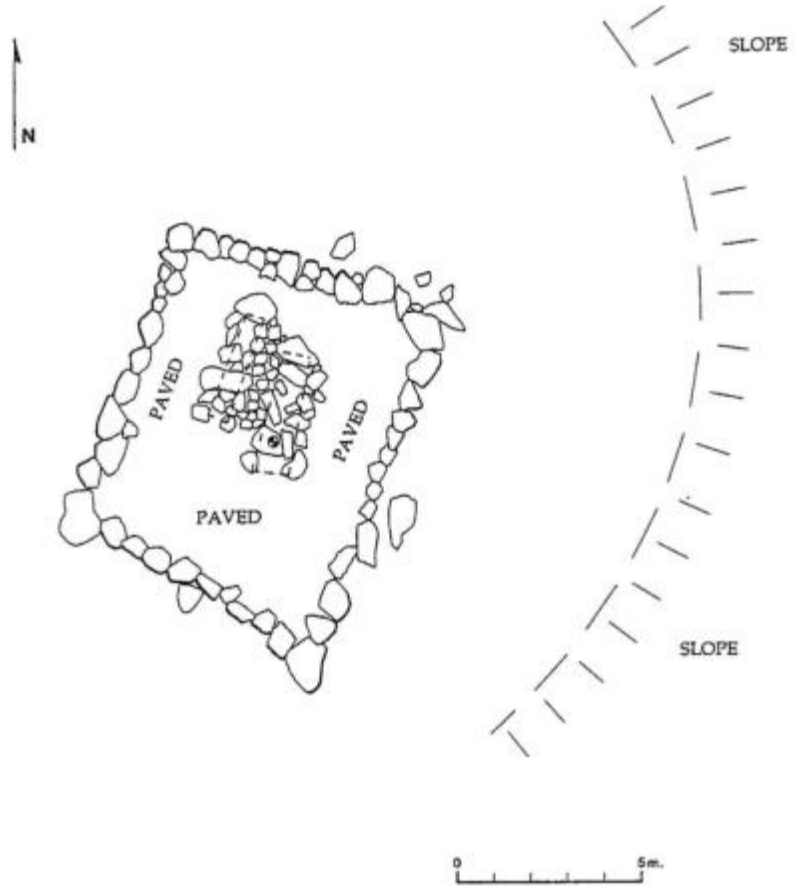


Figure 6.34 PoD24-37 *lolong* plan (Courtesy of W.S. Ayres).

6.2 Architectural Summary

From site descriptions alone it is clear that there is a significant amount of variability amongst burial platforms and *lolong*. Certain patterns are more obvious than others, such as the fact that most burial platforms are not attached to their respective enclosing walls, and few are located in the exact center of the enclosure.

This section focuses on 11 isolated burial platforms and 22 *lolong* to identify patterning in the qualitative variables (e.g. construction style) of these architectural features (see Table 6.2). Twenty-six of these structures are located within the Nan Madol site complex, two are from neighboring Temwen Island, three are from Awak, and two are from Salapwuk.

Of the 11 isolated burial platforms, all but PoD24-17 are located at Nan Madol. The most common construction type amongst these burial platforms (7 of 11, 64 %) is basalt cobble or boulder construction with some use of columnar basalt, as wall facing. The burial

Site	Structure	Construction Style	Architectural Layout	Entry	Ancillary Features	Other	Rank
PoB7-10	Iolong	Enclosing Wall - B and CB	Center of Enclosure	?			17
		Platform - B and some CB					
PoB7-39	Iolong	Enclosing Wall - B and CB	Center of Enclosure	NW	Sakau stones		15
		Platform - B and CB					
PoB7-44	Iolong	Enclosing Wall - B and CB	Far off center	?	Multiple walkways		16
		Platform - B and CB					
PoC3-1	ANG 1 - Iolong	Enclosing Wall - HS, B, CR	Agnst 3 walls in N half of enclosure	SW?	CR platform with cyst	Prox with sakau stone	13
		Platform - B, CR					
PoC3-1	ANG 2 - platform	Platform - B, CR				Prox with sakau stone	31
PoC3-1	ANG 7 - Iolong	Enclosing Wall - CR	Center of Enclosure	SW?	2 cysts of columnar basalt	Pavings to NE	21
		Platform - B, CR					
PoC3-1	Karian - Iolong	Enclosing Wall - HS	Center of enclosure and 2nd btwn 1st and enclsoing wall	SW?	3 pavings, platform, and lintel	Sakau stones outside entry	3
		Cen Platform - HS and B					
		S Platform - CR and CB					
PoC3-1	LMK 1 - Iolong	Enclosing Wall - HS	Near center of enclosure	?	Pavings, platforms and stone alignments	Prox with paving with sakau stones	5
		Platform - HS and B					
PoC3-1	LMK 18 - Iolong	Enclosing Wall - HS	Center of Enclosure	?	Paving and 2 sakau stones	Prox with paving with sakau stones	6
		Platform - HS and B					
PoC3-1	LPK 2 - Iolong	Enclosing Wall - CR and B	Center of Enclosure	SW	Secondary enclosure and sakau		19
		Platform - CB, B, CR					

Table 6.2a Qualitative data and ranking for each structure discussed in Chapter 6.

Site	Structure	Construction Style	Architectural Layout	Entry	Ancillary Features	Other	Rank
PoC3-1	NDA 1 - Iolong	Enclosing Wall - HS	Center of Enclosure	W	2nd entry, paving, steps, sakau stone & alignment	In Iolong complex	1
		Platform - HS					
PoC3-1	NDA 4 - Iolong	Enclosing Wall - HS	Attached to N wall	n/a	Stone alignment	In Iolong complex	11
		Platform - HS					
PoC3-1	NDA 5 - Iolong	Enclosing Wall - HS	Center of Enclosure	W	Step feature	In Iolong complex	10
		Platform - HS					
PoC3-1	PDA 4 - platform	Platform - HS, B, CR			Flanked by pavings		23
PoC3-1	PDA 9 - platform	Platform - B and CB					28
PoC3-1	PDI - Iolong	Enclosing Wall - CB and B	Center of Enclosure	SW			12
		Platform - CB and B					
PoC3-1	Pahnwi 23	House Plat - B, CR, CB			Paving and platform		33
PoC3-1	Pahnwi 29	Enclosing Wall - CR and CB	Near center of enclosure	SW			18
		Platform - B and CB					
PoC3-1	Pahnwi 30	Enclosing Wall - HS, B, CR	Near center of enclosure	NW	Sakau stone?		7
		Platform - HS, B, CR					
PoC3-1	Peinering 2	Platform - B and CR				In enclosure with 2 other platforms	32
PoC3-1	Peinioar 1	Platform - B and CB				Sakau stone and FCR	29
PoC3-1	Peinkitel 1	Enclosing Wall - HS	Center of Enclosure	SW	Stone alignments, steps, pavings, support wall, and a sakau stone	In Iolong complex	2
		Platform - HS					

Table 6.2b Qualitative data and ranking for each structure discussed in Chapter 6.

Site	Structure	Construction Style	Architectural Layout	Entry	Ancillary Features	Other	Rank
PoC3-1	Peinkitel 2	Enclosing Wall - HS	Center of Enclosure	?	Stone alignment	In lolong complex	9
		Platform - HS					
PoC3-1	Peinkitel 3	Enclosing Wall - HS	Center of Enclosure	SW	Stone alignment	In lolong complex	8
		Platform - HS					
PoC3-1	Sapwenpwe 2	Platform - B and CB			Sakau stone		25
PoC3-1	Sapwenpwe 8	Platform - B and CB			Paving		26
PoC3-1	Sapwohng	Platform - B and CB			Paving		27
PoC3-1	Sapwuhdir	Platform - B and CB			Stone alignment and paving		24
PoC3-1	Sapwuhtik B - lolong	Enclosing Wall - HS	Center of Enclosure	SW	Platform, sling stones, alignments, and 2nd entry	Proximity with sakau stone	4
		Platform - HS					
PoC3-5	lolong	Enclosing Wall - B and CB	Near center of enclosure	?	Support wall, stone alignments, and yam features		14
		Platform - HS and B					
PoC3-8	lolong	Enclosing Wall - B	Partly attached to NW wall	n/a	Yam features		20
		Platform - B					
PoD24-17	platform	B and 1 CB			Sakau stone		30
PoD24-37	lolong	Enclosing Wall - B	Near center of enclosure	n/a			22
		Platform - B and some CB					

Table 6.2c Qualitative data and ranking for each structure discussed in Chapter 6.

platforms from Angeir and Peinering are both constructed of coral rubble and basalt cobbles, and neither burial chamber is covered. The house platform (Feature 23) from Pahnwi is constructed of coral rubble and basalt cobbles with the incorporation of some columnar stone. Feature 4 from Pahndauwas stands out as it is constructed entirely in the header-stretcher style with basalt cobble and coral rubble fill. This type of platform is the most elaborate, and likely of higher status than the other types. Based on the availability of construction material, the most elaborate and highest ranking structures are built in the header-stretcher style, followed by basalt cobble and/or coral rubble construction utilizing columnar stone, and platforms using no columnar stone rank third. This ranking is predicated on the additional time necessary to quarry columnar stones from outcrops, which was unnecessary for the acquisition of basalt boulders or rubble. These burial platforms embody a less elaborate version of the *lolong*, as all they are lacking is the *lolong* enclosing wall.

Burial platforms are associated with ancillary features such as *sakau* stones, pavings, platforms, and stone alignments. Only two platforms are not associated with other features; the nine other platforms (82%) are in association with one or more ancillary features. Four of the burial platforms are found near or in direct association with *sakau* stones. Five of these burial platforms are directly associated with paved areas or stone alignments. A single platform is in close association with a scatter of fire-cracked rock.

Variation in *lolong* tombs is more apparent in construction styles and ancillary features than in architectural layout. Nineteen *lolong* (86%) are associated with a variety of ancillary features, and 11 are associated with more than one. Nine *lolong* are directly or closely associated with *sakau* stones, which is the most common association. One of these *sakau* stones is located in a secondary enclosure attached to the *lolong* (Lukepenkarian). *Sakau* stones are closely followed by stone alignments (8), other platforms (7), and pavings (6). There are secondary entries in the enclosing walls of two, possibly three, *lolong* structures, though they are typically uncommon. Three *lolong* have supporting walls or buttresses attached to their enclosing wall (two interior, one exterior). Yam cultivation features are

almost certainly late prehistoric or historic additions to both *lolong* on Temwen. There are paved footpaths associated with one of the *lolong* from Awak, which are not part of the original construction and may have been added during the historic period. One *lolong* from Angeir is associated with two square niches or cysts constructed from small basalt columns, which were likely used as some type of repository. The best explanation for the common presence of some these features in association with all types of mortuary structures is that they were used in rituals associated with burial rites or they held some sort of ideological significance.

Construction style and materials used varies across the structures sampled and even within a single structure. Eight of the *lolong* (36%) do not share a consistent construction style and/or materials used for the burial platform and enclosing wall. Of the 14 remaining *lolong*, eight are built entirely in the header-stretcher style, one is built of basalt cobbles and small columns with some use of header-stretcher, one *lolong* is entirely constructed of basalt boulders and cobbles, two are constructed of basalt cobbles with columnar basalt facing, and two are built primarily of basalt boulders and cobbles with the incorporation of a few basalt columns. Of the eight *lolong* without a consistent construction style across the structure, the most common variant is a header-stretcher style enclosing wall with a burial platform that is a composite of header-stretcher and basalt cobble construction (three *lolong*). Three *lolong* incorporate a significant amount of coral rubble in their enclosing walls. One has an enclosing wall entirely built from coral rubble with a burial platform constructed of coral rubble and basalt cobbles. Another has a coral rubble wall with some basalt facing, and a burial platform incorporating coral rubble, columnar basalt and basalt cobbles. The third has a coral rubble wall with some columnar basalt facing with platform of columnar basalt and basalt cobbles. The last two composite *lolong* do not fit either of these categories. The first has a basalt boulder and rubble enclosing wall with some columnar stone facing, and a header-stretcher type burial platform utilizing small basalt cobbles as fill. The second has an entirely composite enclosing wall - part header-stretcher, part coral rubble (sometimes faced with basalt), and

part basalt cobble - with a burial platform of coral and basalt rubble. The highest frequency of composite structures is at Nan Madol (7 of 16, 43%), as the majority of *lolong* from other areas (5 of 6, 83%) have a consistent construction style.

Of the 33 structures discussed in this study 28 incorporate columnar basalt. The average column length used in these structures is 1.2 meters. Other sites on the island have similar ranges to most of the structures at Nan Madol, though three structures at Nan Madol stand out (Feature 1 at Nahndauwas, Feature 1 at Pein Kitel and Karian). These three *lolong* are constructed from a greater number of large (up to 6m long) columnar stones. Within the entire sample the largest columnar stones used in the construction of *lolong* are typically found in the enclosing wall. This suggests that the most investment in stone size is focused on the most visible structural feature of the *lolong*.

The most common architectural layout for *lolong* in this study is a single burial platform located near the center of the enclosure (17 of 22, 77%). Only one *lolong* (PoB7-44) has a burial platform located away from the center of the enclosure without being attached to the enclosing wall. Three *lolong* have their burial platforms attached to at least one of their enclosing walls; Angeir Feature 1 is attached to three. Karian is the only structure with more than one burial platform, one in the center of the enclosure and another located between the wall and the central platform.

Of the 22 *lolong* discussed here, 11 have distinct entryways, two have probable entries, and nine either never had an entryway or have no identifiable entryway. For the *lolong* with definite entryways, seven are located in the southwestern wall, two are located in the west wall, and two are located in the northwestern wall. Both possible entryways are located in the southwestern walls of their *lolong*. Clearly, there is some link between westerly directions and the location of the primary entryways in these structures, but ethnohistory and oral tradition are not clear on the subject. This westerly orientation is not explicitly linked to the geography of Pohnpei, since all of the structures examined in this analysis are primarily located on the eastern half of the island and a broader geographical sample is needed to state

anything definitive related to geographic alignments. None of the *lolong* face out to sea, but they are not oriented towards the center of the island either. Beliefs related to the history of the interior of the island (i.e. it was the residence of cannibals and monsters; see Bernart 1977) prevent meeting house (*nahs*) entryways being oriented towards the center of the island (Mauricio 1993:396), which may have been the case for *lolong* as well. Another possible interpretation of the facing orientations is based on the identity and/or worldview of those associated with specific *lolong*. Since these structures are likely associated with specific clans or kin-groups (Ayres and Haun 1980; Kubary 1874; Mauricio 1993; Seikel 2011), it is probable that group identity may play a significant role in some aspects of architectural variation. It is possible that orientation may be linked to the direction from which a given clan originated (see Mauricio 1987), since the Saudeleur was a hereditary title established by foreign brothers. Additional studies along the lines of Mauricio's (1987) work would be valuable in understanding the social importance of these directions. Even without knowing the true impetus behind the facing orientations of *lolong* it is clear that it is a decision tied to identity and ideology rather than practicality.

Even though each *lolong* has been examined separately, in terms of architectural layout, six need to be discussed further as they are part of tomb complexes. Nahndauwas (Figure 6.35) and Pein Kitel (Figure 6.36) are islets that function as *lolong* tomb complexes. Each islet incorporates three *lolong* within an islet-encompassing enclosing wall. The layouts of these islets show differences in organization, planning, and construction times. The architectural focus of Nahndauwas is the central *lolong*, which is in alignment with the islet enclosing wall and is flanked by two smaller *lolong*. This layout, in comparison with Pein Kitel, suggests that it may have been pre-planned and possibly constructed over a shorter period of time than Pein Kitel. Pein Kitel does not have the more uniform, geometric layout of Nahndauwas. The alignment of the large *lolong* with the two smaller *lolong* is not indicative of a planned focal structure for this islet. This suggests a larger number of building and/or planning phases for the various architectural features and structures on Pein Kitel. Though

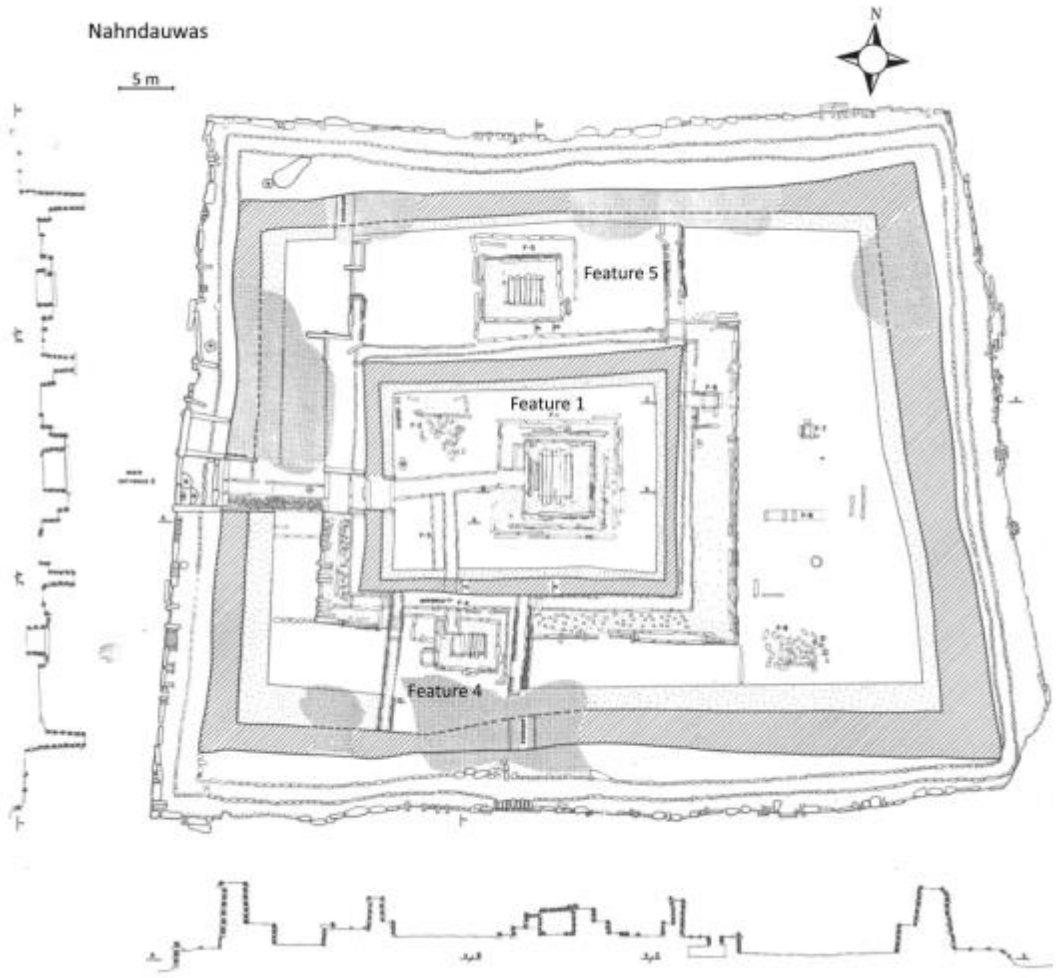


Figure 6.35 Plan map of Nahndauwas complex (From Athens n.d.).

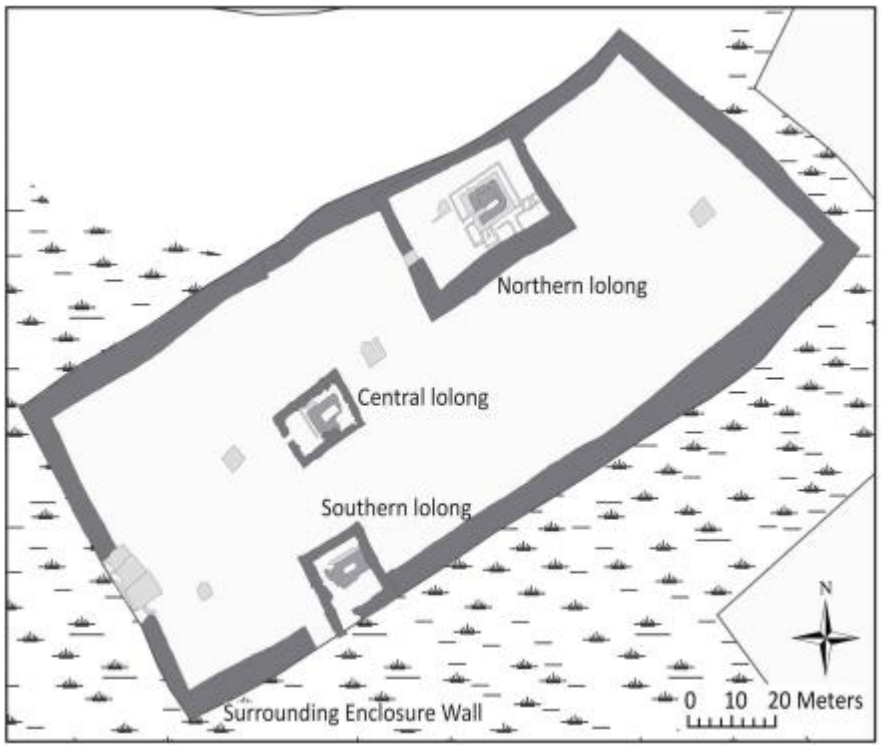


Figure 6.36 Plan map of Pein Kitel complex (digitized from Athens n.d.).

Nahndauwas and Pein Kitel are the only *lolong* complexes identified in this study, by strict definition, *lolong* and isolated burial platforms are often found in relatively close proximity to one another.

The placement of mortuary sites within settlement areas is informative about how the population regarded death (Binford 1971; Saxe 1970). Sixteen of the 22 *lolong* (73%) and 10 of the 11 burial platforms (91%) examined in this study are located at the site of Nan Madol (see Figure 6.37). The distribution of these structures is around the periphery of the site, primarily along the seawall. This is markedly different from the 10 isolated burial platforms, which are scattered across Nan Madol with no particular patterning. These platforms may have been directly associated with small, potentially family-sized, kin-groups. This suggests that *lolong* may have been more formal burial sites separated from daily activities, while isolated burial platforms may have had other functions prior to their use as burial sites (i.e. Feature 23 on Pahnwi). Bath and Athens (1990) statement that the seawall islets contain the majority of mortuary structures at Nan Madol is generally supported based on the distribution of *lolong*, but it is now evident that the distribution of burial platforms comprises an important part of the mortuary landscape.

Distribution of architectural mortuary sites at Nan Madol is well documented in comparison to other parts of the island. The location and distribution of mortuary features outside of Nan Madol is lacking because complete settlement survey data do not exist for most areas of Pohnpei. It is not prudent to posit the patterning at Nan Madol as typical for the rest of the island without additional mortuary distribution data to compare with the Nan Madol distribution. Further large-scale survey is needed to undertake wide-scale distributional studies, and it would be valuable to revisit available survey data (e.g. Awak Valley) as part of this process. Nonetheless, differences in the distributions of mortuary structures at Nan Madol suggest ideological differences in how Pohnpeian society regarded formal (*lolong*) and less formal (e.g. burial platforms) burial sites. In addition this, *lolong*, due to their scale, may have been used as territorial markers placed to demarcate settlement boundaries by clan

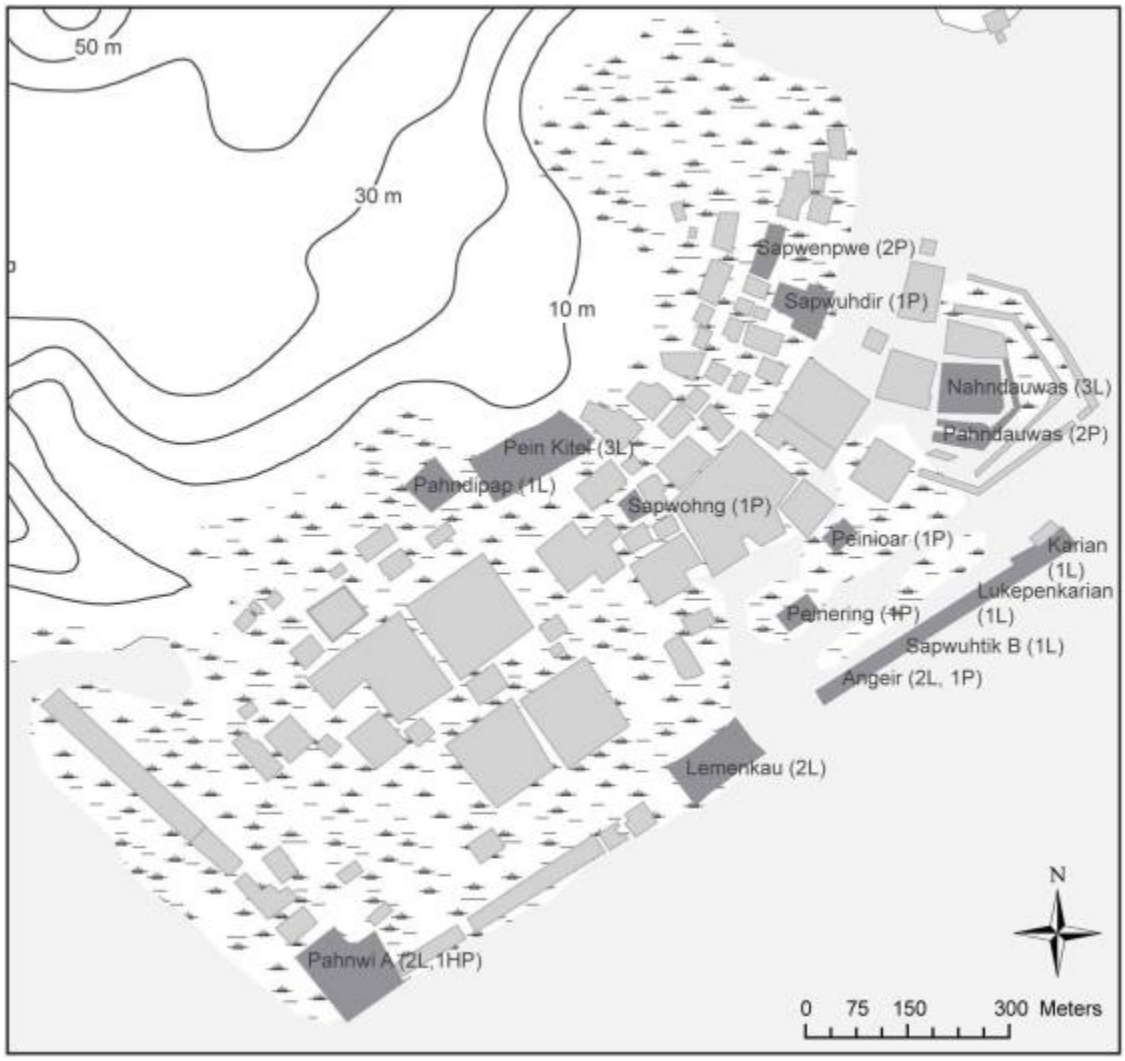


Figure 6.37 Distribution of mortuary structures within Nan Madol (L=lolong, P=burial platform and HP=house platform).

groups. Burial platforms may be more directly related to habitation sites for specific family groups due to their distribution.

6.3 Chronology of Burial Sites

There are only three directly dated burial contexts on Pohnpei (see Table 6.3). Other dates associated with mortuary structures are relative dates based on the dating of underlying features (i.e. islet-fill). The majority of these dates are taken from unidentified charcoal samples, which means some dates may be skewed since they were possibly derived from long-lived wood species. Less than half of the mortuary structures discussed here have

associated dates, but those that do provide invaluable information for understanding the construction and use of mortuary structures.

Site	Islet	Structures	Cal. Date Range	Material	Context
PoB7-44		lolong	AD 1178-1445	Bone Collagen	Direct
PoC3-1	Nahndauwas	lolong	AD 1100-1600	Charcoal	Relative
PoC3-1	Pahndauwas	platforms	AD 1025-1510	Charcoal	Relative
PoC3-1	Pahnwi	both	AD 1210-1406	Charcoal	Relative
PoC3-1	Sapwenpwe	platform	AD 1045-1340	Charcoal	Relative
PoC3-5		lolong	AD 1220-1385	Charcoal	Direct
PoC3-8		lolong	AD 1298-1624	Charcoal	Direct

Table 6.3 Overview of radiocarbon dates associated with mortuary structures.

All the indirectly dated mortuary structures are located within Nan Madol. The samples were excavated from associated architectural features or islet construction layers which extend under the structure. The burial platforms on Pahndauwas likely date to between AD 1025 and 1510, and the Sapwenpwe platforms date between AD 1050 and 1340 (Athens 1990). Dates from the islet fill at Pahnwi place the construction of the nearby burial contexts at AD 1210-1410, if not later (Bryson 1989). Charcoal samples from the islet fill at Nahndauwas suggest the associated *lolong* were constructed between AD 1100 and AD 1600 (Bryson 1989). These relative dates place the architectural burial sequence at AD 1025-1650.

The three directly dated sites are PoB7-44, PoC3-5 and PoC3-8 from Awak and Temwen. One sample from the base on the tomb chamber at PoB7-44 dates the structure to AD 1180-1450 (Ayres et al. 1981). This date is consistent with the dates from the Temwen structures. PoC3-5 dates between AD 1220 and 1390 based on four samples from the excavations alongside the inside of the enclosing wall. Two samples from PoC3-8 enclosure excavation places it slightly later in the sequence, AD 1300-1625. These three date ranges securely place the construction of *lolong* between AD 1180 and 1625, though they may have been constructed or utilized for a longer time period as suggested by the relative dates from Nan Madol.

The direct dates from the excavations discussed here are the only radiocarbon ages acquired from mortuary contexts outside Nan Madol. These dates indicate that *lolong* were in use across the island during the entire period in which *lolong* were constructed at Nan Madol. All radiocarbon dates for mortuary contexts are consistent, but the long age ranges and considerable overlap in calibrated ages complicates any attempt to try to separate chronological trends in architectural variability. As this data is all that is available there is an obvious need to further test the chronology of mortuary structures with additional radiocarbon dates in the future. Additional dates confirming similar construction ages for enclosing walls and platforms would be a valuable contribution to the understanding the development of *lolong* over time, particularly to determine if these structures were built in phases or were constructed over a short time. Further dating studies should be completed to clarify the development of *lolong* as an architectural type, but at present it is apparent that the earliest *lolong* were built across Pohnpei and were not restricted to Nan Madol.

The dates from all the excavated deposits suggest *lolong* were built and used for 400 to 500 years (c. AD 1200-1650), while isolated burial platforms were used for a much longer period, approximately 700 years (c. AD 1000-1700). The ages of all the mortuary structures are consistent with the estimated age of the Saudeleur dynasty based on Mauricio's (1993:163) examination of the numbers of the Nahnmwarki of Madolenihmw and Saudeleur rulers listed in oral traditions. Using 25 years as the average length of time each individual held their title the centralization under the Saudeleur dates to AD 1160-1461 (Mauricio 1993:163). Based on the average length of time each Nahnmwarki ruled in the historic period (~15 years) 25 years might be a bit long to be used for an average, but the exact number of Saudeleur rulers is unclear in oral tradition (at least 7 to 13; see Bernart 1977; Mauricio 1993) and 12 may be an underestimate. Regardless of potential error in genealogical data (15 to 25 years), *lolong* date to the period which the Saudeleur were in power.

6.4 Discussion and Conclusions

The first aspect of the qualitative data which requires discussion is a general ranking of mortuary types. A previous study (Seikel 2011) focused on the status distinctions between sub-surface burials, platform burials, and *lolong* burials on Pohnpei. The study found that *lolong* were the highest ranking mortuary contexts, followed by burial platforms, bone caches, house platforms, and sub-surface burials using a combination of architectural, demographic and artifactual analyses (Seikel 2011). These findings are integral to the ranking of this dataset in that isolated platforms are ranked lower than *lolong* and higher than house platforms used as burial structures.

The ranking within architectural types is based on variation in architectural construction styles, associated ancillary features, and inclusion in mortuary complexes (see Table 6.1). Often the most common architectural style within a specific type of structure tends to define the middle of the ranking, as there would be fewer examples of the more costly styles (i.e. header-stretcher). This is particularly evident in relation to isolated burial platforms, of which 64% are built of basalt cobbles with the incorporation of some columnar stone. The ranking of isolated platforms is somewhat more straightforward than *lolong*, since they are comprised of a single architectural component.

The ranking of *lolong* based on variation in construction is complicated by structures which incorporate multiple construction materials and ancillary features. Approximately a third of the *lolong* examined in this study do not display a consistent construction style (e.g. header-stretcher or stacked stone) across the entire structure. Often this variability manifests as the burial platform or the enclosing wall being constructed in the header-stretcher style while the other architectural components are not. It has to be recognized that this variability may be due to construction choices to emphasize one particular aspect of the structure over another, rather than stylistic limitation based on access to specific construction materials. It may also be indicative of multiple building phases, which could be another indicator of slightly

lower status. Though these possibilities cannot be further addressed on a structure by structure basis at this time it is important to note the possibility of conflating certain status associations based on qualitative data alone. Ideological factors play significant roles in decisions related to architecture that may influence what is believed to be rank differentiation, so discussions of what caused a structure to deviate from the typical plan can only be posited based on observed patterns.

The data presented in this chapter on burial platforms and *lolong* support the general proposition that ranking within architectural types mirror social distinctions. The range of stylistic variability paired with information on associated ancillary features indicates ties between architecture and social distinctions (e.g. Nahndauwas Feature 1 versus PoD24-37). There is greater stylistic variability within *lolong* than in isolated burial platforms, which suggests social differentiation may be more significant in the *lolong* context.

Even with much of the architectural variability being attributed to social distinctions, ideological values, and group identity, there is always the possibility of stylistic change over time based on changing preferences. There is significant overlap in the dates related to specific architectural styles, and the construction/use period of burial platforms and *lolong*. However it is possible to use the available dates to construct a hypothetical sequence of architectural change, which can be tested further when more dates are available. Based on the chronological data presented, columnar basalt was probably in use by AD 1000. Dates from mortuary structures utilizing the header-stretcher construction style indicate its use by AD 1100-1200. This suggests that columnar basalt was in use for at least a hundred years before header-stretcher style constructions were built. The early use of columnar stone in header-stretcher constructions coincides with the centralization of socio-political power at Nan Madol, but more direct dates from mortuary structures will be needed to refine and confirm this architectural sequence.

Criteria 1 posits that the structures utilizing the most columnar basalt are associated with high status individuals or groups. Of all the construction styles used in mortuary

structures, header-stretcher construction incorporates the most columnar basalt. Therefore, structures comprised entirely of header-stretcher construction using columnar stone are the most likely to have been built by elites and potentially using coercive labor mobilization strategies. Of the 33 structures discussed in this chapter, only seven *lolong* are built entirely using header-stretcher construction (Nahndauwas 1, 4 and 5, Pein Kitel 1-3, and Sapwuhtik B), and an additional 4 *lolong* (Karian, Lemenkau 1 and 18, and Pahnwi 30) are built mostly in the header-stretcher style. These 11 *lolong* have the most potential to be linked to coercive labor mobilization practices. It is notable that all these structures are located at Nan Madol.

In addition to the amount of stone used, Criteria 1 also correlates the size of columns used in construction with the status of the builder. The average length of columns used in the mortuary features discussed in this chapter is 1.2 meters. Isolated burial platforms tend to incorporate smaller columns than *lolong*, and *lolong* enclosing walls typically include larger stones than their platforms. There are a few structures that have columnar stone length averages over 1.2 meters, including PoB7-44 in Awak. Three in particular stand out: the Feature 1 at Nahndauwas, Feature 1 at Pein Kitel and Karian. All three of these structures are located at Nan Madol and have associated oral traditions (Bernart 1977; Hadley 1981; Hambruch 1936a). These structures are also notable for their construction style and the presence of ancillary features.

The presence of ancillary features was incorporated into the ranking due to the added time invested in these features. More complex structures signal greater investment, and imply association with groups or individuals of high status (see Criteria 3 in Chapter 2). Variability in *lolong* tend to account for much of the rank placements, but ancillary features played a significant role in distinguishing the relative ranks of burial platforms utilizing the same construction style. This significance is possibly due to the small number of variables and the presence/absence data for each which may inflate the significance of these features.

Ancillary features are significant beyond the hierarchical ranking of architectural features. Over 80% of all mortuary structures discussed here are associated with ancillary

features. The combination of shellfish food remains, *sakau* stones and pavings present at a number of structures is suggestive of ancillary features being associated with feasting and mortuary ritual (see Chapters 4 and 5). The layout of *lolong* enclosures is also telling in relation to ritual use of space. Though the majority of burial platforms are located near the center of their enclosures, none of them are located exactly in the center. One consideration regarding the placement of the burial platform off-center within the enclosure is the creation of additional space for activities linked to mortuary ritual and/or feasting. The distribution of ancillary features within most *lolong* enclosures support this proposal.

In addition to practical concerns linked to mortuary ritual, there may be other ideological reasons for the placement of architectural features. In some cases *lolong* platforms are not located near the center of the enclosure, and there is no obvious limitation of space (e.g. multiple burial platforms). Pohnpeian tradition suggests that constructing the burial platform against the enclosing wall of a *lolong* indicates that the deceased has no fear of being disturbed by enemies after burial (Ayres pers. comm.). In this way the placement of major architectural components may be related to individual or group identity.

