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P-T conditions of fluid trapping at Hohentauern/Sunk sparry magnesite deposit (Eastern Alps, Austria)

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The Carboniferous of the Veitsch nappe in the Graywacke Zone (Eastern Alps/Austria) is the type region of the “Veitsch type” sparry magnesite. The Hohentauern/Sunk deposit, at the structural base of the Veitsch Nappe, is one the best known magnesite deposits. Sparry magnesite of the Hohentauern/Sunk deposit is characterized by pinolite (Fig. 1), rosette and banded (zebra) textures. All geological, petrographical and geochemical features support a diagenetic dolomitization of the carbonate host rocks followed by the magnesite formation via metasomatic replacement and redolomitization. The magnesite forming fluid with high salinity has a marine/evaporitic origin.

Fig. 1. Handspecimen of sparry magnesite (pinolite) from Sunk, Austria

Fluid inclusions are relatively abundant in the magnesite, but generally less than 5 µm in size. At room temperature two phase (L+V) and three phase (L+V+S) inclusions have been recognized. The liquid-rich inclusions display a Raman spectrum typical for H_2O and in some cases of gas rich inclusions CO_2. Commonly, fluid inclusions contain solid daughter crystals, identified as dolomite by Raman spectroscopy.

The results of the chemical composition of the extracted inclusion fluid of the magnesite samples using crush-leach technique show very low Na/Br (22 to 77) and Cl/Br (60 to 119) ratios. Their compositions lie at the end of the evaporation trend on the Na/Br and Cl/Br molar ratio diagram. The position of the plots at the end of the evaporation trend and the extent of fractionation indicate that the highly saline fluids were the product of evaporitic concentration predominantly of seawater. The fluid compositions of magnesite samples indicate evaporitic bittern brines to be the original fluid source.

The inclusions in the magnesite show different homogenization temperatures (T_h) around 150°C to 190 °C and a well defined mode around 170 – 180 °C and a broader range of T_h at 350 °C . Final ice melting temperatures (T_m) were observed mainly between -30 °C and -10 °C with a clear peak centered on -20 °C to -15 °C. They have a well defined mode around -20 °C which indicates a substantial content of NaCl in the fluids. The salinity of the fluid was calculated in the H_2O-NaCl system (Bodnar 1993) with the use of *BULK* software from the computer package *FLUIDS* (Bakker 2003). Microthermometric data indicate that fluids trapped in primary fluid inclusions in Hohentauern/Sunk magnesite are brines characterized by high and variable bulk total salinities (22.4 eq mass% NaCl) belonging to the H_2O-NaCl system. The observed variation in homogenization temperatures (T_h) and final ice melting temperatures (T_m) of the fluid inclusions from sparry magnesite may be interpreted as the result of local mixing of two fluids with different salinities. As a result, the study of fluid inclusions of sparry magnesite indicates a high salinity of the

Mg-rich solutions which transformed the dolomite protolites.

Possible *P-T* conditions of fluid trapping are estimated using the intersection point of isochores with the lithostatic thermobaric gradients. We consider that the timing for magnesite mineralization and fluid trapping coincides with HT/LP metamorphism (peak around 270 ± 30 Ma), magmatism and extensional tectonics which are characteristic for some segments of the Austroalpine crystalline basement in which a geothermal field gradient of 45 °C/km and geobarometric gradients of 27.1 MPa are supposed (Schuster et al. 2001, Schuster & Stüwe 2008). The isochore intersection with the general lithostatic gradient at the time of magnesite mineralization is around 245 °C and 136 MPa, which corresponds to a depth of approximately 5 km. The calculated temperature is the maximum achievable temperature for the fluids. Therefore, the real trapping temperature is most probably between the measured T_h with a mode at 170 °C and a temperature of 245 °C for lithostatic pressure with a geothermal field gradient of 45 °C/km. This temperature is similar to the temperature (247 °C) calculated by the Na-K geothermometer (Azim Zadeh, 2009).

REFERENCES

Azim Zadeh A. M. (2009) *PhD thesis*, Montanuniversität, Leoben, 181 pp.

Schuster R, Stüwe K. (2008) *Geology*, 38: 175-178.

Schuster R., Scharbert S., Abart R., Frank W. (2001) *Mitteilungen der Geologie und Bergbau Studenten Österreichs*, 40: 111-141.