

Structural States and Isotopic Compositions of Water in Hydrothermal Quartz, Koryu Deposit, Japan

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Abstract

Two different types of hydrogen in hydrothermal quartz from the Koryu deposit were distinguished by measurement of hydrogen isotope ratios and unpolarized and polarized infrared absorption spectra at room temperature and at -150°C . The results of these measurements suggest that the hydrogen species in the hydrothermal quartz are liquid water (H_2O) in fluid inclusions, silanol-type OH in the crystal structure of quartz, and liquid water in nanometer-sized domains of water molecules. Among them, the liquid water in liquid domains is most abundant. The hydrogen isotope ratio of liquid water in liquid domains is 40 per mil lower than that of water in fluid inclusions. This implies that a large amount of silanol OH was incorporated into the quartz during the rapid crystal growth stage and liquid domains of nanometer size were then formed in the quartz during subsequent hydrothermal activity and cooling. The water extracted between 300° and 500°C yields the δD value of the hydrothermal solution associated with quartz precipitation.