Criteria 3 hypothesizes that structures with greater number of ancillary features are linked to high status clans or individuals as the formalization of ritual space would increase the investment in the structure as a whole. The majority of mortuary structures discussed in this chapter have ancillary features, but most only have one or two. Five *lolong* are associated with four or more ancillary features (Karian, Feature 1 at Lemenkau, Feature 1 at Nahndauwas, Feature 1 at Pein Kitel, and Sapwuhtik B). In addition to these five, the other *lolong* at Nahndauwas and Pein Kitel may be considered part of this list since they are part of mortuary complexes.

In summary, in the qualitative analysis Criteria 1 and 3 identified 11 *lolong* which were most likely affiliated with high status individuals and groups, and therefore may have the most potential to have been built through coercion. These structures are Karian, Lemenkau Features 1 and 18, all of the *lolong* on Nahndauwas and Pein Kitel, Pahnwi Feature 30, and

Sapwuktik B. It is notable that none of the isolated burial platforms met the criteria, since it has been proposed that they were a lower ranking form of mortuary treatment (see above and Seikel 2011). Unfortunately, only 10 of the identified structures will be discussed in quantitative terms because Sapwuhtik B is not currently documented in a way which it can be included in further discussion.

This chapter recognizes that both ideology and differentiation of social status play a significant role in Pohnpeian mortuary activities and architecture. Mortuary feasting and other rituals likely occurred at the gravesite around the time of death or secondary interment prior to the historic period based on features associated with these burial structures. Pohnpei's mortuary monuments created a forum in which to hold rituals partly designed to reify social structure after the death of a community member while also being a means to signal status differentiation. Burial in isolated burial platforms outlasted *lolong* construction and use, and was possibly a more common form of burial throughout the island's history. *Lolong* were an elaboration of burial structure and practice. Although *lolong* represented the ideal during the state period on Pohnpei, commoners and other members of society would have been precluded from constructing and utilizing this type of structure on socio-economic grounds.

This qualitative analysis has provided evidence for the link between architecture and socio-political change. The structures identified under Criteria 1 and 3 in this chapter should also be identified as structures with the potential to be constructed using coercive strategies under the other criteria in Chapters 7 and 8. Though social differentiation is indicated in this analysis, the results lack precision since they do not consider issues related to scale or construction requirements. The next chapter uses quantitative analyses to examine issues of scale and investment, which will be used to refine the interpretations of the dataset.

Chapter 7: Quantification of Architecture

Architectural sites have long been the target of archaeological fieldwork, but the analyses rarely "intensively scrutinize the architectural features themselves" (Abrams 1989:49). This is surprising since architecture has been consistently linked to socio-political development, territoriality, and ideology since at least the 1950s (e.g. Erasmus 1965; Kinnes 1981; McGuire 1983). Theoretical discussions have identified architectural features and monuments as culturally embedded, and therefore connected to socio-political change, status differentiation, group ideology and identity, boundary marking, social competition, and symbolism (e.g. Abrams 1989; Alcock 2002; Blier 2006; Joyce 2004; Kinnes 1981; Kolb 1994; McGuire 1983; Paynter and McGuire 1991).

The implications of detailed quantitative analyses of architectural features will be significant to the understanding of spatial variability within specific architectural types, and provides a method to augment typological syntheses. Discussions of statistical data in relation to scale, visibility, standardization of form and labor investment provides an opportunity to address mobilization of labor, possible variation in architectural values associated with ritual and secular structures, change in architectural styles over time, and the identification of structures as outliers within a specific type. Statistical comparisons can further examine patterns identified in typological discussions. I suggest that quantitative methods of architectural analysis help to mitigate the limitations of typological comparisons in relation to questions of architecture and socio-political relations. This study builds upon similar analyses of this kind (e.g. Abrams 1989; Abrams and Bolland 1999; Erasmus 1965; Joyce 2004; Kolb 1994, 1997; Kolb and Snead 1997; Rolett 2010).

This chapter focuses on the quantification of architectural features and what this type of data can add to the results presented in the qualitative analysis (Chapter 6). Using statistical comparisons, this chapter will address questions linked to the construction and scale of

mortuary structures (e.g. is there a typical size for architectural features) on Pohnpei and how it relates to labor mobilization strategies and socio-politics.

7.1 Quantitative Statistical Analysis

Of the structures discussed in Chapter 6, only the Sapwuhtik B and Angeir Feature 7 *lolong* are not included in this discussion as there are no detailed maps to provide accurate measurements. This analysis incorporates a discussion of 31 separate mortuary features comprised of 20 *lolong* and 11 isolated burial platforms. In order to obtain measurements for area and height, and other dimensions each map was digitized using ArcGIS. This allowed for accurate calculations of the area of stone constructions and the space enclosed by each structure (footprint), and measurements of height, length and width for each structure. Each of these measurements has been statistically analyzed using standard deviations and coefficients of variation to identify the range of architectural variation and to determine patterning which may be significant.

Standard deviation is a measure of the spread of variation from the mean and can be used to identify potential outliers that fall outside this spread. In order to identify all the potential outliers to each set of variables (e.g. wall height, platform height, platform area) outliers identified using standard deviations were removed from the analysis until the mean began to approach the median for the whole dataset or until no further outliers were produced using standard deviations. This method identifies outliers that may not have been obvious in the initial analysis.

The coefficient of variation (Cv) is a ratio used to examine the amount of variation within a dataset, and is used to compare relative variability between datasets. The benefit of using the coefficient of variation rather than other measures of variability (e.g. standard deviation) is that it is a unit-less measure, so you can compare the relative variation of multiple datasets with different units of measure. The Cv can only be used to compare datasets; it cannot be used to explore these datasets. In this study the coefficient of variation

was used to examine which architectural components display the most or least overall variability to determine which components may have been standardized.

7.1.1 Area and Volume

Statistical comparison of area and volume can differentiate groups of burial structures based on size (see Tables 7.1 and 7.2 for volume and area data). This results in the identification of what may have been atypical for *lolong* and isolated burial platforms, and allow for the identification of outlier structures. All the quantitative datasets have been analyzed using standard deviations to identify outlier structures for burial platforms and *lolong* enclosing walls as outlined above.

Site_No	IsletAbr	Structure Type	Height	EstArea	Vol
PoD24-37		lolong wall		21.627	
PoB7-44		lolong wall	0.511	207.823	106.251
PoB7-39		lolong wall	0.936	138.717	129.787
PoB7-10		lolong wall	0.921	76.758	70.677
PoC3-8		lolong wall	0.521	66.262	34.523
PoC3-5		lolong wall	0.634	175.578	111.272
PoC3-1	ANG	F1 lolong wall	0.679	47.522	32.275
PoC3-1	KARA	lolong wall	5.556	534.835	2,971.546
PoC3-1	LMK	F18 lolong wall	0.953	108.833	103.734
PoC3-1	LMK	F1 lolong wall	1.070	295.329	316.038
PoC3-1	LPK	F2 lolong wall	0.892	238.683	212.939
PoC3-1	NDA	F1 lolong wall	3.157	143.152	451.860
PoC3-1	NDA	F4 lolong wall		31.385	
PoC3-1	NDA	F5 lolong wall		36.648	
PoC3-1	PDI	lolong wall	0.600	70.890	42.534
PoC3-1	PEK	South lolong wall	1.528	89.519	136.786
PoC3-1	PEK	Central lolong wall	0.972	68.291	66.379
PoC3-1	PEK	North lolong wall	2.222	255.816	568.424
PoC3-1	PWIA	F30 lolong wall	2.850	93.035	265.149
PoC3-1	PWIA	F29 lolong wall	4.238	170.653	723.225

Table 7.1 Quantitative data for *lolong* enclosing walls.

Site_No	IsletAbr	Structure Type	Height	EstArea	Vol
PoD24-37		lolong platform		10.008	
PoB7-44		lolong platform	0.450	28.868	12.979
PoB7-39		lolong platform	1.078	28.828	31.084
PoB7-10		lolong platform	0.728	29.016	21.136
PoC3-8		lolong platform	0.363	27.866	10.101
PoC3-5		lolong platform	0.678	22.356	15.158
PoC3-1	ANG	F1 lolong platform	0.575	13.057	7.508
PoC3-1	KARA	Central lolong platform	1.944	29.827	57.983
PoC3-1	KARA	South lolong platform	0.833	20.371	16.969
PoC3-1	LMK	F1 lolong platform	0.724	33.989	24.597
PoC3-1	LMK	F18 lolong platform	0.536	24.085	12.908
PoC3-1	LPK	F2 lolong platform	0.757	19.090	14.452
PoC3-1	NDA	F1 lolong platform	2.354	48.187	113.432
PoC3-1	NDA	F4 lolong platform	0.752	24.882	18.699
PoC3-1	NDA	F5 lolong platform	1.340	42.069	56.372
PoC3-1	PDI	lolong platform	0.900	13.035	11.732
PoC3-1	PEK	North lolong platform	1.389	20.198	28.055
PoC3-1	PEK	Central lolong platform	0.833	21.109	17.584
PoC3-1	PEK	South lolong platform	0.972	26.044	25.315
PoC3-1	PWIA	F29 lolong platform	3.475	28.663	99.603
PoC3-1	PWIA	F30 lolong platform	1.340	55.647	74.567
PoD24-17		burial platform	0.583	42.739	24.921
PoC3-1	ANG	burial platform	0.603	32.390	19.542
PoC3-1	PDA	F9 burial platform		17.264	
PoC3-1	PDA	F4 burial platform	0.677	16.417	11.114
PoC3-1	PEE	burial platform	0.619	34.298	21.230
PoC3-1	PEO	burial platform	0.339	43.217	14.651
PoC3-1	PWIA	house platform w/ burial	1.700	20.474	34.806
PoC3-1	SOE	burial platform	0.449	17.645	7.922
PoC3-1	SPW	F2 burial platform	0.423	24.279	10.270
PoC3-1	SPW	F8 burial platform	0.410	22.268	9.130
PoC3-1	SWD	burial platform	0.401	22.201	8.903

Table 7.2 Quantitative data for burial platforms.

Area is the first of the variables addressed. Enclosing wall areas range between 21 m^2 and 535 m^2 (mean 144 m^2, median 101 m^2), and platforms range between 10 m^2 and 56 m^2 (mean 27 m^2, median 26 m^2). The statistical outliers in both datasets are at the upper limits of these ranges and are all from Nan Madol. Statistical analyses place the typical range of enclosing wall areas between 21 and 257 m^2, with two outliers at 295 and 535 m^2 respectively. The majority of structures (70%) cluster between 10 and 150 m^2. These outliers are the enclosing walls for Karian and Lemenkau Feature 1. Neither of these outliers is particularly surprising based on their architectural contexts. Karian is the only *lolong* which occupies an entire islet, and it is also said to have been the burial place for the priestly class (Hambruch 1936a). Lemenkau Feature 1 was identified as an outlier in the second round of statistical analysis. It is distinctive because the enclosing wall encompasses a significant area, and the structure is directly linked to burial and other rituals through its close association with other features, which incorporate at least a dozen *sakau* stones.

Davidson (1967:91-92) reported that burial platforms at Nan Madol are of a similar size to those elsewhere on Pohnpei, which means platform size may be more standardized than enclosure walls. Statistics show significantly more variation amongst the area of enclosing walls than burial platforms (Cv walls 85%; Cv platforms 39%). The results from the statistical analysis of burial platforms show that the results from the first round established the range of variation. The typical range of platform area is between 6 and 48 m^2. The majority of these platforms (53%) cluster between 20 and 30 m^2. This variability does not entirely support Davidson's observation, but since much of this variation is present at Nan Madol it is not disproven either. The outlier platforms were all identified at Nan Madol, and include the central tomb at Nahndauwas and the northern *lolong* from Pahnwi. The Nahndauwas platform is not a surprising outlier as it is said to have been the burial place of the Saudeleur (Bernart 1977; Hambruch 1936a). The Pahnwi outlier does not have the benefit of oral tradition tied to the structure, but may be larger in scale due to its potentially later age (see Chapter 6 chronology).

The second variable analyzed is volume. Statistical analyses were completed for both datasets to identify the range of variation and their respective outliers. The typical range for the volume of *lolong* enclosing walls (original mean 373 m^3, median 130 m^3), as determined by standard deviations, falls between 32 and 393 m^3. There is no clear clustering within the dataset. The enclosing wall outliers include the northern *lolong* on Pein Kitel (568 m^3), the central *lolong* at Nahndauwas (452 m^3), the southern *lolong* from Pahnwi (723 m^3) and Karian (2,973 m^3). The possible reasons for Karian's and Nahndauwas' outlier status have already been noted. The northern *lolong* on Pein Kitel is reportedly the tomb of Isohkelekel, the first Nahnmwarki on Pohnpei and the person credited with inciting the overthrow of the Saudeleur dynasty (Bernart 1977; Hambruch 1936a). There are no known traditions associated with the southern tomb on Pahnwi.

The standard volume range for burial platforms (mean 28 m^3, median 18 m^3), isolated or not, is seven m^3 to 55 m^3. There is clustering between 10 and 20 m^3 (43% of the dataset). The most obvious outliers are the platform from the central tomb at Nahndauwas (113 m^3) and the southern *lolong* platform from Pahnwi (100 m^3), both of which have been discussed. Other outliers include the central platform at Karian (58 m^3), the platform from the northern *lolong* on Pahnwi (75 m^3), and the platform from the northern *lolong* on Nahndauwas (56.4 m^3). The volume of burial platforms is less variable than that of enclosing walls (Cv walls 187%; Cv platforms 96%). These results are consistent with the area results.

Area and volume were graphically plotted to identify any additional outlier structures (see Figure 7.1). If the volume is capped at 400 m^3 and the area is capped at 250 m^2 for enclosing walls, no other outliers are identified. If the volume and area variables of burial platforms are capped at 40 m^3 and m^2 respectively, there are two other potential outliers that become apparent. Interestingly, both are isolated platforms (Peinioar Feature 1 and PoD24-17). What is particularly noteworthy about these platforms is their area. The Peinioar platform is of interest due to its close association with a large *sakau* stone and a scatter of fire-cracked

stone, which are suggestive of ritual feasting. PoD24-17 is called the Nankiahk tomb, but there are no known oral traditions linked to the structure.

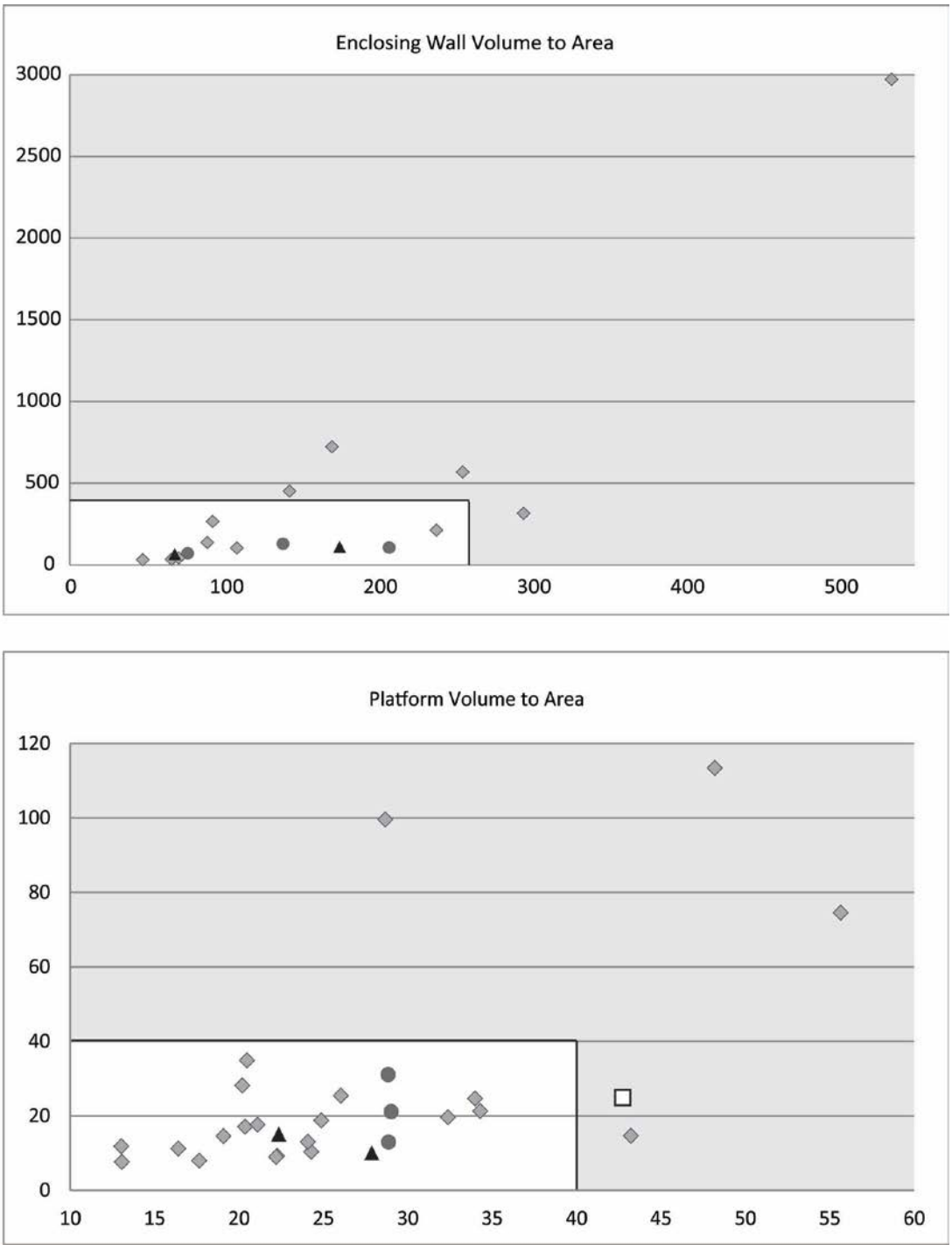


Figure 7.1 Area to volume plots for platforms and enclosing walls. Diamonds are markers for Nan Madol, triangles for Temwen, circles for Awak, and squares for Salapwuk.

7.1.2 Height

Monuments act as significant visual markers in the landscape, typically as symbols of elite power or status hierarchy (Abrams and Bolland 1999:264; Kirch 1990:206). As such, height may be an important variable to consider in addition to area and volume (refer to Tables 7.1 and 7.2). Statistics show that typical heights for enclosing walls range between 0.5 and 2 m (original mean 2 m, median 1 m). The dataset outliers are Karian (6 m), the central *lolong* on Nahndauwas (3 m), and the southern *lolong* on Pahnwi (4 m), which are consistent with the area and volume results. The fourth outlier, which does not appear in the area and volume results, is the northern *lolong* on Pahnwi (3 m). Within the enclosing wall data, *lolong* from the main island tend to have shorter walls (0.5 to 1 m).

The typical height range for burial platforms is between 0.3 and 2 m (original mean 1 m, median 0.7 m). The platform outliers include the southern *lolong* platform from Pahnwi (4 m), the platform from the central tomb at Nahndauwas (2 m), the house platform on Pahnwi which was used as a burial structure (2 m), and the central platform at Karian (2 m). The only surprise amongst these outliers is the Pahnwi house platform, but its ranking may suggest different stylistic or scale parameters used for house platforms and burial platforms. This is supported by the fact that other isolated burial platforms tend to range between 0.3 and 0.7 m in height, which is significantly shorter than the house platform. *Lolong* platforms are more variable in height than isolated platforms, though those from the main island tend to be shorter (0.3 to 1 m) than those at Nan Madol (0.5 to 4 m).

The other factor related to the height of architectural features is the relationship between the *lolong* enclosing walls and their platforms. In general, enclosing wall heights are greater than platform heights, though three *lolong* platforms are taller than their enclosing walls. The trend to build enclosing walls higher than platforms may be one way in which some individuals were excluded from ritual activities within the *lolong* enclosure. This potential juxtaposition may be more common on the main island, since two of the three tombs identified (PoB7-39 and PoC3-5) are located outside Nan Madol. The relationship between

wall and platform height may also be affected by taphonomic factors, such as the removal of construction materials.

7.1.3 Additional Comparisons of Scale

It is possible that a society had general rules relating to architectural construction aside from those apparent in raw measurements of area, volume and height (e.g. proportions or desired shapes). The analysis of architectural footprints and length to width ratios may suggest standards in relation to the scale of architectural components in a single structure.

The first analysis is related to scale. Is there patterning in the footprint size of *lolong* and burial platforms, and is there a proportional relationship between the footprints of *lolong* platforms and the enclosing walls? Both questions were addressed through standard deviations and variance.

Footprint variance was addressed individually for enclosing walls and platforms (see data in Table 7.3). Ninety percent of the enclosing walls sampled fell within one standard deviation of the group mean (sd 356, mean 397 m^2), placing the majority of enclosing wall footprint sizes between 41 and 753 m^2. This shows that size ranges significantly, particularly at Nan Madol where both outliers were identified (Karian and Lemenkau Feature 1). Both outliers were identified in the wall area analysis in the previous discussion. Platform footprint size varies less than enclosing walls, with 85% of the variance lying between 8 and 51 m^2. Platform footprints on the main island tend to fall between 15 and 30 m^2. When comparing isolated burial platforms with *lolong* platforms, there is no obvious patterning in size. Based on this analysis, there is a wide range of variability in Pohnpeian mortuary structures.

Though there is no particular patterning in footprint sizes, it is possible that platform footprint size is proportionally related to enclosure footprint sizes (see Table 7.4). Based on statistical analysis of the platform to enclosure size ratios, 95% of the variability in these measures falls between 0 and 0.25. The coefficient of variation (Cv 55%) indicates that there is no clear pattern in the platform to enclosure footprint ratio.

Site	Islet	Structure Type	EstArea	Rank
PoC3-1	LMK	F1 lolong enclosure	1,511.575	1
PoC3-1	KARA	lolong enclosure	1,035.085	2
PoC3-1	PEK	North lolong enclosure	654.297	3
PoC3-1	NDA	F1 lolong enclosure	632.349	4
PoC3-5		lolong enclosure	615.577	5
PoB7-44		lolong enclosure	460.777	6
PoC3-1	PWIA	F29 lolong enclosure	404.740	7
PoC3-1	LPK	F2 lolong enclosure	357.962	8
PoC3-1	NDA	F5 lolong enclosure	325.067	9
PoB7-39		lolong enclosure	294.723	10
PoC3-1	LMK	lolong enclosure	267.149	11
PoC3-1	PWIA	F30 lolong enclosure	224.579	12
PoC3-1	PEK	South lolong enclosure	196.008	13
PoB7-10		lolong enclosure	189.092	14
PoC3-8		lolong enclosure	161.923	15
PoC3-1	PEK	Central lolong enclosure	151.061	16
PoC3-1	NDA	F4 lolong enclosure	149.027	17
PoC3-1	PDI	lolong enclosure	133.555	18
PoC3-1	ANG	F1 lolong enclosure	99.846	19
PoD24-37		lolong enclosure	78.254	20
PoD24-17		burial platform	45.298	21
PoC3-1	PEO	burial platform	43.225	22
PoC3-1	PEE	burial platform	36.547	23
PoC3-1	ANG	F2 burial platform	33.233	24
PoC3-1	SPW	F2 burial platform	24.437	25
PoC3-1	PWIA	house platform	24.001	26
PoC3-1	SWD	burial platform	23.393	27
PoC3-1	SPW	F8 burial platform	22.450	28
PoC3-1	SOE	burial platform	18.109	29
PoC3-1	PDA	F4 burial platform	18.715	30
PoC3-1	PDA	F9 burial platform	17.648	31

Table 7.3 Architectural footprint areas for enclosing walls and burial platforms including size rankings.

Site	Islet	Structure Type	Ratio
PoB7-44		lolong	0.060
PoB7-39		lolong	0.094
PoB7-10		lolong	0.158
PoD24-37		lolong	0.128
PoC3-8		lolong	0.172
PoC3-5		lolong	0.035
PoC3-1	ANG	lolong enclosure	0.166
PoC3-1	KARA	enclosure	0.054
PoC3-1	LMK	lolong (1)	0.023
PoC3-1	LMK	lolong (18)	0.124
PoC3-1	LPK	lolong enclosure	0.075
PoC3-1	NDA	lolong (F1)	0.076
PoC3-1	NDA	lolong (F4)	0.206
PoC3-1	NDA	lolong (F5)	0.149
PoC3-1	PDI	enclosure	0.098
PoC3-1	PEK	Central lolong	0.176
PoC3-1	PEK	South lolong	0.147
PoC3-1	PEK	North lolong	0.049
PoC3-1	PWIA	lolong (F29)	0.079
PoC3-1	PWIA	lolong (F30)	0.271

Table 7.4 Table showing *lolong* platform to *lolong* enclosure footprint ratios.

Site	Islet Abr.	Structure	Width	Length	W to L Ratio
PoD24-37		lolong enclosure	8.024	9.982	0.804
PoD24-37		burial platform	3.341	3.388	0.986
PoB7-10		lolong enclosure	10.764	11.460	0.939
PoB7-10		burial platform	5.065	6.024	0.841
PoB7-39		lolong enclosure	14.930	20.109	0.742
PoB7-39		burial platform	5.302	5.763	0.920
PoB7-44		lolong enclosure	21.201	23.586	0.899
PoB7-44		burial platform	5.312	5.996	0.886
PoC3-5		lolong enclosure	19.746	25.236	0.782
PoC3-5		burial platform	4.264	4.703	0.907
PoC3-8		lolong enclosure	11.609	14.524	0.799
PoC3-8		burial platform	5.755	5.813	0.990
PoC3-1	ANG	F1 lolong enclosure	7.834	11.322	0.692
PoC3-1	ANG	F1 burial platform	4.166	4.941	0.843
PoC3-1	KAR	lolong enclosure	28.823	39.582	0.728
PoC3-1	KAR	cen. burial platform	5.059	6.459	0.783
PoC3-1	KAR	south burial platform	4.345	5.506	0.789
PoC3-1	LMK	F1 lolong enclosure	34.593	42.851	0.807
PoC3-1	LMK	F1 burial platform	5.284	6.699	0.789
PoC3-1	LMK	F18 lolong enclosure	14.400	17.638	0.816
PoC3-1	LMK	F18 burial platform	5.733	5.736	0.999
PoC3-1	LPK	F2 lolong enclosure	14.068	27.056	0.520
PoC3-1	LPK	F2 burial platform	3.628	6.487	0.559
PoC3-1	NDA	F1 lolong enclosure	22.192	29.164	0.761
PoC3-1	NDA	F1 burial platform	6.897	7.272	0.948
PoC3-1	NDA	F4 lolong enclosure	12.506	13.610	0.919
PoC3-1	NDA	F4 burial platform	5.054	6.100	0.829
PoC3-1	NDA	F5 lolong enclosure	10.895	31.067	0.351
PoC3-1	NDA	F5 burial platform	6.290	7.591	0.829
PoC3-1	PDI	lolong enclosure	11.620	11.626	0.999
PoC3-1	PDI	burial platform	2.980	4.469	0.667
PoC3-1	PEK	South lolong enclosure	13.007	15.127	0.860
PoC3-1	PEK	South burial platform	4.210	7.173	0.587
PoC3-1	PEK	Cen. lolong enclosure	10.523	14.521	0.725
PoC3-1	PEK	Cen. burial platform	5.000	6.210	0.805
PoC3-1	PEK	North lolong enclosure	23.188	30.505	0.760
PoC3-1	PEK	North burial platform	5.873	5.893	0.997

Table 7.5a Table showing width to length ratios for platforms and enclosing walls. Outliers highlighted in grey.

Site	Islet Abr.	Structure	Width	Length	W to L Ratio
PoC3-1	PWIA	F29 lolong enclosure	16.057	25.682	0.625
PoC3-1	PWIA	F29 burial platform	5.533	6.011	0.920
PoC3-1	PWIA	F30 lolong enclosure	13.617	17.813	0.764
PoC3-1	PWIA	F30 burial platform	6.973	8.611	0.810
PoD24-17		burial platform	6.424	7.186	0.894
PoC3-1	ANG	F2 burial platform	5.511	6.598	0.835
PoC3-1	PDA	F4 burial platform	4.436	4.607	0.963
PoC3-1	PDA	F9 burial platform	3.658	4.919	0.744
PoC3-1	PEE	burial platform	5.742	6.578	0.873
PoC3-1	PEO	burial platform	6.095	7.156	0.852
PoC3-1	PWIA	F18 house platform	5.143	5.337	0.964
PoC3-1	SOE	burial platform	3.871	4.965	0.780
PoC3-1	SPW	F2 burial platform	4.498	5.254	0.856
PoC3-1	SPW	F8 burial platform	4.247	5.609	0.757
PoC3-1	SWD	F2 burial platform	4.626	5.456	0.848

Table 7.5b Table showing width to length ratios for platforms and enclosing walls.

The second and final analysis is linked to the question of standardization of dimensional proportions. Width-to-length ratios were determined for each architectural component of these mortuary sites (Table 7.5). Based on the statistical analysis of these ratios, this variable is the most consistent of all the variables and dimensions discussed thus far. The ratios for most architectural features (95%) fall between 0.6 and 1. Over 85% of these structures have a ratio of 0.7 or higher, and all the variation below 0.7 is from architectural features at Nan Madol. In general these results show that mortuary features tend to be on the square side of rectangular. As with other variables, the variation in the width-to-length ratios is more restricted for structures on the main island (0.7 to 1). Isolated burial platforms also fall within the same range.

7.1.4 Size Rankings

In the first set of rankings individual structures were ranked based on volume calculations (refer to Table 7.6). Of the 31 structures analyzed here only 26 have height data.

In order to incorporate the five structures without height data, the average of the typical height range was used as a conservative estimate for the respective architectural elements.

Enclosing walls were separated from burial platforms in the first set of volume rankings to determine rankings for individual architectural components. The volume rankings for isolated platforms and *lolong* enclosing walls mirror the outlier analysis, as expected. One interesting pattern apparent in the enclosing wall rankings is that the *lolong* from the main island tend to fall within the middle of the rankings. This shows that main island *lolong* tend to be more modest than those constructed at Nan Madol, and represent what is considered

Site_No	IsletAbr	StrucType	PlatformVol	Wall Vol	Plat 2	Vol	Vol Rank
PoD24-37		lolong	7.22	26.60		33.81	21
PoB7-44		lolong	12.98	106.25		119.23	11
PoB7-39		lolong	31.08	129.79		160.87	9
PoB7-10		lolong	21.14	70.68		91.81	14
PoC3-8		lolong	10.10	34.52		44.62	17
PoC3-5		lolong	15.16	111.27		126.43	10
PoC3-1	ANG	lolong	7.51	32.28		39.78	18
PoC3-1	KARA	lolong	57.98	2971.55	16.97	3046.50	1
PoC3-1	LMK	lolong (F1)	24.60	316.04		340.64	5
PoC3-1	LMK	lolong (F18)	12.91	103.73		116.64	12
PoC3-1	LPK	lolong	14.45	212.94		227.39	7
PoC3-1	NDA	lolong (F1)	113.43	451.86		565.29	4
PoC3-1	NDA	lolong (F4)	18.70	19.44		38.14	19
PoC3-1	NDA	lolong (5)	56.37	45.07		101.44	13
PoC3-1	PDI	lolong platform	11.73	42.53		54.27	16
PoC3-1	PEK	North lolong	28.06	568.42		596.48	3
PoC3-1	PEK	Central lolong	17.58	66.38		83.96	15
PoC3-1	PEK	South lolong	25.31	136.79		162.10	8
PoC3-1	PWIA	lolong (F29)	99.60	723.23		822.83	2
PoC3-1	PWIA	lolong (F30)	74.57	265.15		339.72	6
PoD24-17		burial platform	24.92			24.92	22
PoC3-1	ANG	burial platform	19.54			19.54	24
PoC3-1	PDA	burial platform	12.45			12.45	26
PoC3-1	PDA	burial platform	11.11			11.11	27
PoC3-1	PEE	burial platform	21.23			21.23	23
PoC3-1	PEO	burial platform	14.65			14.65	25
PoC3-1	PWIA	house platform w/ burial	34.81			34.81	20
PoC3-1	SOE	burial platform	7.92			7.92	31
PoC3-1	SPW	burial platform	10.27			10.27	28
PoC3-1	SPW	burial platform	9.13			9.13	29
PoC3-1	SWD	burial platform	8.90			8.90	30

Table 7.6 Structure rankings based on total volume of each major architectural component. Estimates based on determined average height highlighted in grey.

the average size for *lolong*. The greater number of *lolong* enclosing walls falling between 50 to 150 m^3 supports the proposition about the mid-range *lolong* being more numerous than small or large *lolong*.

The platform rankings show that though there is overlap between the volume of stone used for isolated platforms and *lolong* platforms, *lolong* platforms comprise most of the structures ranked in the top 10. There is a grouping of isolated platforms that rank in the 20s. This patterning suggests that isolated burial platforms tend to be smaller than *lolong* platforms, but this is not always the case.

Combined volume rankings were determined in order to compare *lolong* as a group and to determine whether there was overlap in volume estimates for *lolong* and isolated burial platforms (Table 7.6). The ranking results surprisingly show that the largest isolated burial platforms use similar volumes of stone as the smallest *lolong*. The range of overlap occurs between 20 and 40 m^3.

Volume rankings do not account for the amount of space a structure occupies. Architectural footprint ranks were determined to see if they were consistent with the volume rankings (refer to Table 7.3). There is a clear gap between isolated burial platforms and *lolong* footprint sizes. Three of the four top ranked footprints also ranked in the top four of the volume rankings, and the lower ranked burial platforms are consistent in both. Ratios of volume to architectural footprint size were also calculated to determine if there is patterning in volume of stone to space (Table 7.7). The ratio results were highly variable (Cv 85%) and there was no clear patterning apparent.

The quantitative rankings and the ranking based on the qualitative analysis (Chapter 6) are not the same, but the results are similar as many of the highest and lowest ranking structures hold similar standing in each set of ranks. These comparisons show that architectural rankings vary based on which component is emphasized. The results are generally consistent, but the most accurate ranking would be one based on as many components as possible. This topic is further reviewed in relation to labor investment

calculations later in Chapter 8, as labor investment estimates account for both architectural construction styles and amounts of stone used.

Site_No	IsletAbr	StrucType	Vol	EstAreaM	Ratio
PoB7-10		lolong	91.81	189.09	0.49
PoB7-39		lolong	160.87	294.72	0.55
PoB7-44		lolong	119.23	460.78	0.26
PoC3-5		lolong	126.43	615.58	0.21
PoC3-8		lolong	44.62	161.92	0.28
PoD24-37		lolong	33.81	78.25	0.43
PoC3-1	ANG	lolong	39.78	99.85	0.40
PoC3-1	KARA	lolong	3046.50	1035.08	2.94
PoC3-1	LMK	lolong (F1)	340.64	1511.57	0.23
PoC3-1	LMK	lolong (F18)	116.64	267.15	0.44
PoC3-1	LPK	lolong	227.39	357.96	0.64
PoC3-1	NDA	Central lolong	565.29	632.35	0.89
PoC3-1	NDA	Southern lolong	101.44	325.07	0.31
PoC3-1	NDA	Northern lolong	57.29	149.03	0.38
PoC3-1	PDI	lolong	54.27	133.56	0.41
PoC3-1	PEK	Northern lolong	596.48	654.30	0.91
PoC3-1	PEK	Central lolong	83.96	151.06	0.56
PoC3-1	PEK	Southern lolong	162.10	196.01	0.83
PoC3-1	PWIA	lolong (F29)	822.83	404.74	2.03
PoC3-1	PWIA	lolong (F30)	339.72	224.58	1.51
PoC3-1	PWIA	house platform w/ burial	34.81	24.00	1.45
PoD24-17		burial platform	24.92	45.30	0.55
PoC3-1	PEE	burial platform	21.23	36.55	0.58
PoC3-1	ANG	burial platform	19.54	33.23	0.59
PoC3-1	PEO	burial platform	14.65	43.23	0.34
PoC3-1	PDA	burial platform	12.45	17.65	0.71
PoC3-1	PDA	burial platform	11.11	18.71	0.59
PoC3-1	SPW	burial platform	10.27	24.44	0.42
PoC3-1	SPW	burial platform	9.13	22.45	0.41
PoC3-1	SWD	burial platform	8.90	23.39	0.38
PoC3-1	SOE	burial platform	7.92	18.11	0.44

Table 7.7 Structure volume to architectural footprint ratios

7.2 Overview of Quantitative Results

Quantitative analysis has shown that there is significant variability in the size and scale of mortuary structures. Mortuary features from sites other than Nan Madol display less variability, which is indicative of Nan Madol's place as a socio-political center. Nearly all the outliers identified in these analyses are structures at Nan Madol, many of which are associated with Pohnpeian oral traditions. The outliers identified by the statistical analysis are not particularly surprising, but some structures which were expected to be outliers were not. There are two complexes comprised of multiple *lolong*, Nahndauwas and Pein Kitel, which do not consistently appear in the outlier analyses. The only architectural feature from these compounds that was immediately apparent in the statistical analyses was the platform in the central tomb of Nahndauwas. The platform from the northern tomb at Nahndauwas was only identified in the second round of outlier analysis on the volume calculations, and the enclosing walls for the northern tomb on Pein Kitel and the central tomb on Nahndauwas were identified in subsequent analyses. Statistics show that the enclosing wall of two smaller *lolong* on Nahndauwas and all the Pein Kitel tombs fall within the standard range of variation determined by these analyses. These results indicate that what is exceptional about these structures is that they are part of large mortuary compounds.

