Thermal history modelling of the western margin of the Bohemian Massif using high-resolution apatite fission-track thermochronology

Lucie Novakova1,2, Raymond Jonckheere1, Bastian Wauschkuhn2, Lothar Ratchbacher2

1 Czech Academy of Sciences, Institute of Rock Structure and Mechanics, V Holešovickách 41, 182 09 Praha
2 TU Bergakademie Freiberg, Institute of Geology, Bernhard-von-Cotta-Straße 2, 09599 Freiberg

The KTb deep borehole and the Naab are located on the western margin of the Bohemian Massif (BM), the largest exposure of Variscan basement in Central Europe (Figure 1). The KTb and the Naab area present contrasting fission-track signatures. The apatite ages of 50 to 70 Ma in the upper KTb section are interpreted as deriving from a single geological event, i.e., Late Cretaceous to Palaeogene exhumation (Wagner et al., 1994; Wauschkuhn et al., 2015). No older tracks survive and those formed later experienced no significant thermal effect on their fission-track ages. The track-length distributions are unimodal, with mean lengths of ~15-14 μm. The apatite fission-track ages of the Naab basement are older, ranging from 120 to 250 Ma (Vercoutere, 1994). The track length distributions range from unimodal, over skewed and mixed to bimodal, with mean lengths of ~11 ± 1.5 μm. The Naab apatites contain two distinct track populations. The older, predating the Late Cretaceous to Palaeogene exhumation, experienced higher temperatures than the younger, formed after exhumation, which accounts for the higher ages and shorter lengths (Figure 2). In the Naab and the KTb, however, the confined tracks are shorter than lab-based annealing models predict. Our methodological research suggests that the model predictions are inaccurate rather than the geological constraints (Jonckheere et al., 2017; Wauschkuhn et al., 2015).

Our project aims at a high-resolution re-investigation of the Naab fission-track record using advanced methods. These include (a) on irradiation to increase the number of confined tracks (Figure 3); (b) step-etching to establish the formation sequence of the tracks; (c) determining the specific zero-length for each sample by measuring induced track lengths; (d) measuring the track length to calculate their individual effective etch times; (e) measuring the confined track lengths and orientations in reflected and transmitted light. We discuss the agreement and disagreement between the modelled thermal histories and the independent geological evidence, and the factors suspected of causing a mismatch. Figures 4 and 5 illustrate confined track data obtained after an initial etch step of 10 s in 5.5 M HNO3.

REFERENCES