

THERMAL HISTORY OF MISSISSIPPI VALLEY TYPE DEPOSITS RECORDED BY FLUID INCLUSIONS

FALL, András, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

Fluid inclusions may be considered time capsules that can contribute information about the temperature, pressure, composition and origin of fluids of mineral precipitation and about their history after the entrapment of the inclusions. All of these can be incorrectly interpreted if basic assumptions, referred to as the Roedder's rules, are ignored before data collection: 1) the trapped fluid was homogeneous; 2) nothing is added to or lost from the inclusion after trapping; and 3) the volume of the inclusion is constant after trapping. The only way to test the validity of these assumptions is to obtain data only from fluid inclusion assemblages (FIA) – fluid inclusions that were trapped at the same time. This condition implies that all the inclusions within an FIA were trapped at the same temperature and pressure, and all trapped a fluid of the same chemical composition. Assuming that the inclusions represent the original trapping conditions and there has been no post-entrapment reequilibration, all inclusions in an FIA should have the same homogenization temperature (T_h). However, fluid inclusions assumed to be trapped at the same time frequently show a variation in T_h . The range in T_h within an FIA might be affected by factors that vary depending on the geologic environment where the FIA is formed. These factors may include natural temperature and pressure fluctuations during and after formation of an FIA, also fluid inclusion size, physical properties of the host mineral, as well as sample collection and preparation, and thermal gradients during T_h measurements. Overlooking these assumptions and factors may lead to misinterpretation of data obtained from fluid inclusions. The goal of this project is to identify FIAs in samples from different major geological environments and determine smallest range in homogenization temperature that might be expected under ideal conditions.

Fluid inclusions in hydrothermal MVT deposits are relatively simple, normally comprising two-phase aqueous inclusions containing a liquid phase and a vapor bubble generally < 10% of the inclusion volume, at times accompanied by hydrocarbon inclusions. The homogenization temperatures range is 50-180°C and salinity range is 15-30 wt% NaCl equivalent, however initial ice melting temperatures indicate a fluid composition closer to the NaCl-CaCl₂-H₂O system. Data obtained from primary and secondary FIAs in fluorite from the Cave-in-Rock fluorite district, southern Illinois, show a slight variation of T_h within a specific inclusion assemblage. The observed FIAs show T_h variations with standard deviations that range from 0.26 for some FIAs consisting of secondary inclusions trapped along healed fractures, up to 3.16 for some FIAs of primary fluid inclusions trapped along growth zones of fluorite. The factors influencing the T_h variations within the different type of FIAs will be discussed. Given that there is a close resemblance in the formation of different MVT deposits and their fluid inclusion are generally well characterized showing also similar properties, the observed T_h variations within FIAs in the fluorite should be appropriate to different host minerals and MVT deposits.