Fluid Inclusion Study on the Axile Gold Deposit in Altay, Xinjiang

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Introduction. Axile gold deposit, located 40 km east to Habahe of Altai region, differs from many other gold deposits in wallrocks and alterations (Xu et al., 2005). It is a newly found gold deposit in this area, and little known about its mechanism of the ore origin is made. This paper focuses on fluid inclusion characteristics of vein quartz to provide evidences of ore-forming fluid about genesis of deposit.

Geological Setting. The Axile mineralizing zone occurs in the Ashele basin which is located in Kelan rift of Paleozoic·Main strata in the basin are Devonian and Carboniferous which consist of volcanic rocks, pyroclastic rocks and normal detrital rocks (Wang et al., 2000; Cheng et al., 1996). Regional faults strike mainly NW, namely the Kuerkali deep fault in the southwest and the Habahe deep fault in the northeast (Dong et al., 2002). The intrusive rocks occurs widely, which are mainly granitoids as well as associated veins, basic rocks and intermediate rocks. The intrusive rocks can be divided into two different stage: mid-Variscan and late-Variscan intrusive complexes. Mid-Variscan intrusive complex consists of basic-intermediate acid rocks, lithologicaly from gabbro to granite. The main intrusion in this region is Habahe plagioclase granite, in which develop the northwest Axile sub-fault containing gold-bearing quartz veins (Fig.1).

Ore Geology. Four mineralizing zones have been found in this mining area (Fig.1). Vein 33 occurs among diorite and granite in the northwest of the mining area, with 40m wide of Wallrock alteration zone. The ore bodies extend 240m and 1~3m wide, with 0.5~64g/t of gold grade. The alteration consists of silicification, pyritization, chloritization and epidotization. Silicification and pyritization are closely associated with mineralization. Vein 12 occurs in the diorites and is located in the deep fault of central mining zone, with 0.6~2g/t of gold grade. Vein 18, located in northeast mining area, occur in the sud-fault within the granites. The alterations are potassic alteration and sericitization. The ore body is 0.5~1m wide, with 0.2~5g/t of gold grade. Vein19 is controlled by sub-fault and located in the south of vein 18 vein. Ore body is 1~5m wide and gold grade is 0.5~24g/t. There is an obvious lithology change in the profile of axile main fault: hornblende granite - striped-granite (slight,schistosity)– mylonitic granite (chloritization)− mylonite− orebody− mylonite− mylonite (schistosity)− nubbly granite-quarternary.

The mineralizing stages can be divided into three: (I) early white quartz vein stage, which is characterized by white-lens quartz vein in shear zone; (II) sulfide-poor quartz vein stage, which is the main mineralized stage; (III) disseminated pyritized quartz vein stage, in which quartz shows miarolitic cavity sometimes. In stage II, the gold-bearing vein fills in diorite fracture, limonitization strongly occur near the surface, and the drilling samples are grey-transparent quartz. Some samples in this stage have 64g/t of gold grade.

The ore minerals are native gold, pyrite and chalcopyrite. Oxide minerals are limonite, hematite, and malachite. Gangue minerals are: quartz, feldspar, sericite and chlorite, ect. The ore contain granular texture, metasomatic texture,shattering texture, and nubbly structure, dissemination structure and drusitic cellular structure. The ore-bearing wallrock alterations includes limonitization, pyritization, silicification, sericitization, kaolinitization.