This analysis has shown that in addition to a general preference for more square plans over narrow rectangular ones, there is a typical range of variation for *lolong* and burial platforms. Groupings within this range should be indicative of status distinctions between clans or other groups in any given location. Some of the smallest *lolong* may be lower status, but they may also exhibit some of the earliest examples of this type of construction. The majority of the structures included in this discussion are from Nan Madol, which shows the potentially wide range of status distinctions between those who occupied or utilized the site.

Criteria 3 proposes that *lolong* wall height is linked to including some and excluding others from mortuary ritual. The creation of exclusivity is a tactic used by elites to reinforce

social divisions. The walls identified as outliers in this quantitative analysis are more likely to be components of elite structures. These structures include Karian, the central tomb on Nahndauwas, and both *lolong* on Pahnwi.

Criteria 4 primarily deals with labor investment, which is in part predicated on architectural scale. This chapter has defined outliers in regards to scale for 31 mortuary structures on Pohnpei. These analyses identified the outliers of scale as Karian, Lemenkau Feature 1, Nahndauwas Features 1 and 5, both *lolong* on Pahnwi, and Pein Kitel Feature 1. It is hypothesized that these outlier structures are more likely to be identified as potentially being built through coercive means under Criteria 4, which is further addressed in the next chapter.

7.3 Conclusions

This set of analyses has shown that there are trends apparent in all quantifiable architectural components. For instance a preference for more square shaped structures is clear when comparing length-to-width ratios. Variability in scale is indicative of social hierarchy through architectural construction. In this case scale is not limited to the area a structure occupied, but also the heights to which it was built. A building or structure with walls of unusual height may have an edifice that is just as impressive as or more impressive than a shorter structure occupying a larger area. Examining scalar variation within sites and settlement areas shows that a relative status hierarchy in architecture that mirrors the hierarchical structure of the society. This enables a discussion of which structures were mostly likely built utilizing coercive labor strategies.

Criteria 3 proposes that mortuary structures with the tallest walls are associated with high status and elite individuals, since high walls create a sense of exclusivity and limits the participation of some in mortuary rituals. The statistical analysis of structural wall height under Criteria 3 identified four structures as outliers which are more likely to have been constructed by elites. These include Karian, Nahndauwas Feature 1 and both *lolong* on Pahnwi. All of these structures are located at Nan Madol and all were also identified examining other

aspects of architectural scale (e.g. area, architectural footprint) as outliers. Of these four structures only one was not identified by the qualitative data as significant, the southern *lolong* on Pahnwi, primarily due to the large quantities of coral rubble used to construct the enclosing wall. The recurrence of the same structures in the results of each analysis strengthens the case for the use of coercion in labor mobilization for those structures. The next chapter deals specifically with labor investment estimates and sources of columnar stone to address Criteria 2 and 4. If the structures identified in the qualitative and statistical analyses as potential elite structures are identified again, there should be a good case for the use of coercive labor strategies and the potential scale with which they may have been deployed.

Chapter 8: Architecture and Labor Investment

Energetic calculations of labor associated with architectural constructions have long been used to understand social factors relating to resource and labor mobilization, and therefore answer questions about the size of the labor force and the management systems in place to complete a construction project (Abrams 1989; Abrams and Bolland 1999; Ayres and Scheller 2002; Erasmus 1965; Kolb 1994, 1997; Kolb and Snead 1997; Rolett 2010). It has been proposed that analysis of labor investment is more valuable than statistical comparisons of area and volume to discussions of these questions (Abrams 1989; Kolb 1997). Part of the reasoning behind the distinction made between analysis of raw quantitative data and labor investment estimates is that energetics considers the behavior related to the construction of structures (e.g. materials acquisition and transport) and not just the structures in a vacuum.

This chapter presents labor investment estimates for 27 structures for which there is available data on the volume of stone used in construction. It then compares the results of the analysis of the labor investment estimates with the quantitative results. This chapter also examines the geochemistry of columnar stone to determine the number of potential sources used in specific structures and examine geochemical data as a means to refine labor investment estimates for those structures.

8.1 Labor Investment Estimates

Labor investment calculations are estimates of time spent on a specific building or construction project. Activities which need to be accounted for include the acquisition of resources, transport of construction materials, and the time invested in construction. Labor investment calculations derived from archaeological data can only be considered as estimates, since it is not typically possible to account for every variable tied to the processes involved (Abrams 1989; Abrams and Bolland 1999; Kolb 1994, 1997; Kolb and Snead 1997). Regardless of this limitation, each activity in the construction process has its own unique factors which

must be considered in addition to the mobilization of labor. Historic, ethnographic and experimental observations are invaluable to refining estimates of labor investment where they are available, because they can provide key information on the factors involved in each stage of the construction process (e.g. Abrams and Bolland 1999; Ayres and Scheller 2002).

8.1.1 Acquisition of Materials and Resources

The acquisition of materials is very much based on access to the sources of those materials and the time involved in obtaining them. Some materials, such as basalt boulders or coral rubble, may be relatively easy to access due to their wide geographic distribution and therefore, would not necessarily require negotiation with clan members or other groups to access them. On the other hand, columnar basalt is not evenly distributed on Pohnpei, and is a limited access material. Limited access materials are more likely to be considered to have higher value or status. Therefore, access to columnar basalt outcrops or quarries was likely negotiated along clan ties and inter-group connections. Access and use privileges were probably more easily obtained by elites who had larger social networks than lower status individuals. Building materials may also be acquired through the recycling of stone from older, disused structures (Abrams and Bolland 1999; Ayres and Scheller 2002). Recycling of materials was more likely to occur as a way to mitigate limited access to quarries or to lower labor costs preceding and following a period of socio-political centralization. The impact of political centralization on stone acquisition is most apparent at the seat of power, the center, since there should be no quarry access restrictions for polity projects because of the participation of the paramount. Therefore, power centers should have evidence for the use of many quarries rather than a limited set of quarries. Other non-paramount construction projects may retain the previous pattern which indicated that resource access may have been limited to those undertaking personal endeavors to increase their individual notoriety.

Time spent negotiating access to specific resources is compounded by the time it takes to acquire materials. In the case of Pohnpeian mortuary structures, much of the effort

put in to the acquisition of building materials was in the quarrying of basalt stone and coral rubble. It is possible that there were perishable structures associated with these burial structures, though no direct archaeological evidence has been uncovered. Columnar basalt was likely obtained through the use of heat and cool water to fracture pieces from the outcrop (Ayres pers. comm.). Quarrying of this sort would have been necessary since it is unlikely there were enough stones scattered loose near any given outcrop to complete many structures. The acquisition of boulders or basalt cobbles is significantly less involved; at most boulders or cobbles were excavated from the landscape for use in construction. Coral rubble provided other challenges because it had to be dredged from the lagoon during low tides. Once these materials are acquired they must be transported to the building location.

8.1.2 Transport of Construction Materials

The transportation of materials to construction sites can be broken down into the distance to be covered, the terrain involved, and the method of transportation. For Pohnpei it has been proposed that boulders used in construction were typically acquired relatively near to the planned building site, while columns used in constructions, particularly at Nan Madol, may have been transported from up to 30 km away (see Ayres and Scheller 2002). The distance coral rubble was transported is tied to the distance between the coastal dredging location and the construction site. Construction materials were transported over a range of distances for reasons both practical and social. In the case of columnar basalt, the closest source was not necessarily the most accessible. As already noted, social networks and clan affiliations probably established trade connections between groups, with the exception of a centralized paramount leader who could bypass these networks. Without direct evidence tying construction materials to their sources, proposed distance figures are only estimates.



Figure 8.1 Pohnpeians carrying a sakau stone using the litter method of transport (From Ayres and Scheller 2002).

Terrain and features in the landscape also contribute to transportation challenges. They affect both the time it takes to transport materials and the method of transportation. Based on experimental studies and sparse ethnographic evidence Ayres and Scheller (2002) suggest three probable modes of transportation: carrying stones using litter-like rigs (Figure 8.1), dragging stone via sledges or runners, and the floatation of materials on rafts or canoes. These methods were deemed most likely due to the hilly terrain of Pohnpei and the lack of carts or large livestock in prehistory. The stone carrying technique is still used on the island to transport heavy items (i.e. yams and *sakau* stones).

8.1.3 Construction Time

The amount of time it takes to construct a structure is based on the style and method of construction and the number of people participating in the construction. There are three primary architectural styles used in mortuary structures: header-stretcher, stacked boulder/cobble construction, and boulder construction with columnar basalt facing. General observations about which architectural styles were more labor intensive can be made. However, without ethnohistoric and/or ethnographic accounts or experimental projects

outlining construction methods and duration of building phases, it is difficult to determine accurate estimates of labor investment. An understanding of construction methods and comparative data from similar constructions can be valuable in mitigating gaps in existing datasets until further studies can be undertaken within the appropriate cultural context. There is some evidence for the use of levers and counter-weights in the Pohnpeian context (see Ayres and Scheller 2002:113-114), and this evidence paired with energetic expenditure data from other stacked stone architectural sites will provide a starting point for estimating the labor involved in architectural building projects on Pohnpei.

There are many practical hurdles which need to be overcome to develop reasonable labor investment calculations, which have been illustrated here. Recognizing the variables that need to be considered is the relatively straightforward part of the endeavor. Researchers have realized that labor costs involved in traditional building construction cannot be accurately estimated with modern analogs. Experimental studies have been invaluable in refining variables associated with material acquisition, transport of materials, and construction time (see Ayres and Scheller 2002; Erasmus 1965; Sand et al. 2002). Ayres' work (see Ayres and Scheller 2002) is particularly relevant to this discussion of labor investment as it is particularly concerned with Pohnpeian estimates.

8.1.4 Investment and Pohnpeian Architecture

It is not possible to reconstruct every aspect of the construction processes for prehistoric structures, but it is possible to obtain a reasonable estimate of labor investment. As Abrams and Bolland (1999:267) state, "what is required is (1) a general knowledge of the elements of the building itself and (2) an identification of the major (i.e. most costly) activities responsible for those elements." The goal of these calculations is not a perfect reconstruction of each element and factor, but a reasonably accurate estimation of the labor input and variables involved in prehistoric construction projects. The purpose of this analysis is to attempt the first detailed estimates of labor investment for architectural features on Pohnpei.

What I outline here are the variables and constraints that need to be considered and how they are addressed in the analysis.

8.1.4.1 Mass Estimates from Volume Calculations

It is necessary to account for each construction material to achieve accurate labor investment estimates. The volume estimates derived from the maps presented in the previous section account for the total volume per structure, but they need to be broken down by component. The following provides an overview of how the mass calculations for each construction material were obtained.

In order to complete these labor investment calculations it is necessary to estimate the mass for the volume of stone used in each structure (n=27). The estimates for kilograms per cubic meter (kg/m^3) for columnar basalt and basalt boulders were taken from Ayres and Scheller (2002:120). As there are no specific estimates for the mass per volume of coral rubble currently published, a value was derived by calculating the mass per volume of a set of coral fragments of varying densities. The results of these experiments were averaged to determine a standard for mass per volume for coral rubble. See Table 8.1 for the mass per volume estimates for these materials.

Stone Type	Mass (kg/m^3)
Columnar Basalt	2,900
Basalt Boulders	2,700
Coral Rubble	1,700

Table 8.1 Stone mass estimates for different construction materials.

Percentage estimates of the amount of each type of building stone contributing to the overall volume of each structure were determined using maps, photographs and site descriptions. The total mass of each construction material in individual structures was derived from these percentages (see Table 8.2). These mass estimates are integral to calculating the labor investment for each phase of the construction process.

8.1.4.2 Stone Acquisition

For the purpose of this study it is assumed that the primary method for stone acquisition was digging and levering boulders and stones from the landscape using poles. The estimates used for this part of the analysis are based on experimental data produced by Erasmus (1965:286) under similar constraints to those faced on Pohnpei for acquiring boulders. The experiment showed that one man was able to quarry 1,700 kg of stone over a five hour period, providing an hourly estimate of 340 kg using a wood post. In order to account for quarrying coral rubble and columnar basalt, estimates for these materials have been adjusted to show that two (or more) people would have been needed to quarry that same amount of material as one individual quarrying basalt boulders (i.e. what was initially listed as the effort of one man was switched to two, and doubled to indicate the realistic time it would have taken one individual).

The labor invested in quarry time appears reasonable for most of the structures involved in this study (see Table 8.3). All the material necessary for constructing isolated burial platforms, including the Pahnwi house platform, could be quarried by five men in 70 hours or less. The materials for two of the *lolong* could have been quarried by five men in 100 hours or less, while the quarrying for two more could be accomplished by 10 men in the same time frame. Twenty men could have quarried the materials for seven of the remaining 13 *lolong* in 200 hours or less. All of the structures that would have required more than 20 men to quarry the materials are located at Nan Madol. Nearly all of the isolated burial platforms examined here are also located at Nan Madol, so little can be said about what may have been typical elsewhere. However, the estimate for PoD24-17 is within the range of the Nan Madol platforms.

8.1.4.3 Materials Transport

As previously discussed, the distance traveled and the method of transport are two primary factors involved in the transport of construction materials from quarry to

construction site. Terrain is an additional factor, which in this study is subsumed in the calculations of transport time using a specific method.

The distance over which materials must be transported to these sites is highly variable. Ayres and Scheller (2002:112-113) note that basalt boulders and cobbles were locally obtained, while columnar basalt, especially that used at Nan Madol, may have been transported from up to 30 km away. For the purpose of this analysis, what are considered two reasonable sets of distance estimates have been used? The first set of estimates is for the sites located on the main island: one km for basalt boulders, five km for columnar basalt, and five km for coral rubble. The second set of estimates is for the structures at Nan Madol: five km for basalt columns and boulders and one km for coral rubble.

There are multiple possibilities for methods of stone transport (see above). There is generally little published data on stone transportation, though there is some published information on litter and sledge transport in the Pacific which allows for estimates of transportation times to be calculated for stone used in architectural features (Ayres and Scheller 2002; Spennemann 2002). These calculations only account for transportation time, not the time to collect lashing materials or timber for rig construction.

The litter method will be addressed first since the experimental data was acquired on Pohnpei, and it is likely the most labor intensive form of materials transport. The assumption for the first set of analyses is that all construction material was carried by the litter method. These transportation calculations are based on Ayres' and Scheller's (2002:114-115) data from the *sakau* stone transportation experiment using additional information provided by Ayres (pers. comm.) to produce a more detailed timeline for the process. The transportation time of a 380 kg stone over a 150 m distance by 12 men was 45 minutes. This suggests that a single individual could be expected to carry 32 kg of stone one km over a five hour time frame. This data provides the foundation for the stone transportation calculations. The litter method calculations (Table 8.4) show that it requires over 100 hours and up to hundreds of thousands of hours for 50 men to transport the materials required to build any of the structures analyzed

Site_No	IsletAbr	Structure Type	Vol	Construction Components	Vol CB	Vol B	Vol CR	Mass CB	Mass B	Mass CR	Total Mass
PoB7-44		lolong wall	106.25	95% B, 5% CB	5.31	100.94	0.00	15,406.33	272,532.58	0.00	287,938.90
PoB7-44		lolong platform	12.98	90% B, 10% CB	1.30	11.68	0.00	3,763.85	31,538.47	0.00	35,302.32
PoB7-39		lolong wall	129.79	85% B, 15% CB	19.47	110.32	0.00	56,457.51	297,862.04	0.00	354,319.55
PoB7-39		lolong platform	31.08	90% B, 10% CB	3.11	27.98	0.00	9,014.35	75,534.05	0.00	84,548.40
PoB7-10		lolong wall	70.68	90% B, 10%CB	7.07	63.61	0.00	20,496.26	171,744.55	0.00	192,240.81
PoB7-10		lolong platform	21.14	90% B, 10% CB	2.11	19.02	0.00	6,129.54	51,361.33	0.00	57,490.88
PoC3-8		lolong wall	34.52	100% B	0.00	34.52	0.00	0.00	93,211.07	0.00	93,211.07
PoC3-8		lolong platform	10.10	100% B	0.00	10.10	0.00	0.00	27,273.81	0.00	27,273.81
PoC3-5		lolong wall	111.27	90% B, 10%CB	11.13	100.15	0.00	32,268.99	270,391.90	0.00	302,660.89
PoC3-5		lolong platform	15.16	85% CB, 15% B	12.88	2.27	0.00	37,363.44	6,138.82	0.00	43,502.26
PoC3-1	ANG	F1 lolong wall	32.28	30% CB, 35% B, 35% CR	9.68	11.30	11.30	28,079.30	30,499.93	19,203.66	77,782.89
PoC3-1	ANG	F1 lolong platform	7.51	80% CR, 20% B	0.00	1.50	6.01	0.00	4,054.11	10,210.34	14,264.44
PoC3-1	KARA	lolong wall	2,971.55	85% CB, 8% CR, 7%B	2,525.81	208.01	237.72	7,324,859.94	561,622.12	404,130.20	8,290,612.27
PoC3-1	KARA	Central lolong platform	57.98	75% CB, 25% B	43.49	14.50	0.00	126,114.05	39,138.84	0.00	165,252.90
PoC3-1	KARA	South lolong platform	16.97	10% CB, 90% CR	1.70	0.00	15.27	4,920.93	0.00	25,962.15	30,883.08
PoC3-1	LMK	F18 lolong wall	103.73	85% CB, 8% CR, 7%B	88.17	7.26	8.30	255,705.12	19,605.79	14,107.87	289,418.78
PoC3-1	LMK	F18 lolong platform	12.91	50% CB, 50% B	6.45	6.45	0.00	18,717.05	17,426.22	0.00	36,143.26
PoC3-1	LMK	F1 lolong wall	316.04	85% CB, 8% CR, 7%B	268.63	22.12	25.28	779,033.71	59,731.19	42,981.17	881,746.07
PoC3-1	LMK	F1 lolong platform	24.60	50% CB, 50% B	12.30	12.30	0.00	35,666.06	33,206.33	0.00	68,872.39
PoC3-1	LPK	F2 lolong wall	212.94	90% CR, 3% CB, 7% B	6.39	14.91	191.65	18,525.70	40,245.49	325,796.84	384,568.03
PoC3-1	LPK	F2 lolong platform	14.45	50% B, 35% CR, 15%CB	2.17	7.23	5.06	6,286.75	19,510.60	8,599.12	34,396.46
PoC3-1	NDA	F1 lolong wall	451.86	85% CB, 8% CR, 7%B	384.08	31.63	36.15	1,113,834.58	85,401.52	61,452.94	1,260,689.03
PoC3-1	NDA	F1 lolong platform	113.43	90% CB, 10% B	102.09	11.34	0.00	296,058.15	30,626.70	0.00	326,684.85
PoC3-1	PDI	lolong wall	42.53	60% B, 40% CB	17.01	25.52	0.00	49,339.46	68,905.10	0.00	118,244.56
PoC3-1	PDI	lolong platform	11.73	60% B, 40% CB	4.69	7.04	0.00	13,608.72	19,055.28	0.00	32,614.01

Table 8.2a Table of mass estimates for mortuary architecture.

Site_No	IsletAbr	Structure Type	Vol	Construction Components	Vol CB	Vol B	Vol CR	Mass CB	Mass B	Mass CR	Total Mass
PoC3-1	PEK	South lolong wall	136.79	85% CB, 8% CR, 7%B	116.27	9.57	10.94	337,176.74	25,852.50	18,602.85	381,632.09
PoC3-1	PEK	South lolong platform	25.31	85% CB, 15% B	21.52	3.80	0.00	62,400.72	10,252.45	0.00	72,653.17
PoC3-1	PEK	Central lolong wall	66.38	85% CB, 8% CR, 7%B	56.42	4.65	5.31	163,624.50	12,545.65	9,027.56	185,197.71
PoC3-1	PEK	Central lolong platform	17.58	85% CB, 15% B	14.95	2.64	0.00	43,344.91	7,121.58	0.00	50,466.49
PoC3-1	PEK	North lolong wall	568.42	85% CB, 8% CR, 7%B	483.16	39.79	45.47	1,401,165.80	107,432.18	77,305.70	1,585,903.68
PoC3-1	PEK	North lolong platform	28.06	90% CB, 10% B	25.25	2.81	0.00	73,223.98	7,574.89	0.00	80,798.88
PoC3-1	PWIA	F29 lolong wall	723.23	65% CR, 30% CB, 5% B	216.97	36.16	470.10	629,206.13	97,635.43	799,164.11	1,526,005.67
PoC3-1	PWIA	F29 lolong platform	99.60	60% CB, 40% B	59.76	39.84	0.00	173,308.82	107,570.99	0.00	280,879.82
PoC3-1	PWIA	F30 lolong wall	265.15	85% CB, 8% CR, 7%B	225.38	18.56	21.21	653,591.67	50,113.11	36,060.23	739,765.02
PoC3-1	PWIA	F30 lolong platform	74.57	85% CB, 8% CR, 7%B	63.38	5.22	5.97	183,806.78	14,093.10	10,141.06	208,040.94
PoD24-17		burial platform	24.92	99% B, 1% CB	0.25	24.67	0.00	722.71	66,613.70	0.00	67,336.41
PoC3-1	ANG	F2 burial platform	19.54	75% CR, 25% B	0.00	4.89	14.66	0.00	13,190.73	24,915.82	38,106.55
PoC3-1	PDA	F4 burial platform	11.11	75% CB, 25% B	8.34	2.78	0.00	24,172.92	7,501.94	0.00	31,674.85
PoC3-1	PEE	burial platform	21.23	55% B, 45% CR	0.00	11.68	9.55	0.00	31,526.80	16,241.08	47,767.88
PoC3-1	PWIA	house platform w/ burial	34.81	50% B, 45%CR, 5% CB	1.74	17.40	15.66	5,046.83	46,987.74	26,626.38	78,660.95
PoC3-1	PEO	burial platform	14.65	95% B, 5% CB	0.73	13.92	0.00	2,124.36	37,579.12	0.00	39,703.48
PoC3-1	SOE	burial platform	7.92	95% B, 5% CB	0.40	7.53	0.00	1,148.75	20,320.94	0.00	21,469.68
PoC3-1	SPW	F2 burial platform	10.27	95% B, 5% CB	0.51	9.76	0.00	1,489.14	26,342.37	0.00	27,831.51
PoC3-1	SPW	F8 burial platform	9.13	95% B, 5% CB	0.46	8.67	0.00	1,323.82	23,417.86	0.00	24,741.68
PoC3-1	SWD	burial platform	8.90	95% B, 5% CB	0.45	8.46	0.00	1,290.89	22,835.46	0.00	24,126.36

Table 8.2b Table of mass estimates for mortuary architecture.

						Quarry Time for 1 man				5 men				10 men				25 men			
Site_No	IsletAbr	Structure Type	Mass CB	Mass B	Mass CR	QT CB	QT B	QT CR	Total	QT CB	QT B	QT CR	Total	QT CB	QT B	QT CR	Total	QT CB	QT B	QT CR	Total
PoB7-44		lolong wall	15,406.33	272,532.68	0.00	90.63	801.57	0.00	892.19	18.13	160.31	0.00	178.44	9.06	80.16	0.00	89.22	3.63	32.06	0.00	35.69
PoB7-44		lolong platform	3,763.85	31,538.47	0.00	22.14	92.76	0.00	114.90	4.43	18.55	0.00	22.98	2.21	9.28	0.00	11.49	0.89	3.71	0.00	4.60
									1,007.09				201.42				100.71				40.28
PoB7-39		lolong wall	56,457.51	297,862.04	0.00	332.10	876.06	0.00	1,208.17	66.42	175.21	0.00	241.63	33.21	87.61	0.00	120.82	13.28	35.04	0.00	48.33
PoB7-39		lolong platform	9,014.35	75,534.05	0.00	53.03	222.16	0.00	275.18	10.61	44.43	0.00	55.04	5.30	22.22	0.00	27.52	2.12	8.89	0.00	11.01
									1,483.35				296.67				148.34				59.33
PoB7-10		lolong wall	20,496.26	171,744.55	0.00	120.57	505.13	0.00	625.70	24.11	101.03	0.00	125.14	12.06	50.51	0.00	62.57	4.82	20.21	0.00	25.03
PoB7-10		lolong platform	6,129.54	51,361.33	0.00	36.06	151.06	0.00	187.12	7.21	30.21	0.00	37.42	3.61	15.11	0.00	18.71	1.44	6.04	0.00	7.48
									812.82				162.56				81.28				32.51
PoC3-8		lolong wall	0.00	93,211.07	0.00	0.00	274.15	0.00	274.15	0.00	54.83	0.00	54.83	0.00	27.42	0.00	27.42	0.00	10.97	0.00	10.97
PoC3-8		lolong platform	0.00	27,273.81	0.00	0.00	80.22	0.00	80.22	0.00	16.04	0.00	16.04	0.00	8.02	0.00	8.02	0.00	3.21	0.00	3.21
									354.37				70.87				35.44				14.17
PoC3-5		lolong wall	32,268.99	270,391.90	0.00	189.82	795.27	0.00	985.09	37.96	159.05	0.00	197.02	18.98	79.53	0.00	98.51	7.59	31.81	0.00	39.40
PoC3-5		lolong platform	37,363.44	6,138.82	0.00	219.78	18.06	0.00	237.84	43.96	3.61	0.00	47.57	21.98	1.81	0.00	23.78	8.79	0.72	0.00	9.51
									1,222.93				244.59				122.29				48.92
PoC3-1	ANG	F1 lolong wall	28,079.30	30,499.93	19,203.66	165.17	89.71	112.96	367.84	33.03	17.94	22.59	73.57	16.52	8.97	11.30	36.78	6.61	3.59	4.52	14.71
PoC3-1	ANG	F1 lolong platform	0.00	4,054.11	10,210.34	0.00	11.92	60.06	71.98	0.00	2.38	12.01	14.40	0.00	1.19	6.01	7.20	0.00	0.48	2.40	2.88
									439.83				87.97				43.98				17.59
PoC3-1	KARA	lolong wall	7,324,859.94	561,622.12	404,130.20	43,087.41	1,651.83	2,377.24	47,116.48	8,617.48	330.37	475.45	9,423.30	4,308.74	165.18	237.72	4,711.65	1,723.50	66.07	95.09	1,884.66
PoC3-1	KARA	Central lolong platform	126,114.05	39,138.84	0.00	741.85	115.11	0.00	856.96	148.37	23.02	0.00	171.39	74.18	11.51	0.00	85.70	29.67	4.60	0.00	34.28
PoC3-1	KARA	South lolong platform	4,920.93	0.00	25,962.15	28.95	0.00	152.72	181.67	5.79	0.00	30.54	36.33	2.89	0.00	15.27	18.17	1.16	0.00	6.11	7.27
									48,115.10				9,631.02				4,815.51				1,926.20
PoC3-1	LMK	F18 lolong wall	255,705.12	19,605.79	14,107.87	1,504.15	57.66	82.99	1,644.80	300.83	11.53	16.60	328.96	150.41	5.77	8.30	164.48	60.17	2.31	3.32	65.79
PoC3-1	LMK	F18 lolong platform	18,717.05	17,426.22	0.00	110.10	51.25	0.00	161.35	22.02	10.25	0.00	32.27	11.01	5.13	0.00	16.14	4.40	2.05	0.00	6.45
									1,806.15				361.23				180.62				72.25
PoC3-1	LMK	F1 lolong wall	779,033.71	59,731.19	42,981.17	4,582.55	175.68	252.83	5,011.06	916.51	35.14	50.57	1,002.21	458.26	17.57	25.28	501.11	183.30	7.03	10.11	200.44
PoC3-1	LMK	F1 lolong platform	35,666.06	33,206.33	0.00	209.80	97.67	0.00	307.47	41.96	19.53	0.00	61.49	20.98	9.77	0.00	30.75	8.39	3.91	0.00	12.30
									5,318.53				1,063.71				531.85				212.74
PoC3-1	LPK	F2 lolong wall	18,525.70	40,245.49	325,796.84	108.97	118.37	1,916.45	2,143.80	21.79	23.67	383.29	428.76	10.90	11.84	191.65	214.38	4.36	4.73	76.66	85.75
PoC3-1	LPK	F2 lolong platform	6,286.75	19,510.60	8,599.12	36.98	57.38	50.58	144.95	7.40	11.48	10.12	28.99	3.70	5.74	5.06	14.49	1.48	2.30	2.02	5.80
									2,288.74				457.75				228.87				91.55
PoC3-1	NDA	F1 lolong wall	1,113,834.58	85,401.52	61,452.94	6,551.97	251.18	361.49	7,164.64	1,310.39	50.24	72.30	1,432.93	655.20	25.12	36.15	716.46	262.08	10.05	14.46	286.59
PoC3-1	NDA	F1 lolong platform	296,058.15	30,626.70	0.00	1,741.52	90.08	0.00	1,831.60	348.30	18.02	0.00	366.32	174.15	9.01	0.00	183.16	69.66	3.60	0.00	73.26
									8,996.23				1,799.25				899.62				359.85
PoC3-1	PDI	lolong wall	49,339.46	68,905.10	0.00	290.23	202.66	0.00	492.89	58.05	40.53	0.00	98.58	29.02	20.27	0.00	49.29	11.61	8.11	0.00	19.72
PoC3-1	PDI	lolong platform	13,608.72	19,005.28	0.00	80.05	55.90	0.00	135.95	16.01	11.18	0.00	27.20	8.01	5.59	0.00	13.59	3.20	2.24	0.00	5.44
									628.84				125.77				62.88				25.15

Table 8.3a Estimates of hours spent quarrying stone. Totals highlighted in grey.

						Quarry Time for 1 man				5 men				10 men				25 men			
Site_No	IsletAbr	Structure Type	Mass CB	Mass B	Mass CR	QT CB	QT B	QT CR	Total	QT CB	QT B	QT CR	Total	QT CB	QT B	QT CR	Total	QT CB	QT B	QT CR	Total
PoC3-1	PEK	South lolong wall	337,176.74	25,852.50	18,602.85	1,983.39	76.04	109.43	2,168.86	396.68	15.21	21.89	433.77	198.34	7.60	10.94	216.89	79.34	3.04	4.38	86.75
PoC3-1	PEK	South lolong platform	62,400.72	10,252.45	0.00	367.06	30.15	0.00	397.22	73.41	6.03	0.00	79.44	36.71	3.02	0.00	39.72	14.68	1.21	0.00	15.89
									2,566.08				513.22				256.61				102.64
PoC3-1	PEK	Central lolong wall	163,624.50	12,545.65	9,027.56	962.50	36.90	53.10	1,052.50	192.50	7.38	10.62	210.50	96.25	3.69	5.31	105.25	38.50	1.48	2.12	42.10
PoC3-1	PEK	Central lolong platform	43,344.91	7,121.58	0.00	254.97	20.95	0.00	275.92	50.99	4.19	0.00	55.18	25.50	2.09	0.00	27.59	10.20	0.84	0.00	11.04
									1,328.42				265.68				132.84				53.14
PoC3-1	PEK	North lolong wall	1,401,165.80	107,432.18	77,305.70	8,242.15	315.98	454.74	9,012.87	1,648.43	63.20	90.95	1,802.57	824.22	31.60	45.47	901.29	329.69	12.64	18.19	360.51
PoC3-1	PEK	North lolong platform	73,223.98	7,574.90	0.00	430.73	22.28	0.00	453.01	86.15	4.46	0.00	90.60	43.07	2.23	0.00	45.30	17.23	0.89	0.00	18.12
									9,465.88				1,893.18				946.59				378.64
PoC3-1	PWIA	F30 lolong wall	653,591.67	50,113.11	36,060.23	3,844.66	147.39	212.12	4,204.17	768.93	29.48	42.42	840.83	384.47	14.74	21.21	420.42	153.79	5.90	8.48	168.17
PoC3-1	PWIA	F30 lolong platform	183,806.78	14,093.10	10,141.06	1,081.22	41.45	59.65	1,182.32	216.24	8.29	11.93	236.46	108.12	4.15	5.97	118.23	43.25	1.66	2.39	47.29
									5,386.49				1,077.30				538.65				215.46
PoC3-1	PWIA	F29 lolong wall	629,206.13	97,635.43	799,164.11	3701.21	287.16	4,700.97	8,689.34	740.24	57.43	940.19	1,737.87	370.12	28.72	470.10	868.93	148.05	11.05	188.04	347.57
PoC3-1	PWIA	F29 lolong platform	173,308.82	107,570.99	0.00	1,019.46	316.39	0.00	1,335.85	203.89	63.28	0.00	267.17	101.95	31.64	0.00	133.58	40.78	12.66	0.00	53.43
									10,025.19				2,005.04				1,002.52				401.01
PoD24-17		burial platform	722.71	66,613.70	0.00	4.25	195.92	0.00	200.17	0.85	39.18	0.00	40.03	0.43	19.59	0.00	20.02	0.17	7.84	0.00	8.01
PoC3-1	ANG	burial platform	0.00	13,190.73	24,915.82	0.00	38.80	146.56	185.36	0.00	7.76	29.31	37.07	0.00	3.88	14.66	18.56	0.00	1.55	5.86	7.41
PoC3-1	PDA	burial platform	24,172.92	7,501.94	0.00	142.19	22.06	0.00	164.26	28.44	4.41	0.00	32.85	14.22	2.21	0.00	16.43	5.69	0.88	0.00	6.57
PoC3-1	PEE	burial platform	0.00	31,526.80	16,241.08	0.00	92.73	95.54	188.26	0.00	19.92	19.11	39.03	0.00	9.27	9.55	18.83	0.00	3.71	3.82	7.53
PoC3-1	PEO	burial platform	2,124.36	37,579.12	0.00	12.50	110.53	0.00	123.02	2.50	22.11	0.00	24.60	1.25	11.05	0.00	12.30	0.50	4.42	0.00	4.92
PoC3-1	PWIA	house platform w/ burial	5,046.83	46,987.74	26,626.38	29.69	138.20	156.63	324.51	5.94	27.64	31.33	64.90	2.97	13.82	15.66	32.45	1.19	5.53	6.27	12.98
PoC3-1	SOE	burial platform	1,148.75	20,320.94	0.00	6.76	59.77	0.00	66.52	1.35	11.95	0.00	13.30	0.68	5.98	0.00	6.65	0.27	2.39	0.00	2.66
PoC3-1	SPW	burial platform (F2)	1,489.14	26,342.37	0.00	8.76	77.48	0.00	86.24	1.75	15.50	0.00	17.25	0.88	7.75	0.00	8.62	0.35	3.10	0.00	3.45
PoC3-1	SPW	burial platform (F8)	1,323.82	23,417.86	0.00	7.79	68.88	0.00	76.66	1.56	13.78	0.00	15.33	0.78	6.89	0.00	7.67	0.31	2.76	0.00	3.07
PoC3-1	SWD	burial platform	1,290.89	22,835.46	0.00	7.59	67.13	0.00	74.76	1.52	13.43	0.00	14.95	0.76	6.72	0.00	7.48	0.30	2.69	0.00	3.99

Table 8.3b Estimates of hours spent quarrying stone. Totals highlighted in grey.

