

Fluid inclusions characteristics of Tuwu porphyry copper deposit, eastern Tianshan in Xinjiang

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Tuwu porphyry copper deposit lies in the contacting zones among late Carboniferous Qi'eshan Group lava, clastic rocks and volcanic-clastic rocks between Dacotan and Kanggu'ertage faults, and located in Carboniferous diorite-porphyrries and plagioclase granite-porphyry.

A series of research work have been carried out, and the result shows the temperatures of homogenization of the fluid inclusions vary from 125°C to 363°C, and mostly clustering on 140°C to 200°C. The salinities of fluids range from 0.18 to 58.28 wt% NaCl, and mostly range from 2 to 10 wt% NaCl. The gas components of fluid inclusions are mainly H₂O and CO₂, and the liquid components of fluid inclusions are mainly Ca²⁺, Na⁺, SO₄²⁻, Cl⁻. The Results of ion chromatographic analysis showing that the ratio of F⁻/Cl⁻ range from 0.009 to 0.024, SO₄²⁻/Cl⁻ range from 0.45 to 1.01, and there is little or no K⁺ in the samples.

The ore fluid in the fluid inclusions display right- inclines chondrite-normalized REE distribution patterns and positive Eu and negative Ce anomaly, and the LREE/HREE ratios vary from 5.39 to 6.75, δ Eu ranging from 1.80 to 1.91. The δ D_{V-SMOW} of the inclusions in quartz range from -70‰ to -66‰, and the δ ¹⁸O_{V-SMOW} values of quartz range from 9.4‰ to 12.3‰. According to the calculated results the δ ¹⁸O_{H2O} range from -5.6‰ to -1.7‰.

A series of research work combined with the geological characteristics of Tuwu porphyry copper deposit indicate that the ore-forming fluid was mainly derived from mixture fluid of meteoric water with magma water.

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Common mistakes of using Urey model on equilibrium stable isotope fractionation calculations

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Urey model or so-called Bigeleisen-Mayer equation has been the theoretical corner-stone of the stable isotope geochemistry for decades. Theoretically, it is required to use 'pure' harmonic frequencies in Urey model. However, since the publication of Urey model in 1947 [1], many researchers ignored this important requirement. They either directly used the experimentally observed spectroscopic data in which anharmonicity contributions are included, or used the harmonic frequencies from quantum chemistry calculations but further improperly scaled the frequencies to fit the experimentally observed fundamentals. These wrong ways become one of the largest error sources in the prediction of equilibrium isotopic fractionation. Another mistake is that although Urey model is not sufficient for dealing with the H-D isotope exchange reactions, many researchers still directly used this method to study H-D exchange reactions. By following the work of Richet *et al.* [2], we provide a detailed formulism to include the anharmonicity, quantum mechanical rotation, centrifugal distortion and vibration-rotation-coupling corrections to Urey model, and use many examples to show how important it is to use theoretical methods beyond Urey model for dealing with H-D isotope exchange reactions. By correcting the above common mistakes, the accuracy of the theoretical prediction of equilibrium stable isotope fractionation could be largely improved.

[1] Urey (1947) *J. Chem. Soc.*, 562-581. [2] Richet *et al.* (1977) *Ann. Rev. Earth Planet. Sci.* **5**, 65-110.