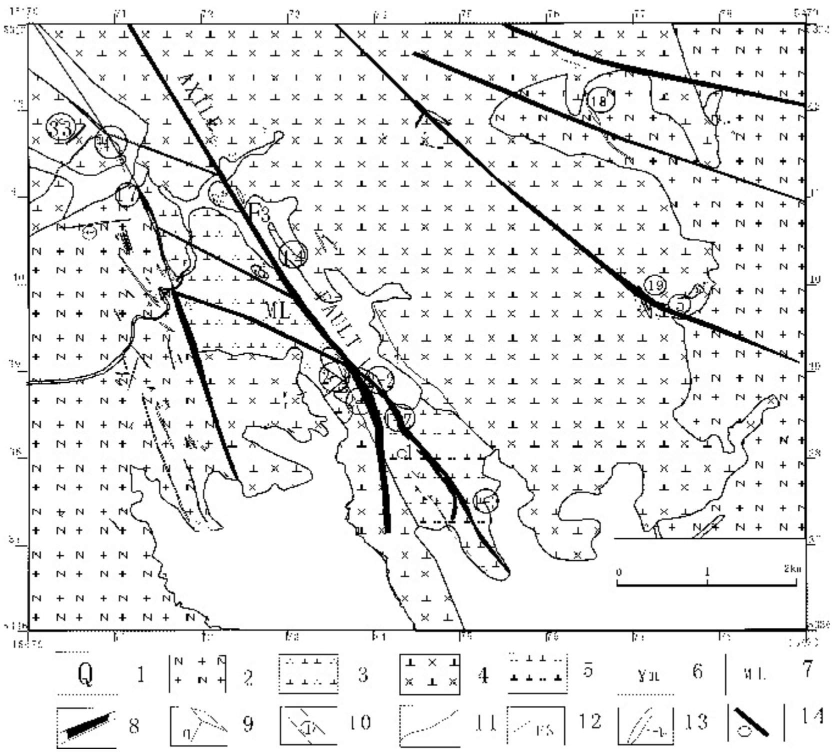

Fig.1 Regional geologic sketch map of the Axile gold deposit (After Shan et al., 2006). 1-Quarternary, 2-plagiogranite, 3-quartz diorite, 4-garbbro diorite, 5- granite, 6-phyric granitic, 7-mylonite, 8- tectonic belt, 9-gabbro vein, 10- Mineralized body, 11-line of geologic limitation, 12-axile fault, 13-quartz vein, 14-ore body

Fluid inclusions. Using advanced Linkam cooling-heating stage (THMS600) controlled by "Linksys" software, measuring accuracy between 0.1 and 0.2°C under 30°C, measuring accuracy between 0.5 and 1°C above 30°C, authors carried out systematic studies on the primary fluid inclusions in quartz through microscope observation, frozen and homogenization temperature, then concluded that there were three typical inclusions:

CO_2-rich inclusions (LH_2O-LCO_2), occurring in the stage I, consists of an aqueous phase and a liquid CO_2 phase, with the sizes ranging from 5 to 28μm. The homogenization temperatures range from 221.9~225.5°C (10 inclusions), with salinity from 5.8% to 7.1% (6.6% of average salinity) (fig.2) and fluid density from 0.65 g/cm^3 to 0.82 g/cm^3 (0.73 g/cm^3 of average density). The melting temperatures of CO_2 (tm, CO_2) range from -61.8 to -66.3°C (33 inclusions), and the homogenization temperatures of CO_2 (th, CO_2) range from 15.3 to 28.6°C (46 inclusions).

Aqueous inclusions (L-V), occurring both in the stages II and III, consists of an aqueous phase and a vapor phase, with the sizes of ranging from 2 to 19.8μm. The homogenization temperatures range from 125.2 to 240.3°C (63 inclusions) (Fig.2).

Monophase aqueous inclusions, occurring in the stage III, consists of only one an aqueous phase in room temperature. They have -3.2 to -5.3°C of ice melting temperatures (5 inclusions), with salinity from 5.26wt% to 8.3wt%.

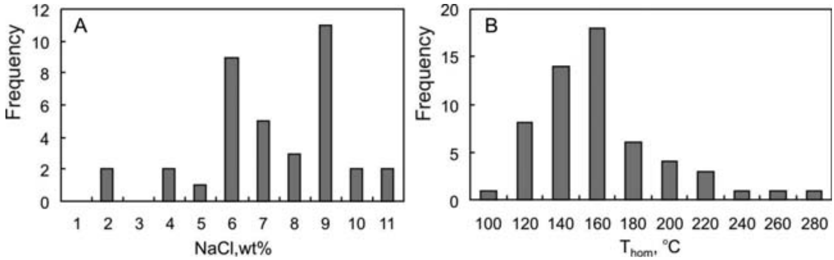

Fig.2 Salinity, wt.% NaCl eqw., (A) and homogenization temperature (B), histograms for the Axile gold deposit.