			Loads of 380 kg			Hours if 1 man				Hours if 10				Hours if 25			
Site_No	IsletAbr	Structure Type	CB Loads	B Loads	CR Loads	CB	B	CR	Total	CB	B	CR	Total	CB	B	CR	Total
PoB7-44		lolong wall	40.54	717.19	0.00	12,162.89	43,031.46	0.00	55,194.35	1,216.29	4,303.15	0.00	5,519.44	486.52	1,721.26	0.00	2,207.77
PoB7-44		lolong platform	9.90	83.00	0.00	2,971.46	4,979.76	0.00	7,951.22	297.15	497.98	0.00	795.12	118.86	199.19	0.00	318.05
									63,145.57				6,314.56				2,525.82
PoB7-39		lolong wall	148.57	783.85	0.00	44,571.72	47,030.85	0.00	91,602.57	4,457.17	4,703.09	0.00	9,160.26	1,782.87	1,881.23	0.00	3,664.10
PoB7-39		lolong platform	23.72	198.77	0.00	7,116.59	11,926.43	0.00	19,043.02	711.66	1,192.64	0.00	1,904.30	284.66	477.06	0.00	761.72
									110,645.59				11,064.56				4,425.82
PoB7-10		lolong wall	53.94	451.96	0.00	16,181.26	27,117.56	0.00	43,298.82	1,618.13	2,711.76	0.00	4,329.88	647.25	1,084.70	0.00	1,731.95
PoB7-10		lolong platform	16.13	135.16	0.00	4,839.11	8,109.68	0.00	12,948.79	483.91	810.97	0.00	1,294.88	193.56	324.39	0.00	517.95
									56,247.62				5,624.76				2,249.91
PoC3-8		lolong wall	0.00	245.29	0.00	0.00	14,717.54	0.00	14,717.54	0.00	1,471.75	0.00	1,471.75	0.00	588.70	0.00	588.70
PoC3-8		lolong platform	0.00	71.77	0.00	0.00	4,306.39	0.00	4,306.39	0.00	430.64	0.00	430.64	0.00	172.26	0.00	172.26
									19,023.93				1,902.39				760.96
PoC3-5		lolong wall	84.92	711.56	0.00	25,475.52	42,693.46	0.00	68,168.98	2,547.55	4,269.35	0.00	6,816.90	1,019.02	1,707.74	0.00	2,726.76
PoC3-5		lolong platform	98.32	16.15	0.00	29,497.45	969.29	0.00	30,466.74	2,949.75	96.93	0.00	3,046.67	1,179.90	38.77	0.00	1,218.67
									98,635.72				9,863.57				3,945.43
PoC3-1	PEK	South lolong wall	887.31	68.02	48.95	266,192.16	20,409.87	2,937.29	289,539.32	26,619.22	2,040.99	293.73	28,953.93	10,647.69	816.39	117.49	11,581.57
PoC3-1	PEK	South lolong platform	164.21	26.98	0.00	49,263.73	8,094.04	0.00	57,357.77	4,926.37	809.40	0.00	5,735.78	1,970.55	323.76	0.00	2,294.31
									346,897.09				34,689.71				13,875.88
PoC3-1	PEK	Central lolong wall	430.59	33.01	23.76	129,177.24	9,904.46	1,425.40	140,507.10	12,917.72	990.45	142.54	14,050.71	5,167.09	396.18	57.02	5,620.28
PoC3-1	PEK	Central lolong platform	114.07	18.74	0.00	34,219.67	5,622.30	0.00	39,841.97	3,421.97	562.23	0.00	3,984.20	1,368.79	224.89	0.00	1,593.68
									180,349.07				18,034.91				7,213.96
PoC3-1	PEK	North lolong wall	3,687.28	282.72	203.44	1,106,183.52	84,814.88	12,206.16	1,203,204.57	110,618.35	8,481.49	1,220.62	120,320.46	44,247.34	3,392.60	488.25	48,128.18
PoC3-1	PEK	North lolong platform	192.69	19.93	0.00	57,808.41	5,980.18	0.00	63,788.59	5,780.84	598.02	0.00	6,378.86	2,312.34	239.21	0.00	2,551.54
									1,266,993.16				126,699.32				50,679.73
PoC3-1	KARA	lolong wall	19,275.95	1,477.95	1,063.50	5,782,784.17	443,385.89	63,810.03	6,289,980.08	578,278.42	44,338.59	6,381.00	628,998.01	231,311.37	17,735.44	2,552.40	251,599.20
PoC3-1	KARA	Central lolong platform	331.88	103.00	0.00	99,563.73	30,899.09	0.00	130,462.81	9956.37	3,089.91	0.00	13,046.28	3,982.55	1,235.96	0.00	5,218.51
PoC3-1	KARA	South lolong platform	12.95	0.00	68.32	3,884.94	0.00	4,099.29	7,984.23	388.49	0.00	409.93	798.42	155.40	0.00	163.97	319.37
									6,428,427.13				642,842.71				257,137.09
PoC3-1	PDI	lolong wall	129.84	181.33	0.00	38,952.20	54,398.77	0.00	93,350.97	3,895.22	5,439.88	0.00	9,335.10	1,558.09	2,175.95	0.00	3,734.04
PoC3-1	PDI	lolong platform	35.81	50.01	0.00	10,743.73	15,004.17	0.00	25,747.90	1,074.37	1,500.42	0.00	2,574.79	429.75	600.17	0.00	1,029.92
									119,098.87				11,909.89				4,763.96

Table 8.4a Litter transportation estimates.

			Loads of 380 kg			Hours if 1 man				Hours if 10				Hours if 25			
Site_No	IsletAbr	Structure Type	CB Loads	B Loads	CR Loads	CB	B	CR	Total	CB	B	CR	Total	CB	B	CR	Total
PoC3-1	PWIA	F30 lolong wall	1,719.98	131.88	94.90	515,993.43	39,562.98	5,693.72	561,250.13	51,599.34	3,956.30	569.37	56,125.01	20,639.74	1,582.52	227.75	22,450.01
PoC3-1	PWIA	F30 lolong platform	483.70	37.09	26.69	145,110.62	11,126.13	1,601.22	157,837.96	14,511.06	1,112.61	160.12	15,783.80	5,804.42	445.05	64.05	6,313.52
									719,088.10				71,908.81				28,763.52
PoC3-1	PWIA	F29 lolong wall	1,655.81	256.94	2,103.06	496,741.68	77,080.61	126,183.81	700,006.09	49,674.17	7,708.06	12,618.38	70,000.61	19,869.67	3,083.22	5,047.35	28,000.24
PoC3-1	PWIA	F29 lolong platform	456.08	283.08	0.00	136,822.75	84,924.47	0.00	221,747.22	13,682.28	8,492.45	0.00	22,174.22	5,472.91	3,396.98	0.00	8,869.89
									921,753.31				92,175.33				36,870.13
PoC3-1	NDA	F1 lolong wall	2,931.14	224.74	161.72	879,343.09	67,422.25	9,703.10	956,468.43	87,934.31	6,742.23	970.31	95,646.84	35,173.72	2,696.89	388.12	38,258.74
PoC3-1	NDA	F1 lolong platform	779.10	80.60	0.00	233,730.12	24,178.98	0.00	257,909.09	23,373.01	2,417.90	0.00	25,790.91	9,349.20	967.16	0.00	10,316.36
									1,214,377.53				121,437.75				48,575.10
PoC3-1	LMK	F18 lolong wall	672.91	51.59	37.13	201,872.46	15,478.25	2,227.56	219,578.27	20,187.25	1,547.83	222.76	21,957.83	8,074.90	619.13	89.10	8,783.13
PoC3-1	LMK	F18 lolong platform	49.26	45.86	0.00	14,776.62	13,757.54	0.00	28,534.15	1,477.66	1,375.75	0.00	2,853.42	591.06	550.30	0.00	1,141.37
									248,112.43				24,811.24				9,924.50
PoC3-1	LMK	F1 lolong wall	2,050.09	157.19	113.11	615,026.61	47,156.20	6,786.50	672,462.36	61,502.66	4,715.62	678.65	66,896.93	24,601.06	1,886.25	271.46	26,758.77
PoC3-1	LMK	F1 lolong platform	93.86	87.39	0.00	28,157.42	26,215.53	0.00	53,372.94	2,815.74	2,621.55	0.00	5,437.29	1,126.30	1,048.62	0.00	2,174.92
									723,342.25				72,334.23				28,933.69
PoC3-1	LPK	F2 lolong wall	48.75	105.91	857.36	14,625.55	31,772.76	51,441.61	97,839.92	1,462.56	3,177.28	5,144.16	9,783.99	585.02	1,270.91	2,057.66	3,913.60
PoC3-1	LPK	F2 lolong platform	16.54	51.34	22.63	4,963.22	15,403.10	1,357.76	21,724.08	496.32	1,540.31	135.78	2,172.41	198.53	616.12	54.31	868.96
									119,564.00				11,956.40				4,782.56
PoC3-1	ANG	F1 lolong wall	73.89	80.26	50.54	22,167.87	24,078.89	3,032.16	49,278.92	2,216.79	2,407.89	303.22	4,927.89	886.71	963.16	121.29	1,971.16
PoC3-1	ANG	F1 lolong platform	0.00	10.67	26.87	0.00	3,200.61	1,612.16	4,812.77	0.00	320.06	161.22	481.28	0.00	128.02	64.49	192.51
									54,091.69				5,409.17				2,163.67
PoD24-17		burial platform	1.90	175.30	0.00	570.56	10,517.95	0.00	11,088.51	57.06	1,051.80	0.00	1,108.85	22.82	420.72	0.00	443.54
PoC3-1	PDA	F4 burial platform	63.61	19.74	0.00	19,083.88	5,922.58	0.00	25,006.46	1,908.39	592.26	0.00	2,500.65	763.36	236.90	0.00	1,000.26
PoC3-1	ANG	F2 burial platform	0.00	34.71	65.57	0.00	10,413.73	3,934.08	14,347.81	0.00	1,041.37	393.41	1,434.78	0.00	416.55	157.36	573.91
PoC3-1	PWIA	house platform w/ burial	13.28	123.65	70.07	3,984.34	37,095.58	4,204.17	45,284.09	398.43	3,709.56	420.42	4,528.41	159.37	1,483.82	168.17	1,811.36
PoC3-1	PEO	burial platform	5.59	98.89	0.00	1,677.12	29,667.73	0.00	31,344.85	167.71	2,966.77	0.00	3,134.49	67.08	1,186.71	0.00	1,253.79
PoC3-1	SOE	burial platform	3.02	53.48	0.00	906.91	16,042.85	0.00	16,949.75	90.69	1,604.29	0.00	1,694.98	36.28	641.71	0.00	677.99
PoC3-1	PEE	burial platform	0.00	82.97	42.74	0.00	24,889.58	2,564.38	27,453.96	0.00	2,488.96	256.44	2,745.40	0.00	995.58	102.58	1,098.16
PoC3-1	SPW	F2 burial platform	3.92	69.32	0.00	1,175.64	20,796.61	0.00	21,972.24	117.56	2,079.66	0.00	2,197.22	47.03	831.86	0.00	878.89
PoC3-1	SPW	F8 burial platform	3.48	61.63	0.00	1,045.12	18,487.78	0.00	19,532.90	104.51	1,848.78	0.00	1,953.29	41.80	739.51	0.00	781.32
PoC3-1	SWD	burial platform	3.40	60.09	0.00	1,019.13	18,028.00	0.00	19,047.12	101.91	1,802.80	0.00	1,904.71	40.77	721.12	0.00	761.88

Table 8.4b Litter transportation time estimates.

in this study. The large *lolong* structures from Nan Madol are amongst the highest ranking features in hours of labor required. Clearly these estimates demonstrate that the litter method was not particularly efficient as a mode of transport for the volume of stone used in most Pohnpeian architectural features, especially mortuary structures. It is more likely that litters were used over short distances, possibly over particularly rough terrain. These estimates demonstrate why the reuse of stone from older, abandoned structures may have been common practice on Pohnpei. In the absence of recycling, the use of sledges, runners, or rafts would probably be more effective transportation methods than the litter method.

The second set of analyses is based on the use of a sledge to transport stone building materials. Though sledges were likely a common form of transportation in prehistory, there are few published studies specifically related to sledges and transportation time. Experimental data and ethnohistoric information on the use of sledges to transport megalithic stones has been recorded on Tonga (Spennemann 2002). Spennemann (2002) noted that it took 16 men one day to drag a one ton (1,000 kg) stone over one km. For the purpose of this analysis, it is assumed that a work day is seven hours long. Based on these figures, one man would be able to drag 62.5 kg of stone over a one km distance in seven hours using a sledge. Labor hours per number of individuals were determined for the sledge method by pairing these figures with the estimated weights of stone used in each structure (see Table 8.5). Similar to the litter method, the sledge method would have required 50 men to work over 100 hours and up to nearly 95,000 hours to transport the material required to build mortuary structures. The sledge method is more efficient than the litter method, as it takes approximately 29% less time. Granted, this estimate needs to be revised with experiments on Pohnpei since Tonga is relatively flat when compared to Pohnpei. With this in mind, in some locations on Pohnpei the terrain may not have been conducive to the sledge method of materials transportation.

Based on the labor hour investment determined by these calculations, the transportation of construction materials for these monuments was the majority of the overall labor investment for each structure. It is probable that multiple transportation methods were

used to transport construction materials from their quarries to the building site of any given structure, because Pohnpei's occasionally rough terrain would make the use of a single method impractical in many cases. It is likely that water transport was also used for sites located in coastal areas, but until further experimental studies can be undertaken these estimates are as accurate as is currently possible. What is particularly useful from the transportation estimates is the significant differentiation between the amounts of labor invested in each structure. Unsurprisingly, the large *lolong* located at Nan Madol are the highest ranked structures, while other *lolong* and isolated burial platforms are ranked lower based on investment. The rankings are consistent with those established for quarry time estimates for 25 men.

8.1.4.4 Construction of Architectural Features

The most detailed published labor investment estimates for construction times are from Mesoamerica (e.g. Abrams and Bolland 1999; Arnold and Ford 1980; Carmean 1991; Erasmus 1965; Ford and Arnold 1982), but they are typically linked to cut limestone and mortar structures. There are a few publications discussing labor investment in stacked stone architecture (e.g. Kolb 1994, 1997; Sand et al. 2002), and only one that specifically discusses the construction process in more than general terms (e.g. Sand et al. 2002). The estimates used to determine construction times for Pohnpeian structures are based on published data on the Rukunikoro Fort reconstruction project on Fiji (Sand et al. 2002). This project reconstructed damaged portions of the fort walls with a team of 12 workers over the course of 11 days (Sand et al. 2002). Using the reconstruction project timeline as a baseline, Sand and colleagues (2002:25) estimated that it would have taken 50 workers less than a week to construct the entire site. The site is comprised of approximately 3,000 m^3 of stone that were transported to Rukunikoro in Fiji (Sand et al. 2002). The majority of the construction material used was coral rubble with the incorporation of some basalt rubble and limestone.

			62.5 kg Loads			Hours if one man				Hours if 10				Hours if 25			
Site_No	IsletAbr	Structure Type	CB Loads	B Loads	CR Loads	CB	B	CR	Total	CB	B	CR	Total	CB	B	CR	Total
PoB7-44		lolong wall	246.50	4,660.52	0.00	8,627.54	30,523.65	0.00	39,151.19	862.75	3,052.37	0.00	3,915.12	345.10	1,220.95	0.00	1,566.05
PoB7-44		lolong platform	60.22	504.62	0.00	2107.76	3,532.31	0.00	5,640.07	210.78	353.23	0.00	564.01	84.31	141.29	0.00	225.60
									44,971.26				4,479.13				1,791.65
PoB7-39		lolong wall	903.32	4,765.79	0.00	31,616.21	33,360.55	0.00	64,976.76	3,161.62	3,336.06	0.00	6,497.68	1,264.65	1,334.42	0.00	2,599.07
PoB7-39		lolong platform	144.23	1,208.55	0.00	5,048.04	8,459.81	0.00	13,507.85	504.80	845.98	0.00	1,350.79	201.92	338.39	0.00	540.31
									78,484.61				7,848.46				3,139.38
PoB7-10		lolong wall	327.94	2,747.91	0.00	11,477.91	19,235.39	0.00	30,713.30	1,147.79	1,923.39	0.00	3,071.33	459.12	769.42	0.00	1,228.53
PoB7-10		lolong platform	98.07	821.78	0.00	3,432.54	5,752.47	0.00	9,185.01	343.25	575.25	0.00	918.50	137.30	230.10	0.00	367.40
									39,898.31				3,989.83				1,595.93
PoC3-8		lolong wall	0.00	1,491.38	0.00	0.00	10,439.64	0.00	10,439.64	0.00	1,043.96	0.00	1,043.96	0.00	417.59	0.00	417.59
PoC3-8		lolong platform	0.00	436.38	0.00	0.00	3,054.67	0.00	3,054.67	0.00	305.47	0.00	305.47	0.00	122.19	0.00	122.19
									13,494.31				1,349.43				539.77
PoC3-5		lolong wall	516.30	4,326.27	0.00	18,070.64	30,283.89	0.00	48,354.53	1,807.06	3,028.39	0.00	4,835.45	722.83	1,211.36	0.00	1,934.18
PoC3-5		lolong platform	597.82	98.22	0.00	20,923.53	687.55	0.00	21,611.07	2,092.35	68.75	0.00	2,161.11	836.94	27.50	0.00	864.44
									69,965.60				6,996.56				2,798.62
PoC3-1	ANG	F1 lolong wall	449.27	488.00	307.26	15,724.41	17,079.96	2,150.81	34,955.18	1,572.44	1,708.00	215.08	3,495.52	628.98	683.20	86.03	1,398.21
PoC3-1	ANG	F1 lolong platform	0.00	64.87	163.37	0.00	2,270.30	1,143.56	3,413.86	0.00	227.03	114.36	341.39	0.00	90.81	45.74	136.55
									38,369.04				3,836.90				1,534.76
PoC3-1	KARA	lolong wall	117,197.76	8,985.95	6,466.08	4,101,921.57	334,508.39	45,262.58	4,461,692.54	410,192.16	31,450.84	4,526.26	446,169.25	164,076.86	12,580.34	1,810.50	178,467.70
PoC3-1	KARA	Central lolong platform	2,017.82	626.22	0.00	70,623.87	21,917.75	0.00	92,541.62	7,062.39	2,191.78	0.00	9,254.16	2,824.95	876.71	0.00	3,701.67
PoC3-1	KARA	South lolong platform	78.73	0.00	415.39	2,755.72	0.00	2,907.76	5,663.48	275.57	0.00	290.78	566.35	110.23	0.00	116.31	226.54
									4,559,897.64				455,989.76				182,395.91
PoC3-1	LMK	F18 lolong wall	4,091.28	313.69	225.73	143,194.87	10,979.24	1,580.08	155,754.19	14,319.49	1,097.92	158.01	15,575.42	5,727.79	439.17	63.20	6,230.17
PoC3-1	LMK	F18 lolong platform	299.47	278.82	0.00	10,481.55	9,758.68	0.00	20,240.23	1,048.15	975.87	0.00	2,024.02	419.26	390.35	0.00	809.61
									175,994.42				17,599.44				7,039.78
PoC3-1	LMK	F1 lolong wall	12,464.54	955.70	687.70	436,258.88	33,449.46	4,813.89	474,522.23	43,625.89	3,344.95	481.39	47,452.22	17,450.36	1,337.98	192.56	18,980.89
PoC3-1	LMK	F1 lolong platform	570.66	531.30	0.00	19,972.99	18,595.55	0.00	38,568.54	1,997.30	1,859.56	0.00	3,856.85	798.92	743.82	0.00	1,542.74
									513,090.77				51,309.08				20,523.63
PoC3-1	LPK	F2 lolong wall	296.41	643.93	5,212.75	10,374.39	22,537.48	36,489.25	69,401.12	1,037.44	2,253.75	3648.92	6,940.11	414.98	901.50	1,459.57	2,776.05
PoC3-1	LPK	F2 lolong platform	100.59	312.17	137.59	3,520.58	10,925.94	963.10	15,409.62	352.06	1,092.59	96.31	1,540.96	140.82	437.04	38.52	616.38
									84,810.73				8,481.07				3,392.43

Table 8.5a Sledge labor time estimates.

			62.5 kg Loads			Hours if one man				Hours if 10				Hours if 25			
Site_No	IsletAbr	Structure Type	CB Loads	B Loads	CR Loads	CB	B	CR	Total	CB	B	CR	Total	CB	B	CR	Total
PoC3-1	NDA	F1 lolong wall	17,821.35	1,366.42	983.25	623,747.36	47,824.85	6,882.73	678,454.94	62,374.74	4,782.49	688.27	67,845.49	24,949.89	1,912.99	275.31	27,138.20
PoC3-1	NDA	F1 lolong platform	4,736.93	490.03	0.00	165,792.56	17,150.95	0.00	182,943.52	16,579.26	1,715.10	0.00	18,294.35	6,631.70	686.04	0.00	7,317.74
									861,398.46				86,139.85				34,455.94
PoC3-1	PDI	lolong wall	789.43	1,102.48	0.00	27,630.10	38,586.86	0.00	66,216.95	2,763.01	3,858.69	0.00	6,621.70	1,105.20	1,543.47	0.00	2,648.68
PoC3-1	PDI	lolong platform	217.74	304.08	0.00	7,620.88	10,642.96	0.00	18,263.84	762.09	1,064.30	0.00	1,826.38	304.84	425.72	0.00	730.55
									84,480.80				8,448.08				3,379.23
PoC3-1	PEK	South lolong wall	5,394.83	413.64	297.65	188,818.98	14,477.40	2,083.52	205,379.89	18,881.90	1,447.74	208.35	20,537.99	7,552.76	579.10	83.34	8,215.20
PoC3-1	PEK	South lolong platform	998.41	164.04	0.00	34,944.40	5,741.37	0.00	40,685.78	3,494.44	574.14	0.00	4,068.58	1,397.78	229.65	0.00	1,627.43
									246,065.67				24,606.57				9,842.63
PoC3-1	PEK	Central lolong wall	2,617.99	200.73	144.44	91,629.72	7,025.57	1,011.09	99,666.37	9,162.97	702.56	101.11	9,966.64	3,665.19	281.02	40.44	3,986.66
PoC3-1	PEK	Central lolong platform	693.52	113.95	0.00	24,273.15	3,983.08	0.00	28,261.24	2,427.32	398.81	0.00	2,826.12	970.93	159.52	0.00	1,130.45
									127,927.61				12,792.76				5,117.10
PoC3-1	PEK	N lolong enclosure wall	22,418.65	1,718.92	1,236.89	784,652.85	60,162.02	8,658.24	853,473.11	78,465.28	6,016.20	865.82	85,347.31	31,386.11	2,406.48	346.33	34,138.92
PoC3-1	PEK	N lolong platform	1,171.58	121.20	0.00	41,005.43	4,241.94	0.00	45,247.37	4,100.54	424.19	0.00	4,524.74	1,640.22	169.68	0.00	1,809.90
									898,720.48				89,872.05				35,948.82
PoC3-1	PWIA	F30 lolong wall	10,457.47	801.81	576.96	366,011.34	28,063.34	4,038.75	398,113.43	36,601.13	2,806.33	403.87	39,811.34	14,640.45	1,122.53	161.55	15,924.54
PoC3-1	PWIA	F30 lolong platform	2,940.91	225.49	162.26	102,931.80	7,982.13	1,135.80	111,959.73	10,293.18	789.21	113.58	11,195.97	4117.27	315.69	45.43	4,478.39
									510,073.16				51,007.32				20,402.93
PoC3-1	PWIA	F29 lolong wall	10,067.30	1,562.17	12,786.63	352,355.43	54,675.84	89,506.38	496,537.65	35,235.54	5,467.58	8,950.64	49,653.77	14,094.22	2,187.03	3,580.26	19,861.51
PoC3-1	PWIA	F29 lolong platform	2,772.94	1,721.14	0.00	97,052.94	60,239.76	0.00	157,292.70	9,705.29	6,023.98	0.00	15,729.27	3,882.12	2,409.59	0.00	6,291.71
									653,830.35				65,383.04				26,153.21
PoD24-17		burial platform	11.56	1,065.82	0.00	404.72	7,460.74	0.00	7,865.45	40.47	746.07	0.00	786.55	16.19	298.43	0.00	314.62
PoC3-1	ANG	burial platform	0.00	211.05	398.65	0.00	7,386.81	2,790.57	10,177.38	0.00	738.68	279.06	1,017.74	0.00	295.47	111.62	407.10
PoC3-1	PDA	burial platform	386.77	120.03	0.00	13,536.83	4,201.09	0.00	17,737.92	1,353.68	420.11	0.00	1,773.79	541.47	168.04	0.00	709.52
PoC3-1	PEE	burial platform	0.00	504.43	259.86	0.00	17,655.01	1,819.00	19,474.01	0.00	1,765.50	181.90	1,947.40	0.00	706.20	72.76	778.96
PoC3-1	PEO	burial platform	33.99	601.27	0.00	1,189.64	21,044.31	0.00	22,233.95	118.96	2,104.43	0.00	2,223.40	47.59	841.77	0.00	889.36
PoC3-1	PWIA	house platform w/ burial	80.75	751.80	426.02	2,826.23	26,313.13	2,982.16	32,121.51	282.62	2,631.31	298.22	3,212.15	113.05	1,052.53	119.29	1,284.86
PoC3-1	SOE	burial platform	18.38	325.14	0.00	643.30	11,379.72	0.00	12,023.02	64.33	1,137.97	0.00	1,202.30	25.73	455.19	0.00	480.92
PoC3-1	SPW	burial platform (F2)	23.83	421.48	0.00	833.92	14,751.73	0.00	15,585.64	83.39	1,475.17	0.00	1,558.56	33.36	590.07	0.00	623.43
PoC3-1	SPW	burial platform (F8)	21.18	374.69	0.00	741.34	13,114.00	0.00	13,855.34	74.13	1,311.40	0.00	1,385.53	29.65	524.56	0.00	554.21
PoC3-1	SWD	burial platform	20.65	365.37	0.00	722.90	12,787.86	0.00	13,510.76	72.29	1,278.79	0.00	1,351.08	28.92	511.51	0.00	540.43

Table 8.5b Sledge labor time estimates.

Table 8.6a Construction time estimates.

Site_No	IsletAbr	Structure Type	Total Mass	Construction Style	Hours - 1 man	Hours - 2	Hours - 5	Hours - 10	Hours - 25
PoB7-44		lolong wall	287,938.90	Combination	159.12	79.52	31.82	15.91	6.36
PoB7-44		lolong platform	35,302.32	Combination	19.51	9.75	3.90	1.95	0.78
					178.63	89.32	35.73	17.86	7.15
PoB7-39		lolong wall	354,319.55	Combination	195.81	97.90	39.16	19.58	7.83
PoB7-39		lolong platform	84,548.40	Combination	46.72	23.36	9.34	4.67	1.87
					242.53	121.27	48.51	24.25	9.70
PoB7-10		lolong wall	192,240.81	Combination	106.24	53.12	21.25	10.62	4.25
PoB7-10		lolong platform	57,490.88	Stacked Stone	21.18	10.59	4.24	2.12	0.85
					127.42	63.71	25.48	12.74	5.10
PoC3-8		lolong wall	93,211.07	Stacked Stone	34.34	17.17	6.87	3.43	1.37
PoC3-8		lolong platform	27,273.81	Stacked Stone	10.05	5.02	2.01	1.00	0.40
					44.39	22.19	8.88	4.44	1.78
PoC3-5		lolong wall	302,660.89	Combination	167.26	83.63	33.45	16.73	6.69
PoC3-5		lolong platform	43,502.26	Header-stretcher	32.05	16.03	6.41	3.21	1.28
					199.31	99.66	39.86	19.93	7.97
PoC3-1	ANG	F1 lolong wall	77,782.89	Combination	42.99	21.49	8.60	4.30	1.72
PoC3-1	ANG	F1 lolong platform	14,264.44	Stacked Stone	5.26	2.63	1.05	0.53	0.21
					48.24	24.12	9.65	4.82	1.93
PoC3-1	KARA	lolong wall	8,290,612.27	Header-stretcher	6,108.87	3,054.44	1,221.77	601.89	244.35
PoC3-1	KARA	Central lolong platform	165,252.90	Header-stretcher	121.77	60.88	24.35	12.18	4.87
PoC3-1	KARA	South lolong platform	30,883.08	Stacked Stone	11.38	5.69	2.28	1.14	0.46
					6,242.01	3,121.01	1,248.40	624.20	249.68
PoC3-1	LMK	F18 lolong wall	289,418.78	Header-stretcher	213.26	106.63	42.65	21.33	8.53
PoC3-1	LMK	F18 lolong platform	36,143.26	Header-stretcher	26.63	13.32	5.33	2.66	1.07
					239.89	119.94	47.98	23.99	9.60
PoC3-1	LMK	F1 lolong wall	881,746.07	Header-stretcher	649.71	324.85	129.94	64.97	25.99
PoC3-1	LMK	F1 lolong platform	68,872.39	Combination	38.06	19.03	7.61	3.81	1.52
					687.77	343.88	137.55	68.78	27.51
PoC3-1	LPK	F2 lolong wall	384,568.03	Stacked Stone	141.68	70.84	28.34	14.17	5.67
PoC3-1	LPK	F2 lolong platform	34,396.46	Combination	19.01	9.50	3.80	1.90	0.76
					160.69	80.35	32.14	16.07	6.43
PoC3-1	NDA	F1 lolong wall	1,260,689.03	Header-stretcher	928.93	464.46	185.79	92.89	37.16
PoC3-1	NDA	F1 lolong platform	326,684.85	Header-stretcher	240.72	120.36	48.14	24.07	9.63
					1,169.64	584.82	233.93	116.96	46.79
PoC3-1	PDI	lolong wall	118,244.56	Combination	65.35	32.67	13.07	6.53	2.61
PoC3-1	PDI	lolong platform	32,614.01	Combination	18.02	9.01	3.60	1.80	0.72
					83.37	41.68	16.67	8.34	3.33
PoC3-1	PEK	South lolong wall	381,632.09	Header-stretcher	281.20	140.60	56.24	28.12	11.25
PoC3-1	PEK	South lolong platform	72,653.17	Header-stretcher	53.53	26.77	10.71	5.35	2.14
					334.74	167.37	66.95	33.47	13.39
PoC3-1	PEK	Central lolong wall	185,197.71	Header-stretcher	136.46	68.23	27.29	13.65	5.46
PoC3-1	PEK	Central lolong platform	50,466.49	Header-stretcher	37.19	18.59	7.44	3.72	1.49
					173.65	86.82	34.73	17.36	6.95
PoC3-1	PEK	North lolong wall	1,585,903.68	Header-stretcher	1,168.56	584.28	233.71	116.86	46.74
PoC3-1	PEK	North lolong platform	80,798.88	Header-stretcher	59.54	29.77	11.91	5.95	2.38
					1,228.10	614.05	245.62	122.81	49.12

Site_No	IsletAbr	Structure Type	Total Mass	Construction Style	Hours - 1 man	Hours - 2	Hours - 5	Hours - 10	Hours - 25
PoC3-1	PWIA	F30 lolong wall	739,765.02	Header-stretcher	545.09	272.54	109.02	54.51	21.80
PoC3-1	PWIA	F30 lolong platform	208,040.94	Header-stretcher	153.29	76.65	30.66	15.33	6.13
					698.38	349.19	139.68	69.84	27.94
PoC3-1	PWIA	F29 lolong wall	1,526,005.67	Stacked Stone	562.21	281.11	112.44	56.22	22.49
PoC3-1	PWIA	F29 lolong platform	280,879.82	Combination	155.22	77.61	31.04	15.52	6.21
					717.44	358.72	143.49	71.74	28.70
PoD24-17		burial platform	67,336.41	Stacked Stone	24.81	12.40	4.96	2.48	0.99
PoC3-1	ANG	F2 burial platform	38,106.55	Stacked Stone	14.04	7.02	2.81	1.40	0.56
PoC3-1	PDA	F4 burial platform	31,674.85	Header-stretcher	23.34	11.67	4.67	2.33	0.93
PoC3-1	PEE	burial platform	47,767.88	Stacked Stone	17.60	8.80	3.52	1.76	0.70
PoC3-1	PEO	burial platform	39,703.48	Stacked Stone	14.63	7.31	2.98	1.46	0.59
PoC3-1	PWIA	house platform w/ burial	78,660.95	Stacked Stone	28.98	14.49	5.80	2.90	1.16
PoC3-1	SOE	burial platform	21,469.68	Stacked Stone	7.91	3.95	1.58	0.79	0.32
PoC3-1	SPW	F2 burial platform	27,831.51	Stacked Stone	10.25	5.13	2.05	1.03	0.41
PoC3-1	SPW	F8 burial platform	24,741.68	Stacked Stone	9.12	4.56	1.82	0.91	0.36
PoC3-1	SWD	burial platform	24,126.36	Combination	13.33	6.67	2.67	1.33	0.53

Table 8.6b Construction time estimates.

Based on the information available, a number of assumptions are made: it took 50 men six days of seven hours each to build a structure using 3,000 m^3 of stone, and 80% of the stone was coral and 20% was basalt. Calculated estimates of the total weight of stone used in each structure are employed in place of m^3 occupied, since material weights vary (e.g. basalt weights more than coral). The parameters outlined here suggest that it was possible for one man to build a structure using 2,714.3 kg of stone in an hour. Further experimental studies would be valuable in revisiting this figure, but it is considered accurate for the present study. It is unlikely that a single individual would have constructed any clan or family burial structure alone, so it is assumed that the figures presented using two or more individuals would provide more accurate estimates.

These assumptions and estimates form the basis of the stacked stone construction time estimates (see Table 8.6). Once estimates for stacked stone construction were calculated, construction time indices were used to estimate building times for header-stretcher and combination style architectural features. There have not been experimental studies with construction times for other styles of architectural construction so the following construction index has been proposed until future research can refine these estimates: twice the time for header-stretcher constructions and one and a half times for combination styles.

Approximately three-quarters of the structures analyzed here could have taken five men less than a week to build (40 hours or less). All but one structure, Karian, could have been constructed by 25 men in 50 hours or less. Karian would have taken more than 100 hours to build even with a workforce of 50, with the majority of work being invested in the header-stretcher style enclosing wall. Most burial platforms (24 of 27 or 89%), isolated or associated with *lolong*, could be constructed by five men in a day or two. In general *lolong* from Nan Madol tend to be more labor intensive than those located elsewhere on Pohnpei.

8.1.4.5 Overall Labor Investment

Labor investment calculations allow for detailed discussions of management and organization of large scale building projects (Abrams and Bolland 1999; Kolb 1997; Kolb and Snead 1997). This type of study allows for the testing of hypotheses and assumptions related to a given society's relationship with architectural features (see Erasmus 1965 and Joyce 2004 for examples). Analyses of labor investment aim to address questions about the number of individuals involved in each step of the building process and how much time was invested, allowing for discussions of how labor may have been mobilized and if a single individual could manage the workers or if a more complex management hierarchy was required. This is the final goal of this analysis.

In order to determine the overall labor investment hours, it is necessary to determine the most likely number of individuals involved in the construction project. Twenty-five individuals were determined to be a reasonable minimum number that could be mobilized through clan commitments based on personal observations of family events and section feasts. The final labor investment figures are shown in Table 8.7; note that the transportation estimates were averaged for the purpose of these final estimates. The rank ordering of these estimates are consistent with the rankings determined for each step in this analysis, though many show an averaging of the ranks for individual activities. In general these labor estimates illustrate status differences between Nan Madol and other locations. The top ten ranked structures based on the overall investment calculations are all *lolong* from Nan Madol. The *lolong* from Awak and Temwen follow in the ranking, with the exception of PoC3-8. It ranks with the isolated burial platforms probably because the structure was never completed. The *lolong* from Temwen and Awak are likely of a somewhat lower status than those at Nan Madol based on the labor investment estimates. The house platform ranks highest amongst the isolated platforms, possibly due to its original purpose rather than its final function. The burial platform from Salapwuk (PoD24-17) ranks lowest in investment, which might suggest it was

Table 8.7a Overall labor investment times for 25 men.

