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

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The Naab area is situated on the western border of the Bohemian Massif, 60 km south of the KTB (Kontinentalen Tiefbohrung). The main super-deep borehole of the KTB reached a depth of 9,101 meters in the Earth's continental crust. The fission-track data for the KTB and the Naab area present contrasting signatures. The apatite fission-track ages in the upper section of the KTB borehole and surrounding area are in the range 50-70 Ma (Wagner et al., 1994; Wauschkuhn et al., 2015). The apatite fission-track ages of the Naab basement are older than those of the KTB area, and span a broader range: 120-200 Ma (Vercoutere, 1994). The distributions of the confined-track lengths range from unimodal over skewed and mixed to bimodal, with mean lengths in the range 11-13 µm. In broad terms, this can be interpreted as that the Naab samples contain both an older and younger (in particular pre- and post-late Cretaceous) fission-track population. The aim of our research is to investigate the applicability of lab-based models to geological data, using improved measurement techniques.

We studied eighteen samples dated by Vercoutere (1994) from the Palaeozoic basement and seven large rock samples from the Rotliegend strata north of the Luhe fault. We intend to extend the confined-track length measurements of Vercoutere (1994), aiming to achieve higher resolution through methodological innovations made possible by computer-controlled motorized microscopes. Improved statistics increase the resolution of the modelled thermal histories, which permits to better distinguish systematic from statistical differences between the modelled palaeotemperatures and geological estimates. Experiments have shown that the rate of length increase permits to distinguish older from younger tracks (Jonckheere et al., 2017). This allows us to distinguish between tracks formed before and after the Late Cretaceous to Palaeocene exhumation. The etch rate of a confined track is also an indicator of its individual thermal history, supplementing the information gleaned from its etchable length under fixed conditions. We compiled a comprehensive, high-resolution confined-track-length dataset. The Naab thermal histories were determined using modern modelling algorithms, implementing the most recent empirical equations.

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