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Thermochronological record of long term faulting, burial and exhumation history in the Sudetes (Bohemian Massif, Central Europe): a multi-system thermochronological approach

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Reconstructing erosional and faulting history in the old crystalline basement terrains, with lacking or sparse post-tectonic geological records, is a challenging task where even radiometric data on the basement rocks need not to provide ultimate answers. NE part of the Bohemian Massif (known as the Sudetes) represents a classic example where numerous attempts to constrain denudation, faulting and relief formation on the Variscan basement, often based on incomplete lines of evidence, led to formulation of controversial models. In this study we aim to reconstruct the post-orogenic exhumation history of the Rychlebské hory Mts. in the eastern Sudetes and constrain paleo-activity along the Sudetic Marginal Fault (SMF) - one of the morphologically most prominent, but poorly understood features of Central Europe, forming a >140 km long escarpment separating the Sudetic Mountains from the foreland in the northeast. We do so by applying zircon (U-Th)/He (ZHe), apatite fission track (AFT) and apatite (U-Th)/He (AHe) dating methods to the basement samples from different fault-bounded blocks and sparsely preserved post-orogenic sedimentary samples.
New thermochronological data reveals that in the Late Cretaceous at ∼95-80 Ma, the Carboniferous-Permian basement blocks SW and NE of the SMF were buried to ∼4-7 km and >6.5 km depths, respectively, by sediments of the Bohemian Cretaceous Basin System. This finding contradicts the traditional paleogeographic reconstructions suggesting exposure of large portions of the Sudetes for most of the Mesozoic-Cenozoic. During the burial, the SMF acted as a normal fault as documented by offset in ZHe ages across the fault. At 85-70 Ma, the basin was inverted, Cretaceous strata eroded and basement blocks were exhumed to the near-surface at exhumation rate of ∼300 m/Ma as evidenced by Late Cretaceous-Paleocene AFT ages and thermal modelling results. There is no appreciable difference in AFT and AHe ages across the fault suggesting that the SMF acted as a reverse fault during the exhumation. In the Late Eocene-Oligocene, the basement was locally heated to <∼70°C in a response to thermal activity related to opening of the Eger rift system and associated magmatism. No signal of Neogene or Quaternary thermal activity in the thermochronological data confirms that Late Cenozoic uplift and erosion of the basement blocks resulting in the present-day topography did not exceed ∼1.5 kilometres in the study area. This study highlights the importance of mutli-system thermochronological applications and the critical role of post-tectonic sediments in reconstructing histories of old crystalline basement terrain. More details can be found in Danišík et al. (2012).

References

Danišík, M., P. Štepančíková, and N. Evans (2012), Constraining long-term denudation and faulting history in intraplate regions by multi-system thermochronology - an example of the Sudetic Marginal Fault (Bohemian Massif, Central Europe), Tectonics, doi:10.1029/2011TC003012, in press.