Variation of salinity and gas composition of fluid inclusions in the Culebra granitic rocks of the Pallca mining area in Peru

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Salinities of aqueous fluid inclusions are commonly determined by microthermometry with referring melting temperatures of ice and/or clathrate to adequate phase diagrams of H_2O-salt-gas systems. However, the phase diagrams for complex compositions of naturally occurring fluid inclusions with gas components are currently not available. A difficulty also lies on that one should estimate gas compositions to apply the diagrams even for simple binary gas mixtures in brines. Furthermore, it is difficult to observe the phase changes in small inclusions.

On the other hand, recent technical and theoretical developments in Raman spectroscopic analysis make it possible to estimate salinities of small fluid inclusions. The Raman microprobe can analyze vapor-rich and other inclusions of low liquid water content which are difficult to analyze by microthermometry (Mernagh and Wilde, 1989). The Raman spectrum of liquid water in the OH stretching region (2800-3800 cm^{-1}) shows a complex profile of several broad and overlapping bands (ditto). Dubessy et al. (2002) also pointed that solutes interact with water molecules through the solvation of ions, causing a modification of the structure of liquid water, hence the spectra of the region show an important evolution with increasing salt concentration.

To apply Raman spectroscopic analysis to salinity measurements of natural fluid inclusions, synthetic brines were analyzed to obtain calibration curves by the reflex Raman microscope (Renishaw) with a LD laser as the source of 532 nm radiation. Dubessy et al. (2002) mentioned the dependency of the crystal orientation of host quartz on the Raman spectra of water inclusions. Therefore, the dependency was also investigated by analyzing the synthetic brines covered with doubly polished thin sections of natural quartz cutting in parallel to and perpendicular to its C axis. The results show systematic variations in the spectra due to the orientation of the covered thin sections.

A number of fluid inclusions were observed in quartz phenocryst of the Culebra granodiorite and quartz porphyry of the Pallca mining area in Peru. Most fluid inclusions distribute within several trails probably formed by microfracturing and healing. Raman microspectroscopic analyses of the trailed inclusions revealed four types of trails with different salinities and gas compositions of the CO_2-CH_4-N_2 (-H_2O-salt) systems. It is also worth to note that CH_4 is a major gas component in fluid inclusions of the trail in which sphalerite was observed, implying CH_4 dominant fluids as a source of ore dissemination in the rocks.

An evolution of fluids observed as fluid inclusions in the Culebra granitic rocks will also be preliminarily discussed in the presentation.