



Tattitch, B. C., Candela, P., Piccoli, P., Bodnar, R. J., & Fedele, L. (2012). Copper Partitioning in CO<sub>2</sub>-Bearing Melt-Vapor-Brine Systems. Abstract from Goldschmidt, Montreal, Canada.

[Link to publication record in Explore Bristol Research](#)  
PDF-document

## University of Bristol - Explore Bristol Research

### General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:  
<http://www.bristol.ac.uk/pure/about/ebr-terms.html>

### Take down policy

Explore Bristol Research is a digital archive and the intention is that deposited content should not be removed. However, if you believe that this version of the work breaches copyright law please contact [open-access@bristol.ac.uk](mailto:open-access@bristol.ac.uk) and include the following information in your message:

- Your contact details
- Bibliographic details for the item, including a URL
- An outline of the nature of the complaint

On receipt of your message the Open Access Team will immediately investigate your claim, make an initial judgement of the validity of the claim and, where appropriate, withdraw the item in question from public view.

# Copper Partitioning in CO<sub>2</sub>-Bearing Melt-Vapor-Brine Systems

BRIAN TATTITCH<sup>1\*</sup>, PHILIP CANDELA<sup>1</sup>, PHILIP PICCOLI<sup>1</sup>,  
ROBERT BODNAR<sup>2</sup>, LUCA FEDELE<sup>2</sup>

<sup>1</sup>Laboratory for Mineral Deposits Research, University of Maryland,  
College Park, USA, [bctatti@geol.umd.edu](mailto:bctatti@geol.umd.edu) (\*presenting author)

<sup>2</sup>Virginia Tech, Blacksburg, USA

Analysis of fluid and melt inclusions from arc-related intrusions and porphyry copper deposits (PCD) reveal that many fluid inclusions from PCD are typically characterized by  $X_{\text{CO}_2} < 0.10$ , which is lower than that found in volatile phases exsolved from shallow (e.g., 5 to 10 km), arc magmas, in general ( $X_{\text{CO}_2}$  up to order  $\sim 0.45$ ). This disparity remains to be resolved.

The efficiency with which copper can be removed from arc magmas into exsolving volatile phases is a function of the competition between crystalline phases ( $\pm$  liquid sulphides), and the exsolving vapor  $\pm$  brine. Experiments in melt-vapor-brine systems permit the investigation of the partitioning of copper between silicate melts and volatile phases under magmatic conditions. However, the effect of CO<sub>2</sub> on melt-volatile phase equilibria relevant to the formation of PCD has remained unconstrained. In this study, the partitioning of copper in CO<sub>2</sub>-bearing, sulfur-free and sulfur-bearing, experiments may provide additional insights into copper partitioning and the generation of PCD.

We present results from experiments performed at 800 °C and 100 MPa in CO<sub>2</sub>-bearing, sulfur-free and sulfur-bearing melt-vapor-brine systems with  $X_{\text{CO}_2}$  (bulk vapor  $\pm$  brine) = 0.10 and 0.38. The compositions of vapor and brine inclusions and run-product glasses were used as proxies for the compositions of the magmatic phases. The salinities of vapor inclusions that nucleated clathrate (CO<sub>2</sub>  $\pm$  H<sub>2</sub>S clathrate) upon cooling were determined via Raman analysis and microthermometry [1]. The partitioning of copper between brine and vapor ( $D^{\text{bv}}_{\text{Cu}}(\pm 2\sigma)$ ) increases from 25( $\pm 6$ ) to 100 ( $\pm 30$ ) for sulfur-free experiments and from 11( $\pm 3$ ) to 95( $\pm 23$ ) for sulfur-bearing experiments, as  $X_{\text{CO}_2}$  is increased from 0.10 to 0.38. The partitioning of copper between vapor and melt increases with the addition of sulfur at  $X_{\text{CO}_2} = 0.10$ : ( $D^{\text{vm}}_{\text{Cu}}(\pm 2\sigma) = 9.6(\pm 3.3)$ ) (sulfur-free, metaluminous melt); 18( $\pm 8$ ) (sulfur-bearing, peralkaline melt); and 30( $\pm 11$ ) (sulfur-bearing, metaluminous melt). These values are to be contrasted with ( $D^{\text{vm}}_{\text{Cu}}(\pm 2\sigma) = 2(\pm 0.8)$ ) at  $X_{\text{CO}_2} = 0.38$  (the effect of sulfur cannot be distinguished at this mole fraction of CO<sub>2</sub>). These data demonstrate that changes in the salinity of the vapor and brine, which are controlled by changes in  $X_{\text{CO}_2}$ , play a major role in controlling copper partitioning in sulfur-free, CO<sub>2</sub>-bearing systems. Sulfur-bearing experiments demonstrate that magmatic vapors are enriched in copper in the presence of sulfur at low  $X_{\text{CO}_2}$ . However, the enrichment of copper in the magmatic vapor is suppressed for sulfur-bearing systems at high  $X_{\text{CO}_2}$ . These data indicate that the efficient removal of copper from silicate melts into vapor  $\pm$  brine is mitigated by high concentrations of CO<sub>2</sub>. Furthermore, the poisoning effect of CO<sub>2</sub> is more pronounced for sulfur-bearing volatile phases. As a result, high concentrations of CO<sub>2</sub> may play a negative role in the formation of PCD.

[1] Fall et al. (2011) *Geochimica et Cosmochimica Acta* **75**, 951-964.