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Cu Mineralisation in the Middleback Ranges:

Conditions of Mineralisation.

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1 Abstract

The Moola Prospect situated within the Middleback Ranges on the northern Eyre Peninsula, South Australia, is comprised of potential IOCG-style, Cu mineralisation which appears to share some geological and mineralogical affinities with other IOCG deposits throughout the Gawler Craton. This recently identified mineralisation represents a new exploration region within the southern extent of the Olympic Cu-Au province which has proven to be highly lucrative with the recent discovery of the Hillside deposit in the neighbouring Yorke Peninsula. A broad investigation into host rock lithology, alteration and mineralisation paragenesis, as well as paleotemperature-pressure conditions of the deposit was carried out on drill core from OneSteel's inaugural exploratory diamond drill hole.

The mineralisation is hosted within the Paleoproterozoic Myola Volcanics, a package of rhyolites, rhyodacites and felsic gneisses which are intruded by amphibolite sills and granitic intrusives, assumed to be the neighbouring Wertigo granite. Prominently vein hosted, the mineralisation is localised around a north-northeast trending shear zone inferred to be an expression of the Kimban aged, Kalinjala shear zone which is located ~60 Km west of the Middleback Ranges. The alteration mineralogy present is divisible into two main assemblages, an early albite-epidote assemblage which has experienced extensive overprinting by the main mineralising phase associated with a quartz-carbonate-sericite± hematite-sulphide assemblage. Ore mineral paragenesis occurs as a transition of overlapping minerals that record coprecipiation. The first mineral to form was magnetite which was later extensively martitised during the transition to hematite precipitation which is preceded by a transition to pyrite, then finally chalcopyrite. A later phase of native copper mineralisation is recorded within the transecting shear zone which represents a supergene enrichment interpreted to have occurred as meteoric water gained access to depth via the structural weakness of the shear zone and remobilised any sulphides present, which were redeposited as native copper.

The temperature of mineralisation was established by TitaniQ thermometry which provided a precise temperature range between 415-530 °C with the peak at ~475 °C, which represents the conditions at which the paragenically linked quartz and mineralisation formed. Chlorite thermometry was also performed to obtain a temperature of mineralisation, with a few samples corresponding with the conditions established by the TitaniQ thermometer; however a majority of the data overestimates the temperature range by an unacceptable amount. Pressure conditions were reconstructed using the much more reliable TitaniQ temperature range inconjuntion with fluid inclusion data to establish the pressure conditions of mineralisation which ranged between ~5-7 kbar, and indicated mineralisation occurred at a deep crustal setting.

Fluid and mineralisation characteristics indicate a moderate salinity inferred from the fluid inclusions study, with NaCl ranging between 27.5-7.5 equiv wt%, along with a sulphur isotopic signature corresponding with magmatically derived fluids with the $\delta^{34}S$ ranging between -10.5 and -1.2 ‰. Which corresponds with other IOCG style mineralisation present throughout the Craton, with the Moola Prospect also being spatially associated to the interpreted source of these fluids within the Galwer Craton, the Hiltaba Suite granitoids? Even though the Moola Prospect shares affinities with IOCG style mineralisation this study cannot definitively identify its model of genesis as it also comprises characteristics that contradict this model, indicating that further study is required to better understand the extent and nature of this mineralising system.