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In Situ LA-ICP-MS Analysis of Fluid Inclusions in Barite and Calcite from Hutti Gold Deposit, India

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Hutti gold deposit is a classic orogenic greenstone-hosted gold deposit in India. As in most orogenic gold deposits, gold is localized in Hutti along quartz reefs and sulfidized wall rock.The early quartz veins and the quartz reefs that host mineralization have predominantly low-salinity CO_2-H_2O-NaCl fluids with minor CH_4. Late-stage calcite veins are common in the Hutti deposit. In addition, post-ore late-stage barite veins have been reported.

Microanalysis of individual fluid inclusions by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) is a powerful tool for directly determining fluid chemistry in fossil hydrothermal systems. In the present study, we provide the geochemistry of fluid inclusions in barite and calcite that were co-precipitated in veins using the new protocol (LA-ICPMS).

The vein of barite consists of excellent large translucent to transparent crystals of barite with prisms often up to 8 cm in length. In other cases, smaller crystals ranging from a few millimeters to a few centimeters are present.

The post-ore stage barite-calcite veins deposited from fluids of moderate salinity (10-16 wt % NaCl equiv.) and at temperatures close to 145-150^oC are also reported in Nevin and Pandalai (2010) and Badhe and Pandalai (2015).

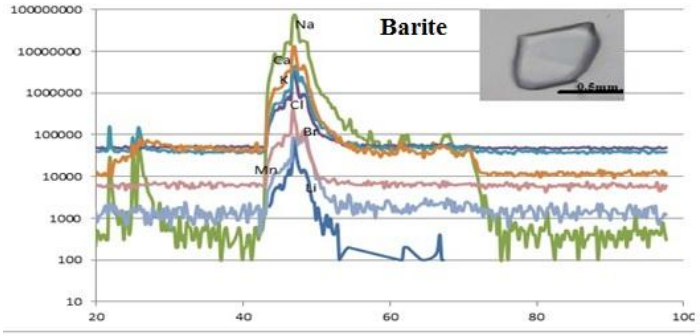
The absolute elemental concentrations are calculated based on the applied internal standard. For example, Na concentration derived from calculated salinity from microthermometric observation.

Fig.1 illustrates the time-resolved LA-ICPMS signals of a liquid-rich fluid inclusion in barite and calcite. Most elements occurring synchronously with the narrow Na peak suggests their presence in the aqueous solution, whereas delayed peaks are attributed to solid minerals. Halogen elements such as Cl and Br were detected in the fluid inclusions and were quantitatively determined.

All fluid inclusions contain NaCl, KCl, and $CaCl_2$. $BrCl_2$ occurs as major dissolved salts with trace amounts of alkaline metals such as Li, Mg, Rb, Sr, Cs, B, and Ba. The ratio of Ca/K and Na/K average values are higher in fluid inclusions in barite than calcite. Mg/K and Ba/K values in barite and calcite are less than 1. Li and B concentrations in fluids are higher in calcite than barite. The dataset is more limited for Fe and Cu; they were below their limits of detection. The halogens Cl and Br have high concentrations.

Fluid inclusion studies on the quartz reefs in the underground exposures and quartz veins in surface exposures in the Hutti schist belt have revealed that the fluids related to early (D1) quartz veins, quartz veins associated with the shear zone, and a few, later, (D2-related) quartz veins are all associated with fluids belonging to the CO_2-H_2O-NaCl-(CH_4) system (Pandalai et al., 2003), while late-stage post-ore cavity-filling barite-calcite veins with fluid inclusions belong to the H_2O-NaCl system (Badhe and Pandalai, 2015).

The high molar Br/Cl ratios and the chemistry of fluids need to be explained in the context of the tectonic setting of an evolving island-arc orogen. The exact origin of these high-saline waters is unclear yet.


Barite
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Cl
Br
Mn
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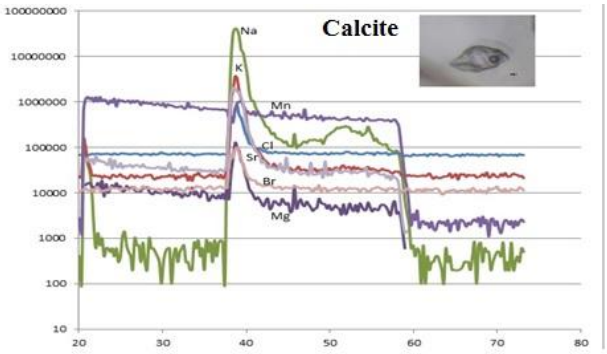
Calcite
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