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Extension tectonics of the south-eastern margin of the Tribeč Mts.

JOZEF HÓK[1], JÁN IVANIČKA[1]

[1]Geological Survey of Slovak Republic, Mlynská dolina 1, 817 04 Bratislava

Abstract. The analysis of semi-brittle structures provided data for the recognition of two deformation stages: 1. Early Miocene brittle-ductile gravity gliding, related to the uplift of the crystalline core of the Tribeč Mts., and 2. Late Miocene normal brittle faulting controlling the deposition of the Komjatice depression filling.

Key words: Western Carpathians, Tribeč Mts., Miocene gravity tectonics, Komjatice depression

Introduction

The Tribeč Mts. forms a horst of NE-SW direction, divided cross-wise into the Zobor and Rázdiel parts. The southern Zobor part is formed of granitoid rocks and an imbricated Mesozoic envelope sequence. The geological structure of the Rázdiel part included granitoids, pre-Permian metamorphic rocks and a stratigraphically reduced envelope sequence with a markedly represented Permian basal formation, the Krížna and Choč Nappes (Fig. 1). The basic conception of the Tribeč Mts. geological structure has been shown in the geological map on the scale 1 : 50 000 (BIELY, 1974). The so far carried out geological investigations in the Tribeč Mts. were aimed mostly at the Rázdiel area, e.g. Kamenický (in Maheľ et al. 1967), KRIST (1971), IVANIČKA and HÓK (1992), IVANIČKA et al. (1992) and KRIST et al. (1992), HÓK et al. (1994).

The envelope sequence in the Zobor part is on the majority of the area represented only by quartzites of the Lower Triassic, which were in the past the subject of sedimentological investigation (HÓK, 1989). An exception are the occurrences of upper carbonate Mesozoic members north of Nitra and sporadic occurrences, e.g. in the are of Kostoľany pod Tribečom, Lefantovce, or Krnča. The envelope Mesozoic surrounds the granitoid core and the quartzites are modelling the characteristic positive relief, with rock walls situated on the side of the crystalline core.

During the basic geological mapping we could identify brittle-ductile deformation of the envelope Mesozoic, located in the surroundings of Kostoľany pod Tribečom.

Geological setting of the studied area and methods of investigation

The area of Kostoľany pod Tribečom is build of granitoid rocks of granodiorite to quartz diorite type. The base of the Mesozoic is formed of quartzites or quartz sandstones of the Lower Triassic. The granodiorites are at the boundary with quartzites affected by mylonitization. The foliation planes of mylonites are conform with the bedding of the Mesozoic rocks. Above the quartzites there are rudimentarily developed Lower Triassic chlorite-sericite sandy shales and Middle Triassic carbonates. South-west of Kostoľany pod Tribečom, above Middle Triassic limestones and dolomites, there are sporadically preserved Upper Triassic quartz sandstones and Liasic sand limestones.

On the bedding planes of the quartzites there is very well preserved slickensides, which has however not been observed in carbonate sequences. In both sequences we could sporadically observe mezoscopic folds of decimetre to meter dimensions. The fold axes are of NE-SW direction, they are open to isoclinal, with fold planes dropping to the north-west, or vertical.

The development of the Tribeč horst is related to the sedimentation of Neogene rocks and the development of the Komjatice depression, the sediments of which are lying along the margin of the mountain range. The sedimentation started in the Middle Badenian by marine transgression and lasted to the Pliocene, while the sedimentation environment was gradually becoming less saline already from the Lower Sarmatian (PRIECHODSKÁ, HARČÁR, 1988).

During the field investigations we concentrated on collecting available structural data, above all slickensides, joints and fold axes. Subsequently we evaluated the obtained data using usual methods of structural analysis (c.f. e.g. ANGELIER, 1994) and we processed the data in the form of diagrams (Fig. 2).

