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MAGMATIC AND HYDROTHERMAL EVOLUTION OF THE BROWNS CREEK INTRUSIVE COMPLEX AND ASSOCIATED GOLD MINERALISATION

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A thesis submitted for the degree of Master of Science of
The Australian National University.

Declaration

All work, results, observations and interpretations which are presented in this thesis are my own, except where other contributions and publications are referenced



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Nicola Kovacs

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Abstract

The Browns Creek Au-Cu deposit near Blayney, New South Wales, consists skarn-hosted, magmatically derived and structurally controlled mineralisation. The deposit is hosted by altered Blayney Volcanics and Cowriga Limestone. The skarn alteration is a result of the intrusion of the Carcoar Granodiorite, which is a member of the Browns Creek Intrusive Complex. Other members of this complex are the Long Hill Phase of the Carcoar Granodiorite, the Mine Dyke Group and the Post-Mineralisation Intrusives. The Mine Dyke Group has been responsible for the mineralisation.

The Carcoar Granodiorite is 430.4 ± 4.7 Ma old (based on U-Th-Pb dating techniques on zircons). This date is around 15 Ma older than previously determined ages for this intrusive. The granodiorite is a multiple phase intrusive. The most notable phase is the cumulate Long Hill Phase. This mafic phase was previously believed to be a separate intrusive body to the granodiorite. Greater abundances of iron, magnesium and lower abundances of aluminium and potassium are consistent with the Long Hill Phase representing a cumulate phase of the Carcoar Granodiorite. Other elements show similar abundances to the granodiorite.

Several forms of alteration are associated with the intrusion of the Carcoar Granodiorite. The granodiorite has marblised the Cowriga Limestone Member and hornfelsed the Blayney Volcanics. The dominant alteration assemblage is the skarn metasomatisation, visible at the mine and other pockets along the contact of the Carcoar Granodiorite with the country rock.

The orebody has formed close to the contact of the Carcoar Granodiorite with the Blayney Volcanics and the marblised Cowriga Limestone Member. A complex structural corridor had previously formed. Three dominant structural trends can be identified in the vicinity of the mine north-south, northwest and northeast. The north-south structural trend was the first to be activated in this area. This has created

a structural fabric that was reactivated by later structural movements. The northwest structural trend has resulted in the juxtaposition of the Carcoar Granodiorite with the Cowriga Limestone Member. Regional scale, northeast structures have controlled the dilation of pre-existing north-south structures. This has facilitated the emplacement of the Mine Dyke Group and hence the mineralisation.

The Mine Dyke Group is a series of dykes that predominantly lie within the ore zone. The dykes are mostly granitic in composition and range from aplites to pegmatites. They are mostly oriented north-south and some show evidence of intruding along north-south oriented faults and shears. The dykes have intruded syn- to post-mineralisation and two were dated using U-Th-Pb techniques on zircons. These analyses yielded ages of 430.0 ± 5.4 Ma and 432.3 ± 4.9 Ma. The Mine Dyke Group is the phase of the Browns Creek Intrusive Complex that is associated with mineralisation. As the Carcoar Granodiorite predates the mineralisation, the ages of the Mine Dyke Group in conjunction with the Carcoar Granodiorite can be utilised to obtain a date for the mineralisation event. The three dates give a mean age of 431 ± 3 Ma for this event.

The orebody is cross-cut by a late intrusive body identified in the latter part of the mine's operation. The Post-Mineralisation Intrusive is quartz monzodioritic to granodioritic in composition and is slightly more mafic than the Carcoar Granodiorite. It has intruded after the formation of the orebody and is not associated with any mineralisation. There is a slight amount of skarn alteration that is observed with this intrusion, overprinting the pre-existing skarn and mineralisation.

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