Site_No	IsletAbr	Structure Type	Quarry Time Total	Litter Total	Sledge Total	Average Transport	Construction Total	Total labor	Rank
PoB7-10		lolong wall	25.03	1,731.95	1,228.53	1,480.24	4.25	1,509.52	
PoB7-10		lolong platform	7.48	517.95	367.40	442.68	0.85	451.01	
								1,960.53	15
PoB7-39		lolong wall	48.33	3,664.10	2,599.07	3,131.59	7.83	3,187.75	
PoB7-39		lolong platform	11.01	761.72	540.31	651.02	1.87	663.89	
								3,851.64	12
PoB7-44		lolong wall	35.69	2,207.77	1,566.05	1,886.91	6.36	1,928.96	
PoB7-44		lolong platform	4.60	318.05	225.60	271.83	0.78	277.20	
								2,206.17	14
PoC3-5		lolong wall	39.40	2,726.66	1,934.18	2,330.47	6.69	2,376.56	
PoC3-5		lolong platform	9.51	1,218.67	864.44	1,041.56	1.28	1,052.35	
								3,428.92	13
PoC3-8		lolong wall	10.97	588.70	417.59	503.14	1.37	515.48	
PoC3-8		lolong platform	3.21	172.26	122.19	147.22	0.40	150.83	
								666.31	23
PoC3-1	ANG	F1 lolong wall	14.71	1,971.16	1,398.21	1,684.68	1.72	1,701.12	
PoC3-1	ANG	F1 lolong platform	2.88	192.51	136.55	164.53	0.21	167.62	
								1,868.74	16
PoC3-1	KARA	lolong wall	1,884.66	251,599.20	178,467.70	215,033.45	244.35	217,162.47	
PoC3-1	KARA	Central lolong platform	34.28	5,218.51	3,701.66	4,460.09	4.87	4,499.24	
PoC3-1	KARA	South lolong platform	7.27	319.37	226.54	272.95	0.46	280.68	
								221,942.38	1
PoC3-1	LMK	F1 lolong wall	200.44	26,758.77	18,980.89	22,869.83	25.99	23,096.26	
PoC3-1	LMK	F1 lolong platform	12.30	2,174.92	1,542.74	1,858.83	1.52	1,872.65	
								24,968.91	5
PoC3-1	LMK	F18 lolong wall	65.79	8,783.13	6,230.17	7,506.65	8.53	7,580.97	
PoC3-1	LMK	F18 burial platform	6.45	1,141.37	809.61	975.49	1.07	983.01	
								8,563.98	8
PoC3-1	LPK	F2 lolong wall	85.75	3,913.60	2,776.04	3,344.82	5.67	3,436.24	
PoC3-1	LPK	F2 lolong platform	5.80	868.96	616.38	742.67	0.76	749.23	
								4,185.47	10
PoC3-1	NDA	F1 lolong wall	286.59	38,258.74	27,138.20	32,698.47	37.16	33,022.21	
PoC3-1	NDA	F1 burial platform	73.26	10,316.36	7,317.74	8,817.05	9.63	8,899.94	
								41,922.15	3
PoC3-1	PDI	lolong wall	19.72	3,734.04	2,648.68	3,191.36	2.61	3,213.69	
PoC3-1	PDI	lolong platform	5.44	1,029.92	730.55	880.23	0.72	886.39	
								4,100.08	11
PoC3-1	PEK	South lolong wall	86.75	11,581.57	8,215.20	9,898.38	11.25	9,996.39	
PoC3-1	PEK	South lolong platform	15.89	2,294.31	1,627.43	1,960.87	2.14	1,978.90	
								11,975.29	7
PoC3-1	PEK	Central lolong wall	42.10	5,620.28	3,986.65	4,803.47	5.46	4,851.03	
PoC3-1	PEK	Central lolong platform	11.04	1,593.68	1,130.45	1,362.06	1.49	1,374.59	
								6,225.62	9
PoC3-1	PEK	North lolong wall	360.51	48,128.18	34,138.92	41,133.55	46.74	41,540.81	
PoC3-1	PEK	North lolong platform	18.12	2,551.54	1,809.89	2,180.72	2.38	2,201.22	
								43,742.03	2

Site_No	IsletAbr	Structure Type	Quarry Time Total	Litter Total	Sledge Total	Average Transport	Construction Total	Total labor	Rank
PoC3-1	PWIA	F30 lolong wall	168.17	22,450.01	15,924.54	19,187.27	21.80	19,377.24	
PoC3-1	PWIA	F30 lolong platform	47.29	6,313.52	4,478.39	5,395.95	6.13	5,449.38	
								24,826.62	6
PoC3-1	PWIA	F29 lolong wall	347.57	28,000.24	19,861.51	23,930.87	22.49	24,300.94	
PoC3-1	PWIA	F29 lolong platform	53.43	8,869.89	6,291.71	7,580.80	6.21	7,640.44	
								31,941.38	4
PoD24-17		burial platform	8.01	443.62	314.62	379.08	0.99	388.08	27
PoC3-1	PDA	F4 burial platform	6.57	1,000.26	709.52	854.89	0.93	862.39	20
PoC3-1	ANG	F2 burial platform	7.41	573.91	407.10	490.50	0.56	498.48	26
PoC3-1	PWIA	house platform w/ burial	12.98	1,811.36	1,284.86	1,548.11	1.16	1,562.25	17
PoC3-1	PEO	burial platform	4.92	1,253.79	889.36	1,071.58	0.59	1,077.08	18
PoC3-1	SOE	burial platform	2.66	677.99	480.92	579.46	0.32	582.43	25
PoC3-1	PEE	burial platform	7.53	1,098.16	778.96	938.56	0.70	946.79	19
PoC3-1	SPW	F2 burial platform	3.45	878.89	623.43	751.16	0.41	755.02	21
PoC3-1	SPW	F8 burial platform	3.07	781.32	554.21	667.76	0.36	671.20	22
PoC3-1	SWD	burial platform	2.99	761.88	540.43	651.16	0.53	654.68	24

Table 8.7b Overall labor investment times for 25 men.

an older structure and/or it was lower status than the other sampled platforms from Nan Madol.

The only structures that would have required 25 men to invest more than 5,000 hours were all *lolong* located at Nan Madol. Of the 12 *lolong* at Nan Madol nine (75%) are included in the 5,000 hours plus category. Isolated burial platforms typically take less than 1,000 hours for 25 men, but two (22%) from Nan Madol took between 1,000 and 2,000 hours to organize and build. This study suggests that any structure taking less than 2,000 hours (assuming 25 workers) could have been managed by a small, local clan or family group. Under the same conditions structures taking between 2,000 and 5,000 hours may have been managed by a regional clan group or community, while any structure taking over 5,000 hours would have required a network that expanded beyond kin-ties to be completed. One example of the 5,000 plus hours is Karian, which would have taken 200 men over 27,000 hours to organize and construct (see Table 8.8 for total labor estimates varying the size of the labor force).

Generally, labor management could have been managed by an individual or two for the quarrying and construction steps, while significantly more organization would have been required for material transportation. The amount of labor hours required for 25 men to transport the stone material suggests that multiple work-crews of 25 men may have needed to work simultaneously. The organization required for such an undertaking would require at least one manager per work-crew and at least one individual to organize the entire undertaking. Burial platforms and the smallest *lolong* may have been managed by an extended family or local clan, but other large *lolong* or burial complexes may have necessitated a wider network of individuals. These findings are consistent with those of Abrams and Bolland (1999:286) in that "the *bureaucracy* charged with the planning and executing of even very large architectural projects was relatively limited in scale." The fact that a bureaucracy would be required to manage some of the largest construction projects is indicative of social hierarchy and some level of socio-political centralization. The presence of the most labor intensive mortuary architecture at Nan Madol supports its status as a major

socio-political center. The layout of the site and the varying levels of apparent pre-planning of the placement of structures on the islets (e.g. Nahndauwas, Ideht, and Pahn Kadira) indicate that Nan Madol may have been a local center before it became a regional center.

These results also support Abrams' and Bolland's (1999:287) assertion that architectural energetics "is beginning to yield testable hypotheses concerning social power, territorial and political inclusiveness, and economic specialization in various cultural settings." These labor investment estimate rankings are suggestive of Nan Madol's status as a regional socio-political center, which suggests that clans or families invested more in mortuary structures, particularly *lolong*, at centers of power than those located within their local communities. It is also apparent that there are hierarchical divisions between structures in proximity to one another (e.g. at Nan Madol or within the Awak Valley), which is suggestive of competition between chiefly lineages or clans and/or hierarchical differentiation.

The question remains as to whether this apparent hierarchical differentiation or competition used coercion to complete structures. Of the 27 structures addressed in this analysis, 11 *lolong* would have required 100,000 or more hours of total labor input. The results show that all the *lolong* at Nan Madol included in this analysis except Angeir Feature 1 meet Criteria 4. That constitutes 41% of the total sample, none of which are located outside Nan Madol. Most of the structures that were identified based on labor investment were also identified using other criteria, but Pahndipap and Lukepenkarian Feature 2, which are at the lower end of the labor investment range, were not.

These results of the labor investment calculations support the proposition that coercive labor mobilization strategies were restricted to elites and paramount chiefs, since Nan Madol was the socio-political center of the prehistoric Pohnpeian state. Additional work should be done to confirm these results with a wider sample of structures outside Nan Madol, and to refine these labor estimates.

Table 8.8a Overall labor hours per structure with varying numbers of laborers.

Site_No	IsletAbr	Structure Type	1 man	25 men	30 men	40 men	50 men	100 men	200 men
PoB7-44		enclosing wall	48,224.09	1,928.96	1,607.47	1,205.60	964.48	482.24	241.12
PoB7-44		burial platform	6,930.05	277.20	231.00	173.25	138.60	69.30	34.65
			55,154.14	2,206.17	1,838.47	1,378.85	1,103.08	551.54	275.77
PoB7-39		enclosing wall	79,693.64	3,187.75	2,625.45	1,992.34	1,593.87	796.94	398.47
PoB7-39		burial platform	16,597.35	663.89	553.24	414.93	331.95	165.97	82.99
			96,290.98	3,851.64	3,209.70	2,407.27	1,925.82	962.91	481.45
PoB7-10		enclosing wall	37,737.99	1,509.52	1,257.93	943.45	754.76	377.38	188.69
PoB7-10		burial platform	11,275.20	451.01	375.84	281.88	225.50	112.75	56.38
			49,013.20	1,960.53	1,633.77	1,225.33	980.26	490.13	245.07
PoC3-8		enclosing wall	12,887.08	515.48	429.57	322.18	257.74	128.87	64.44
PoC3-8		burial platform	3,770.79	150.83	125.69	94.27	75.42	37.71	18.85
			16,657.87	666.31	555.26	416.45	333.16	166.58	83.29
PoC3-5		enclosing wall	59,414.10	2,376.56	1,980.47	1,485.35	1,188.28	594.14	297.07
PoC3-5		burial platform	26,308.80	1,052.35	876.96	657.72	526.18	263.09	131.54
			85,722.90	3,428.92	2,857.43	2,143.07	1,714.46	857.23	428.61
PoC3-1	PEK	South lolong wall	249,909.67	9,996.39	8,330.32	6,247.74	4,998.19	2,499.03	1,249.55
PoC3-1	PEK	South lolong platform	49,472.52	1,978.90	1,649.08	1,236.81	989.45	494.73	247.36
			299,382.19	11,975.29	9,979.41	7,484.55	5,987.64	2,993.82	1,496.91
PoC3-1	PEK	Central lolong wall	121,275.70	4,851.03	4,042.52	3,031.89	2,425.51	1,212.76	606.38
PoC3-1	PEK	Central lolong platform	34,364.70	1,374.59	1,145.49	859.12	687.29	343.65	171.82
			155,640.40	6,225.62	5,188.01	3,891.01	3,112.81	1,556.40	778.20
PoC3-1	PEK	North lolong wall	1,038,520.27	41,540.81	34,617.34	25,963.01	20,770.41	10,385.20	5,192.60
PoC3-1	PEK	North lolong platform	55,030.52	2,201.22	1,834.35	1,375.76	1,100.61	550.31	275.15
			1,093,550.79	43,742.03	36,451.69	27,338.77	21,871.02	10,935.51	5,467.75
PoC3-1	KARA	lolong wall	5,429,061.66	217,162.47	180,968.72	135,726.54	108,581.25	54,290.62	27,145.31
PoC3-1	KARA	Central lolong platform	112,480.94	4,499.24	3,749.36	2,812.02	2,249.68	1,124.81	562.40
PoC3-1	KARA	South lolong platform	7,016.90	280.68	233.90	175.42	140.34	70.17	35.08
			5,548,559.50	221,942.38	184,951.98	138,713.99	110,971.19	55,485.60	27,742.80
PoC3-1	PDI	lolong wall	80,342.20	3,213.69	2,678.07	2,008.56	1,606.84	803.42	401.71
PoC3-1	PDI	lolong platform	22,159.84	886.39	738.66	554.00	443.20	221.60	110.80
			102,502.05	4,100.08	3,416.73	2,562.55	2,050.04	1,025.02	512.51
PoC3-1	PWIA	F30 lolong wall	484,431.04	19,377.24	16,147.70	12,110.78	9,688.62	4,844.31	2,422.16
PoC3-1	PWIA	F30 lolong platform	136,234.46	5,449.38	4,541.15	3,405.86	2,724.69	1,362.34	681.17
			620,665.50	24,826.62	20,688.85	15,516.64	12,413.31	6,206.65	3,103.33
PoC3-1	PWIA	S lolong enclosure wall	607,523.43	24,300.94	20,250.78	15,188.09	12,150.47	6,075.23	3,037.62
PoC3-1	PWIA	S lolong platform	191,011.03	7,640.44	6,367.03	4,775.28	3,820.22	1,910.11	955.06
			798,534.46	31,941.38	26,617.82	19,963.36	15,970.69	7,985.34	3,992.67
PoC3-1	NDA	F1 lolong wall	825,555.25	33,022.21	27,518.51	20,638.88	16,511.11	8,255.55	4,127.78
PoC3-1	NDA	F1 burial platform	222,498.70	8,899.94	7,416.62	5,562.47	4,449.97	2,224.99	1,112.49
			1,048,053.87	41,922.15	34,935.13	26,201.35	20,961.08	10,480.54	5,240.27
PoC3-1	LMK	F18 lolong wall	189,524.29	7,580.97	6,317.48	4,738.11	3,790.49	1,895.24	947.62
PoC3-1	LMK	F18 burial platform	24,575.18	983.01	819.17	614.38	491.50	245.75	122.88
			214,099.46	8,563.98	7,136.65	5,352.49	4,281.99	2,140.99	1,070.50
PoC3-1	LMK	F1 lolong wall	577,406.54	23,096.26	19,246.88	14,435.16	11,548.13	5,774.07	2,887.03
PoC3-1	LMK	F1 burial platform	46,816.27	1,872.65	1,560.54	1,170.41	936.33	468.16	234.08
			624,222.81	24,968.91	20,807.43	15,605.57	12,484.46	6,242.23	3,121.11

Table 8.8b Overall labor hours per structure with varying numbers of laborers.

Site_No	IsletAbr	Structure Type	1 man	25 men	30 men	40 men	50 men	100 men	200 men
PoC3-1	LPK	F2 lolong wall	85,906.00	3,436.24	2,863.24	2,147.65	1,718.12	859.06	429.53
PoC3-1	LPK	F2 burial platform	18,730.81	749.23	624.36	468.27	374.62	187.31	93.65
			104,636.80	4,185.47	3,487.89	2,615.92	2,092.74	1,046.37	523.18
PoC3-1	ANG	F1 lolong wall	42,527.88	1,701.12	1,417.60	1,063.20	850.56	425.28	212.64
PoC3-1	ANG	F1 burial platform	4,190.55	167.62	139.69	104.76	83.81	41.91	20.95
			46,718.43	1,868.74	1,557.28	1,167.96	934.37	467.18	233.59
PoD24-17		burial platform	9,701.96	388.08	323.40	242.55	194.04	97.02	48.51
PoC3-1	PDA	F4 burial platform	21,559.79	862.39	718.66	538.99	431.20	215.60	107.80
PoC3-1	ANG	F2 burial platform	12,461.99	498.48	415.40	311.55	249.24	124.62	62.31
PoC3-1	PWIA	house platform w/ burial	39,056.29	1,562.25	1,301.88	976.41	781.13	390.56	195.28
PoC3-1	PEO	burial platform	26,927.05	1,077.08	897.57	673.18	538.54	269.27	134.64
PoC3-1	SOE	burial platform	14,560.82	582.43	485.36	364.02	291.22	145.61	72.80
PoC3-1	PEE	burial platform	23,669.85	946.79	788.99	591.75	473.40	236.70	118.35
PoC3-1	SPW	F2 burial platform	18,875.43	755.02	629.18	471.89	377.51	188.75	94.38
PoC3-1	SPW	F8 burial platform	16,779.90	671.20	559.33	419.50	335.60	167.80	83.90
PoC3-1	SWD	burial platform	16,367.03	654.68	545.57	409.18	327.34	163.67	81.84

8.2 Geochemical Investigations of Pohnpeian Architecture

In an important paper, Ayres (2002:59) suggested sourcing of architectural stone as a valuable addition to studies of regional networks and socio-political organization, but there has been limited work attempting to match stone building materials to sources on Pohnpei or elsewhere in the Pacific (e.g. Ayres and Scheller 2002; McCoy and Athens 2012). Petrographic and geochemical studies can identify how many stones sources may have been used in a structure, match stones with their sources, and can be used to refine labor investment calculations. A pilot geochemical study was made to determine whether geochemical identification of Pohnpeian basalts from pre-contact constructions using portable X-ray fluorescence (pXRF) is a viable way to address questions of source identification and quarry access. Geochemical analysis of basalts from quarries and structures may allow for the reconstruction of regional exchanges of stone used in monument building. This could have significant implications for labor investment studies, and our understanding of pre-contact socio-political relations specifically on Pohnpei.

Sites and structures must be linked to their quarry sources before discussions of resource networks can occur. The primary purpose of this study is to directly link architectural stone to its source quarry using pXRF analysis. This will also allow for more accurate transportation distances to be estimated for labor investment calculations. The viability of the use of pXRF in this type of geochemical study will also be examined.

8.2.1 Pohnpeian Geology

Pohnpei is a dissected volcanic shield approximately 20 kilometers wide, which until recently was believed to have formed as a result of hotspot volcanism (Bloom 1970a:147; Keating et al. 1984; Mattey 1982; Spengler et al. 1992, 1994). A recent re-examination of past studies accompanied by field observations now suggest that Pohnpei formed as a result of fracture-induced volcanism due to tectonic plate movements and related subduction events (Rehman et al. 2013). Potassium-Argon dating places shield-building formations between four

and nine million years ago (Dixon et al. 1984; Keating et al. 1984; Mattey 1982; Spengler et al. 1992). Late-stage volcanic activity on Pohnpei extended to approximately one to two million years ago (Dixon et al. 1984; Keating et al. 1984; Spengler et al. 1992).

Approximately half the land area occupies slopes of 30 degrees or greater (Spengler et al. 1992, 1994). Erosion on these steep slopes has caused deep channels to be formed over time. “The unique presence of these deep channels on Pohnpei, as well as the numerous indentations in the island’s coastline, are suggestive of rapid local subsidence since the Pleistocene Epoch’s low stand of the sea” (Spengler et al. 1992:28). Subsidence was not consistent across Pohnpei’s geologic history, but over the last eight million years the island has subsided approximately 280 meters (Spengler et al. 1992:29). Subsidence prevented the formation of coastal plains normally caused by volcanic erosion early in Pohnpei’s geologic history. The geology of the island includes basaltic bedrock and boulders with columnar basalt outcroppings scattered along the islands steep valleys and intertidal peat beds.

8.2.2 Geochemical Analysis of Architectural Stone: PoC3-5 Case Study

The dataset for this case study was collected during fieldwork in 2011. The methodology of this study is similar to that of McCoy and Athens (2012) in sourcing architectural stone. It will determine the potential number of quarry sources used in a single structure and identify possible source quarries for the columnar stone used. The PoC3-5 *lolong* was chosen for this case study because the presence of mineral inclusions in some stones and not in others indicates that more than one source quarry was utilized. The site’s location in proximity to Nan Madol was a secondary consideration. With the proximity to Nan Madol, it is possible to suggest that some of the same quarries were probably utilized for construction material.

Columnar basalt samples were collected in the field and analyzed in the laboratory to gain access to un-weathered samples of stone in case weathering had a significant impact on basalt geochemistry on Pohnpei. Twenty-five basalt samples from stone used in PoC3-5 were

collected using a portable sampling drill with half-inch diamond drill bits. Twelve were taken from stone used in the burial platform and 13 from the enclosing wall. Samples were chosen based on distribution within the structure and variability in physical appearance on the basis that visible differences in stone composition are indicative of distinct sources.

Three samples were also taken from the columnar basalt outcrop at Ipwal Quarry in Sokehs. The purpose of sampling quarries and architectural features was to test the possibility that individual columns could be sourced to a quarry. The two sampling locations were chosen due to geographic distance from each other and accessibility. It would have been preferable to sample additional columnar outcrops, but time and logistics prevented extensive sampling.

Samples were cut in the laboratory with a diamond saw and analyzed using pXRF. Samples were cut in order to control for variation in chemical composition based on basalt weathering. A Bruker Tracer III-V pXRF was used to analyze samples for values of Ti, Mn, Fe, Rb, Sr, Y, Zr and Nb. See Clark and colleagues (2014) for specifics on instrument parameters and ARTAX Spectra settings. Each sample was analyzed at least four times to control for within sample variability and the results for the weathered exterior surfaces could be excluded from analysis if they were found to significantly skew the geochemical signatures. The pXRF data was calibrated by Christian Reepmeyer (ANH, ANU) using 18 international standards (AGV-1, BCR-1, BCR-2, BHVO-1, BHVO-2, BIR, CRPG-BR, DNC-1, JB-1, KILAUEA 93-1489, NIST1633a, NIST1646, NIST2704, NIST278, NIST27D, RGM-1, TAFAHI, WSE) and four ANU laboratory standards (GC-6, GC-11, GC-188, GC-200) through linear regression. Nine correction cycles were run during calibration for background stripping and peak deconvolution.

The calibrated pXRF data from the material collected in 2011 was compared to data reported in previous geochemical studies on Pohnpeian basalts (see review below). Statistical analysis was undertaken to determine the number of possible sources and to identify potential quarries for the samples from the Temwen *lolong*.

8.2.3 Previous Geochemical Studies

Most geochemical studies undertaken on Pohnpei were geared toward characterizing the geologic history of the island (Dixon et al. 1984; Keating et al. 1984; Mattey 1982; Spengler 1990; Spengler et al. 1992, 1994), which has provided descriptive information on basalts and data on the chemical compositions of three distinct lava flows. Although these datasets were part of wider geologic interest in the region, they are important to archaeological study of stone artifacts, including stone construction material. This review focuses on three studies incorporating detailed geochemical data. Studies predating these were primarily concerned with the geologic formation of Pohnpei and are excluded from this discussion.

The first study by Mattey (1982) was concerned with characterizing the basalts on Pohnpei, Chuuk and Kosrae to better understand the formation and volcanic history of the Caroline Islands. The work incorporated petrography and geochemical analysis of 100 basalt samples to characterize the geology of each island and to determine whether it is possible to differentiate between islands. Dense ground cover and thick soil deposits prevented a full examination of the relationships of his designated lava series for each island, so Mattey (1982) used potassium-argon dating to form hypotheses relating to the relative age and sequence of the volcanic series. Using the geochemical analyses and the potassium-argon dates Mattey (1982) determined that Kosrae, Pohnpei and Chuuk had distinguishable geochemical signatures and hypothesized that they were formed by hot-spot volcanism, which has recently been disproven (see Rehman 2013). What is particularly relevant to this study is the classification of Pohnpeian basalts and the geochemical data produced for Pohnpeian basalts. Mattey (1982:4) identified three separate lava series: the Pohnpei Main Lava Series (PMLS), the Pohnpei Transitional Lava Series (PTLS) and the Pohnpei Basanite Series (PBS). Each series varies slightly from the other.

Spengler's thesis (1990) and related publications (Spengler et al. 1992, 1994) significantly expanded the understanding of geomorphology, hydrogeology and geochemistry on Pohnpei. His review covers the topics pertinent to geochemical studies. Spengler (1990; et

al. 1992, 1994) identified three primary lava flows on Pohnpei: the Awak, Kupwuriso and Main Lava series. Spengler's samples were collected in greater number and from a wider geographic distribution than previous studies. His assignment of geologic samples to lava flows were based on stratigraphic relations observed in the field in addition to petrographic characteristics (Spengler et al. 1994:11). Samples were geochemically analyzed using XRF and isotopic analysis (Spengler et al. 1994:9). Spengler's studies (1990; et al. 1992, 1994) show that Pohnpeian basalts are chemically diverse in composition, even within individual lava flows; the compositional characteristics of each flow were identified. The Awak group compositions ranged from basanite to trachyte, Kupwuriso ranges between alkali olivine basalt to nephelinite, and the Main Lava series includes alkali olivine basalts with high frequencies of olivine phenocrysts and basalts incorporating clinopyroxene and plagioclase (Spengler et al. 1992:16-17, 1994:9). Kupwuriso is the youngest basaltic flow on Pohnpei (Spengler 1990; Spengler et al. 1992), and xenoliths are more common to the Kupwuriso volcanics (Spengler et al. 1992:22). Jointed columnar flows may have been more common in the Late Stage volcanics (Awak and Kupwuriso) (see Spengler 1990). Spengler, much like Dixon (et al. 1984), noted possible quarries for the Nan Madol columnar building materials (Spengler et al. 1992:24). He believes the peninsulas at Dollapwail and Nan Diadi are probable candidates (Spengler et al. 1992:24). Spengler (et al. 1994) also compared his geochemical data with Mattey's to establish correspondence between both classification schemes.

Archaeological studies incorporating geochemical analysis of stone used in prehistoric architectural sites has only recently been undertaken on Pohnpei (McCoy and Athens 2012), though it had been suggested for a number of years (Ayres and Scheller 2002). McCoy and Athens' study focuses on architectural samples from Nan Madol and some potential quarry samples collected by Athens in 1982 and 1984 (McCoy and Athens 2012). As with the case study presented below, pXRF was used to determine the chemical compositions of the basalt samples. The quarry samples were analyzed alongside Spengler's (1990; et al. 1992, 1994) trace element data to identify affinities to specific lava series (McCoy and Athens 2012). The

architectural samples were then added to the quarry distribution. Many of the Nan Madol samples were grouped with the Main Shield volcanics with a few grouping with the Awak or Kupwuriso series (McCoy and Athens 2012). The quarry and architectural samples fall within the Main Shield series were divided into three subgroups based on physical description and size range.

This study uses Spengler's (1990; et al. 1992, 1994) lava series identifications as the island standard for the comparative analysis, since his studies are the most recent and were cross-checked with Mattey's (1982) data. What follows are the results of the geochemical analysis of the PoC3-5 basalts, and their implications for architectural analysis on Pohnpei.

8.2.4 Results of pXRF Analysis

The calibrated data from the pXRF analysis (see Table 8.9) was examined through a series of statistical analyses. Within the architectural dataset comparisons of averages using standard deviations and chi-square statistics were used alongside bi-plots to determine specific trends within the geochemical data. Once completed, principle components analysis and discriminant function analysis were used to compare the architectural geochemistry with potential sources using Spengler's and Mattey's geochemical data from natural features (see Figure 8.2 for map showing sampled locations).

	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
Ipwal1								
Average	21,671.81	1,279.70	77,539.34	25.70	801.46	25.15	302.98	48.53
St Dev.	1,700.33	239.98	7,335.84	4.60	72.56	4.81	13.16	9.55
Ipwal2								
Average	26,072.80	1,393.34	83,765.08	27.92	818.77	29.08	308.05	52.03
St Dev.	3,852.08	289.34	2,935.81	4.58	44.12	3.44	18.62	4.02
Ipwal3								
Average	25,372.69	1,385.50	83,664.41	28.53	826.14	30.08	312.05	52.73
St Dev.	1,886.86	180.85	2,750.28	3.62	47.48	6.62	13.47	3.47
PoC3-5-BPEast1								
Average	18,280.12	1,156.93	74,616.75	16.66	502.60	23.28	158.22	26.50
St Dev.	3,939.88	269.17	10,181.09	3.46	95.97	3.46	18.72	3.14
PoC3-5-BPEast2								
Average	21,655.53	1,337.21	80,626.77	16.70	480.48	20.74	163.74	27.43
St Dev.	1,341.77	383.88	10,202.16	3.05	206.65	5.45	23.25	7.26
PoC3-5-BPEast3								
Average	22,127.47	1,525.23	80,787.45	24.57	792.67	26.90	218.26	40.81
St Dev.	2,422.59	231.79	6,614.88	4.16	104.89	3.67	17.07	2.46
PoC3-5-BPNorth1								
Average	20,931.36	1,759.70	72,946.28	32.26	1139.24	26.60	257.98	49.56
St Dev.	3,404.72	208.83	6,975.81	6.64	204.47	4.44	35.84	9.59
PoC3-5-BPNorth2								
Average	20,361.78	1,377.02	84,346.21	18.51	576.41	21.44	176.00	29.19
St Dev.	1,859.71	367.70	8,173.74	4.40	166.32	5.68	25.41	5.54
PoC3-5-BPNorth3								
Average	23,958.25	1,500.90	83,326.19	23.94	819.11	29.05	231.72	45.87
St Dev.	1,652.74	317.35	2,109.76	3.63	85.94	5.39	14.99	5.40
PoC3-5-BPSouth1								
Average	21,753.17	1,257.58	78,007.09	24.07	722.53	24.90	202.55	36.39
St Dev.	2,431.09	275.24	5,300.85	2.26	132.44	4.75	23.92	5.55
PoC3-5-BPSouth2								
Average	21,321.92	1,593.80	83,996.28	19.14	542.22	22.55	169.02	29.23
St Dev.	4,459.73	265.21	11,449.56	3.02	150.62	7.59	32.85	4.17
PoC3-5-BPSouth3								
Average	21,492.80	1,450.02	83,801.09	21.45	673.56	26.75	221.48	40.68
St Dev.	3,536.98	548.89	5,308.97	2.78	182.70	6.04	22.47	6.58

Table 8.9a Geochemical data from PoC3-5 and Ipwal quarry listed as averages and standard deviations.

	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
PoC3-5-BPWest1								
Average	21,745.04	1,191.22	79,010.45	26.11	867.69	24.45	241.40	50.07
St Dev.	2,622.15	182.34	3,398.54	2.96	54.65	4.46	4.54	6.54
PoC3-5-BPWest2								
Average	21,468.39	1,454.44	85,369.80	26.97	759.13	22.90	231.87	49.08
St Dev.	2,821.96	275.68	4,885.47	2.08	33.22	3.31	22.04	3.86
PoC3-5-BPWest3								
Average	22,265.79	1,365.96	80,556.55	29.32	948.05	30.35	260.60	53.07
St Dev.	3,860.74	186.48	4,383.62	3.91	87.70	5.51	18.77	3.29
PoC3-5-enclwall1								
Average	20,906.95	1,611.50	90,725.79	25.47	671.94	27.25	213.50	43.00
St Dev.	1,564.51	407.32	22,976.68	2.11	248.48	8.55	17.67	5.64
PoC3-5-enclwall2								
Average	23,697.87	1,677.86	93,827.50	18.29	649.93	22.30	192.11	32.96
St Dev.	4,566.95	120.80	8,906.90	4.30	91.71	2.67	12.26	2.53
PoC3-5-enclwall3								
Average	22,176.29	1,518.59	89,837.88	21.31	615.67	23.20	201.64	40.08
St Dev.	3,912.18	224.82	10,513.77	1.97	270.52	5.77	13.22	7.30
PoC3-5-enclwall4								
Average	25,115.03	1,376.29	82,515.85	21.22	652.54	22.57	190.23	36.69
St Dev.	4,570.93	433.56	10,136.74	3.18	142.56	4.07	20.07	6.91
PoC3-5-enclwall5								
Average	17,635.95	1,284.12	77,397.70	20.00	602.58	23.35	163.90	28.93
St Dev.	3,359.57	279.36	9,563.45	3.70	108.27	3.83	26.16	8.94
PoC3-5-enclwall6								
Average	22,904.53	1,532.97	86,060.72	32.11	844.75	26.70	290.22	56.16
St Dev.	1,970.84	235.32	3,666.16	2.38	158.76	4.30	20.76	6.21
PoC3-5-enclwall7								
Average	23,291.03	1,312.88	89,859.31	24.62	688.02	21.59	223.38	46.47
St Dev.	3,853.94	182.00	8,032.99	3.43	305.68	2.97	10.07	7.24
PoC3-5-enclwall8								
Average	20,266.85	1,175.36	77,050.75	21.07	598.76	21.82	175.15	29.25
St Dev.	2,356.12	374.57	12,599.02	2.94	133.59	3.81	17.90	5.58
PoC3-5-enclwall9								
Average	19,051.76	1,277.48	84,590.20	19.91	508.75	20.14	158.15	26.02
St Dev.	2,360.44	322.98	11,310.04	4.54	162.45	7.04	34.85	5.59

Table 8.9b Geochemical data from PoC3-5 and Ipwal quarry listed as averages and standard deviations.

	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
PoC3-5-enclwall10								
Average	22,339.02	1,571.68	83,014.35	24.62	680.40	22.35	211.80	34.98
St Dev.	1,699.16	291.36	8,151.78	3.98	90.28	5.37	20.94	4.00
PoC3-5-enclwall11								
Average	23,299.17	1,310.66	82,806.06	28.78	880.06	30.45	251.52	46.00
St Dev.	4,048.76	184.17	3,742.75	3.45	66.36	2.43	18.90	5.66
PoC3-5-enclwall12								
Average	19,595.57	1,274.90	77,215.40	20.96	548.24	19.65	177.80	26.57
St Dev.	3,852.88	204.23	13,507.78	4.34	172.05	2.88	33.54	6.89
PoC3-5-enclwall13								
Average	18,823.93	1,213.34	84,334.30	21.72	565.99	26.45	183.42	33.65
St Dev.	1,182.78	283.55	7,310.60	1.59	93.48	2.55	13.19	2.71

Table 8.9c Geochemical data from PoC3-5 and Ipwal quarry listed as averages and standard deviations.

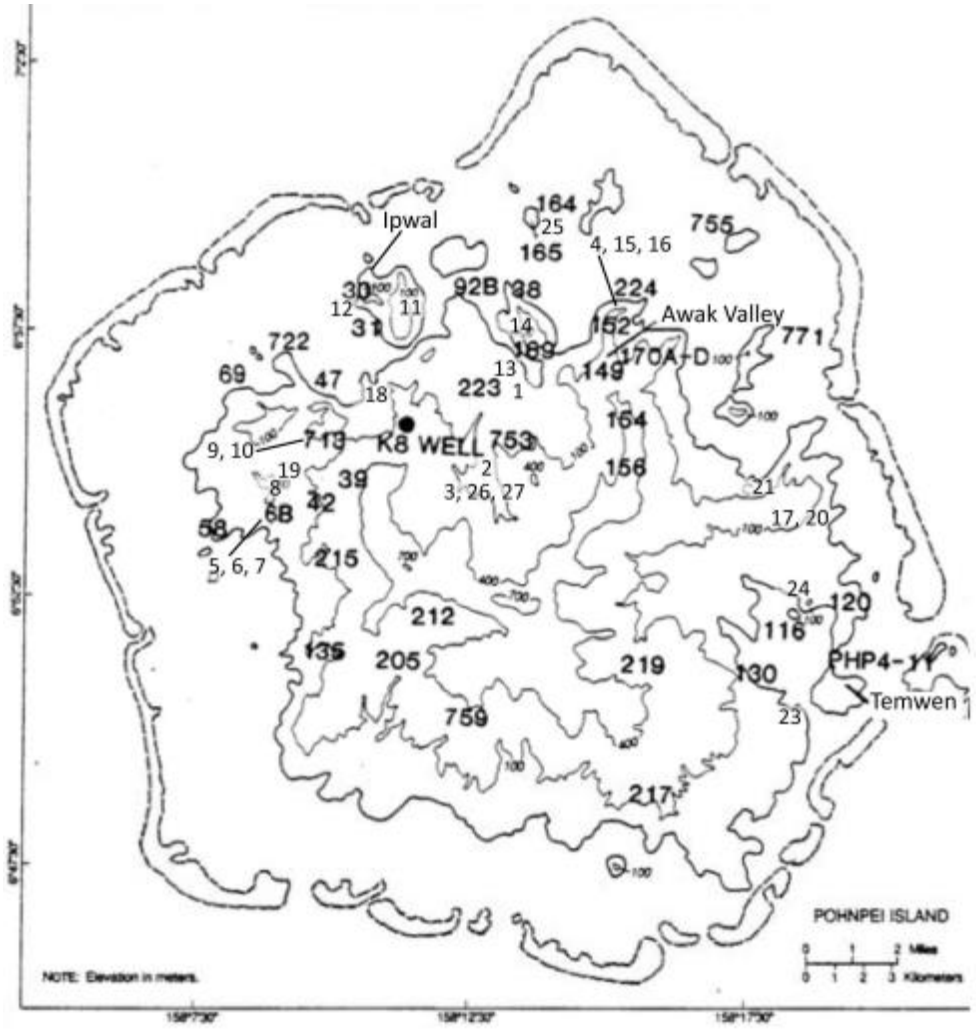


Figure 8.2 Geologic map of Pohnpei with quarry sources from Spengler and Mattey notated (Modified from Spengler et al. 1994).

8.2.4.1 Statistical Relationships within Architectural Dataset

Prior to the comparative analysis of the architectural samples with the geologic source samples, it was necessary to examine the chemical signatures of the samples collected in 2011 to determine which elements might be the most helpful in distinguishing between potential stone sources. This examination looked for element clustering that might suggest how many sources may have been utilized and if any particular elements may display more variability than others.

The first step was to determine whether weathering affects pXRF results. The averaged counts for each element were statistically compared using chi-squares to determine if there was a significant difference between averages including and excluding the exterior weathered surface. The results show that there is no significant difference between datasets, which indicates that weathering does not significantly impact basalt geochemistry for the eight elements analyzed. The p-values for each elemental comparison ranged between 0.29 and 0.89. Based on this statistical result none of the pXRF data was excluded from following steps in the analysis.

Each trace element was examined and compared using bi-plots and standard error ranges to look at variability within individual elements. Plots of each element were produced with each architectural sample differentiated, and error ranges included (Figure 8.3; see Table 8.10 for Figure 8.3 sample key). Of the eight elements examined, Ti, Fe, and Mn show less variability than other trace elements. Y shows similar patterning to Rb, Sr, Zr, and Nb, but the distinctions between groups is not as distinctive in the Y plot. The groupings in the plots of Rb, Sr, Zr, and Nb show evidence that there may have been up to three columnar quarries utilized in PoC3-5.

