



Constraining Exhumation and Rift Evolution in the Vosges and Black Forest Using Apatite (U-Th)/He Thermochronology

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Within Central Europe, remnants of the Variscan orogeny are found today at elevations exceeding 1000 m. Among these remnants are the Black Forest and Vosges Mountains that are separated by the N-NE-oriented Upper Rhine Graben. Subsidence of the Upper Rhine Graben began during the Eocene and was accompanied by the uplift of Variscan basement, which is now exposed in the Vosges Mountains and Black Forest at the western and eastern rift flanks, respectively. Overlying Mesozoic sediments have been extensively eroded, exposing the Variscan bedrock and confining the younger sediments to isolated, higher-elevation areas. The unloading of the lithosphere due to the erosion of 2 km of sediments amplifies the uplift due to flexural isostatic adjustment.

The Black Forest has been the focus of several low-temperature thermochronology studies, including zircon and apatite fission track analyses as well as apatite (U-Th)/He dating. In contrast, the Vosges Mountains have received significantly less attention, with no published apatite (U-Th)/He ages available. Results from previous fission track studies suggest a complex thermal history for the region, including a transient heating episode during the initial rifting phase, as well as recent hydrothermal events that have influenced the thermochronological measurements. However, the total amount of exhumation and the timing and extent of rock uplift remain so far unconstrained.

In this study, we aim to further constrain the thermal evolution of the region using more than 30 new apatite (U-Th)/He ages from two E-W profiles across the Upper Rhine Graben and its rift flanks. Samples were collected from outcrops previously dated using apatite fission tracks or, where unavailable, along new horizontal and vertical profiles. The southern profile spans the highest peaks, connecting the eastern edge of the Black Forest with the western edge of the Vosges Mountains. The second profile is located along the northern borders of the two mountain ranges.