Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.6175

The 4D trans-crustal architecture of a porphyry copper-forming magmatic system

LAWRENCE C CARTER[1], SIMON R TAPSTER[2], BEN J WILLIAMSON[1,3], YANNICK BURET[3], DAVE SELBY[4,5] AND DAN PARVAZ[6,7]

[1]Camborne School of Mines, University of Exeter
[2]British Geological Survey
[3]Natural History Museum
[4]Durham University
[5]China University of Geosciences
[6]Selfrag AG
[7]Lightning Machines
Presenting Author: l.c.carter@exeter.ac.uk

Porphyry type copper deposits will play a major role in the shift towards a green economy. They form from large, long-lived, trans-crustal magmatic systems, mostly in subduction-related settings e.g. [1][2][3][4]. The timescales controlling the generation of 'fertile', porphyry ore-forming magmas remains a point of contention, and it remains unclear if 'fertility' is expressed throughout all parts of magmatic systems.

To address this, we revisit the construction of the archetypal ~8 km crustal section through the Yerington plutonic-porphyry-volcanic system, Nevada [5]. We pair field observations with zircon CA-ID-TIMS U-Pb and molybdenite Re-Os geochronology to temporally define construction of the magmatic-hydrothermal system along with zircon LA-ICP-MS trace element and Lu-Hf isotope analyses, and barometrically constrained depths of fractionation using haplogranitic melt-minima [6] to generate a projection of the evolving trans-crustal magmatic plumbing.

We show after long lived (>1.5 Myrs) emplacement of un-mineralised intrusions and associated volcanism, there was a rapid and abrupt (~<200 kyrs) switch in the magmatic plumbing, that tapped the fertile porphyry deposit forming magmas from a ~20-40 km deep, mid-lower crustal staging ground. These magmas were transferred up into the upper crust to form plutons and porphyry stocks within which the magmas further evolved. A small portion of these were intruded upwards to form aplite dykes (over at least ~400 kyrs) which acted as crystal mush conduits [7] for rising hydrothermal mineralising fluids. Their mineralising, 'fertile' geochemical signature was also expressed in the co-genetic volcanic terrane.

[1] Seedorff et al. (2005) *Econ Geol* **100**, 251-298. [2] Sillitoe (2010) *Econ Geol* **105**, 3-41. [3] Richards (2015) *Lithos* **223**, 27-45. [4] Wilkinson (2013) *Nat Geo* **6**, 917-925 [5] Dilles (1987) *Econ Geol* **82**, 1750-1789. [6] Blundy & Cashman (2001) *Contrib Mineral Petrol* **140**, 631-650. [7] Carter et al. (2019) *Proceedings of the 15th SGA Biennial*, 973-976.