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SYNTHETIC FLUID INCLUSIONS IN QUARTZ: PRODUCTION OF STANDARD SOLUTIONS AT HIGH TEMPERATURE AND PRESSURE

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Fluid inclusion research is relevant to our understanding of many natural processes in which fluids play a role. Natural fluids which are preserved in fluid inclusions in single crystals (usually quartz) are in general very complex and consist of many components. The majority of fluids can be described in a H_2O-gas-salt system, where the gas may include CO_2 and CH_4 and the salt may include NaCl and KCl.

The main analytical technique for fluid inclusions is microthermometry, which relates phase changes to fluid compositions. Synthetic inclusions with known fluid composition and density are helpfull for clarifying this relationship. These synthetic inclusions also allow the investigation of fluid phase equilibria under crustal conditions, and the investigation of the systematics of natural fluid inclusions. The inclusions are manufactured to calibrate the temperatures of phase transitions observed in natural fluid inclusions, and to provide calibration standards for analytical methods.

The experimental setup includes 10 externally-heated, cold-seal pressure vessels (Tuttle-type autoclaves) which are available for hydrothermal experiments up to conditions of approximately 800 °C and 1 GPa. Argon is used as a pressure medium. Temperature control is operated by computer via measurements from internal thermocouples. Pressure is permanently monitored with pressure transducers. Fluid inclusions are synthesized in pre-fractured quartz sealed in gold capsules with fluid components of known concentrations (see also BODNAR & STERNER, 1987). Experimentation time varies between 1 and 4 weeks. Gases in the capsules are obtained from chemicals that decompose at elevated temperatures during the start of each experiment, e.g. 150 °C, producing chemically inert metals in addition to the selected gases (e.g CO_2 from silver-oxalate, N_2 from silver-azide). Salt solutions include NaCl, KCl, $CaCl_2$, $MgCl_2$, and $FeCl_2$ with salinities near the eutectic compositions in binary H_2O-salt systems.

References

BODNAR R.J.& STERNER S.M. (1987) Synthetic fluid inclusions. - In: ULMER G.C. & BARNES H.L. (eds.): Hydrothermal Experimental Techniques, John Wiley & Sons, New York, pp. 423-457.