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Tracing tectonics in topography in the Bükk Mountains, NE Hungary

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Relief, as we see it today, is shaped and formed by numerous processes the dominance of which is determined by the geographical location of the area the relief belongs to. In areas, however, where solid rocks of distinct tectonic history with clearly definable deformation elements are close to the surface the structural geological character of the subsurface formations fundamentally determine the topography. Location of the most spectacular peaks, shape of the ridges between them, location and orientation of valleys and even the direction of smaller valley sections are determined by the structural features and conditions of the underlying geology.

The authors carried out structural geological analyses in an area (Bükk Mountains, NE Hungary) showing a relatively diverse geology composed of Triassic carbonates, Triassic and Jurassic siliciclastic sediments (foliated sandstone, shales) and Triassic igneous rocks (metamorphosed basalt, andesite and rhyolite). Structural elements of both brittle and ductile deformations have been identified and measured in the form of frontal thrusts, transverse (tension) joints, conjugated lithoclases, cleavage planes, fold limbs and fold axes. Based on the results, the orientation of two major stress fields acting in several phases (mostly in the Cretaceous) have been identified as responsible for the production of the major structural elements.

Observing the interesting orientation of valleys, the strange form of ridges and the appearance of peculiar landforms both in field and on topographic maps / satellite images made the authors curious to find their explanation.

As a result, the orientation of valleys was correlated to the orientation of the prevailing brittle structural elements in a model area within the Bükk Mountains. Even the smaller valley sections were correlated to the joint directions in the model area. Direction of the lines of the ridges was also correlated to the structural features of the model area. Strong correlation between the morphological and structural features was detected even in underground morphological forms as the direction of the passages of caves in the model area also matched the direction of brittle structural elements.

Furthermore, the appearance of unusual relief forms could be explained by the occurrence of special structural features produced by the specific interaction of the two dominant stress fields and the resultant superposed structural elements.

The results enable us to extend the structural analysis and re-construction established for a model area over the surrounding areas without further detailed structural analyses in case a generally similar geological setting and tectonic history can be assumed.