Using zircon petrochronology to constrain timescales of porphyry Cu formation: an example from Bajo de la Alumbrera, NW Argentina

Y. BURET[1*], A. VON QUADT[1], C. A. HEINRICH[1] AND I. PEYTCHEVA[12]

[1]Department of Earth Sciences, Institute of Geochemistry and Petrology, ETH Zurich, Switzerland (*correspondence: yannick.buret@erdw.ethz.ch)

[2]Bulgarian Academy of Science, Geological Institute, Sofia, Bulgaria.

Using high-precision U-Pb dating we are able to determine timescales of porphyry emplacement and ore formation. Previous studies have suggested timescales of porphyry Cu formation ranging from <100 yr [1], to as much as 1 Ma [2]. In contrast recent numerical simulations suggest Cu precipitation occurs in the range of 50-100 ka [3]. Therefore in order to better constrain timescales of porphyry Cu formation, we apply high precision U-Pb zircon geochronology to estimate porphyry emplacement ages. Furthermore, high precision zircon U-Pb dates combined with trace element and Hf isotope analyses of zircons can provide useful insights into upper crustal magmatic processes which immediately precede the formation of porphyry Cu deposits.

This study focuses on the ~7 Ma Bajo de la Alumbrera Cu-Au deposit, NW Argentina. The deposit consists of a composite stock of dacitic porphyries. The relative timing of each porphyry intrusion is established based on clear cross-cutting field relationships between different porphyry intrusions, which include the pre-mineralisation P2 porphyry, pre-syn-minerlisation EP3 porphyry, and the post-mineralisation LP3 and P4 porphyries.

Single zircon crystals from individual porphyry intrusions (P2, EP3, LP3, P4) in the Alumbrera deposit have been dated using CA-ID-TIMS, employing the ET2535 tracer solution for maximum precision and accuracy. All porphyries display protracted zircon crystal growth over 100-200 ka timescales. Using the youngest zircon population from each of the porphyry intrusions, we conclude that Cu mineralisation occurred on 10 ka timescales, similar to those proposed by recent numerical predictions [3]. Trace element analyses from the dated zircons suggest that all of the dated porphyries are derived from the same body of underlying magma and show non-systematic trace element and εHf trends with time.

[1] Cathles and Shannon (2007) *EPSL* **262**: 92-108. [2] Ballard *et al.* (2001) *Geology* **29**: 383-386. [3] Weis *et al.* (2012) *Science* **338**: 1613-1616.