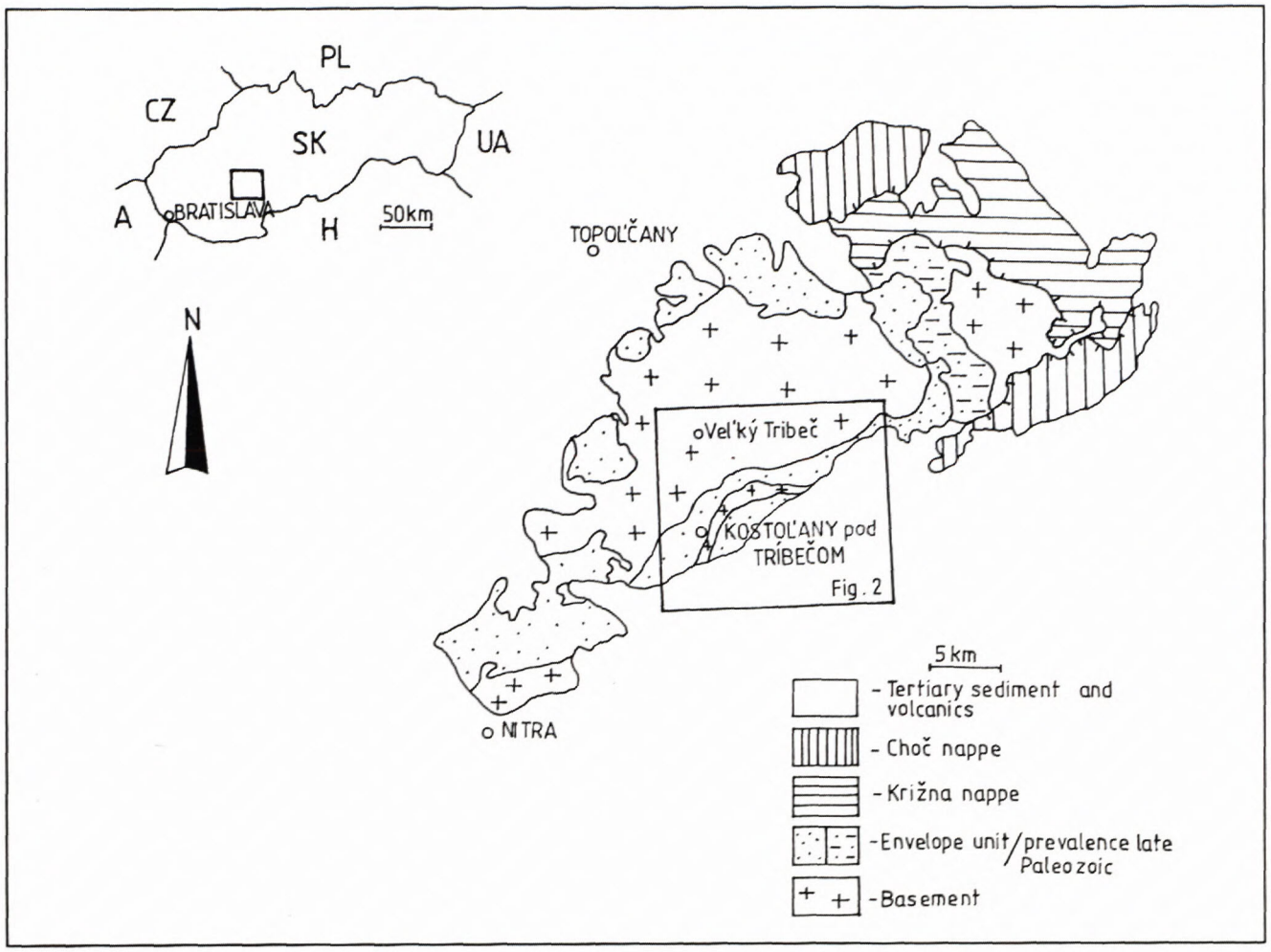

Fig. 1 Simplified geological map of the Tribeč Mts. (after HÓK and IVANIČKA, 1995) with the position of the studied area.

Interpretation of the results

The direction of slickensides striation on the bedding planes of Lower Triassic quartzites defines the direction of extension generally as south-east to south (Fig. 2). The displacement occurred on the bedding planes representing the primary inhomogeneity, which are conform to the foliation and the direction of transport in mylonites of granitoid rocks. The joints are younger than the slickensides and they form a sharply inclined, rectangular system generated in an extensional regime (HANCOCK, 1985, DUNNE-HANCOCK, 1994). The direction of the greatest extension is oriented generally consistently with the extension direction obtained by the analysis of slickensides.

Folds and slickensides formed in brittle-ductile conditions of deformation and we assume that they are related to the initial stages of the uplift of the mountain range which is, according to apatite FT age data (KOVÁČ et al., 1994), estimated at 28±1 Ma, i.e. the Early Miocene. In this time there were by this elevation generated low-angle normal listric faults along which the rocks gravitationally glided, while the bedding planes in the Mesozoic complexes served as primary inhomogeneity. The gravitational gliding caused folding of the whole complex into high-amplitude folds (Fig. 3). The folds formed in favourable conditions, e.g. at the contact of rocks with different rheologies (granitoids/quartzites, or quartzites/limestones) also on the meso-scale.