Paired element bi-plots were produced to examine potential groupings not apparent in the individual element plots (Figure 8.4). Only Y, Rb, Sr, Zr, and Nb were included in this analysis because they showed more variability in the individual element plots than Ti, Fe, and Mn. Four plots, all of which incorporated Zr, showed two possible groupings within the

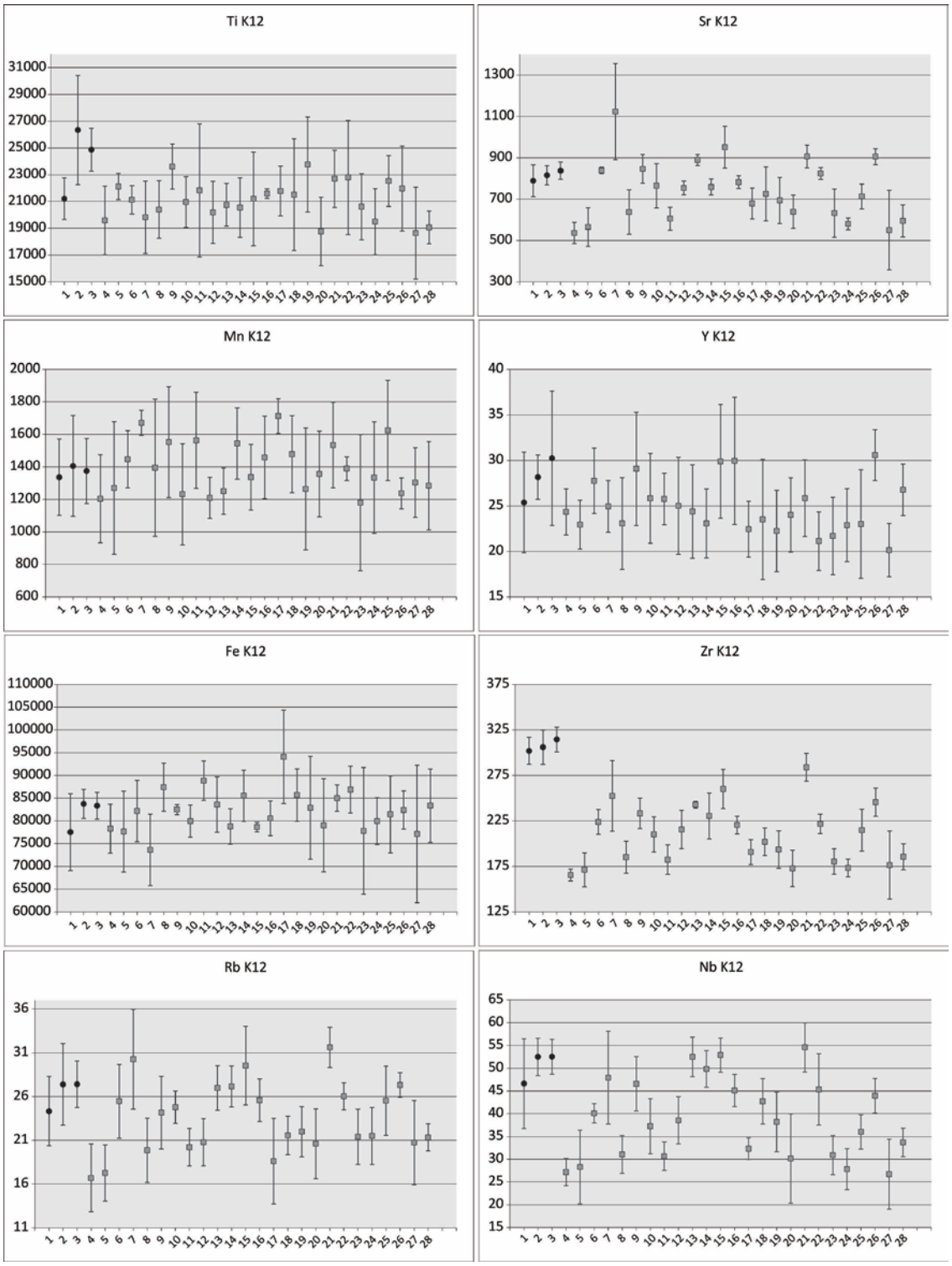


Figure 8.3 Plots of each element to show variability and possible groupings. Ipwal samples are black dots and PoC3-5 samples grey squares. Samples shown in parts per million (ppm) with standard deviations.

Code	Sample
1	lpwal1
2	lpwal2
3	lpwal3
4	PoC3-5-BPEast1
5	PoC3-5-BPEast2
6	PoC3-5-BPEast3
7	PoC3-5-BPNorth1
8	PoC3-5-BPNorth2
9	PoC3-5-BPNorth3
10	PoC3-5-BPSouth1
11	PoC3-5-BPSouth2
12	PoC3-5-BPSouth3
13	PoC3-5-BPWest1
14	PoC3-5-BPWest2
15	PoC3-5-BPWest3
16	PoC3-5-enclwall1
17	PoC3-5-enclwall2
18	PoC3-5-enclwall3
19	PoC3-5-enclwall4
20	PoC3-5-enclwall5
21	PoC3-5-enclwall6
22	PoC3-5-enclwall7
23	PoC3-5-enclwall8
24	PoC3-5-enclwall9
25	PoC3-5-enclwall10
26	PoC3-5-enclwall11
27	PoC3-5-enclwall12
28	PoC3-5-enclwall13

Table 8.10 Key to the X-axis labels in Figure 8.3.

architectural dataset. The other plots show no distinctive clustering, but there was typically a linear patterning in the distribution. This might suggest that Zr may be the most helpful in distinguishing between sources.

A final graphical comparison was made to determine further patterning by plotting Ti/Fe ratios against the Nb values to distinguish groups (Figure 8.5). Three potential source groups were separated out in the graphical comparison.

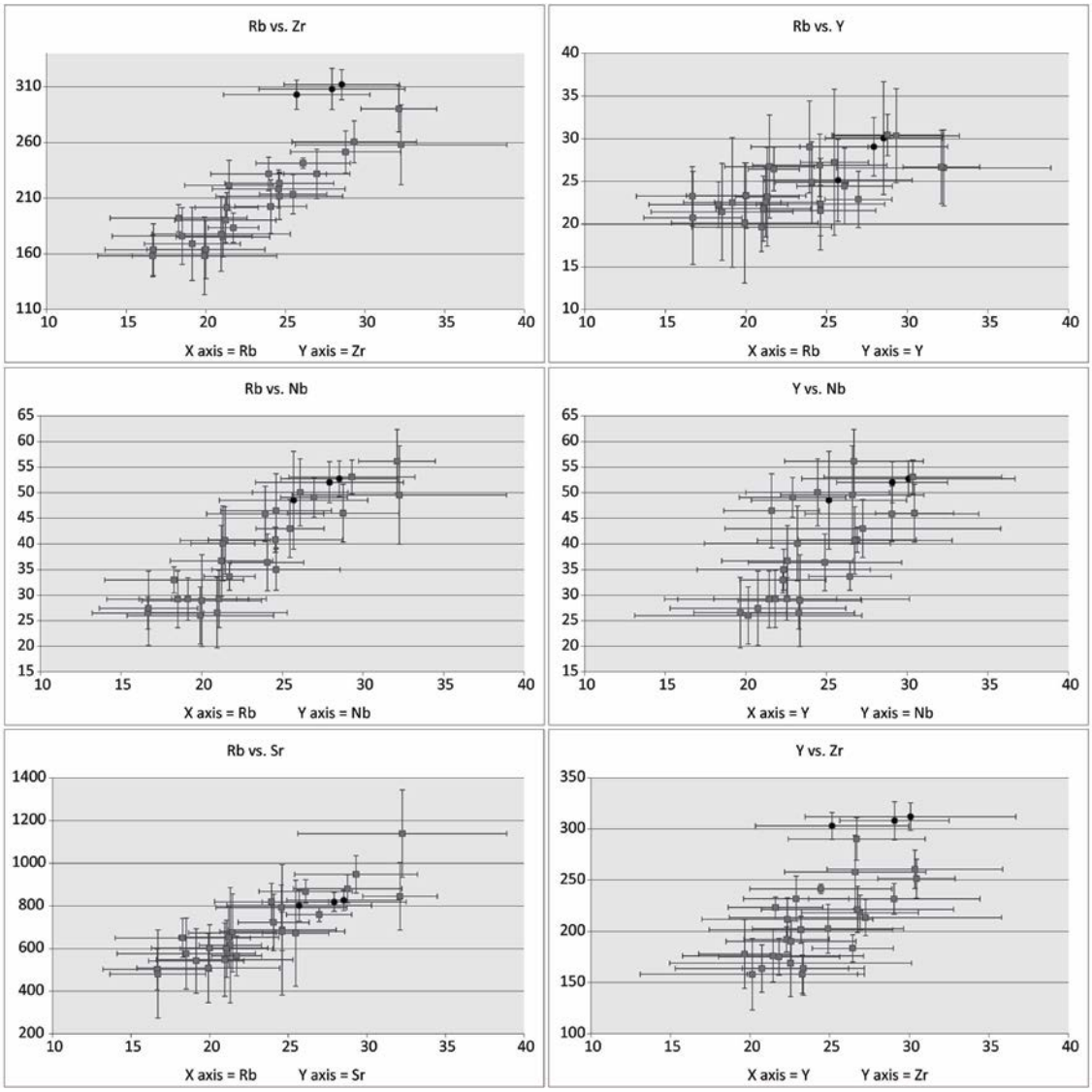


Figure 8.4a Paired bi-plots showing potential quarry groupings. Ipwal samples are black dots and PoC3-5 samples grey squares. Shown as ppm with standard deviations.

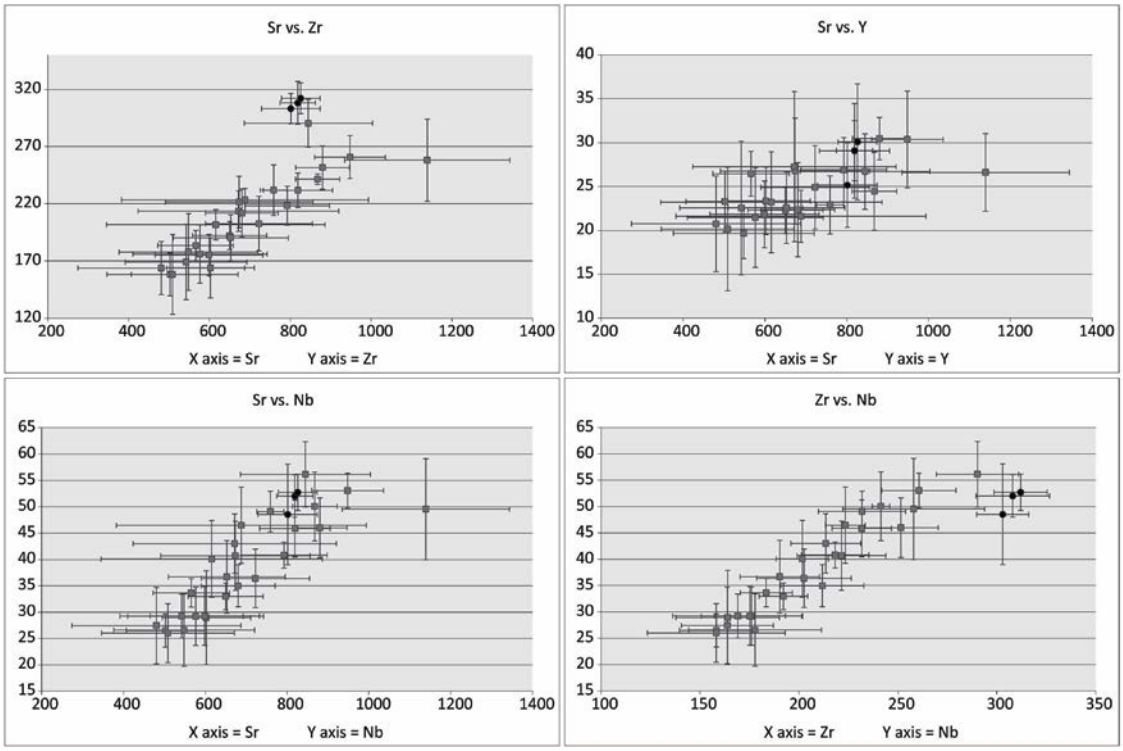


Figure 8.4b Paired bi-plots showing potential quarry groupings. Ipwal samples are black dots and PoC3-5 samples grey squares. Shown as ppm with standard deviations.

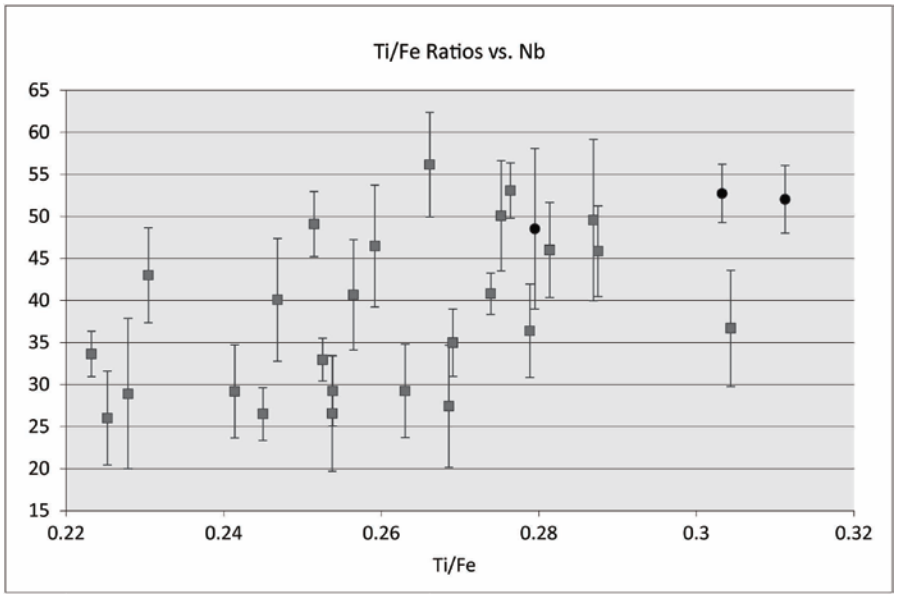


Figure 8.5 Bi-plots of Ti/Fe ratios against Nb values. Ipwal samples are black dots and PoC3-5 samples grey squares. Nb is shown in ppm with error bars showing the standard deviation for each sample.

8.2.4.2 Comparative Statistical Analysis

The variability of trace elements within identified lava flows needed to be determined before potential quarry affinities for architectural stone can be examined (see Table 8.11 for quarry data). The relationship between lava groups and the variability within groups were explored using discriminant function analysis (Figure 8.6). These groups were divided based on Spengler's (1990) lava series, with data points produced by Mattey (1982) left ungrouped to determine if they fit within one of Spengler's identified lava flows. The Main Lava and Dike series grouped together in the statistical analysis and were distinct from the Awak and Kupwuriso groups. The samples taken from the Ipwal Quarry grouped within the Awak series, while Mattey's (1982) samples were not tied to a single volcanic flow. The analysis showed that there is some overlap in the Awak and Kupwuriso groups, as two of the Awak samples were reclassified within the Kupwuriso range. The overlap in these groups is minor, but has potentially significant implications for this study in that additional geochemical or petrographic analysis may be necessary to positively match building stone to a source. What these results show is that it should be possible to differentiate which stone is affiliated with which volcanic series based on trace element geochemistry.

The discriminant function analysis of the lava flows also shows that some geologic sources have similar geochemical signatures to others located more than five kilometers distant. This limits our ability to use pXRF data to link architectural stone to its source, but it does identify a number of possible sources. The three samples from Ipwal Quarry in Sokehs also display some variability, which means individual quarries are unlikely to be geochemically homogeneous.

Quarry ID	Rb K12	Sr K12	Y K12	Zr K12	Nb K12	Author
Awak 116	2.117	2.631	1.568	2.898	2.233	Spengler
Awak 120	1.415	2.935	1.580	2.516	1.875	Spengler
Awak 135	1.833	2.149	1.886	2.941	2.134	Spengler
Awak 149	1.672	3.139	1.623	2.616	2.029	Spengler
Awak 152	1.491	3.043	1.519	2.481	1.869	Spengler
Awak 154	1.431	2.986	1.505	2.467	1.740	Spengler
Awak 164	1.799	3.355	1.813	2.929	2.365	Spengler
Awak 165	1.653	3.120	1.732	2.801	2.068	Spengler
Awak 169	1.230	3.068	1.591	2.425	1.851	Spengler
Awak 170A	1.380	2.980	1.591	2.509	1.813	Spengler
Awak 170D	1.531	2.983	1.556	2.574	1.839	Spengler
Awak 205	1.398	2.904	1.491	2.529	1.763	Spengler
Awak 30	1.531	3.031	1.544	2.600	1.806	Spengler
Awak 69	1.322	2.880	1.580	2.569	1.799	Spengler
Awak 755	1.519	2.990	1.556	2.560	1.799	Spengler
Awak 759	1.724	3.066	1.663	2.740	2.029	Spengler
Awak 771	1.380	2.897	1.477	2.480	1.716	Spengler
Awak 858	1.568	2.994	1.519	2.535	1.763	Spengler
Awak K8:150-160	1.255	2.996	1.519	2.430	1.771	Spengler
Awak K8:200-210	1.279	3.009	1.505	2.413	1.756	Spengler
Awak K8:260-270	1.431	3.153	1.580	2.487	1.851	Spengler
Awak K8:300CLN	1.491	3.030	1.568	2.562	1.833	Spengler
Awak SS-58	1.477	2.929	1.505	2.511	1.826	Spengler
Awak SS-6B	1.431	2.844	1.477	2.427	1.732	Spengler
Kup Temwen	1.633	2.989	1.531	2.358	1.914	Spengler
Kup 212	1.756	3.017	1.477	2.358	1.886	Spengler
Kup 217	1.580	2.761	1.398	2.320	1.748	Spengler
Kup 219	1.146	2.925	1.431	2.320	1.833	Spengler
Kup 223	1.342	2.792	1.431	2.272	1.748	Spengler
Kup 92-B	1.000	2.829	1.398	2.274	1.740	Spengler
Kup K8:100-110	1.000	2.945	1.431	2.305	1.716	Spengler
Kup K8:30-40	1.000	2.923	1.447	2.330	1.748	Spengler
Kup PHP-11	1.724	3.143	1.505	2.360	1.881	Spengler
Kup PHP-4	1.591	3.029	1.544	2.352	1.934	Spengler
Kup PHP-7	1.447	3.075	1.519	2.358	1.940	Spengler
Kup PHP-8	1.079	2.877	1.491	2.316	1.813	Spengler
Kup SS-111	1.531	2.849	1.415	2.346	1.748	Spengler
Kup SS-130	1.079	2.976	1.505	2.356	1.908	Spengler
Kup SS-156	1.146	2.930	1.491	2.336	1.748	Spengler
Main Dike 224	1.505	2.667	1.643	2.476	1.602	Spengler
Main Dike 31	1.279	2.689	1.431	2.391	1.591	Spengler
Main Dike 38	1.000	2.605	1.491	2.389	1.477	Spengler
Main Dike 39	1.114	2.436	1.322	2.260	1.415	Spengler

Table 8.11a Quarry values from Spengler and Mattey after log10 conversion.

Quarry ID	Rb K12	Sr K12	Y K12	Zr K12	Nb K12	Author
Main Dike 47	1.079	2.665	1.505	2.452	1.544	Spengler
Main Dike 713	1.146	2.706	1.462	2.427	1.556	Spengler
Main Dike 714	0.954	2.646	1.505	2.427	1.447	Spengler
Main Dike 753	1.230	2.701	1.556	2.483	1.531	Spengler
Main Dike Village	1.322	2.687	1.519	2.452	1.505	Spengler
Main Lava 215	1.079	2.628	1.544	2.389	1.568	Spengler
Main Lava 42	1.114	2.476	1.380	2.281	1.415	Spengler
Main Lava 722	1.079	2.645	1.491	2.455	1.580	Spengler
Main Lava K8:300ZEOL	1.255	2.641	1.491	2.417	1.531	Spengler
Main Lava K8:350-360	1.079	2.619	1.519	2.430	1.519	Spengler
Main Lava K8-390	1.301	2.554	1.556	2.360	1.580	Spengler
s P10	1.114	2.575	1.544	2.386	1.462	Mattey
s P17	1.398	2.919	1.568	2.580	1.763	Mattey
s P18	1.602	2.857	1.415	2.413	1.813	Mattey
s P19	1.255	2.787	1.431	2.435	1.663	Mattey
s P21	1.342	2.859	1.431	2.481	1.663	Mattey
s P23	1.431	2.870	1.398	2.365	1.756	Mattey
s P24	2.093	2.371	1.580	3.021	2.196	Mattey
s P27	1.447	2.728	1.398	2.279	1.613	Mattey
s P6	0.778	2.382	1.322	2.236	1.255	Mattey
s PON2	1.633	3.075	1.623	2.719	1.929	Mattey

Table 8.11b Quarry values from Spengler and Mattey after log10 conversion.

The second step in the analysis involved comparing trace element data from Spengler's (1990) and Mattey's (1982) study datasets with the architectural samples to identify possible sources. The first aim of the comparative statistics was to determine which volcanic series an architectural sample grouped with. In the discriminant function analysis half of the architectural samples grouped with the Awak series, and a few grouped with the Kupwuriso series. The statistical analysis suggested a loose affinity between half a dozen architectural samples and the Main Lava series, but this result may be questionable since columnar basalt formations are not commonly identified within these flows. Based on the unbalanced distribution of the geologic source locations from the geologic studies (majority from the north half of the island) due to access and terrain issues, it is possible that there are additional sources of architectural stone on the south side of Pohnpei. Further geologic survey and sampling will help to clarify the island-wide distribution of columnar stone sources.

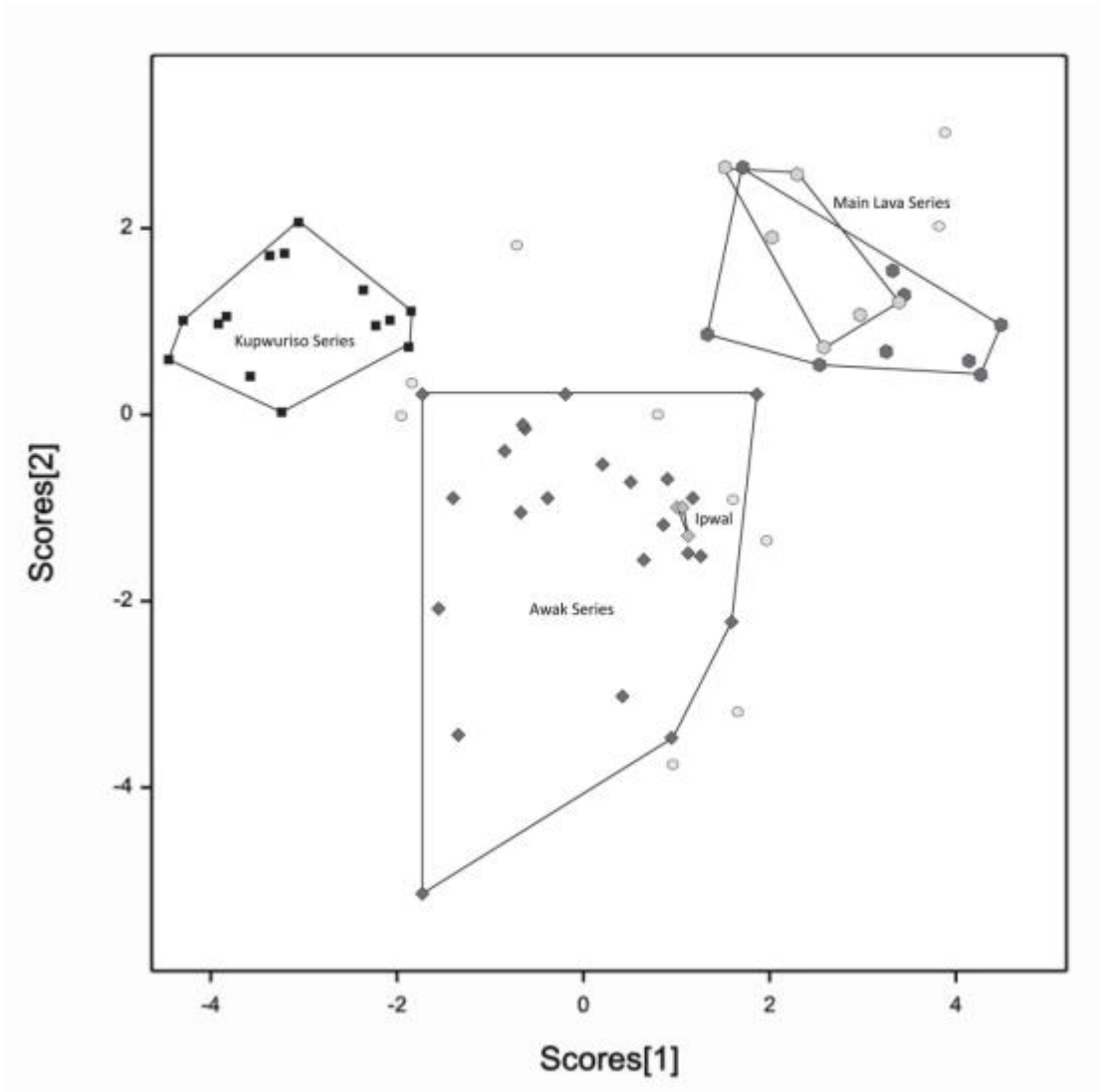


Figure 8.6 Plot of the discriminant function analysis on the identified lava series. Ungrouped circles are unclassified samples from Mattey 1982.

Finally, the architectural samples were compared with the volcanic group samples to identify potential quarry sources within geologic groups. Principal components and discriminant function analyses were run on each volcanic group and the architectural samples entered with them separated to identify possible sources.

The analyses for the Main Lava series show that the architectural samples cluster together, though not directly with any of the geologic source samples. This suggests that the architectural samples were not derived from any of the sources included in this study. The groupings from the discriminant function analysis (Figure 8.7) indicate that the source has

closer affinities to the Main Dike samples from location 31 and the Village on the northern side of the island. Principle components analysis also picked up 753 and Main Lava K8:300ZEOL as possible sources (Figure 8.8). Both of these sources are on the northwest side of Pohnpei.

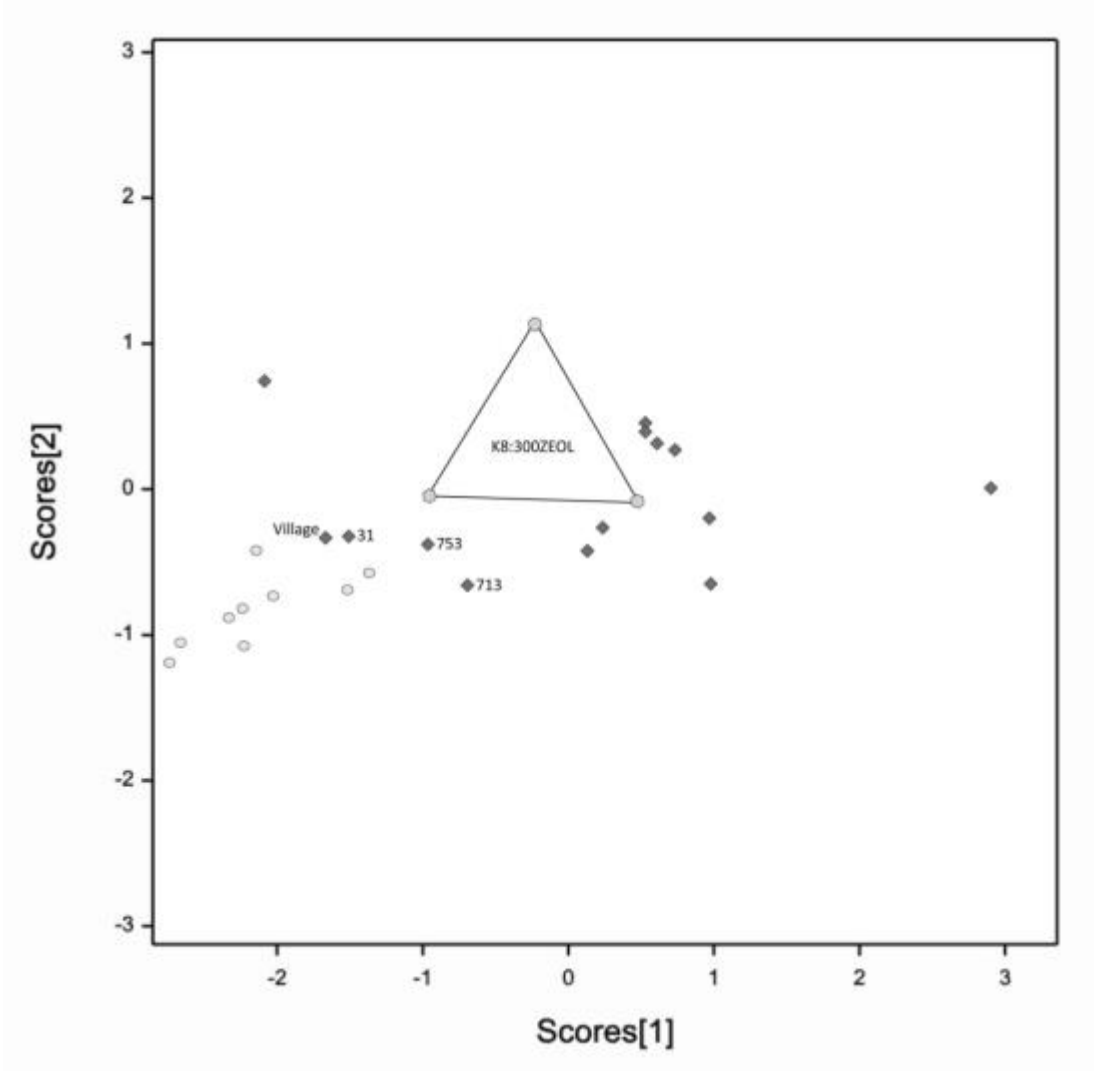


Figure 8.7 Discriminant analysis plot of Main lava series. Unclassified architectural samples are circles and close match quarry samples are labelled.

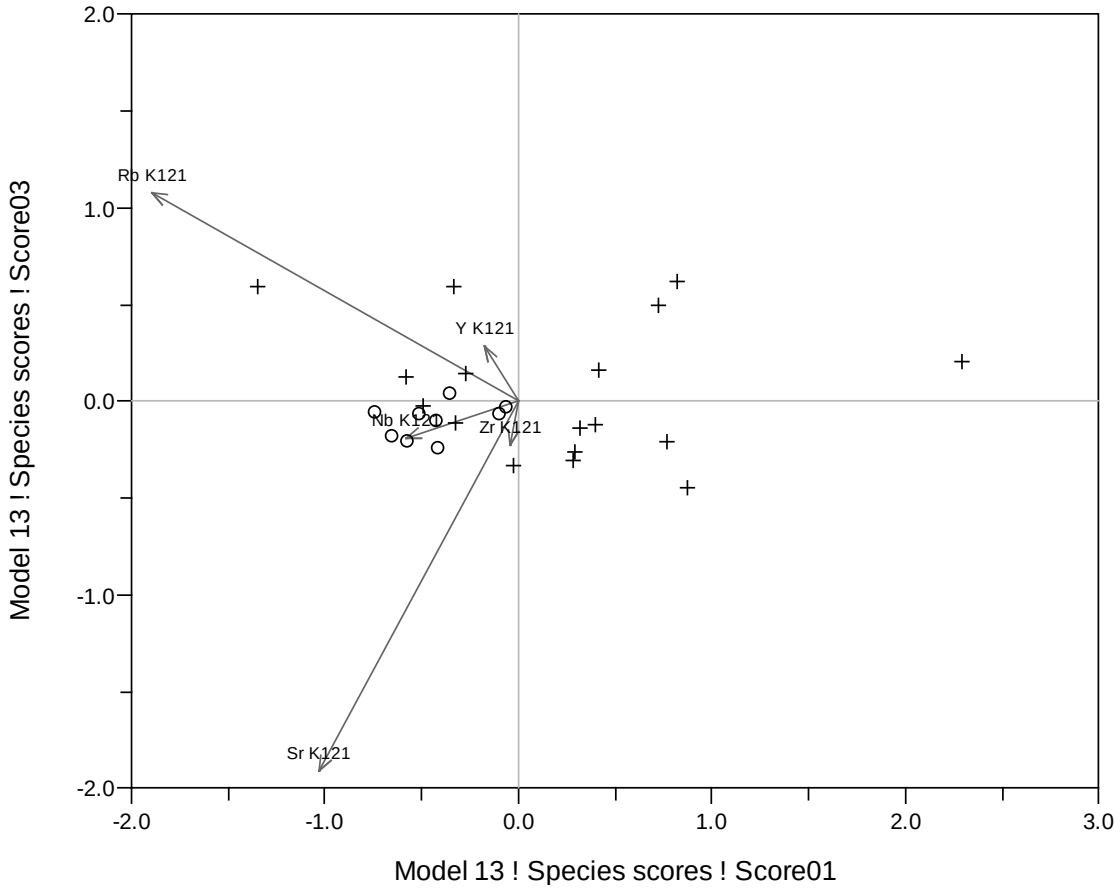


Figure 8.8 PCA of Main lava series data points. Architectural samples are shown as circles and pluses are geologic.

The results of the analyses on the Kupwuriso grouping also show clustering in the architectural samples without direct links to the geologic samples. The closest affinities for the Kupwuriso group from the discriminant function analysis (Figure 8.9) are located in two different areas of Pohnpei, one in Uh district (SS-156) and the other in Madolenihmw mainland near Temwen Island (P23). The principle components analysis also identified P27 as a potential source (Figure 8.10). P27 is located just northwest of the island's center.

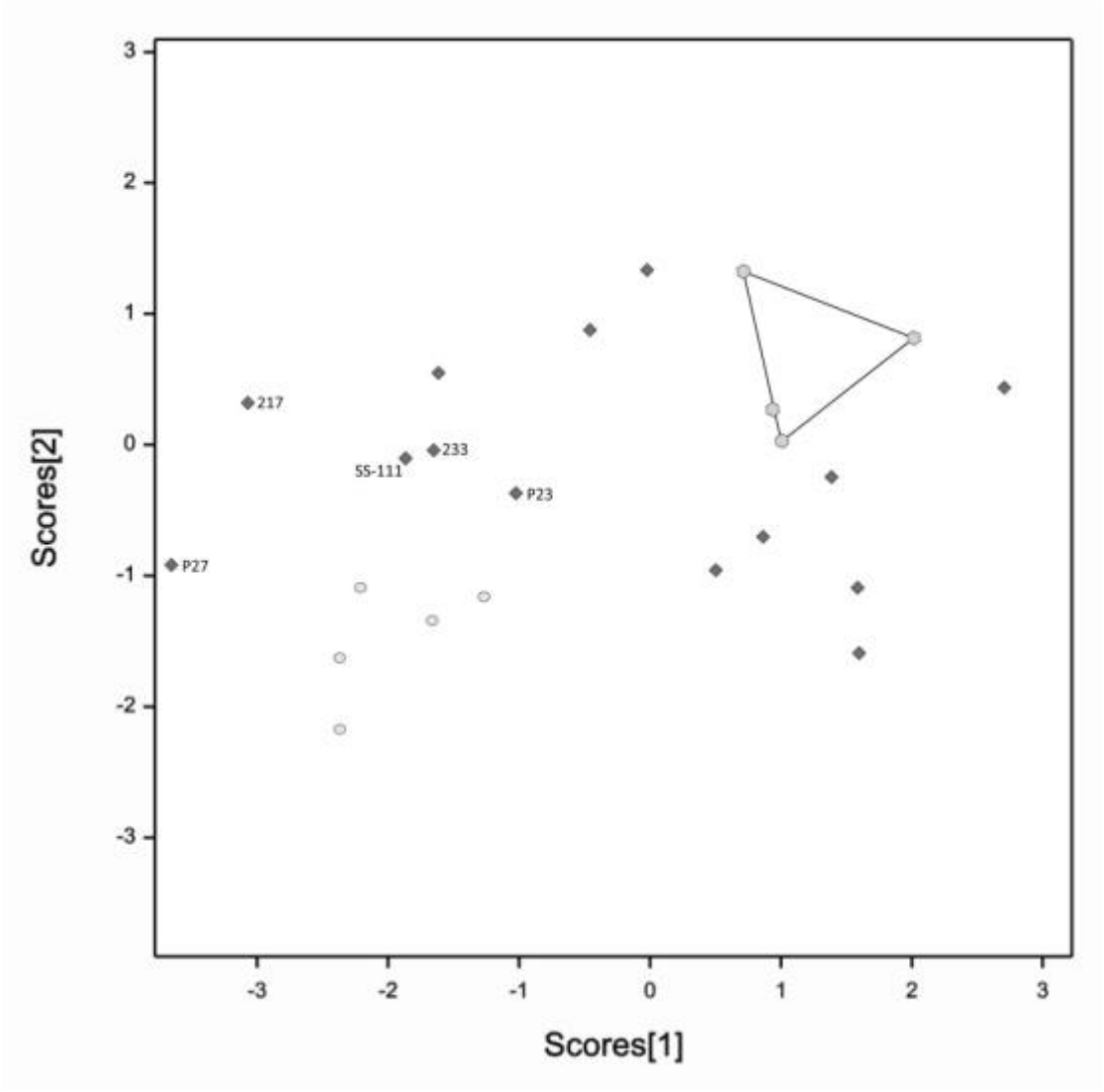


Figure 8.9 Kupwuriso discriminant analysis plot. Architectural samples are shown as circles and others are geologic.

