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The „Geomorphologic Diagonal“ of Central Europe – towards a new morphotectonic interpretation of macroforms in average mountains

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Modern methods of low temperature thermochronology are able to throw light on the geomorphological development of macrorelief landforms. A rarely investigated problem concerns the orientation and morphotectonic evolution of Central European uplands (low to mid-elevation mountain ranges). A conspicuous NW-SE striking boundary takes course through Germany from the Osning and Teutoburg Forest in the NW to the Bavarian Forest in the SE. I call this line the “geomorphological diagonal”. East of this line, more or less NW-SE striking morphotectonic features (e.g., Harz Mountains, Sudety) dominate the macrorelief up to the eastern border of Central Europe (Thornquist-Teysseire Lineament), with the exception of the Ohre Rift and Central Bohemia. West of this line, the macrorelief is either characterized by NNE-SSW to N-S oriented structures (e.g., Upper Rhine Rift) and, to a lesser extent, by (S)SW-(E)NE mountain ranges (southern Rhenish Slate Mountains and Ore Mountains) or by no predominance at all. In the Lower Rhine Embayment and along the Middle Rhine River, (N)NW-(S)SE directed morphotectonic features influence the low mountain ranges.

In several cases geologists have proven that NW-SE morphotectonic structures are related to the Upper Cretaceous (Santonian to Campanian) “basin inversion” (e.g., von Eynatten et al. 2008). A compilation of low temperature thermochronological data (AFT, [U-Th]/He) from Central Europe clearly supports strong crustal cooling during the Upper Cretaceous and lowermost Tertiary in morphotectonically protruded crustal blocks east of the geomorphological diagonal, whereas west of it the age data available so far exhibit a much larger scatter from Upper Paleozoic to Tertiary without clear evidence of an outstanding Upper Cretaceous crustal cooling event.

Based on this data I hypothesize that east of the diagonal macroforms of uplifted denudation surfaces (“peneplains” or “etchplains”) may be inherited from the Cretaceous whereas west of it such landforms could persist and develop longer and were uplifted only during the Tertiary and Quaternary, more or less coeval with the development of the Central European Rift System. The Upper Cretaceous basin inversion strongly influenced the present-day macrorelief east of the geomorphologic diagonal whereas west of it the macrorelief was shaped by younger morphotectonic activities. This hypothesis will be discussed with respect to recent tectonic models on the collision history of Africa and Europe, the impingement of the thinned Central European crust, and the rotating relative drifting direction of Africa and the Adriatic plate with respect to the Eurasian plate (Kley & Voigt 2008). NW-SE structures may have been revived by Quaternary glacial isostatic processes and even by historical earthquakes.

References:

von Eynatten, H. et al., (2008), Int J Earth Sci (Geol Rundsch) 97:1315–1330

Kley, J. & Voigt, T., (2008), Geology 36:839-842