CO_2 in boiling ore systems – A fundamental control on metal fractionation factors?

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Carbon dioxide is a common ingredient in magmatic-hydrothermal ore-forming systems that undergo boiling, such as porphyries and magmatic iron oxide deposits. An understanding of the effect of CO_2 on metal transport and vapour-liquid partitioning in these deposits is, therefore, critical to ore system modelling, yet this topic remains largely unexplored.

Using a large-volume titanium autoclave designed for sampling immiscible fluids, we have begun a series of experiments on the vapour-liquid partitioning of metals in aqueous-carbonic fluids. The results of this study are of particular use in deciphering metal transport in boiling ore systems with multiple coexisting metals, e.g., the poorly-understood magmatic iron oxide (±copper-gold-uranium-REE)-type deposits.

Interestingly, while the vapour-brine fractionation of chemically disparate elements such as Cu and the HFSE are quite different in CO_2-free aqueous fluids [1,2,3], our initial experiments have produced identical partitioning coefficients for Cu and U between CO_2-rich water vapour and CO_2-poor, NaCl-rich liquid ($D_{V/L}$). At 400°C and a bulk CO_2 content of 2.6 m, $D_{V/L}$ for both Cu and U increase from 0.01±0.002 to 0.2±0.1 with increasing total pressure from 320 to 360 bar. This unanticipated result suggests that carbon dioxide exerts a control over the fraction of Cu and U partitioned into the vapour phase, though whether this is due to a salting-out effect, chemical speciation or some other mechanism is still unknown.

Further experiments are underway in the newly-developed experimental geochemistry laboratory at Curtin University to measure the partitioning of Cu, U and other metals in fluids of variable CO_2 contents.

[1] Shmulovich, Heinrich, Möller & Dulski (2002), *Contrib. Mineral. Petrol.* **144,** 257-273. [2] Pokrovski, Roux & Harrichoury (2005), *Geology* **33,** 657-660. [3] Rempel, Liebscher, Meixner, Romer & Heinrich (2012), *Geochim. Cosmochim. Acta* **94,** 199-216.