The brittle deformation stage is represented by joints conform in their direction with the system of Mojmírovce faults separating the mountain range from the Neogene filling of the Komjatice depression. The Komjatice depression reached the maximum of subsidence in the Pannonian. Investigation using boreholes (BIELA, 1978) confirmed that the sedimentation related to the Tribeč Mts. was controlled by the Mojmírovce fault system of NE-SW direction. We assume that the brittle deformation stage took place in the Late Miocene and that it is

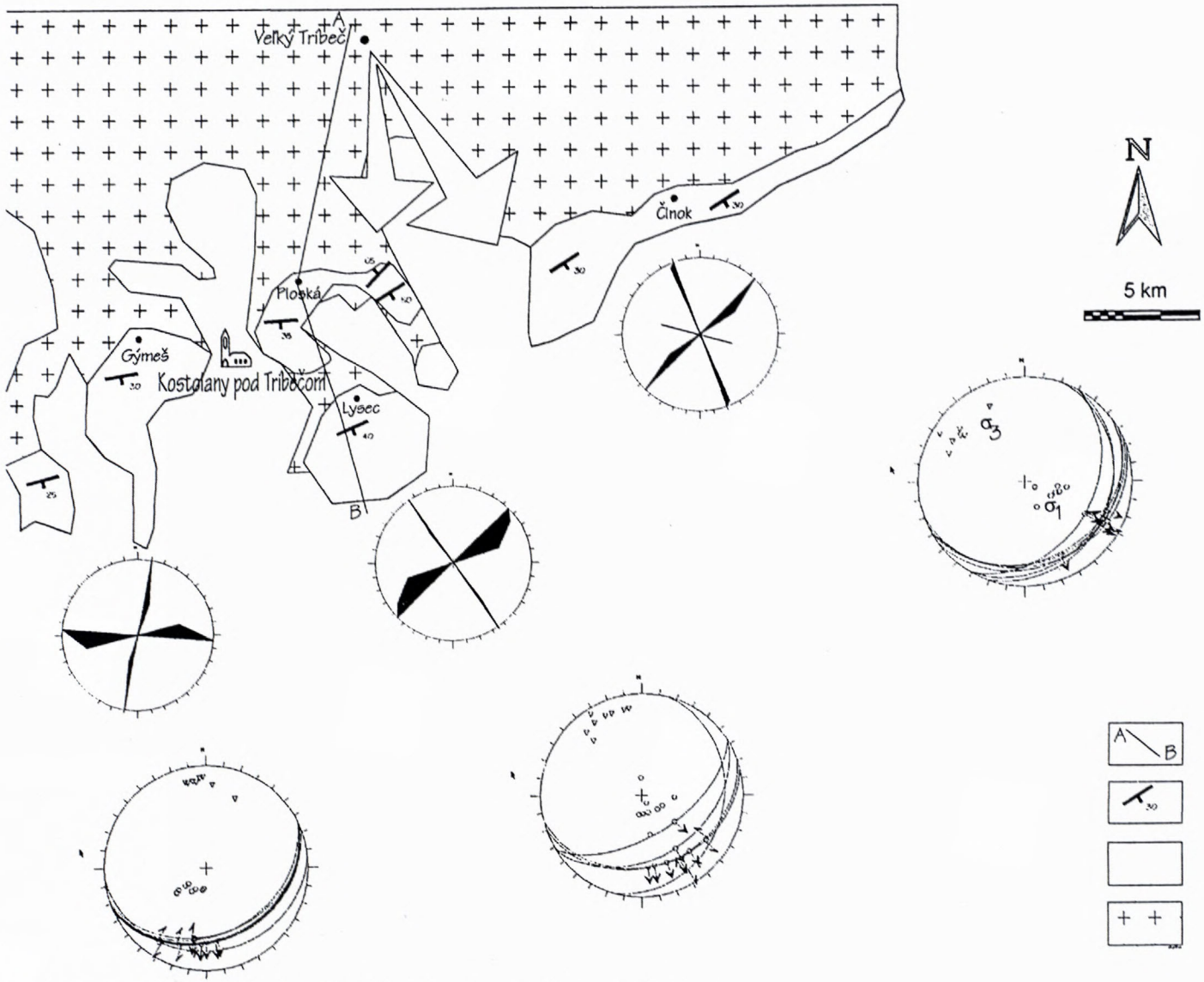

Fig.2 Simplified geological map of the SE part of the Tribeč Mts. (BIELY, 1974 - modified).
The diagrams of the Lambert lower hemisphere projection shows sets of joints directions (n = number of measurements) and projection of fault planes represented by great circles, the sense of displacement is indicated by black arows. Principal stress axis σ_1 - compression and σ_3 - extension are marked by small circles a triangles.
Explanations : geological cross-section A - B, average dip direction of bedding, granitoids.