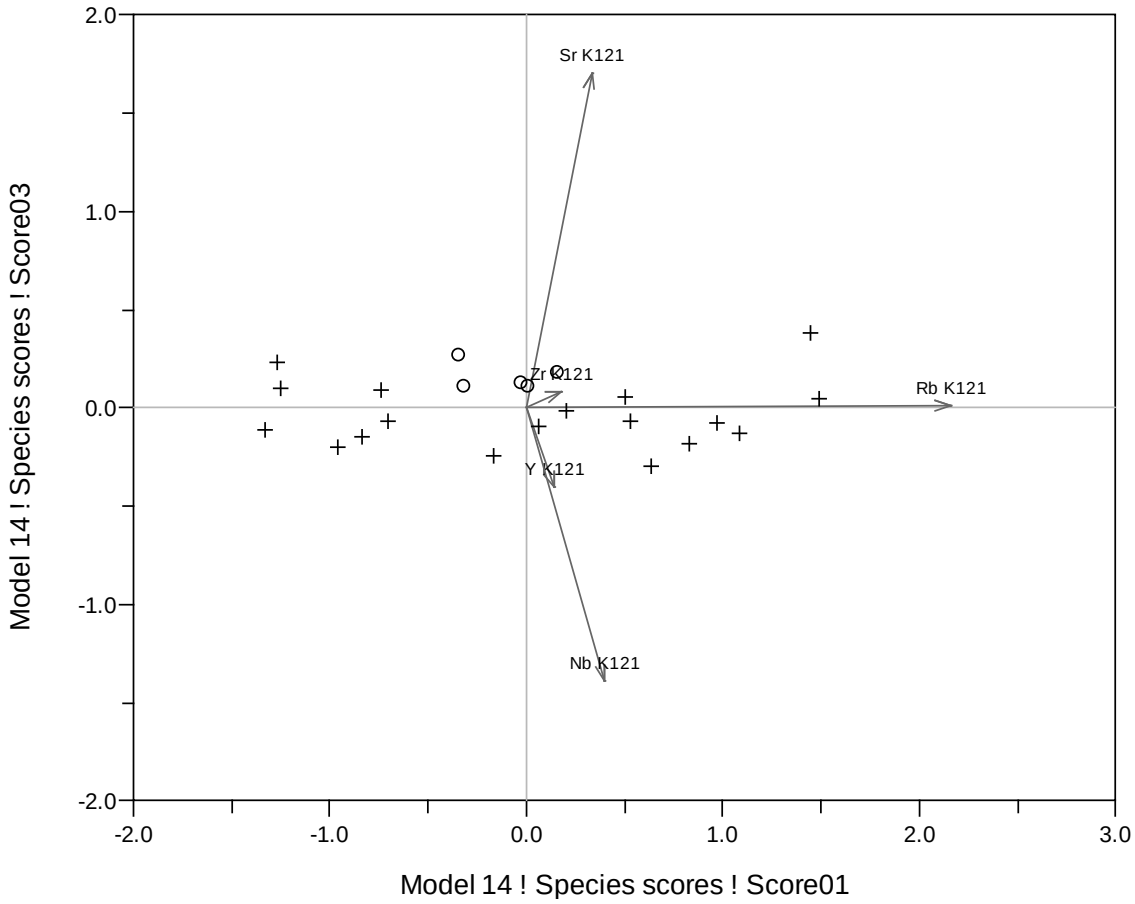


Figure 8.10 PCA plot of Kupwuriso data with architectural samples are circles and pluses are geologic.

The Awak group analyses were more successful in identifying potential sources. Eight of the 11 architectural samples grouped near six possible sources in the discriminant function analysis (Figure 8.11). Five of the six possible sources are scattered across the northern half of the island (SS-6B, Ipwal, P19, P21, and 771), while site 205 is located in the southwest. Sites 205 and SS-6B are the closet matches for a couple of architectural samples falling within this group, which could suggest that some stone used in PoC3-5 could have been transported 15 km or more to the site. This possibility has significance for labor investment calculations. The principle components analysis (Figure 8.12) also identified these six sources, but also identified 154 and K8 as possibilities. They are both from the north side of the island.

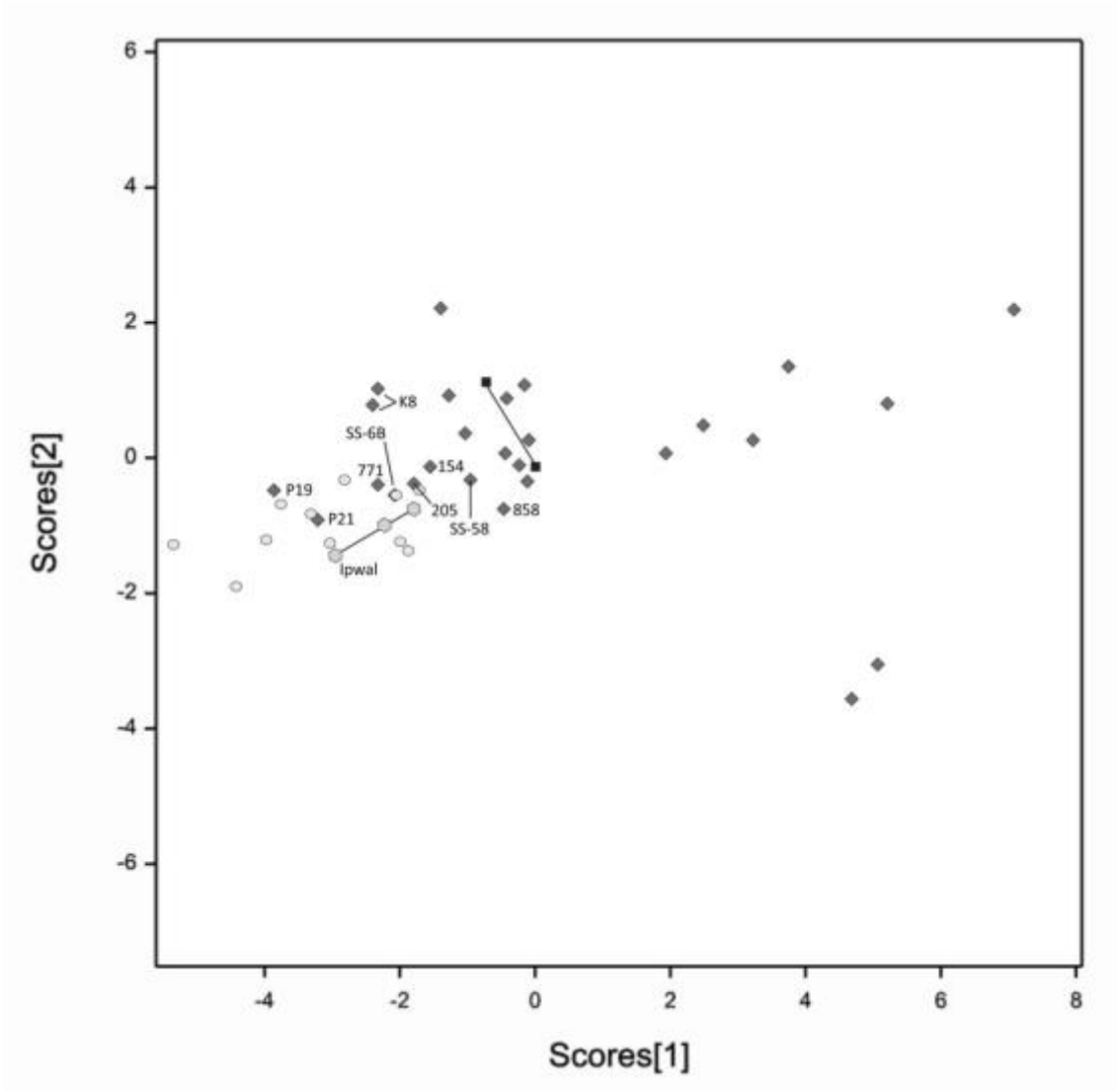


Figure 8.11 Discriminant analysis plot of Awak Basalts. Architectural samples are shown as circles and others are geologic.

The sourcing results indicate that more than one source of columnar stone was used in the construction of PoC3-5 and that the stone sources could be located between three and 21 km away. The results of this case study show that additional geologic analysis methods (e.g. LA-ICPMS and petrography) may be necessary to match architectural stone to specific geologic sources on Pohnpei. There is also the added challenge requiring additional geologic samples from a wider geographic range than provided by the available comparative data.

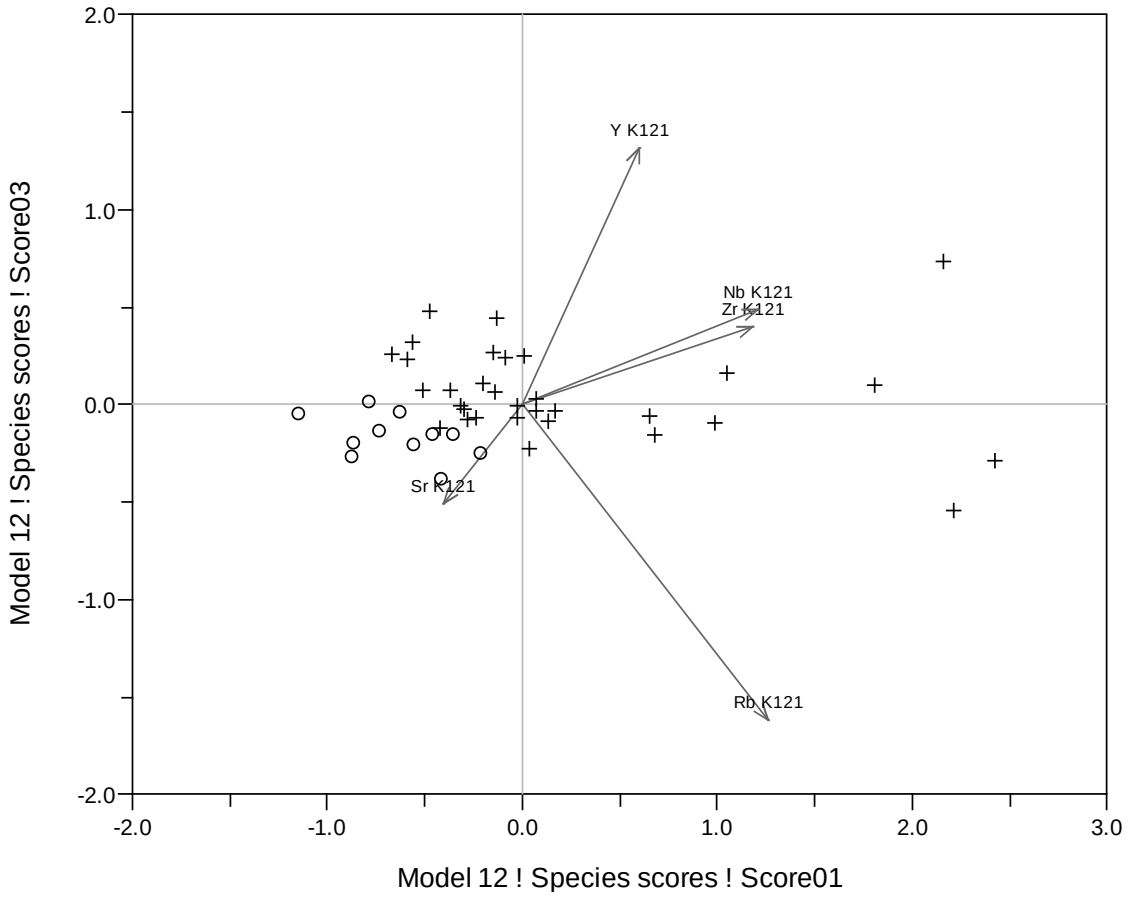


Figure 8.12 Awak PCA plot with architectural samples as circles and geologic samples are pluses.

8.2.5 Geochemistry and Labor Investment

The goal of this pilot study was to examine potential sources of architectural stone and stone transportation distances from quarry to structure as a way to refine labor investment estimates. What impact do the geochemical results have for our current understanding of labor investment estimates for PoC3-5? The inability to identify a single source for the basalt from PoC3-5 limits the ability to accurately revise the labor investment estimates from Section 8.1, but the pXRF data was able to produce a distance range from which stone may have been quarried (3 to 21 km away from PoC3-5). In order to discuss what the implications may be for labor investment costs, it was necessary to use the shortest and longest distances to provide an envelope estimate of labor hours for PoC3-5. These distances were used to recalculate the hours needed for 25 men to transport the columnar basalt for

PoC3-5 from the quarry to the construction site using litters (1,319 hours for 3 km; 9,236 hours for 21 km) or sledges (936 hours for 3 km; 6,551 hours for 21 km) (Table 8.12).

These results show that the distance between the construction site and the columnar basalt quarries can significantly impact on overall labor expenditure for stone constructions (Table 8.13). Quarry distances could impact upon whether two structures of similar size required more or less investment in labor hours. This could significantly impact discussions of social status in relation to architectural constructions. It also has implications for the management of these construction projects: could a family group potentially organize the labor and construction, or would chiefly-level management have been required?

Site_No		5km Litter	5km Sledge	3km Litter	3km Sledge	21km Litter	21 km Sledge
PoC3-5	Enclosing Wall	1,019.02	722.83	611.41	433.7	4,279.89	3,035.87
PoC3-5	Burial Platform	1,179.9	836.94	707.94	502.17	4,955.57	3,515.15
		2,198.92	1,559.77	1,319.35	935.86	9,235.46	6,551.02

Table 8.12 Table showing revised transportation hours for columnar basalt.

Site_No		Overall 5km	Overall 3km	Overall 21km
PoC3-5	Enclosing Wall	2,376.56	2,028.19	5,163.52
PoC3-5	Burial Platform	1,052.35	648.98	4,279.29
		3,428.92	2,677.18	9,442.81

Table 8.13 Table of overall labor estimates showing the impact of the transportation distances used from columnar basalt stones. Distances listed only valid for columnar stone transportation component of overall labor investment calculations.

This study was also able to provide an answer for the question of whether Pohnpeians transport stone construction materials over long distances. A decade ago Ayres and Scheller (2002:112) suggested that stone material could have been transported distances up to 30 km to be used in constructions at Nan Madol. These geochemical results show that the basalts from PoC3-5 could have been sourced from up to 21 km (straight-line distance) away. This supports the plausibility of Ayres and Scheller's (2002) transportation estimates, especially when the Pohnpeian terrain is taken into account. In some cases steep topography would

have prevented a direct over-land transport route from some quarries to construction sites, so these direct-line distances are only approximations.

This study has produced a number of positive leads towards answering questions related to transportation distances used in labor investment calculations. But until additional geological samples can be collected and more accurate geochemical sourcing data can be produced, possibly using other techniques, it is not possible to discuss what sourcing studies might tell us about stone exchange networks between groups on Pohnpei.

8.2.6 Discussion

This pilot study has shown that there is still progress to be made in the geochemical analysis of architectural stone on Pohnpei. Portable XRF analysis is a useful first step in associating stone to specific lava flows on Pohnpei and determining the number of potential sources used, but trace element variability makes further determination of quarries difficult using this method. Laser ablation or other methods should be applied to Pohnpeian stone samples to produce more reliable results.

A positive result of this case study was determining the potential number of columnar basalt sources used in the construction of PoC3-5. Geochemical analysis identified stone from at least three separate sources. Criteria 2 posits that a larger number of stone sources should be used in elite structures, so it is necessary to compare the number of potential sources for one structure against others to determine which qualify as elite constructions. Only one other mortuary complex, Nahndauwas, has been discussed in terms of the potential sources of its columnar stone. A petrographic analysis of columnar stone from Nahndauwas suggested there were at least three types of columnar stone used in the construction of Nahndauwas (Ayres et al. 1997). Unfortunately, petrography cannot distinguish small differences in chemical composition and further work is necessary to determine whether more than three sources were quarried for the columnar basalt used on the islet. At this time the available datasets are small and not comparable, so little can be said about which structures may have been built by

elites rather than local chiefs or families. Since PoC3-5 was not identified as potentially being a high status structure in other analyses, it suggests that elite structures built using coercion should utilize more than three stone quarries. Additional geochemical work on a larger sample of structures is necessary to produce results to properly test Criteria 2.

One thing that this case study has confirmed related to materials transport is that stone may have been moved over much larger distances than we might assume. The results of this geochemical study show that more work is necessary to refine labor investment estimates by identifying the quarry or quarries where architectural stone originated. By determining the distance between the building site and the relevant source, it is possible to refine labor investment calculations linked to transportation times. Assumptions of inland sites primarily utilizing closely located sources due to the challenges of terrain will need to be further tested with geochemical studies. In contrast, coastal sites might have used sources further away since water transport through the lagoon was viable. Identifying a specific quarry would potentially allow a researcher to posit likely transportation routes used and which methods of transport were used in each case. This type of information is integral to the refinement of labor investment estimates.

Investigating stone acquisition for architectural construction can produce valuable data regarding social structure and exchange networks on Pohnpei. Future geochemical studies linking architectural features to quarries could significantly contribute to the reconstruction of these networks by determining which communities on Pohnpei had clan or other trade affiliations. Presumably certain sources were under the control of specific groups and, therefore, were only available to kin or trading partners. Once geochemical studies on Pohnpeian architecture provide larger datasets, it will be possible to look at access rights and exchange partnerships on an island-wide scale. This type of analysis would allow for a greater understanding of socio-political relationships on the island by providing insight into social interaction though island-wide exchange networks which incorporated other materials in addition to architectural stone.

8.3 Conclusions

This chapter has presented labor investments for 27 mortuary structures on Pohnpei and a case study to determine the potential of geochemical analysis in the examination of architectural features. The results of the labor investment and geochemical analyses may be considered preliminary, since work needs to be done to refine the methodologies used, but they are very promising and provide important information.

Criteria 2 proposes that structures with columnar stone from a large number of sources should be associated with elites who have access to a wider exchange network. Unfortunately, due to the small sample size no structures were identified as meeting Criteria 2. Based on the available data it is possible to posit that structures utilizing more than three sources are more likely to be associated with elites who have means to conscript labor. A significant amount of work to expand geochemical datasets on Pohnpei will be required to test this hypothesis.

Criteria 4 proposes a limit of hours invested in a structure which would have been reasonably managed without the use of coercive labor mobilization practices. This limit was estimated at a total of 100,000 hours (see Chapter 2). Based on this limit 11 tomb structures at Nan Madol were identified as potentially being constructed using coercive means. The number of structures identified was not expected, but their location at Nan Madol supports the hypothesis that coercive labor strategies were limited to elites and paramount chiefs whose lives would have been centered in the socio-political center. If the limit is adjusted to meet the average of the initial estimated range, approximately 125,000 hours (see Chapter 2), Lukepenkarian Feature 2 and the *lolong* on Pahndipap no longer qualify under Criteria 4. The labor investment estimates and possibly the hourly limit need to be refined, but the structures identified under Criteria 4 are the most likely to have been built using coercion.

The next chapter reviews all the structures identified in Chapters 6 through 8 as being potentially built using coercive labor mobilization strategies. Each structure is examined to

determine the overall probability that it was constructed using coercive means, and the potential use of coercion in architectural projects is discussed in relation to its importance in the construction, maintenance, and dissolution of the Pohnpeian state.

Chapter 9: Discussion and Conclusions

This chapter deals with how the architectural data provides insight into the roles of coercion and cooperation in the development of socio-political complexity on Pohnpei, particularly during the state period. This chapter starts with a comparison and synthesis of the results presented in Chapters 6 through 8. The focus of this synthesis is on the structures identified as most likely to have been built using coercive labor mobilization strategies under the criteria outlined in Chapter 2. Once the synthesis has been undertaken, I discuss how the results influence the model of socio-political change on Pohnpei outlined in Chapter 3. Finally, the broader implications of identifying coercion using architectural analysis is discussed in relation to existing theoretical perspectives on coercive and cooperative models of socio-political development.

9.1 Comparison of Results

It is necessary to compare the results of each set of rankings to evaluate the validity of one approach to architectural analysis over another, whether quantitative or qualitative. The discussion below reviews the rankings of the structures covered by the analyses of the qualitative characteristics (n=33), stone volume estimates (n=31), architectural footprint size (n=31) and labor time estimates (n=27) (see Table 9.1). There tends to be significant variability in the rankings in each approach. Footprint rankings did not generally match with the other rankings, but those rankings did pair near the volume rankings just under half the time. This occasional pairing of the footprint rankings with the volume rankings is not surprising since larger volumes of stone would be necessary to enclose larger areas. Just over half of the 27 structures with labor investment ranks have rankings that sit between their qualitative and volume rankings. This is predicted since the labor investment estimates are supposed to incorporate qualitative components (e.g. construction style) as well as metric measurements of stone. These rank comparisons clearly demonstrate that labor investment is directly tied to

both qualitative and quantitative components of architecture. Labor investment rankings are considered to be the most accurate indicator of status differentiation between architectural features, which means structures identified as elite using labor investment estimates are also more reliably identified as potentially being built using coercive labor mobilization strategies.

In addition, the labor investment time estimates were compared with architectural footprints in order to determine if there was a relationship between investment time and the space a structure occupied (see Table 9.2). This was expressed as labor hours per m^2. There was considerable variation (Cv 107%) in hours per square meter from structure to structure, and there seems to be no direct link between labor investment and architectural footprint sizes.

Though labor investment is the most informative quantitative approach to architectural analysis, it does not account for all activities related to monumental constructions (Ayres and Scheller 2002; Kolb 1994). As has been demonstrated, estimates form a foundation upon which additional hypotheses can be formulated. Additional labor associated with architectural construction may include food preparation for workers, food and artifacts produced for dedication ceremonies or feasts, and the gathering of rigging or perishable construction materials. No single approach will be capable of addressing every aspect of architectural construction projects, but each one provides the opportunity to recognize patterns or trends which may be significant.

Calculations of the labor invested in architecture provide insights into how societies organized and constructed monumental structures and other forms of public architecture. The labor investment estimates from this study confirm the trends apparent in the quantitative analyses. On Pohnpei there is no direct link between labor investment or architectural scale and the amount of space a structure occupies. The lack of patterning in the ratios of volume to area occupied or labor hours per area occupied make the discussion of social hierarchy through architectural construction possible, since there is no scalar standard for mortuary structures on the island.

Site	Structure	Construction Style	Qual Rank	Vol Rank	Foot Rank	Labor Rank
PoB7-10	lolong	Enclosing Wall - B and CB	17	14	14	15
		Platform - B and some CB				
PoB7-39	lolong	Enclosing Wall - B and CB	15	9	10	12
		Platform - B and CB				
PoB7-44	lolong	Enclosing Wall - B and CB	16	11	6	14
		Platform - B and CB				
PoC3-1	ANG 1 - lolong	Enclosing Wall - HS, B, CR	13	18	19	16
		Platform - B, CR				
PoC3-1	ANG 2 - platform	Platform - B, CR	31	24	24	26
PoC3-1	ANG 7 - lolong	Enclosing Wall - CR	21	n/a	n/a	n/a
		Platform - B, CR				
PoC3-1	Karian - lolong	Enclosing Wall - HS	3	1	2	1
		Cen Platform - HS and B				
		S Platform - CR and CB				
PoC3-1	LMK 1 - lolong	Enclosing Wall - HS	5	5	1	5
		Platform - HS and B				
PoC3-1	LMK 18 - lolong	Enclosing Wall - HS	6	12	11	8
		Platform - HS and B				
PoC3-1	LPK 2 - lolong	Enclosing Wall - CR and B	19	7	8	10
		Platform - CB, B, CR				
PoC3-1	NDA 1 - lolong	Enclosing Wall - HS	1	4	4	3
		Platform - HS				
PoC3-1	NDA 4 - lolong	Enclosing Wall - HS	11	19	17	n/a
		Platform - HS				
PoC3-1	NDA 5 - lolong	Enclosing Wall - HS	10	13	9	n/a
		Platform - HS				
PoC3-1	PDA 4 - platform	Platform - HS, B, CR	23	27	30	20
PoC3-1	PDA 9 - platform	Platform - B and CB	28	26	31	n/a
PoC3-1	PDI - lolong	Enclosing Wall - CB and B	12	16	18	11
		Platform - CB and B				
PoC3-1	Pahnwi 23	House Plat - B, CR, CB	33	20	26	17
PoC3-1	Pahnwi 29	Enclosing Wall - CR and CB	18	2	7	4
		Platform - B and CB				
PoC3-1	Pahnwi 30	Enclosing Wall - HS, B, CR	7	6	12	6
		Platform - HS, B, CR				
PoC3-1	Peinering 2	Platform - B and CR	32	23	23	19
PoC3-1	Peinioar 1	Platform - B and CB	29	25	22	18
PoC3-1	Peinkitel 1	Enclosing Wall - HS	2	3	3	2
		Platform - HS				
PoC3-1	Peinkitel 2	Enclosing Wall - HS	9	8	13	7
		Platform - HS				
PoC3-1	Peinkitel 3	Enclosing Wall - HS	8	15	16	9
		Platform - HS				
PoC3-1	Sapwenpwe 2	Platform - B and CB	25	28	25	21
PoC3-1	Sapwenpwe 8	Platform - B and CB	26	29	28	22
PoC3-1	Sapwohng	Platform - B and CB	27	31	29	25
PoC3-1	Sapwuhdir	Platform - B and CB	24	30	27	24
PoC3-1	Sapwuhtik B - lolong	Enclosing Wall - HS	4	n/a	n/a	n/a
		Platform - HS				
PoC3-5	lolong	Enclosing Wall - B and CB	14	10	5	13
		Platform - HS and B				
PoC3-8	lolong	Enclosing Wall - B	20	17	15	23
		Platform - B				
PoD24-17	platform	B and 1 CB	30	22	21	27
PoD24-37	lolong	Enclosing Wall - B	22	21	20	n/a
		Platform - B and some CB				

Table 9.1 Comparative rankings for quantitative and qualitative analyses.

Site_No	IsletAbr	StrucType	Total labor	EstArea	Ratio	Rank
PoB7-44		lolong	2,206.17	460.78	4.79	26
PoB7-39		lolong	3,851.64	294.72	13.07	21
PoB7-10		lolong	1,960.53	189.09	10.37	23
PoC3-8		lolong	666.31	161.92	4.12	27
PoC3-5		lolong	3,428.92	615.58	5.57	25
PoC3-1	PEK	Southern lolong	11,975.29	196.01	61.10	7
PoC3-1	PEK	Central lolong	6,225.62	151.06	41.21	9
PoC3-1	PEK	Northern lolong	43,742.03	654.30	66.85	5
PoC3-1	KARA	lolong	221,942.38	1,035.08	214.42	1
PoC3-1	PDI	lolong	4,100.08	133.56	32.70	13
PoC3-1	PWIA	lolong (F30)	24,826.62	224.58	110.55	2
PoC3-1	PWIA	lolong (F29)	31,941.38	404.74	78.92	3
PoC3-1	NDA	Central lolong	41,922.15	632.35	66.30	6
PoC3-1	LMK	lolong (F18)	8,563.98	267.15	32.06	12
PoC3-1	LMK	lolong (F1)	24,968.91	1,511.58	16.52	19
PoC3-1	LPK	lolong	4,185.47	357.96	11.69	22
PoC3-1	ANG	lolong	1,868.74	99.85	18.72	18
PoD24-17		burial platform	415.34	45.3	9.17	24
PoC3-1	PDA	burial platform	862.39	18.71	46.08	8
PoC3-1	ANG	burial platform	498.48	33.23	15.00	20
PoC3-1	PWIA	house platform w/ burial	1,562.25	24.00	65.09	4
PoC3-1	PEO	burial platform	1,077.08	43.23	24.92	17
PoC3-1	SOE	burial platform	582.43	18.11	32.16	10
PoC3-1	PEE	burial platform	946.79	36.55	25.91	16
PoC3-1	SPW	burial platform (F2)	755.02	24.44	30.90	11
PoC3-1	SPW	burial platform (F8)	671.20	22.45	29.90	14
PoC3-1	SWD	burial platform	654.68	23.39	27.99	15

Table 9.2 Ratio of labor time and architectural footprint data.

The largest and most architecturally complex structures that were identified as having the potential to be linked to coercive labor mobilization strategies are all located at Nan Madol. Labor investment estimates indicate that differences in investment were based, at least in part, on whether the mortuary structures represent families, clan groups, or chiefs on a local or regional scale. This pattern is clearer in the *lolong* dataset than the burial platforms in each analysis. Typically more time and effort was spent reflecting status through architecture at socio-political centers like Nan Madol, since there may have been a greater need to legitimize clan status through architecture at socio-political centers to maintain the

status of clans within the social hierarchy of the centralized political system. The need to legitimize social status and to continually compete for status would have made the use of coercion in construction more likely to achieve these goals.

9.2 Data Interpretation and Synthesis

This section synthesizes the results of the analyses presented in Chapters 6 through 8. All the data discussed in previous chapters have been analyzed in relation to the criteria posited in Chapter 2. These criteria are:

1. Structures incorporating the highest quantity of columnar stone and the largest stones are associated with the highest ranking members of society.
2. Elite structures should incorporate stone from a wider variety of stone sources than other structures.
3. Structures with a greater number of ancillary components and higher enclosing walls are associated with high ranking members of society.
4. Structures requiring over approximately 100,000 cumulative labor hours to build were most likely built using coercive labor mobilization strategies.

There is some data that do not fit within the purview of these criteria which are valuable to our understanding of social structure on Pohnpei as well. This information will be briefly reviewed prior to the discussions of the criteria to provide additional context for the discussion that follows.

Demographic profiles for a number of structures and sites show that burial structures tended to be reused over time. Age and sex profiles suggest that mortuary structures were probably used by family groups or clans (see Chapter 5). This is of particular interest as the social differentiation as projected by mortuary structure is probably linked to a specific group (e.g. clan, priests, rulers) rather than a specific leader or individual.

All of the criteria are based on the premise that the ability to use coercion to mobilize labor for mortuary monuments is likely limited to the highest status groups and chiefs. This does not mean it was universally used by elites or that every interaction in the building process was coercive. Individuals chosen to assist in the management of projects were unlikely to have been coerced into the work, but general labor and/or material support were more likely to have been conscripted as was the case in ancient China, Egypt, and Rome (e.g. Brunt 1980; Janssen 1978; Martinon-Torres et al. 2014). Coercion may have been used to complete building projects but that does not assume that every participant was coerced. Elites have a significant amount of social and/or political capital, but power has its limits. In cases where power is abused serially the legitimacy of an elite clan, chief or chiefly line is endangered (e.g. Qin China [Kiser and Cai 2003]). Therefore, the benefits of coercive actions must be considered in relation to the potential costs to the group or individual employing them.

The criteria listed above are meant to identify the most likely instances in which coercion was used in the construction of mortuary monuments. Existing datasets are able to address Criteria 1, 3 and 4, but Criteria 2 is not able to be discussed further based on limited petrographic and geochemical data from the structures discussed (see Chapter 8). Since Criteria 2 cannot be confirmed with current datasets the following discussion focuses on the results related to Criteria 1, 3 and 4.

Criteria 1 posits that the amount and size of columnar stones used architectural features are directly linked to the status of the group or individuals that constructed it. The amount of columnar basalt used in each structure is largely dependent on the construction style used. These styles include header-stretcher, stacked stone (coral and basalt), stacked stone with columnar stone facing, and a combination of one or more of these styles. The header-stretcher style of construction utilizes the most columnar stone on average.

Construction styles vary considerably at Nan Madol. Construction using stacked basalt cobbles with some columnar stone is common for isolated burial platforms (6 of 10; 60%).

Three of the four remaining platforms were built with coral and basalt rubble, one of which incorporated columnar stone. The last platform is constructed in the header-stretcher style. Half of the *lolong* at Nan Madol are constructed entirely in header-stretcher style. One *lolong* (6% of the sample) is a composite structure using a combination of each style of construction. The other Nan Madol *lolong* are variations on stacked stone styles (coral and basalt cobbles and columnar stone), or exhibited different construction styles for different architectural components (e.g. walls versus platforms).

Outside of Nan Madol the most common architectural style is stacked basalt cobbles with some columnar basalt facing. Eighty-three percent (5 of 6) of the mortuary structures outside Nan Madol are built in this style, though the amount of columnar basalt used varies. The use of header-stretcher style construction is limited. Only one of these *lolong* (PoC3-5) incorporates header-stretcher construction, but it is only used in the burial platform. The enclosing wall is constructed in the more typical stacked stone style with some columnar basalt facing.

Overall, there is greater stylistic variability within *lolong* than in isolated burial platforms, which suggests social differentiation may be more marked in *lolong* than other burial contexts. This does not mean that status distinctions were absent from burial structures and mortuary contexts other than *lolong*, but it demonstrates that evidence for coercion may be more evident in *lolong* rather than other types of burial structures. This review also indicates that elites and rulers at Nan Madol were more likely to use coercive labor mobilization strategies.

Average columnar stone lengths support the use of coercion at Nan Madol more regularly than other places on Pohnpei, based on the second component of Criteria 1. Seventy-five percent (3 of 4) structures with longer than average stone lengths are located at Nan Madol.

Criteria 3 has two components, the number of ancillary features associated with a mortuary structure and the height of its architectural features. The incorporation of ancillary

features in and near mortuary structures may have played a role in distinguishing the relative ranks of specific structures, particularly amongst those with similar construction styles. This proposition is linked to the idea that investment in specific features is directly related to social status, and therefore more complex structures are tied to individuals or groups with a higher status (e.g. mausoleum of Qin Shihuangdi [Dai 2001; Martinon-Torres et al. 2014], Egyptian pyramids [Janssen 1978; Warburton 2007]). Even though ancillary features may be linked to the ideology and/or mortuary rites (see Chapter 5) it does not discount their use as relative status markers. Ancillary features are associated with approximately 85% of the structures examined in this study. *Lolong* are typically associated with more than one ancillary feature, while isolated burial platforms tend to be associated with a single feature. *Sakau* stones are more clearly linked to feasts and ritual practices than the other types of features (e.g. pavings, stone alignments, platforms, etc.), and are in close association with 40% of mortuary structures. Depending on their size *sakau* stones may have been relocated to other sites after *lolong* declined in ritual importance, rather than sourcing a new stone, which may account for their absence near some mortuary features. The other notable types of ancillary features were geared to the organization or division of ritual space associated with mortuary rites. The only ancillary features with a specific architectural purpose are wall buttresses associated with three *lolong*. The overwhelmingly ritual association of these features links them to Pohnpeian ideology related to death (see Chapter 5).

The height component of Criteria 3 was met by five structures identified as outliers in the statistical analysis (see Chapter 7). All these structures are located at Nan Madol, and all but one of the structures are *lolong*. The only structure identified as an outlier that isn't a *lolong* is the repurposed house platform on Pahnwi (Feature 23).

The building of some mortuary structures would have required a large network of laborers, crew managers, and a considerable amount of time which may have required participation beyond the organizational means of a localized chiefdom (see Martinon-Torres et al. 2014 regarding Qin China). Criteria 4 establishes a limit which should distinguish

structures which could be managed by families or local chiefs from those managed by elites and paramount chiefs. It was hypothesized that the cumulative labor time over 100,000 hours could have only been managed by elites or paramount chiefs. The labor invested in mortuary structures at Nan Madol, particularly *lolong*, far outstrips the labor invested in structures elsewhere. None of the mortuary structures outside Nan Madol would have taken more than 100,000 cumulative hours to organize and build. Isolated burial platforms typically took less than 25,000 hours to organize and build, but two (20%) from Nan Madol took over 25,000 hours. Eleven out of 12 (92%) *lolong* at Nan Madol would have taken over 100,000 hours, though two would have taken less than 110,000 cumulative hours. If the hypothesized benchmark is questioned as being too low and an estimate of 30 to 40 work hours per week is assumed, the cumulative labor hour estimate benchmark changes to approximately 125,000 hours. This modification only excludes the *lolong* which are considered to be borderline using the 100,000 hour benchmark, so although the 125,000 hour benchmark may be more realistic the original benchmark was still reasonably accurate. Even with the benchmark adjustments, the labor time estimates show that coercive labor mobilization practices were mostly likely limited to the elites and paramount chiefs at Nan Madol.

The following reviews each structure identified by Criteria 1, 3 or 4 as potentially being built using coercive strategies. Each structure is examined under these criteria and recommendations are made as to which are most likely to have had coercive labor practices associated with their construction based on the number of criteria met.

9.2.1 Karian

The *lolong* on Karian was identified under Criteria 1, 3 and 4. Karian was identified as an outlier in the qualitative and quantitative analyses and labor investment estimates. It is also the only *lolong* documented as having a lintel stones over the entrance. The lintel in addition to the high enclosing wall contributed significantly to the exclusion of some from mortuary rites within the structure. Karian is very likely to have been built by coercive means,

based on cumulative labor estimates exceeding five million hours in addition to meeting every component of Criteria 1 and 3. This result is not particularly surprising since oral tradition associates this structure with the priestly class at Nan Madol, which had significant power (Bernart 1977; Hambruch 1911, 1936a; Kubary 1874).

