

Experimental Investigation on the Influence of Fluorine on the Geological Thermobarometry of Fluid Inclusions

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Fluid inclusions (FIs) are widely utilized as crucial geological thermobarometers for reconstructing the physicochemical conditions of various hydrothermal events in paleo-geological environments. Their applications span comprehensively across the fields of diagenesis and mineralization mechanism research. The composition of natural FI is typically complex, yet the overall fluid composition of many hydrothermal systems can be effectively represented by the NaCl-H₂O system for the purpose of thermobarometric analysis. The trapping P-T (pressure-temperature) conditions of these inclusions are generally estimated based on two key parameters: salinity (expressed as NaCl equivalent) and the homogenization temperature of the inclusions. Nevertheless, in certain unique magmatic-hydrothermal systems, such as those associated with granite-related W-Sn deposits and some pegmatites, the significant presence of fluorine raises questions about its potential impact on the geological thermobarometry of fluid inclusions. However, experimental data remain scarce, limiting the comprehensive interpretation and quantification of this influence. Addressing this gap, in this study, the fluorine-bearing fluid inclusions have been synthesized in the laboratory under high-temperature and high-pressure conditions. Through microthermometric analysis, the P-V-T-X (pressure-volume-temperature-composition) properties of these inclusions are interpreted, providing experimental evidence for the accurate application of FI in inferring the conditions of fluorine-rich hydrothermal systems.