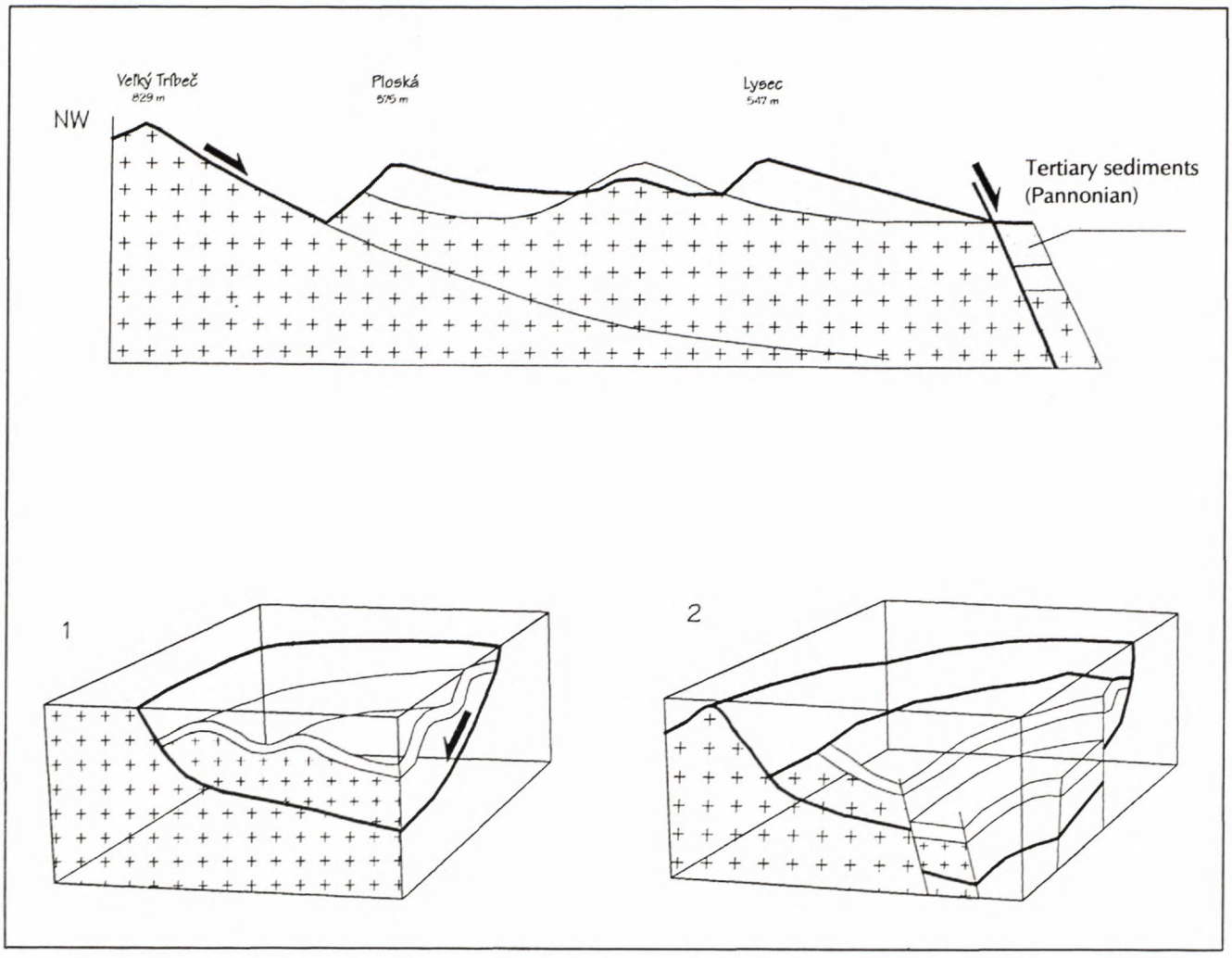

Fig. 3 Geological cross- section A - B (not to scale). Explanations see Fig. 2, with exception of the Tertiary sediments (Pannonian) on SE side of the section. The model of tectonic evolution 1) brittle - ductile extension (Oligocene - Miocene). 2) brittle extension (Pannonian).

related to the development of the Komjatice depression.

Conclusions

At the south-western margin of the Tribeč Mts., in the area of Kostoľany pod Tribečom, the deformation of the envelope sequence rocks of the Tribeč Mts. has been investigated. Two extension phases of NW-SE direction have been distinguished, related to the uplift of the granitoid core. The older phase has been dated as Middle Miocene. It is characterised by brittle-ductile structures which formed in the process of elevation of the mountain range and the formation of normal-slip listric faults. The brittle deformation phase took place in the Late Miocene and it affected the sedimentation in the north-eastern part of the Komjatice depression.

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