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The Study on Fluid Inclusions and Stable Isotopes of Suoerbasitao Gold Deposit in the Eastern Tianshan Mountain, NW China

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1 Introduction

Epithermal gold deposits are commonly found around the circum-Pacific margin, mostly in Mesozoic and Cenozoic volcanic fields (Hedenquist 1987; Corbett G., 2002). However, epithermal gold deposits within the northern Xinjiang mainly occur in the Carboniferous volcanic fields (Yang et al., 2009), such as Axi, Mazhuangshan and Shuangfengshan gold deposits. The metallogenic age of these deposits may be closely associated with the geodynamic evolution of the Central Asian Orogenic Belt (Chen et al., 2012). But epithermal gold deposits in the East Tianshan Mountains like Suoerbasitao are relatively lack of researches on ore-forming fluid characteristics and mineralization. The Suoerbasitao gold deposit is considered as epithermal gold deposit based on its geological characteristics, fluid inclusions and stable isotope geochemistry. Through the study of Suoerbasitao deposit, we are trying to provide evidence for metallogeny of epithermal gold deposits in the northern Xinjiang region of Central Asian Orogenic Belt (CAOB).

2 Geological Characteristics of the Deposit

Suoerbasitao gold deposit is located at the binding site between Bogda back-arc basin in late Paleozoic and Harlik composite island arc in Paleozoic, and which is situated approximately 60km to the west of Balikun County, in the eastern Tianshan Mountain. The deposit is produced in volcanic agency that consists of Lower Carboniferous Takebasitao formation with marine intermediate-basic volcanic rocks and limestone lenses. The ore-body is controlled by complex geological structure in mining area. Wall-rock alteration in Suoerbaistao gold deposit mainly includes silicification, kaolinised, sericitization and carbonation.

Apart from natural gold and silver, ore minerals mainly include pyrite, arsenopyrite, galena, sphalerite which are characterized by relatively sulfur-poor. Gangue minerals mainly include quartz, plagioclase, kaolinite, sericite, chlorite and calcite. The ore has structure of (dense) disseminated, stockwork, breccia, with texture of residual, illusion. There are three ore bodies in the mine with the average Au grade of 1.72 g/t, and with the average Ag grade of 3.64 g/t, respectively. Based on field observations and microscopic, the mineralization process can be divided into three stages: (a) Pyrite and arsenopyrite stage; (b) Pyrite and ore-bearing quartz veins stage, which represents the main stage of gold mineralization in Suoerbasitao deposit; (c) Gold-bearing sulphides stage.

3 Fluid Inclusions

Fluid inclusions are selected from ore-bearing quartz of main mineralization stage (b) for microthermometry by using Linkam THMS600 (-196~600℃). Fluid inclusions coexist in the same crystals individually or in groups with a length of 5-10 μm. Fluid inclusions apparently contain vapor of 10-40 volume%, and homogenize to the liquid phase upon heating. Salinity is estimated based on ice-melting temperature in the system H_2O–NaCl, for dominantly aqueous inclusions.

The ice-melting temperature ranges from -0.2 to -6.5°C, corresponding to salinities of 0.35~9.86 wt.% NaCl equiv., and clusters between 0.35 to 4.96 wt.% NaCl equiv. with an average of 3.0 wt.% NaCl equiv.. Homogenization temperature ranges between 129 and 236°C, with an average of 163°C. Consequently, all the evidences above point out that the ore-forming fluid of Suoerbasitao gold deposit has the characteristics of low temperature and low salinity.

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4 Stable Isotopes

There are five handpicked quartz crystals of main mineralization stage (b), and all of them are measured for oxygen and hydrogen isotopic compositions. The $\delta^{18}O_{SMOW}$ values of quartz range from 13.2 to 14.7‰, and the $\delta^{18}O_{fluid}$ values are estimated between 3.5 and 5.0‰ by using the quartz–water fractionation equations (Clayton et al., 1972) and the temperature calculated from the fluid inclusions data. The δD_{SMOW} values of fluids range between -79.3 and -91.5‰. These data indicate that the ore-forming fluids in the Suoerbasitao gold deposit were mainly derived from meteoric water, with some minor contributions possibly from magmatic fluids.

There are only three pyrite specimens of main mineralization stage (b) were collected for S isotope analysis. The $\delta^{34}S_{CDT}$ values range from -0.3 to 0.6‰, which close to meteoritic values and imply that the ore-forming material of Suoerbaisitao gold deposit maybe come from surrounding volcanic rocks.

5 Discuss

In a δD vs. $\delta^{18}O_{fluid}$ diagram, data points from the Suoerbasitao gold deposit fall into the upper right of low-sulfidation epithermal deposits region which was divided by Hedenquist et al (1994), suggesting that the ore fluids were mainly derived from meteoric fluids, but underwent mixing with minor amounts of magmatic water. Besides, sulfur isotope results imply that the ore-forming materials mainly come from the surrounding volcanic rocks of Lower Carboniferous Takebasitao formation. On the other hand, an estimation of the mineralization pressure which ranges from 3.6 to 32.5 MPa, with an evaluation of the capture depth of less than 1200m, demonstrates that the deposit has some characteristics of epithermal deposits.

The series features of Suoerbasitao gold deposit are very similar with typical epithermal gold deposits. However, similar to the metallogenic age of Axi gold deposit, Suoerbasitao gold deposit was formed in Late Paleozoic (Li et al., 2004). The special metallogenic age that distinguishes to typical epithermal gold deposits may be closely associated with the geodynamic evolution of the Central Asian Orogenic Belt (Chen et al., 2012), which widely collided in Late Carboniferous and extended during Permian (Coleman R G.1989). The most beneficial geodynamic environment for epithermal gold deposits was in region stretching or partial extension in the context of squeezing widely (Corbett G., 2002; Yang et al., 2009). The Suoerbasitao gold deposit produced in Harlik Paleozoic composite back-arc within extensional environment which could provide a favorable structural environment.

Based on the data we have discussed, the Suoerbasitao gold deposit is considered as low sulfidation type of epithermal gold deposit. Through study of the Suoerbasitao gold deposit, we are trying to provide helpful evidence to master epithermal gold metallogeny and guide future exploration in Eastern Tianshan Mountains of Central Asian Orogenic Belt (CAOB).

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