

### **Molybdenum Isotope Compositions and Formation Mechanisms in Metallic Sulfides in Porphyry Deposits**

**Yamei Tian**<sup>1,2</sup>, Jifeng Xu<sup>1,3</sup>, Kang Cao<sup>4</sup>, Feng Huang<sup>1</sup>, Jianming Zhu<sup>3</sup>, Alex McCoy-West<sup>2,5</sup>

<sup>1</sup>State Key Laboratory of Geological Processes and Mineral Resources and School of Earth Science and Resources, China University Of Geosciences, Beijing, China, <sup>2</sup>IsoTropics Geochemistry Laboratory, Earth and Environmental Science, James Cook University, Townsville, Australia, <sup>3</sup>Frontiers Science Center for Deep-time Digital Earth, China University of Geosciences, Beijing, China, <sup>4</sup>State Key Laboratory of Geological Processes and Mineral Resources and School of Earth Science and Resources, China University of Geosciences, Wuhan, China, <sup>5</sup>Economic Geology Research Centre, James Cook University, Townsville, Australia

Molybdenite-bearing porphyry deposits are the primary source of molybdenum (Mo) for industrialized society and a major host of Mo in the upper continental crust. Numerous studies have reported the Mo isotope compositions ( $\delta^{98/95}\text{Mo}$ , normalized to NIST 3134) of molybdenite in magmatic-hydrothermal systems, revealing considerable variations (Greber et al., 2015; Li et al., 2019). In contrast, Mo isotope compositions of metal sulfides associated with molybdenite in magmatic-hydrothermal systems, such as pyrite (Py), chalcopyrite (Ccp), and pyrrhotite (Po), remain poorly constrained. The Pulang porphyry Cu-Au (-Mo) deposit in Yunnan, Southwest China, one of the largest porphyry Cu deposits in China, offers an excellent opportunity to investigate Mo isotope behavior due to its well-developed hydrothermal alteration zones and distinct paragenetic sequences. The metallogenic stages, from older to younger, are classified as K-silicate, epidote-chlorite, chlorite-illite, and quartz-illite stages (Cao et al., 2019). Py, Ccp and Po from Pulang deposit exhibit wide ranges of Mo concentrations and isotope compositions. Compared to the earlier epidote-chlorite stage ( $\delta^{98/95}\text{Mo}$  from -0.57‰ to 3.76‰ for Py; 0.12‰ to 2.6‰ for Ccp), Py (0.68‰ to 1.75‰) and Ccp (-0.31‰ to 0.94‰) from the later chlorite-illite stage display lighter Mo isotopic signatures. For Po, Mo isotope compositions from the lower-temperature quartz-illite stage are heavier than those from the chlorite-illite stage. These results suggest that the Mo isotope compositions of hydrothermal sulfides are partly controlled by crystal lattice conditions, precipitation sequence, and temperature-dependent alteration stages within magmatic-hydrothermal systems. Therefore, Mo isotopes in metallic sulfides have the potential to provide critical constraints on metal-rich fluid precipitation, the delineation of favorable mineralization zones, and the evolutionary pathways of complex magmatic-hydrothermal systems.

#### Reference

[1] Greber et al. (2015) *Lithos* 190-191, 104-110. [2] Li et al. (2019). *EG* 114, 981-992. [3] Cao et al. (2019) *EG* 114, 275-301.