

Characteristics of Ore-Forming Fluid of Nuri Cu-W-Mo Multi-Metal Deposit in Southeast Gangdese, Tibet, China

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The Nuri Cu-W-Mo deposit is a newly discovered, large-sized skarn deposit, which lies on the tectonic metallogenic belt of the Gangdese volcanic-magma arc and belongs to the south side of the Yarlung Zangbo suture zone. A large amount of Late Cretaceous and Paleogene intrusive rocks were found in this Cu-W-Mo ore deposit district. The strata in the ore district are mainly Cretaceous Bima Group and Danshiting Group. The skarn mainly formed within the carbonate rocks and lithologic conversion boundaries.

Four types of inclusions in different mineralization stages of garnet, quartz, and scheelite can be found: gas and liquid two-phase inclusions, three-phase inclusions containing subminerals, high CO₂ content inclusions, and single-phase inclusions. The inclusion homogeneous temperatures of different mineralization stages are as follows: 280° to ~386°C (garnet phase in skarn), 200° to ~340°C (white tungsten mineralization stage), 140° to ~375°C (quartz-polymetallic sulfide stage), and 160° to ~280°C (quartz-calcite-pyrite stage). Their corresponding salinities are 2.9% to ~49.7%, 2.1% to ~7.2%, 2.6% to ~55.8%, and 1.2% to ~15.3%. The results reveal that the salinity of the ore-forming fluid decreased in the process of mineralization. Laser Raman spectroscopy analysis reveals that the main components of the inclusions are H₂O and CO₂, CO, and N₂. Hydrogen and oxygen isotope assay indicates δD of garnet is -114.4‰ to ~-108.7‰, $\delta^{18}O_{H_2O}$ of garnet is 5.9‰ to ~6.7‰, δD of scheelite is -103.2‰ to ~-101.29‰, $\delta^{18}O_{H_2O}$ of scheelite is 2.17‰ to ~4.09‰, δD of quartz is -110.2‰ to ~-92.5‰, and $\delta^{18}O_{H_2O}$ of quartz is -3.5‰ to ~4.3‰. All of those results indicate that in the early skarn stage, the fluids to form garnet and other minerals may come from the deep magmatic hydrothermal fluid. The blending and reaction between hot magma and water vapor from surrounding stratum in the magma rising process can make the δD migration occur in the mineral-containing fluids at an early stage. With the continual rising of the fluids, the water blended with magma gradually increased, then quartz and other minerals were formed gradually. Through conducting sulfur isotope assays of chalcopyrite, pyrite, and molybdenite in different orebodies, we discovered that the $\delta^{34}S$ values were located in the range of -0.32‰ to 1.08‰, which indicates that the sulfur isotope has a small dephlegmation in sulfides, which is a typical characteristic of deposits from magma.

We draw the following conclusions: (1) The ore-forming fluid of the Nuri deposit may be derived from the differentiation of the ultrashallow intrusive body, which formed by a large amount of middle- and high-temperature early-stage magma with middle and low salinity and some metal elements blending with low-temperature and low-salinity magmatic water vapor. (2) The boiling of fluid and insolubilization of two fluids play an important role in chalcopyrite, pyrite, molybdenite, and other sulfide precipitation.