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Sulfide inclusions in barite from the Ashele VMS deposit, northern Xinjiang, China

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The Ashele Cu-Zn deposit is located in the northwestern part of Habahe county, Xinjiang. The strata in the Ashele area are parts of the Early-Middle Devonian Ashele Formation and Late Devonian Qiye Formation. The Ashele Formation, composed of tuff, rhyolite, basalt, limestone, and barite, hosts the Cu-Zn orebodies. Fourteen mineralized zones are found in the deposit area, and the No.1 zone includes four orebodies occurring between the basalt and tuff that are bedded and lenticular. The aqueous inclusions in quartz veins in the volcanic layers, including rhyolite and basalt, have homogenization temperatures from 117 to 214 ^{o}C, and the minor H_2O-CO_2 inclusions have temperatures of 130 ~247^{o}C. The fluids are characterized by medium-low temperatures and low salinities. The barite at the Ashele deposit, considered to have formed during the volcano-sedimentary event, occurs as layered and banded bodies in the second section of the Ashele Formation. The barite-bearing ores can be divided into three types: barite-polymetallic ore, pyrite-barite ore, and pyrite-quartz-barite ore. They were typically deformed during later metamorphic events. Aqueous inclusions in barite have ice melting temperatures of -1.2 to -2.3 ^{o}C and have *T*homogenization temperatures of 172 ^{o}C to 258 ^{o}C, with the salinities from 2.1% to 3.9% NaCl eqv. and densities from 0.96 to 0.97 g/cm^3. The H_2O-CO_2 fluid inclusions have CO_2 homogenization temperatures from 17.4 ^{o}C to 22.4 ^{o}C (to liquid), and total homogenizations are in the range of 168 ^{o}C~192 ^{o}C. The ore fluids in barite are low temperature and low salinity.

We also identified sulfide inclusions in the barite under the microscope. They are mostly circular or elliptical, and some appear idiomorphic. The size of the sulfide inclusions are small, generally less than 5 μm. The sulfide inclusions are found by SEM (scanning electron microscope), and the spectrum results revealed that the sulfide inclusions include galena and sphalerite. The data from electron microprobe analysis (EPMA) show that the sulfide inclusions are mostly galena. The composition of galena is 85.70~86.28% Pb and 13.21~13.49% S, with minor Fe, Co, Ni, As, Au, and Cu. The sulfide inclusions have differences from commonly exsolved phases in barite in that: (1) the sulfide inclusions that are several micrometers are all small, and the particle size of sulfide inclusions are several hundreds times less than the particle size of barite particles; (2) the sulfide inclusions are scattered in the barite; and (3) the solid inclusions differ from exsolved minerals in their structure, and the solid inclusions have characteristics of directional distribution or worm structure. These sulfide inclusions likely were trapped in the growth process of barite, and their composition can reflect the characteristics of residual fluids after the main VMS mineralization. The sulfide inclusions composed of galena and spalerite in barite show that there were Pb-Zn-rich fluids during the crystallization of barite.