

3.6.P02

Correlation between helium and sulfur isotopes observed in the Machangqing copper deposit, China

RUIZHONG HU¹, XIANWU BI¹, P.G BURNARD²
AND MEIFU ZHOU³

¹Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550002, P.R. China

²Centre de Recherches Pétrographiques et Géochimiques (CRPG-CNRS), 15 rue Notre Dame des Pauvres, B.P. 20, 54501 Vandoeuvre-les-Nancy Cedex, France

³Department of Earth Sciences, The University of Hong Kong, Hong Kong, P.R. China

The Machangqing copper mine is a porphyry copper deposit located at both the exo- and endocontact zone of Machangqing alkali-porphyry intrusion. In the deposit the major hydrothermal minerals at the ore-forming stage are chalcopyrite, bornite, pyrite, molybdenite, quartz and calcite etc. The fluid inclusions trapped in quartz coexisting with pyrite are generally primary, <10–25 μm in diameter and have salinities ranging from 10 ~ 22 wt.% NaCl equivalent and homogenization temperatures varying from 250 ~430° C.

Carefully separated coarse (>1mm) pyrite grains were cleaned ultrasonically in alcohol, dried, then loaded in on-line *in vacuo* crushers. He was released from fluid inclusions trapped by the grains into the all metal extraction system by sequentially crushing in modified Nupro type valves. Helium was separated from Ne with a separate charcoal trap at 35 K prior to analysis on a MAP-215 mass spectrometer. Crushed pyrite powder remaining from the He isotope measurements was used for sulfur isotope analysis. The results of helium and sulfur isotopic analysis for the pyrites are: ³He/⁴He ratios range from 0.5±0.1 to 2.1±0.1 Ra (Ra represents the ³He/⁴He ratio of air, 1.39×10⁻⁶), and the δ³⁴S values are within the range of -1.0±0.2‰—2.9±0.2‰.

The previously reported correlation between different isotopes, both radiogenic vs. radiogenic and radiogenic vs. stable isotopes, is dominantly controlled by isotope ratios of mixed reservoirs and has extensively been used to determine the material sources. We demonstrate here that the ³He/⁴He ratios of inclusion fluids hosted by pyrites from the Machangqing copper deposit, are positively correlated with δ³⁴S values of the pyrites. The correlation is caused by mixing of two endmembers, magmatic fluid and meteoric groundwater, with different isotope compositions for helium, but by modification of physico-chemical conditions of the mixed fluids for sulfur. This observation suggests that it should be possible to determine not only the evolutionary trend of physicochemical conditions of the mixed fluid from the correlation, but also the ³He/⁴He values of undiluted magmatic fluid and then the proportion of helium from the two endmembers.

3.6.P03

Microanalysis of low salinity ore fluids by LA-ICP-MS

M.M. ALLAN, B.W.D. YARDLEY, L. FORBES
AND D. BANKS

School of Earth Sciences, University of Leeds, Leeds, LS2 9JT, UK (mmallan@earth.leeds.ac.uk)

Dilute fluids are responsible for metal transport in a variety of ore deposit settings. However their low solute concentrations can make single fluid inclusion analysis by LA-ICP-MS difficult. We have optimised LA-ICP-MS analysis to detect low concentrations of ore metals, and applied it to dilute fluids in two settings: CO₂-rich fluids in post-metamorphic Au-bearing quartz veins (Brusson, NW Italy) [1] and dilute chloride fluids of the intrusion-related Mt. Leyshon Au Deposit, Queensland.

Fluid inclusions were ablated with a GeoLas Q system. The 193nm ArF laser was operated at 10J/cm² and a pulse rate of 5Hz. Ablated material was transported in He to an Agilent 7500c ICP-MS, equipped with a collision cell to remove polyatomic interferences. In all cases, Na was analysed as the internal standard, its concentration estimated by freezing point depression. Single inclusions from Brusson were analysed simultaneously for Cu, Ag and Au, together with As, Na and K, using He in the collision cell. Figure 1 illustrates the relative fluid concentrations of Cu, Ag, and Au in one Brusson sample. Eighty percent of measured Au/Cu ratios lie between 0.005 and 0.075, generally much greater than ca. 10⁻⁵ to 10⁻² values reported for porphyry Cu fluid inclusions [2]. These ratios mirror the much lower proportion of Cu mineralisation at Brusson, and also likely reflect the higher proportion of S to Cl in the ore fluid [1].

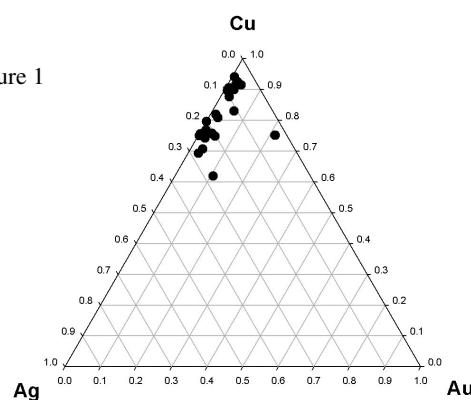


Figure 1

References

- [1] Yardley B.W.D., Banks D.A., Bottrell S.A. and Diamond, L.W. (1993) *Mineralogical Magazine* **57**, 407-422.
[2] Halter W.E., Pettke T., and Heinrich, C.A. (2002) *Science* **296**, 1844-1846.