

## **The Capsize prospect, NE Queensland, Australia: Geology, geochronology and stable isotope (S, O, H) geochemistry of a porphyry and associated lithocap**

Isaac Corral\*, Zhaoshan Chang, Fredrik Sahlström

\*James Cook University, Townsville, Australia, Queensland, Email:  
Isaac.CorralCalleja@jcu.edu.au

The Capsize porphyry Cu prospect is located in the northern Bowen Basin, 150 km south of Townsville, Queensland, Australia. It is hosted in the early Permian Lizzie Creek Volcanic Group (LCV; 288-276 Ma) and its granite basement (297-294 Ma). The LCV shows calc-alkaline character with typical volcanic arc signature (e.g., strong Nb, Ta, P and Ti negative anomaly and positive Th, U and Pb anomaly).

The Capsize porphyry has been drilled with 8 diamond holes. It is under a ~15 Km East-trending lithocap of advanced argillic alteration. Four rhyolitic porphyries (P1-P4; 286-274 Ma) intruding the granite basement and the LCV have porphyry-type alteration and mineralization. P1 is cut across by abundant (>50%) quartz veins and hosts the highest grades. P2 to P4 contain only minor quartz veins with sulfides.

In the porphyry, the earliest grey quartz and/or magnetite veins are cut by lavender to grey quartz±hematite vein that in turn is cut by sulfide-rich (pyrite-chalcopyrite with minor molybdenite and trace galena; no bornite) veins and breccia with anhydrite and quartz cement. Alteration is dominated by green chlorite-sericite-hematite alteration and minor sericite alteration. Potassic alteration is usually found in the halo of quartz-magnetite veins. Mineralization was dated by Re-Os on molybdenite, yielding an age of 286 Ma.

The lithocap replaces andesites and rhyodacites of the LCV (288-279 Ma). Hydrothermal alteration consists of an inner core of advanced argillic alteration (quartz-alunite-pyrophyllite-dickite-disapore-pyrite) grading outwards to quartz-dickite-kaolinite±montmorillonite and then to a propylitic epidote-chlorite-montmorillonite assemblage. Sulfide minerals in lithocap occur as disseminated pyrite, cut by millimetre scale pyrite-enargite veinlets. Both are cut by later pyrite-enargite cemented breccias and by the latest pyrite-dickite cemented breccias. Later tectonic-related gypsum and zeolite veins cut across hydrothermal alteration and mineralization. Three alunites have been dated by Ar-Ar so far, ranging in age from 283 to 256Ma.

$\delta^{34}\text{S}$  of pyrite in the lithocap range from -1.5 to -9.0‰ and  $\delta^{34}\text{S}$  of alunite from 23.1 to 25.2‰. In the porphyry,  $\delta^{34}\text{S}$  of pyrite range from -5.8 to 2.8‰, and  $\delta^{34}\text{S}$  of anhydrite from 17.8 to 21.3‰. Isotope geothermometry (mineral pairs) show a temperature range from 150 to 230°C (alunite-pyrite) and from 280 to 340°C (anhydrite-pyrite). Sulfur isotope temperatures are consistent with the disproportionation temperature of magmatic  $\text{SO}_2$  to  $\text{H}_2\text{S} + \text{SO}_4^{2-}$  in the hydrothermal solution, which is known to be below 400°C.  $\delta^{18}\text{O}$  of alunite and dickite range from -4.2 to 0.5‰ and  $\delta\text{D}$  range from -70.0 to -114.1‰. Calculated isotope composition of the hydrothermal fluid responsible of the alunite-dickite precipitation is characteristic of a mixture of magmatic fluids with a strong component of meteoric waters

The oldest dated alunite ( $283\pm 3$  Ma) and the molybdenite ( $286\pm 1.2$  Ma) indicate they are coeval, however younger alunites must be produced by porphyry centres that have not been found yet. This highlights the potential of the prospect to host undiscovered younger porphyry copper deposits.