

The role of CO₂ in porphyry molybdenum deposits: constraints from partition coefficients for molybdenum between a CO₂-bearing saline fluid and a felsic melt.

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Porphyry-type molybdenum deposits, many of which are in China, supply most of the World's molybdenum. Of particular importance are the molybdenum deposits located in the Qinling-Dabie region that are responsible for more than half of China's molybdenum production. A feature that distinguishes this suite of deposits from the better-known Climax and Endako sub-type of porphyry molybdenum deposits is their formation from CO₂-rich magmatic-hydrothermal fluids [1-2]. The role of CO₂, if any, in the transport of molybdenum by these fluids, however, is poorly understood. To address this issue, we conducted experiments on the partitioning of molybdenum between a fluid containing H₂O-CO₂, H₂O-NaCl, or H₂O-NaCl-CO₂ and a felsic melt at 850 °C and 100 and 200 MPa. The compositions of fluid inclusions trapped in quartz during the experiments and the composition of the coexisting melt were analyzed with LA-ICP-MS and were used to determine partition coefficients for molybdenum between fluid and melt ($D_{Mo} = C_{Mo}^{fluid} / C_{Mo}^{melt}$) in the above systems. The results of the experiments show that in the H₂O-CO₂ system there is almost no change in D_{Mo} with increasing X_{CO_2} . In the H₂O-NaCl system, the D_{Mo} increases progressively with increasing salinity. Addition of > 0.1 mole% CO₂ to a H₂O-NaCl fluid causes the fluid to separate into a high-density brine and a low-density vapor. The D_{Mo} for the brine is significantly higher than the D_{Mo} for the supercritical conditions of the H₂O-NaCl system (Fig.1). Based on our experimental results and the characteristics of ore-forming fluids (CO₂-bearing vapor and brine inclusions invariably coexist in Dabie-type porphyry Mo deposits), the presence of CO₂ promotes the exsolution of separate brine and vapor phases from felsic magmas, a process that leads to an increase in D_{Mo} for the brine and is critical in forming Dabie-type porphyry molybdenum deposits.

Reference

[1] Chen, Wang, Li, Yang & Pirajno (2017), *Ore Geology Reviews* 81, 405-430.

[2] Li, Ulrich, Chen, Thomsen, Pease & Pirajno (2012), *Ore Geology Reviews* 48, 442-459.

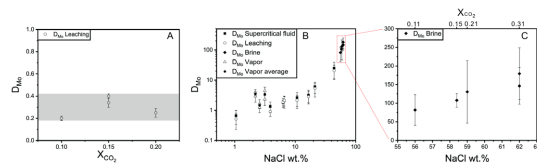


Fig. 1. (A) The D_{Mo} vs. X_{CO_2} in the H₂O-CO₂ series experiments. (B) The D_{Mo} vs. salinity of the fluid in the H₂O-NaCl and H₂O-NaCl-CO₂ series experiments. (C) The D_{Mo} vs. salinity of the fluid with the high salinity in the H₂O-NaCl-CO₂ series experiments. The enlarged high salinity part of (B) represents the D_{Mo} of the brine phase of the H₂O-NaCl-CO₂ series experiments.