

DEFORMATION STRUCTURES ALONG THE NORTHEASTERN EDGE OF THE BÜKK PLATEAU AND THE BÜKKSZENTKERESZT FAULT (BÜKK MTS, HUNGARY)

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Introduction

The Bükk Mountains is a part of the North Hungarian Mountain Range but not of the Inner-Carpathian volcanic chain. It exposes Paleozoic and Mesozoic formations on the southeastern side of the Darnó-zone (a major NE-SW striking tectonic lineament transecting the range) known from no other locality on the surface. The stratigraphy comprises at least two or more successions ranging from Carboniferous to Jurassic, partly metamorphosed, bearing the marks of multiple tectonic deformations.

The structure of the Bükk Mts. is most apparently divided on the map by the arcuate northern edge of the Nagy-fennsík (Northern Plateau Edge Fault, furthermore NPEF) and the Bükkszentkereszt Fault (furthermore BSF) in its southeastern continuation, traces of very steeply dipping surfaces in general. As the true sense of movement along these faults is not ascertained yet, they play radically different roles in the structural models hitherto published. In his basic monography BALOGH (1964) considered the „Northern Anticline” as the structural core of the mountains. This anticline comprises the whole northern part of the mountains and its axis is parallel with the arcuate fault zone. According to him, the northern edge of the plateau is a zone of south-vergent overthrusts in the overturned southern limb of the anticline. The radiolarites of the Southern Bükk later proved to be of Jurassic age, so a new possibility arised: the older units should be nappes over a Jurassic basement, and the zone is the boundary between two nappe units with different grade of metamorphism (BALOGH & *al.* 1984). In other theories the western part of the NPEF is arched to the Darnó-zone and this arch is a product of sinistral strike-slip faulting of some ten kilometers (ZELENKA & *al.* 1983). CSONTOS (1999) has also mentioned the NPEF as one of the most apparent discontinuities. In his theory it is a north-vergent, steeply dipping overthrust with a displacement over 1 km, formed in the Paleogene. He described the BSF as a dextral strike-slip fault linked also to this overthrust, with a displacement of about 3 km. PELIKÁN (*oral comm.* 2001)

proposed a stratigraphical model with two different successions divided along this zone. So according to him, this lineament ought to be a zone of significant displacement.

This displacement, may it be directed to any point of the compass, must have left its markers in the rocks along its shear zone. The aims of the current investigations were to find the exposure-scale and map-scale structures of this deformation phase, separate them by style and position from other deformation markers, determine their relative ages and give the most probable sense of movement. The results are based on field observations with direction measurements on several outcrops along the zone of the major faults presented on the site map.

Discussion

The displacement took place mainly in a belt of incompetent strata acting as a décollement horizon between two massive limestone units and when in standing rocks, the planes are often accompanied by brecciation, crushed and weakened zones. In consequence, the main planes are generally not exposed and we have to rely on the features of the zone affected by the movement, which can be rather wide, 1 km or even more. Alternating successions of laminated limestones and shales, marls or argillitized metavolcanites with significant competence contrast give the best exposures with traceable boundaries on the geological map. Although massive limestones form a lot of outcrops on the slopes, they seldom contain any sedimentary or deformation marker beyond cleavage to be interpreted.

The field observations at some well exposed localities on the eastern section of the NPEF and on the BSF zones suggested a sinistral strike-slip fault model with attached folding and fracturing corresponding to the patterns of simple shear. Along the Garadna valley, on the northeastern edge of the Nagy-fennsík a steeply dipping sinistral fault inclined at a low angle to the zone transects the east-west striking succession and culminates in a stack structure of SW-vergent overthrusts. This fault corresponds to a R-plane in the Riedel shear system, and traces of R' planes can also be found across the valley. This fault alone is a displacement of 1.5 km range. At Lillafüred the strike of the NPEF zone turns to SE and it becomes an E-vergent oblique overthrust on a SW-dipping plane (it is the northwestern end of the BSF). The orientation and folding of the earlier axial plane cleavage on the SW side, chevron folds of this phase with duplex structures and sometimes striae on the cleavage planes mark clearly the eastward movement. The NE side also shows structures of E-W shortening. On the southeastern end of the BSF zone the fault planes are nearly vertical, separating two massive limestone units with narrow belts of poorly exposed laminated cherty limestone, radiolarite and shale. While the NE side keeps the general E-W strike of the early axial plane cleavage, on the SW side there is again a dip subparallel with the fault. Arrays of brecciated

movement planes close to the main fault planes but with a strike perpendicular to it suggest a lateral sense of the displacement.

The characteristic fold types are of class 1B (parallel), mainly small-scale chevron folds and kink bands in laminated limestone, dolomite, metavolcanite and shale, while in massive limestone the deformation was brittle with brecciated movement planes. The structures of this phase overprint in some sites earlier ptygmatic and class 2 (similar) folds observable mainly in cherty limestone, folding the axial plane cleavage or causing boudinage. So formation of this movement zone was a post-metamorphic event (not older than upper Cretaceous) and according to others, it ought to be linked with the movements along the Darnó-zone (CSONTOS 1999) with similar tectonic style (ZELENKA & *al.* 1983). Its age cannot be younger than Miocene as on its southeastern end the lineament is covered by the unaffected Sarmatian upper rhyolite tuff. The younger faults inside the mountains (south-vergent overthrusts of the Garadna valley probably linked to the Kisfennsík nappe and NE-SW striking sinistral faults concentrated between Bánkút and Ómassa) also overprint the structures of this phase. Although these younger deformations were mainly brittle, these phases also could form chevron style folds in laminated rocks and they should be also earlier than the start of the Miocene sedimentation.

Conclusion

According to the markers attributed to this deformation phase, the movement along the NPEF was a sinistral strike-slip faulting combined with an oblique overthrust at the NW section of the BSF. It corresponds to a model of E-vergent movement of the Nagy-fennsík unit relative to the Northern Anticline unit considered as autochthonous. The displacement took place in the Paleogene under physical conditions after the ending of metamorphism, followed by brittle deformation phases characterised by different movement and shortening directions.

References

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