Sm-Nd and Rb-Sr isotopical ages of magnetite-chlorite formation gold deposit in the volcanic rock area of Late Paleozoic Era, East Tianshan

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Abstract Through studying geo-geochemical characteristics and determining Sm-Nd and Rb-Sr isotopical ages in the Kanggur magnetite-chlorite formation gold deposit, some conclusions can be achieved: Sm-Nd isochron age is (290.4 ± 7) Ma, Rb-Sr isochron age is (282.3 ± 5) Ma, mineralization is Late Hercynian and the formation of this gold deposit is related to the macroscopic Huangshan-Qiuqemintashi ductile shear zone which is produced as a result of collision between the Tarim plate and the Junggar plate.

Keywords: gold deposit, Sm-Nd isotope, Rb-Sr isotope, Kanggurtage.

The magnetite-chlorite formation gold deposit, such as Kanggur gold deposit in the volcanic rock area of Late Paleozoic Era, East Tianshan, is a new-type gold deposit found in recent years. Through determining Sm-Nd and Rb-Sr isotopical ages of the ore in this deposit during studies of the National Project 305, authors find that both are very close.

1 Deposit geology

The Kanggur gold deposit is located in the volcanic rock area of the northern Aqishan-Yamansu Island arc belt and trench-arc system on the northeastern rim of the Tarim plate. The outcropped stratigraphic unit in the mining area is mainly Lower Carboniferous Aqishan Formation, which consists of a suite of intermediate-acid volcanic lava, pyroclastic rocks and normal sedimentary rocks, all belonging to sea face to sea-land interchange face. In the northern part of mining area, there is a macroscopic ductile shear zone, intense deformation and superimposed lately by brittle-ductile and brittle deformation (mainly EW, NW and NE direction faults). This gold deposit occurred in the superimposed lately brittle-ductile faults (fig. 1). The hydrothermal action is very strong in the ore belt and there are some different scale quartz veins.

The gold orebodies mainly occurred in phyllonite (its protolith is volcanic rock) and generally hundreds of meters long, 0.5 m to meters thick, showing the characteristics of parallel arrangement and lens out-reproduction. Protolith of both hanging wall and bottom wall of orebodies are andesite and acid tuff. Magnetite (5%—15%), pyrite (3%—10%), hematite (2%—4%), native gold and electrum are major metal minerals, vein minerals are chlorite (20%—50%), quartz (15%—40%), calcite
Fig. 1. Tectonic sketch map of the Kanggur area, East Tianshan. γ₁, Indosinian granite; γ₂, Indosinian granodiorite; γ₃, Hercynian granite; δ₀, Hercynian tonalite; F₁, Kanggur transcrustal fault; F₂, Kushui fault; F₃, Aqikkuduk fault; 1, Xitan gold deposit; 2, Kanggur gold deposit; 3, Matoutan gold deposit; 4, Dadonggou gold ore spot; 5, Xifengshan gold deposit; 6, Changchengshan gold ore spot; 7, Hongshigang gold deposit.

(3% ±), etc. The important wall-rock alteration has silicitization, chloritization and pyrite-phylitic alteration.

2 Sample collection, preparation and determination

The determined samples were collected from different depths of orebodies (50—250 m) in ZK2616, ZK2604 and ZK3804 and had good representativity. At first, the samples were washed by deionized water before crushing, quartz, pyrite and magnetite of about 99% purity were selected respectively from ore samples, then quartz fluid inclusion was dated by the Rb-Sr isochron method and pyrite and magnetite by the Sm-Nd isochron method. Most quartz inclusions associated with magnetite and chlorite are multiphase fluid inclusions containing $L_{CO_2}$ ($L_{CO_2}$ is 15%—25%, $L_{H_2O}$ is 75%—85%) and a CO₂ bubble can be seen in the phase $L_{CO_2}$ at room temperature. The homogenization temperature is generally 230—320°C, salinity is 11%—14% NaCl, belonging to a $H_2O-CO_2-NaCl$ system.

The procedure for the Rb-Sr isochron method: In the first place, some specimens were polished into thin and thermometric sections, many fluid inclusions were carefully observed under a microscope to decide the size fraction. Accordingly bigger samples were crushed. In the second place, quartz was crushed to 40—80 meshes and up to 99% purity can be obtained under a binocular microscope. In the third place, the samples were washed respectively by HCl and HNO₃, then the surface of minerals and crystal fissures were washed by water to eliminate acid. In addition, some secondary inclusions can be driven out by heat-explosion supersonic echo in order to gain true ages of the fluid inclusion. Finally, these samples were exploded at very high temperature to open inclusions and take out gas content of the fluid inclusions for Rb-Sr isochron dating on Finigam MAT-261 mass spectrometer.

The procedure for the Sm-Nd isochron method: The individual mineral samples of magnetite and pyrite were selected respectively up to more than 99% purity through electromagnetic and heavy-media separation after the ore-rich magnetite and pyrite were cleaned and crushed. Then different individual mineral samples were put into two plastic pots respectively, to which HF and HClO₄ were added. After dissolving for about 24 h on the middle temperature electothermal plate, the pots were opened to heat and get HClO₄ away and then 2.5 mol/L HCl was added to them. At last, the upper clear liquid was divided into two parts; one was used to determine the composition of Sm and Nd by mass spectrometric isotope dilution method after it was dealt with by mixed diluent, cation exchange column and HCl washing, and the other was used to separate from Ce, Nd and Sm by HDEHP exchange column, collect the desorption solution of Nd and determine the value of $^{143}Nd/^ {144}Nd$ on the same mass spectrometer.

All determined and analyzed results are given in tables 1, 2, figures 2 and 3.