9.2.2 Lemenkau

Lemenkau Feature 1 meets Criteria 1, 3 and 4. It meets Criteria 1 based on the amount of columnar stone used in the structure and Criteria 3 based on the number of associated ancillary features. This structure also meets the benchmark in labor investment set by Criteria 4. Based on its meeting three of the four criteria this *lolong* is a candidate for the use of coercive labor mobilization.

Feature 18 on Lemenkau fulfills Criteria 1 and 4. This structure only meets the Criteria 1 based on the amount of columnar stone used. This paired with qualifying under Criteria 4 suggests that coercion was a likely contributor to its construction.

9.2.3 Lukepenkarian

The *lolong* on Lukepenkarian was identified only by Criteria 4. This structure was built in less than 105,000 cumulative construction hours and did not appear as an outlier in other analyses. Lukepenkarian Feature 2 in unusual in that in incorporates a secondary enclosure attached to its enclosing wall, which increased the labor invested in the structure. No other criteria were met and given the labor investment estimate is close to the cutoff this structure was most likely constructed via cooperative means.

9.2.4 Nahndauwas

The central *lolong* on Nahndauwas met Criteria 1, 3 and 4. This tomb meets all components of Criteria 1 and 3, and exceeds the benchmark for Criteria 4 with a total of over one million cumulative hours invested in its construction. The central tomb is also particularly marked in regards to associated features, which include the two *lolong* which flank it and the

enclosing wall surrounding the complex in addition to other features. The structure presents a strong case for the use of coercion at Nahndauwas.

The northern and southern *lolong* on Nahndauwas meet Criteria 1 and could be considered under Criteria 3 since they are part of a mortuary complex. These structures were identified under Criteria 1 based on the amount of columnar stone used in their construction. If these structures are considered a part of the complex of which they are part, they meet Criteria 3 based on associated features and structures. On their own they may not be significant as outliers, but until additional metric data can be gathered some scalar comparisons and labor investment estimates are not possible and those determinations cannot be made. Since they are part of a larger complex these structures are considered to be associated with coercive labor management practices.

In oral tradition Nahndauwas is associated with the Saudeleur ruling family, particularly the paramount chiefs (Bernart 1977; Hambruch 1911, 1936a; Kubary 1874). This association further supports the entire complex's association with coercive labor practices, since the Saudeleur rulers were noted as being more despotic as time progressed (Bernart 1977; Hadley 1981). Most accounts are associated with the mistreatment of gods in addition to their people and the exacting of crippling tribute (Bernart 1977; Hadley 1981). It is reasonable to extrapolate this to labor conscription. Nahndauwas is the only mortuary complex which may be reasonably linked to coercion based on traditional history alone. In this case, the archaeological record lends significant support to Pohnpei's traditional history.

9.2.5 Pahndipap

Pahndipap was identified under Criteria 4. This *lolong* was built in less than 105,000 cumulative construction hours, and was not identified in other outlier analyses. It has been suggested that this structure may be one of the first of its type to be constructed at Nan Madol and potentially elsewhere on the island (Ayres pers. comm.), which might explain why it meets one criteria but not others. The development of *lolong* as an architectural style may

have included larger stones, taller walls, and more ancillary features after the use of these structures became more common and they became included in social competition. Since this structure does not meet any of the other criteria it is suggested that it was not built using coercive strategies.

9.2.6 Pahnwi

The southern lolong on Pahnwi (Feature 29) was identified by Criteria 3 and 4. Feature 29 meets Criteria 3 based on the height of the walls suggesting a level of exclusivity associated with the rituals and activities which took place within the enclosing walls. This paired with the labor investment estimates supports the case for the use of coercion in the building of this structure.

The northern lolong on Pahnwi (Feature 30) was identified under Criteria 1, 3 and 4. Feature 30 meets Criteria 1 based on the amount of columnar stone used to build the structure and Criteria 3 based on wall height. It also qualifies as a potential structure which was built using coercive strategies under Criteria 4. Since this lolong satisfies three criteria, it is proposed that it was built, at least in part, using coercion.

The house platform which was repurposed as a burial structure (Feature 23) met Criteria 3 based on its height. Although it is a statistical outlier in one variable this is not enough to consider it as being associated with coercive labor practices, since it meets no other qualification in architectural style, scale or labor investment.

9.2.7 Pein Kitel

The northern *lolong* on Pein Kitel was identified under Criteria 1, 3 and 4. This *lolong* meets both components of Criteria 1 and meets the ancillary feature component of Criteria 3. A cumulative labor investment estimate over one million hours is well above the minimum for a structure to meet Criteria 4. This structure presents a strong case for the use of coercive labor mobilization strategies. This structure is said to be the burial location of Isohkelekel, the

first Nahnmwarki of Madolenihmw (Bernart 1977; Hambruch 1911, 1936a; Kubary 1874). The use of coercive labor to build a burial monument associated with the previous regime for the leader who overthrew the Saudeleur Dynasty may seem inconsistent, but the architectural analyses support the use of coercion.

The central and southern *lolong* on Pein Kitel meet Criteria 1 and 4. These structures qualify under Criteria 1 based on the amount of columnar stone used in their construction and they exceed the benchmark for total labor investment set by Criteria 4. They may also be discussed in relation to Criteria 3 based on their inclusion in a mortuary complex. Neither structure meets the requirements of Criteria 3 on its own based on wall height or associated ancillary features. When viewed as a part of a complex the number of associated features increase meeting Criteria 3. What makes this case distinctive from that of Nahndauwas is that the Pein Kitel complex is not organized along a particular plan. At Pein Kitel the smaller lolong are not directly associated with the largest or each other aside from the fact that they were constructed within the islet enclosing wall. The case for coercion is primarily based on Criteria 1 and 4 for these structures, and though they are not the strongest candidates they are taken as evidence for the use of coercion.

9.2.8 Sapwuhtik B

Sapwuhtik B was meets Criteria 1 and 3 using qualitative data. The use of header-stretcher construction fulfills one component of Criteria 1 and the number of ancillary features associated with the *lolong* meets one part of Criteria 3. The structure has yet to be mapped, so there is no scalar data to further address the other aspects of Criteria 1 and 3 or Criteria 4. Based on field observations I suspect Sapwuhtik B may be a candidate for the use of coercion in its construction, but based on the limited information currently available that determination cannot be made here.

9.2.9 PoB7-44

The PoB7-44 *lolong* was identified under Criteria 1 based on an average length of columnar stone greater than what is considered typical. PoB7-44 is an outlier in only one component of Criteria 1, and this is not enough to support an argument that PoB7-44 was constructed using coercion.

Of the 16 mortuary structures identified as having the potential to be associated with coercive labor mobilization practices 11 are considered good candidates. They include Karian, Features 1 and 18 at Lemenkau, all the *lolong* at Nahndauwas, both *lolong* at Pahnwi, and all the *lolong* on Pein Kitel. In particular, the central tomb at Nahndauwas, Karian and the northern tomb of Pein Kitel stand out in support for the use coercive labor strategies. They meet the all the criteria discussed and they all had cumulative labor estimates over one million hours. Even though the identification of some structures may be less convincing (e.g. the two small *lolong* on Pein Kitel) than others, the identification of coercion in these structures supports the hypotheses outlined in Chapter 2.

All the structures identified are *lolong* located at Nan Madol, which supports the argument that elites and paramount chiefs based at the site had the means and inclination to utilize coercive labor mobilization. Chiefs and clans outside the socio-political center had a more limited network of resources than elites at Nan Madol, since potential tribute would come from a smaller dependent population and they would not have as many opportunities to build reciprocal relations with those from other socio-political units. In addition to local limitations, local and regional chiefs and clans paid tribute to the paramount chiefs at Nan Madol, which reduces the resources available to invest in other projects. Even though there is evidence for status competition outside Nan Madol, it is significantly less marked than that at Nan Madol. Logistical restraints on chiefs and clans outside the socio-political center may have limited social competition through architectural construction to a level which could be managed through familial obligation, reciprocal relationships, and other cooperative

strategies. This could explain why there were no structures outside Nan Madol identified as being built through coercive means. These results have significant implications for the model of socio-political development on Pohnpei.

9.3 Pohnpeian Socio-Political Development

The identification of coercion through the analysis of architectural features has significant implications for the discussion of socio-political relations on Pohnpei during the Saudeleur Dynasty. There is little archaeological evidence of conflict and warfare on Pohnpei during the prehistoric period, though there are accounts of conflicts throughout traditional history (refer to Chapters 3 and 4). The identification of the presence of coercive strategies in the archaeological record lend unprecedented support to oral traditions, and strengthens the argument for the utilization of an integrated model of socio-political change over a purely archaeological one (see Chapter 3). This section examines the model of socio-political development on Pohnpei in relation to the evidence for coercion.

This discussion has obvious implications for the history of social change on Pohnpei, particularly in relation to the centralization of socio-political power and its timing, which brings the discussion back to the trajectory of Pohnpeian socio-politics presented in Chapter 3. The Pohnpeian trajectory of socio-political change includes the following periods: island settlement (c. 500 BC-AD 1), subsistence intensification and localized chiefly rule (AD 1-1000), incipient socio-political centralization (c. 1000-1100), Nan Madol as the seat of socio-political power (c. 1100-1550), socio-political decentralization (c. AD 1550), spread of Nahnmwarki system (AD 1600-1910), and the introduction of democratic government alongside the traditional system (AD 1947 to present).

This study identifies the period between AD 1000 and 1600 as a time of significant change in architecture and investment in monumental-scale projects (see Chapter 3). These dates overlap with the state period (AD 1100-1600) on Pohnpei. Radiocarbon dates indicate

that *lolong* developed as an elaboration of burial platforms, because burial platforms were in use by AD 1000 while *lolong* were initially constructed around AD 1100-1200.

The use of columnar basalt in stacked stone construction occurred prior to the development of the more elaborate header-stretcher style of construction. The complex of Nahndauwas is considered the epitome of the header-stretcher style, and was constructed in stages between AD 1200 and 1600. The construction of the tombs at Nahndauwas probably occurs in the latter part of this range of dates, which means the largest and most elaborate *lolong* are not the oldest on Pohnpei. Architectural elaboration is one indicator of the socio-political shifts leading to political power being centered at Nan Madol.

Lolong phase out of the archaeological record around AD 1600. The best current evidence of this termination of investment in mortuary monuments is PoC3-8, which was never fully completed or was stripped of a significant amount of stone. Radiocarbon dates from PoC3-8 place its construction between AD 1400 and 1600. For whatever reason, the project was never finished. It is likely that the abandonment of PoC3-8 is tied to a shift in labor investment towards other projects and activities with the advent of the Nahnmwarki Period. *Lolong* provided a space for feasting and ritual related to the death of a community member, so it is probable that the shift in investment away from these structures was directed at new ritual or communal areas or that some rituals associated with death became less important to society generally. I believe the first case is more likely based on current and past mortuary practices (see Chapter 5). One particular candidate for this shift in investment is the *nahs* (meeting/feast house). The U-shaped *nahs*, which is still currently in use, is a stylistic modification of previous forms which is associated with the Nahnmwarki Period in local tradition. It is possible that *lolong* declined in importance as *nahs* structures became more important as a focal area for feasting and other activities.

Now that the chronology of mortuary structures analysed in this study has been discussed, it is possible to address the evidence for coercion in relation to this temporal framework. Based on a limited number of radiocarbon dates it has been posited that the

largest and most complex mortuary monuments are not the oldest, which means evidence for coercion may not be associated with the early development of the Pohnpeian state. Radiocarbon dates do, however, support the use of coercive labor mobilization strategies between AD 1200 and 1600. Therefore, coercion is more likely to be associated with the social competition to maintain the legitimacy of the Pohnpeian state, which may have eventually contributed to its dissolution (c. 1550-1600). The decentralization of the centralized government based at Nan Madol is marked by a significant shift in the types of architectural constructions in which labor was invested.

The implications of tying the evidence for coercion with the chronology for the associated structures are significant to the interpretation of the driving forces behind social change in the model of socio-political development on Pohnpei. The current interpretation of the socio-political shifts in the integrated model of change is primarily based on traditional history. The centralized state system under the Saudeleur was initially supported by the public, but the Saudeleur alienated themselves from their subjects through serial abuses of power (see Chapter 3). They also seemingly took a less active role in the religion their dynasty introduced as time progressed, aside from feast related activities (e.g. Bernart 1977); an action which could have further eroded the legitimacy of their rule and the socio-political system. The evidence presented in this thesis for the use of coercion in the construction mortuary structures associated with elites and the Saudeleur rulers from the period of state control is the first concrete archaeological evidence which supports traditional history regarding the use of coercion by the highest ranking members of Pohnpeian society. What originally appeared to be a disjoint between the archaeological and traditional histories of this period of the island's history turned out to be a lack of evidence for coercion and conflict in the archaeological record rather than social change based entirely on cooperative strategies and behavior.

To summarize, this study has found that coercion was a strategy which was primarily utilized at Nan Madol during the state period. Its use manifests in the construction of large

structures, and was probably also used in other situations as well (e.g. exacting tribute, accessing resources). The lack of evidence supporting the use of coercive labor mobilization strategies elsewhere on the island suggests that this strategy may have only been a viable option for elites living in a socio-political center, which supports the hypotheses presented in Chapter 2. Available chronological data suggest that coercion was not a common feature in the building of architectural features early in the state period on Pohnpei. Therefore, coercion became a more common strategy later when reinforcing the legitimacy of the political system became important and when social competition through the sponsorship of building projects became a significant feature of elite society. Another possible reason that evidence for coercion was centered at Nan Madol is that local or regional chiefs did not invest as much in local architectural projects where they could not gain further status. Instead they chose to support the projects of their clan or allies at Nan Madol as a means of gaining prestige at the state level of society. What is clear in the data is that coercion played a significant role in social competition and socio-politics during the state period at the site of Nan Madol, which had wider implications for Pohnpeian society in general.

The discussion of the results of this study has provided insight into social dynamics and the role of coercion in Pohnpeian socio-political development. Identifying the mechanisms (i.e. coercion and cooperation) influencing socio-political change at specific points in Pohnpeian history is valuable on a local level, but does this study have implications for the study of other societies? This type of research can contribute more to the general theory of socio-political change only if it can be applied to other societies.

9.4 Potential Theoretical Implications

The mobilization of labor in prehistory is still poorly understood archaeologically. Even though some have discussed the time invested/required to construct tombs, monuments and temples (e.g. Abrams 1989; Abrams and Bolland 1999; Erasmus 1965; Kolb 1997; Spennemann 2002), the strategies used to mobilize the labor required is often not discussed. The primary

sources of comparative material for labor mobilization in early complex and/or state societies are societies which developed systems of writing early in their history (e.g. China, Egypt, Greco-Roman societies).Though existing written records from theses societies do not necessarily contain relevant material, since not all records survive and the sources of labor used in specific building projects may not be deemed important enough to document (e.g. Rome [Brunt 1980]).

Possibly one of the best documented early state construction projects is the mausoleum of Qin Shihuangdi, the first emperor of China. The mausoleum complex includes a large pyramidal structure, a number of related structures, and a large army made from terracotta. The complex spans 56 square kilometres, and was built over 34 years (Martinon-Torres 2014). It has been estimated that 700,000 workers were involved in its construction, and that the large majority of the laborers included conscripts and convicts (Dai 2001; Martinon-Torres et al. 2014). The terracotta army alone required the coordination of 87 foremen and a significant number of artisans working on retainer to maintain strict standards in the production of the terracotta soldiers and their equipment (Martinon-Torres et al. 2014).

The details of the construction of Qin Shihuangdi's tomb provide invaluable insight into the capability of state-level societies to mobilize labor for public or governmental construction projects. It is clear that the labor invested in any large-scale project involving coercive labor mobilization practices was not necessarily managed by individuals that were coerced, though it cannot be ruled out based on the variety of positions held by slaves in other societies (e.g. Rome [Scheidel 2010]). The possible avenues for coercive labor mobilization (e.g. slavery, corvée, conscription, indentured servitude) far outnumber the strategies for cooperative labor (e.g. volunteer, wage labor), and it is unlikely that the archaeological record would be able to differentiate between mobilization strategies beyond the identification of possible instances of coercion versus cooperation without the assistance of written records or incontrovertible evidence from clearly associated skeletal remains.

These points are particularly relevant to how cooperation and coercion have been addressed in regards to the mortuary monuments of Pohnpei in this study. Instead of attempting to identify specific types of labor mobilization, this thesis focuses on the possible identification of the use of coercive strategies over cooperative ones. The determination of structures which may have involved some level of coercive labor mobilization has implications for how socio-political systems operated in the past, as this thesis has demonstrated. The detection of the use of coercion in one sphere of social interaction could mean that coercive forces may have had a broader impact on the development of the socio-political system, even in cases where there is little to no evidence of violent conflict or warfare in the archaeological record (i.e. Pohnpei). By finding a means to address strategies of labor mobilization without a reliance on written records, this thesis has presented another method through which socio-political relations in complex or state societies can be examined archaeologically.

This study has important implications for the examination of coercive social practices within highly stratified and centralized socio-political systems which constructed large stone monuments and structures in prehistory. The Pacific is an area which has a high incidence of complex, stratified chiefdoms or state societies which invested in large architectural works (e.g. the site of Lelu on Kosrae, Hawaiian *heiau*, Tongan *langi*, and *moai* and *ahu* on Rapa Nui). This region is unique when it comes to discussions of socio-political development because in comparison to continental contexts the time frame of human occupation is relatively short and some level of isolation is involved. Therefore, it is reasonable to suggest that the criteria for identifying instances of coercive labor strategies developed in this thesis for Pohnpei might be more easily applied to and refined through their application to other Pacific island societies.

Even though socio-political change may be considered to follow a typical pattern from island to island, that is far from the case. Pacific island societies may share features with others based on some level of ancestral heritage, but island environments, socio-political trajectories, and histories can vary considerably between islands. Examining the use and effects of coercion within a sample of Pacific societies would allow for broader considerations

of what the identification of coercive behaviors within the archaeological record might mean for the current understanding of socio-political relations.

The analysis of other monuments using similar methods and hypotheses as those used to discuss Pohnpei's mortuary monuments should produce results which could contribute valuable perspectives on the use of coercive and cooperative social strategies and their influence on societal development. Of course the hypothesized criteria used in this thesis would need to be refined based on the society being examined, primarily because architectural constructions tend to vary considerably in materials used and architectural style based on the society being studied.

9.5 Conclusions

This study has demonstrated that the examination prehistoric architectural data can be linked to the society which produced it in a way that goes beyond basic functional or spatial analysis. Structures can be linked to societal norms related to the modes of production, labor management and socio-political strategies. The potential to be able to identify instances of coercion in the archaeological record can contribute significantly to theoretical discourse related to coercive and cooperative models of socio-political change. Coercive theories of social change should not rely so heavily on arguments based primarily on inter-personal conflict and conquest warfare. The development of methods with which other coercive strategies (e.g. slavery, labor conscription, taxation, etc.) can be productively discussed could contribute to a more balanced theoretical approach recognizing the diversity of coercive strategies. The incorporation of less violent coercive strategies in the examination of socio-political development can significantly contribute to explanations of how a seemingly stable and possibly peaceful social system disintegrated, or how a particular social group gained significant status or power within a short period when there is no evidence for conflict or warfare. More often than not either or perspectives of social development do not provide completely satisfactory explanations for what we find in the archaeological record, so it is

time to start building a more nuanced approach to prehistoric social systems and their development.

An examination of instances where coercion in any form was utilized in contrast to the evidence for cooperation within a society not only allows for a discussion of the relative frequency of its use over time which contributed to large societal changes, but also provides a means to compare strategies used by specific groups within a fixed timeframe. Comparing patterns in the use of conflict, coercion and cooperation allows for a more holistic view of social dynamics which can address more than what changed and possibly how that change was possible. As archaeologists, we continue to struggle to account for differing trajectories of social development in seemingly similar societies. One example of this is why one society was capable of maintaining a certain level of social integration when another developing under similar conditions was not. The ultimate goal is to discuss why specific socio-political changes occur in a given society. Constructing methods to apply to archaeological datasets as a means of examining specific social patterns or interactions, like those developed to explore labor mobilization strategies in this thesis, provides valuable information which can be used to address why some changes occur.

Pohnpei provided a good case study for this type of discussion since it maintained a centralized state system for approximately 400 years followed by decentralization of power, and there are large, monumental-scale structures associated with this period of centralization. This study identified structures which were constructed through the use of coercive labor mobilization strategies only at the site of Nan Madol. This suggests that coercion was primarily a tactic used by elites and rulers based at the site, and that the use of coercion on a larger geographic scale may not have been an option for local chiefs or clans. General chronological patterns also support traditional histories in that coercion and abuses of power by the Saudeleur rulers became more prevalent over time, but additional radiocarbon dating would be necessary to confirm this assertion.

Most of what is known about socio-political centralization and decentralization on Pohnpei is concentrated around Nan Madol. Now that we have an understanding of Nan Madol's role as a major socio-political center, it is necessary to consider how these socio-political shifts impacted upon communities outside Nan Madol. Understanding socio-political change on an island scale does not account for small-scale, localized change. In order to further understand socio-political development on a theoretical level more work needs to be done on the formation of social units on all levels (e.g. Ladefoged and Graves 2006:200). Further research on how individual territorial units were influenced by socio-political strategies, such as coercion and cooperation, will allow for more refined theoretical discussions of socio-political change in the Pacific and elsewhere. In order to develop more refined theoretical discussions of socio-political change on different scales it is necessary "to grasp the internal logic of the society that produced the traces and remains in question" (Conte 2006:242). In the Pacific and particularly on Pohnpei we have a reasonable understanding of the how of socio-political change, now we must endeavor to answer more of the whys.

9.6 Future Directions

> On Pohnpei, someone who has just spoken on some aspect of the island's past closes with the words: *Ahi soaipoad rorowei likin ihmwamwail. Ma emen mwahngih, e nek kainenela pwe pereki meh i pwapwa pwa*, 'My words are placed before you who have listened. Those among you who know better should correct my errors.' (Hanlon 1988a:xxii)

This study is only a starting point for the discussion of Pohnpeian socio-political development, and more work needs to be completed to confirm the results. There is still much that can be accomplished through further architectural analysis of structures on Pohnpei. This study was only able to analyze a small cross-section of mortuary monuments from a few locations on Pohnpei. Survey of sites on the western side of the island would be valuable in determining when or whether the Saudeleur managed to integrate the entire island under their leadership. Expanding the range of architectural sites included in this type

of analysis paired with additional radiocarbon dates would be necessary to further address changing investment in different types of architecture (e.g. residential, feast structures, subsistence) over time.

The refinement of labor investment estimates also merits some additional attention. Experimental studies related to canoe and sledge transport on Pohnpei, and studies examining construction time for header-stretcher features would provide additional insights into building as a process. An examination of the methods used to quarry columnar basalt would also be beneficial.

There is still significant potential in geochemical studies on architectural stone. Gathering more quarry sources in addition to architecture samples would contribute to the development of this type of study, and would allow for more accurate discussions of potential resource networks between sites.

On a broader scale, comparative studies of architecture and labor investment on other Pacific islands (e.g. Hawai'i, Tonga, Kosrae) would provide valuable information on the potential role of coercion in other societies. Such studies would also provide a means to further refine the criteria used to identify structures potentially built using coercive labor mobilization strategies. The application of the methods of architectural analysis applied in this thesis on a regional scale would provide insight on the potential limitations of this approach on other Pacific islands, and the future potential to address coercion and cooperation using similar means in other societies and world regions.

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Appendix A: Results of Geochemical Analysis in PPM

Sample	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
Ipwal1-01	23,535	1,052	77,577	31	852	24	307	56
Ipwal1-02	21,704	1,096	75,268	22	788	22	297	53
Ipwal1-03	20,565	1,362	83,695	22	828	24	306	36
Ipwal1-04	23,088	1,649	84,647	30	858	33	320	57
Ipwal1-05	19,467	1,240	66,508	23	681	22	284	41
Ipwal2-01	29,475	1,616	84,165	26	774	27	285	51
Ipwal2-02	21,826	1,074	83,404	20	843	31	323	47
Ipwal2-03	23,535	986	78,815	31	804	30	304	54
Ipwal2-04	32,404	1,207	88,968	29	769	26	289	59
Ipwal2-05	26,261	1,727	84,332	34	879	28	333	56
Ipwal2-06	22,030	1,704	81,279	25	774	30	290	48
Ipwal2-07	24,186	1,306	84,011	32	839	35	323	49
Ipwal2-08	28,865	1,527	85,147	26	867	25	319	52
Ipwal3-01	23,454	1,229	83,386	26	888	22	312	47
Ipwal3-02	27,156	1,284	80,297	25	813	31	304	50
Ipwal3-03	27,888	1,439	85,314	34	766	29	300	54
Ipwal3-04	23,494	1,306	80,476	30	875	40	323	54
Ipwal3-05	24,430	1,727	86,445	30	824	24	300	54
Ipwal3-06	25,813	1,328	86,070	26	791	34	333	57
PoC3-5-BPEast1-01	11,737	919	56,296	16	331	18	122	23
PoC3-5-BPEast1-02	18,206	1,107	82,666	20	510	22	166	24
PoC3-5-BPEast1-03	19,507	1,428	71,597	15	465	28	159	25
PoC3-5-BPEast1-04	22,396	1,019	77,072	12	546	24	161	31
PoC3-5-BPEast1-05	16,131	1,550	84,725	21	569	22	176	29
PoC3-5-BPEast1-06	21,704	919	75,346	16	596	26	166	27
PoC3-5-BPEast2-01	19,792	1,605	92,586	14	140	12	134	24
PoC3-5-BPEast2-02	23,576	820	75,602	21	657	26	198	40
PoC3-5-BPEast2-03	21,501	1,616	90,360	18	584	23	164	25
PoC3-5-BPEast2-04	21,623	1,030	69,609	16	434	20	155	23
PoC3-5-BPEast2-05	21,786	1,616	74,977	14	587	22	167	26
PoC3-5-BPEast3-01	26,139	1,837	75,245	21	607	23	196	44
PoC3-5-BPEast3-02	21,338	1,218	74,995	23	834	25	226	43
PoC3-5-BPEast3-03	22,518	1,406	82,922	22	843	31	218	40
PoC3-5-BPEast3-04	20,525	1,616	79,738	26	859	30	242	40
PoC3-5-BPEast3-05	20,118	1,550	91,039	31	821	24	210	38
PoC3-5-BPNorth1-01	16,944	1,782	62,991	22	781	23	199	34
PoC3-5-BPNorth1-02	23,250	1,660	78,363	30	1,174	26	290	55
PoC3-5-BPNorth1-03	20,443	1,605	80,607	33	1,257	28	270	56
PoC3-5-BPNorth1-04	25,366	2,114	70,234	40	1,204	33	280	56
PoC3-5-BPNorth1-05	18,653	1,638	72,537	35	1,280	22	251	46

Sample	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
PoC3-5-BPNorth2-01	20,199	1,306	72,227	13	330	15	140	22
PoC3-5-BPNorth2-02	18,287	1,295	84,737	18	538	29	171	32
PoC3-5-BPNorth2-03	20,240	1,881	94,788	24	625	24	175	25
PoC3-5-BPNorth2-04	19,711	875	87,266	16	600	23	184	33
PoC3-5-BPNorth2-05	23,372	1,527	82,713	21	789	16	210	34
PoC3-5-BPNorth3-01	25,366	1,295	86,677	23	710	29	225	43
PoC3-5-BPNorth3-02	21,826	1,704	81,815	26	823	35	231	51
PoC3-5-BPNorth3-03	23,617	1,085	81,392	18	795	30	232	45
PoC3-5-BPNorth3-04	23,128	1,881	82,850	26	820	20	215	39
PoC3-5-BPNorth3-05	25,854	1,539	83,897	27	949	31	256	52
PoC3-5-BPSouth1-01	22,274	1,328	83,189	23	793	27	216	39
PoC3-5-BPSouth1-02	18,653	1,472	81,951	25	678	22	186	33
PoC3-5-BPSouth1-03	20,158	1,350	75,239	27	684	21	206	33
PoC3-5-BPSouth1-04	24,959	1,362	70,240	21	553	21	172	33
PoC3-5-BPSouth1-05	22,721	775	79,416	25	904	32	232	45
PoC3-5-BPSouth2-01	16,782	1,207	84,743	22	523	28	159	33
PoC3-5-BPSouth2-02	18,450	1,461	89,736	19	625	23	183	27
PoC3-5-BPSouth2-03	19,263	1,715	64,628	15	287	10	116	24
PoC3-5-BPSouth2-04	25,162	1,892	86,391	22	632	28	192	34
PoC3-5-BPSouth2-05	26,953	1,693	94,485	18	643	23	194	29
PoC3-5-BPSouth3-01	22,559	1,185	86,986	18	793	30	228	38
PoC3-5-BPSouth3-02	26,708	2,412	84,689	24	351	34	245	49
PoC3-5-BPSouth3-03	21,786	1,306	84,862	22	768	25	236	45
PoC3-5-BPSouth3-04	18,165	1,306	87,849	19	717	18	190	32
PoC3-5-BPSouth3-05	18,246	1,041	74,620	24	740	26	208	40
PoC3-5-BPWest1-01	19,060	1,207	74,292	30	861	21	238	58
PoC3-5-BPWest1-02	20,769	1,317	76,982	25	909	28	243	51
PoC3-5-BPWest1-03	25,732	952	79,922	23	779	25	236	41
PoC3-5-BPWest1-04	20,280	1,406	82,922	25	874	29	243	48
PoC3-5-BPWest1-05	22,884	1,074	80,934	28	915	19	247	53
PoC3-5-BPWest2-01	25,162	1,096	84,743	26	760	22	237	46
PoC3-5-BPWest2-02	22,071	1,384	84,296	29	740	21	247	52
PoC3-5-BPWest2-03	17,270	1,815	91,075	26	714	21	196	44
PoC3-5-BPWest2-04	21,745	1,627	88,533	29	793	22	227	50
PoC3-5-BPWest2-05	21,094	1,350	78,202	24	789	29	251	53
PoC3-5-BPWest3-01	17,026	1,439	77,494	26	1,061	28	257	49
PoC3-5-BPWest3-02	20,280	1,295	79,773	29	818	26	232	51
PoC3-5-BPWest3-03	26,546	1,483	88,230	28	936	32	263	54
PoC3-5-BPWest3-04	22,071	1,074	78,065	36	948	26	284	58
PoC3-5-BPWest3-05	25,407	1,539	79,220	26	978	39	267	54
PoC3-5-enclwall1-01	18,165	2,224	131,399	25	230	16	186	35
PoC3-5-enclwall1-02	21,379	1,738	80,107	24	765	27	213	41

Sample	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
PoC3-5-enclwall1-03	21,257	1,328	76,530	23	767	31	214	44
PoC3-5-enclwall1-04	22,071	1,594	85,742	28	828	39	234	49
PoC3-5-enclwall1-05	21,664	1,174	79,851	28	769	23	222	46
PoC3-5-enclwall2-01	31,346	1,539	92,812	17	533	22	198	36
PoC3-5-enclwall2-02	23,332	1,771	87,843	26	726	20	194	36
PoC3-5-enclwall2-03	23,006	1,815	107,369	14	568	20	170	31
PoC3-5-enclwall2-04	21,542	1,572	84,403	18	705	23	198	31
PoC3-5-enclwall2-05	19,263	1,693	96,710	16	717	26	200	32
PoC3-5-enclwall3-01	22,518	1,339	93,485	19	849	33	215	43
PoC3-5-enclwall3-02	24,756	1,428	82,535	22	768	23	211	50
PoC3-5-enclwall3-03	23,372	1,317	86,308	21	744	19	201	38
PoC3-5-enclwall3-04	24,837	1,682	106,416	20	176	22	200	30
PoC3-5-enclwall3-05	15,398	1,826	80,446	24	541	19	181	40
PoC3-5-enclwall4-01	23,576	1,627	96,871	21	755	20	176	40
PoC3-5-enclwall4-02	25,569	809	81,874	27	753	23	217	38
PoC3-5-enclwall4-03	31,835	1,937	80,732	17	445	24	174	29
PoC3-5-enclwall4-04	27,359	1,671	87,236	20	720	19	201	41
PoC3-5-enclwall4-05	24,389	1,174	82,654	23	746	30	206	45
PoC3-5-enclwall4-06	17,961	1,041	65,729	20	496	19	168	27
PoC3-5-enclwall5-01	13,120	997	70,918	18	455	21	129	24
PoC3-5-enclwall5-02	17,107	1,384	91,931	23	702	29	182	38
PoC3-5-enclwall5-03	18,450	1,118	70,121	15	521	23	144	17
PoC3-5-enclwall5-04	17,026	1,207	82,457	22	658	25	175	29
PoC3-5-enclwall5-05	22,477	1,715	71,561	23	677	19	190	38
PoC3-5-enclwall6-01	25,203	1,970	87,206	33	909	21	287	55
PoC3-5-enclwall6-02	24,593	1,439	82,041	32	909	31	302	49
PoC3-5-enclwall6-03	23,942	1,527	91,342	35	537	31	322	64
PoC3-5-enclwall6-04	20,565	1,472	81,856	34	982	29	282	51
PoC3-5-enclwall6-05	22,315	1,527	88,087	29	827	24	260	54
PoC3-5-enclwall6-06	20,809	1,262	85,832	30	905	23	288	63
PoC3-5-enclwall7-01	23,901	1,306	79,476	27	850	19	230	48
PoC3-5-enclwall7-02	17,392	1,483	88,069	26	783	24	208	36
PoC3-5-enclwall7-03	27,685	1,395	9,1372	28	837	17	218	55
PoC3-5-enclwall7-04	25,244	1,008	101,822	19	143	23	230	51
PoC3-5-enclwall7-05	22,233	1,373	88,557	24	827	24	231	42
PoC3-5-enclwall8-01	20,077	897	76,631	25	769	20	186	35
PoC3-5-enclwall8-02	19,426	1,052	69,990	19	465	15	168	27
PoC3-5-enclwall8-03	18,572	1,151	73,352	19	428	22	149	21
PoC3-5-enclwall8-04	17,433	1,903	102,197	24	600	23	167	35
PoC3-5-enclwall8-05	22,477	897	70,269	22	618	24	180	26
PoC3-5-enclwall8-06	23,617	1,151	69,865	17	713	26	201	32
PoC3-5-enclwall9-01	19,996	820	74,685	20	544	21	163	22
PoC3-5-enclwall9-02	17,026	1,483	76,351	26	582	27	175	31

Sample	Ti K12	Mn K12	Fe K12	Rb K12	Sr K12	Y K12	Zr K12	Nb K12
PoC3-5-enclwall9-03	18,246	1,527	84,231	18	584	18	170	26
PoC3-5-enclwall9-04	17,270	1,052	103,179	14	222	9	98	19
PoC3-5-enclwall9-05	22,721	1,505	84,505	22	613	26	186	32
PoC3-5-enclwall10-01	21,582	1,362	89,319	21	548	20	200	31
PoC3-5-enclwall10-02	21,298	1,539	76,143	28	633	24	195	32
PoC3-5-enclwall10-03	24,552	1,815	9,3562	28	724	15	195	34
PoC3-5-enclwall10-04	20,565	1,229	75,042	20	719	23	227	39
PoC3-5-enclwall10-05	23,698	1,915	81,005	25	778	30	241	39
PoC3-5-enclwall11-01	18,938	1,284	77,768	26	926	29	260	40
PoC3-5-enclwall11-02	25,732	1,306	82,362	28	935	29	243	49
PoC3-5-enclwall11-03	23,413	1,262	87,914	29	850	30	225	43
PoC3-5-enclwall11-04	28,621	1,605	84,457	35	777	30	275	54
PoC3-5-enclwall11-05	19,792	1,096	81,529	27	912	35	255	43
PoC3-5-enclwall12-01	23,739	1,395	89,218	24	649	21	189	28
PoC3-5-enclwall12-02	16,537	1,339	83,392	19	627	24	169	27
PoC3-5-enclwall12-03	18,694	1,527	72,352	26	595	16	201	29
PoC3-5-enclwall12-04	14,666	952	52,833	14	210	19	115	14
PoC3-5-enclwall12-05	24,349	1,129	77,714	22	537	17	184	26
PoC3-5-enclwall12-06	19,589	1,306	87,784	21	672	21	208	35
PoC3-5-enclwall13-01	17,392	1,594	94,056	21	604	26	178	29
PoC3-5-enclwall13-02	20,158	974	78,536	19	636	31	191	35
PoC3-5-enclwall13-03	18,938	1,162	75,977	23	484	26	170	35
PoC3-5-enclwall13-04	17,880	930	88,278	23	449	25	175	33
PoC3-5-enclwall13-05	19,752	1,406	84,826	22	656	24	203	36