# Formation Conditions of Syntectonic Veins in Lower Palaeozoic Limestones above Crystalline Basement

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Numerous papers focus on the study of syntectonic veins from a deformational point of view. The veins are used as indicators of strain and for determining the origin of folds (e.g., Thorbjornsen and Dunne 1997), faults and shear structures (e.g. Smith 1996, 1997). Veins are also studied to determine the migration pattern of tectonically-driven fluids and their importance in deformation processes. The role of fluids in fault and shear zones is the topic of the papers by Kerrich et al. (1984), McCaig (1988), Carter and Dworkin (1990) and Brown et al. (1994). Structural permeability of fault-fracture meshes and the origin of fluids has been discussed by Nesbitt and Muehlenbachs (1989) and Sibson (1996) among others. The investigation of fluid inclusions which contain tectonically-expelled fluids can provide interesting information on the evolution of the deformation conditions of rocks (e.g. Xu 1997, Muchez and Sintubin 1998). This study was focused on the physico-chemical conditions of syntectonic veins, which formed during a late stage of the Variscan deformation in the Moravian Karst area.

The Moravian Karst area belongs to the Moravo-Silesian Palaeozoic and is underlain by crystalline granitoid rocks of the Brunovistulicum (Dudek 1980). The Devonian and Carboniferous limestones have been deformed together with this basement. Abundant syntectonic veins were formed within these Palaeozoic limestones. They have very often complex shapes and geometries. They may be irregular, sigmoidal in shape or arranged in a dense network or en-echelon arrays. The mineral assemblage of these veins is very simple; they only contain milky calcite. The white hue of the calcite is produced by a large number of tiny fluid inclusions (Ł 1mm).

Several samples were analysed from the southern (Mokrá, Hády), central (Skalka area) and northern part (Amateur Cave area) of the Moravian Karst. Microthermometric analyses of fluid inclusions in the calcites produced different results in these areas. The temperatures of homogenisation ($T_H$) of primary two-phase $H_2O$-NaCl fluid inclusions in the Skalka area and in the Amateur Cave range between 60°C and 110°C. $T_H$ values of the fluid inclusions in calcites from Mokrá and Hády exhibit slightly higher values between 80° and 140°C. Without pressure corrections we can consider these values as the lowest formation temperatures of the syntectonic calcites. Salinity of the enclosed solutions is lower in the southern part (1.4 to 7.5 eq. wt.% NaCl) than in the central and northern areas (6.5 to 17.8 eq. wt.% NaCl). The identical dull orange-brown luminescence of syntectonic calcites and of the surrounding limestones and the similar range of their stable isotopic composition ($\delta^{13}C$ = -1.5‰ to +2.6 ‰ VPDB, $\delta^{18}O$ = -9.6 to -3.9 ‰ VPDB) suggest that the fluids from which the syntectonic calcites precipitated were buffered by their host limestones (Muchez et al. 1995). The syntectonic fluids could have been expelled from the limestones during their deformation.

The difference in the salinity and $T_H$ in the samples can be explained by the different geological position. Higher values of $T_H$ are produced by heating of the fluids by the basement in the southern area. The veins and limestones investigated in the south are situated a few metres to one hundred metres above the unconformity. In such geological setting, fluids could have partly migrated through the basement rocks, modifying the temperature of fluids and their chemistry. Heating by the basement can be explained by its magmatic reactivation that is reported from the Late Carboniferous and Permian (e.g., Přichystal 1994) and by the geothermal gradient. That is estimated at 46°C/km during the Late Palaeozoic in this region (Střelcová et al.1997). The samples studied from the central and northern areas (Skalka, Amateur Cave) are located ~300 to 600 m above the basement. Syntectonic fluids with low salinities comparable to those in these areas have been recorded from syntectonic Variscan calcite veins at the Variscan thrust front in Belgium (Muchez et al. 1997).

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