Migration of paleo- and recent fluids in the Podlesí granite, Krušné hory Mts., Czech Republic: Fractures, fluid inclusion planes, open microcracks

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Mesoscopic fractures, fluid inclusion planes and open microcracks were studied in rocks of the Podlesí granite stock to characterize the fractured aquifer and its associated fossil and recent fluids. The Podlesí granite stock is located in the western part of the Krušné hory Mts. in northwestern Bohemia. It represents the most fractionated part of the late Variscan Nejdek-Eibenstock pluton in the Saxothuringian zone of the Variscan orogen in Central Europe (Breiter, 2002). The granitic body intruded into the Ordovician phyllites and the biotite granite of the "younger intrusive complex". The Podlesí granite stock consists mainly of albite-protolithionite-topaz granite (stock granite). In the uppermost part, the stock granite is penetrated by several flat-lying dykes of albite-zinnwaldite-topaz granite (dyke granite).

The combination of well logging methods for borehole PTP-3 enabled the study of the orientation and distribution of various geological phenomena, such as the depth, dip, and strike of fractures, rock boundaries etc. (Maros et al., 2002). The fracture frequency, which was found to be 3.04 fractures per meter in the borehole, is very low. Altogether 877 open or closed fractures were identified in the PTP-3 borehole to the depth of 348 m. The fractures are predominantly oblique to subhorizontal with NW–SE strike with and dip to the NE, or of NNE–SSW strike and dipping both to the NW and SE. Steep fractures strike mainly NW–SE and NE–SW. Moreover, two theoretical paleostress orientations were determined with the main stress orientations to the NE–SW and NW–SE (Maros et al., 2002).

A part of the core of stock and biotite granite was oriented using geophysical methods and ImaGeo mobile corescanner to geographical axis. The microstructural phenomena were studied in horizontal and vertical sections.

Fluid inclusion planes (FIP) result from the healing of former opened cracks and therefore appear to be fossilized fluid pathways (Lespinasse, 1999). FIP are non-penetrative cracks interpreted as extensional cracks, which formed subparallel to the average strike of σ_1 (Segall, 1984). Fluid inclusions in FIP are clearly secondary in relation to the host mineral.

FIP of oriented samples of the PTP-3 borehole have mostly intragranular character. They were reliably identified only in quartz and topaz. The lengths of the FIP range from 0.1 mm to 3.2 mm. The number of FIP in quartz is estimated to be 140 FIP/cm^2. Most of FIP are steep, FIP of N–S strikes predominate, however orthogonally striking steep FIP seem to be distinct: NNE–SSW and WNW–ESE. Subhorizontal and moderately dipping FIP seem to be less frequent. Only about 10 % of FIP dips at angles lower than 60°. Two generations of water-rich fluid inclusions were found in FIP: (1) vapour-rich (V > L) fluid inclusions with homogenization temperatures from 350 to 430 °C, and (2) liquid-vapour inclusions with homogenization temperatures between 140 and 270 °C. The salinity of fluid inclusions did not exceed 10 wt.% NaCl equiv. (Dobeš, 2005).

Microcracks, i.e. intercrystalline cracks, grain boundary cracks, and intracrystalline cracks in quartz, topaz, feldspar and mica can characterize the microporosity network of infiltration of fluids in the non-fractured volume of granitic body (Schild et al., 2001). Preliminary study of microcracks in quartz and topaz showed that microcracks had both intragranular, and intergranular character. The length of microcracks range from 0.1 mm to 4.2 mm, the number of microcracks is about 70 MC/cm^2. The strike of microcracks is variable, but orthogonally striking N–S and E–W microcracks seem to predominate. The range of dip angle ranged mostly between 70 and 90°.

References

Breiter, K., 2002: From explosive breccia to unidirectional solidification textures: magmatic evolution of a phosphorus- and fluorine-rich granite system (Podlesí, Krušné hory Mts., Czech Republic). *Bull. Czech Geol. Surv., 77, 2, 67 – 92.*

Dobeš, P., 2005: Fluid inclusion planes and paleofluid records in the Podlesí granite, Krušné hory Mts., Czech Republic. *Bull. Geosciences, 80, 2, 149 – 154.*

Lespinasse, M., 1999: Are fluid inclusion planes useful in structural geology? *J. Struct. Geol., 21, 1 237 – 1 243.*

Maros, G., Palotas, K., Koroknai, B., & Sallay, E., 2002: Tectonic evaluation of borehole PTP-3 in the Krušné hory Mts. with ImaGeo mobile corescanner. *Bull. Czech Geol. Surv., 77, 2, 105 – 112.*

Schild, M., Siegesmund, S., Vollbrecht, A., & Mazurek, M., 2001: Characterization of granite matrix porosity and pore-space geometry by *in situ* and laboratory methods. *Geophys. J. Int., 146, 111 – 125.*

Segall, P., 1984: Rate-dependant extensional deformation resulting from crack growth in rock. *J. geophys. Res., 89, 4 185 – 4 195.*