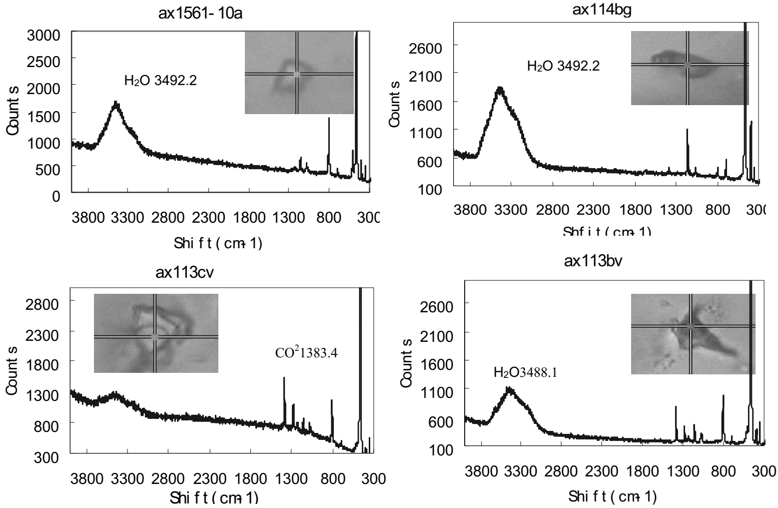

Fig.3 Laser Raman spectrum of fluid inclusions of the Axile gold deposit.

Raman analysis of fluid inclusions have been done in order to confirm the composition characteristics of fluid inclusions. Analysis on 20 inclusion samples (Fig.3) concluded that the inclusion (Lco2-V co2) in quartz shows distinct H_2O spectra peaks, and many inclusions show distinct CO_2 spectra peaks at 1384cm^{-1}, no signal CO_2 and other type spectra peaks. All the characteristics are identical with the phase changes of freezing test on inclusions.

Trace Elements picked up in fluid inclusions are measured by synchrotron radiation X-ray microprobe techniques. The method and test conditions can be referred from references (Huang et al, 2001; Yang et al., 2002). Samples are from Vein 18 of ore-bearing quartz and were tested two times by synchrotron radiation X-ray.

The net peak area counts and the standard deviations(1σ) of glass standard samples, mineralized quartz vein and inclusions were measured by SRXRF method, and the result of average net peak area was gained by normalized correction(net area of the peak counts/ detector counts*105), the element contents of ore bearing quartz vein and inclusions were obtain by the following formula:

$$C^i/P^i = C^s/P^s ,$$

C^i-sampling content; C^s–glass sampling content ; P^i–sampling net peak; P^s-glass sampling net peak

Test results showed that there were Fe(277.6ppm), Co(4.5ppm), Cu(7.1ppm), Zn(5.0ppm), Se(0.2ppm), Au(0.6ppm) anomalies in AX181-18 inclusion compared with background. The result should be confirmed by further verification for some reasons such as AX181-14 inclusion small.

Conclusion

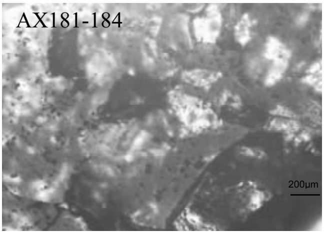

Fig. 5 The fluid inclusion tested by SRXRF.

There were three types of fluid inclusions in the Axial gold deposit. They are CO_2-rich inclusions (L_{H2O}-L_{CO2}), aqueous inclusions (L-V) and monophase aqueous inclusions. L_{H2O}-L_{CO2} inclusions have 221.9~225.5°C of Th, and L-V inclusions have 125.2 to 240.3°C of Th, It is indicated that the ore-forming fluid in the Axile gold deposit may be a low- medium temperature, low salinity(from 5.8% to 7.1%) and low density(from 0.65 g/cm^3 to 0.82 g/cm^3). The Laser Ramam microprobe analysis mainly shows H_2O and CO_2 spectra peaks at Ramam shift 3492.2cm^{-1} and 1383.4cm^{-1}. The SRXRF Test showed that there were anomalies of Fe, Co, Cu, Zn, Se, Au in AX181-18 inclusion, but it needed to be discussed further.

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