SEDIMENTOLOGY AND TECTONICS OF THE PLIO-QUATERNARY SEDIMENTARY SEQUENCES OF SOUTHERN PART OF THE POVAŽSKÝ INOVEC MTS.

Ľ. SLIVA[1], R. VOJTKO[1], P. JONIAK[1], M. KOVÁČ[1] and I. BARÁTH[2]

[1]*Department of Geology and Paleontology, Comenius University, Faculty of Natural Sciences, Mlynská dolina G, 842 15 Bratislava, Slovak Republic*

[2]*State Dionýz Štúr's Geological Institute, Mlynská dolina 1, SK-817 04 Bratislava, Slovak Republic*

Abstract: The Považský Inovec Mts. is one of the latest uplifted core mountains of Tatric zone of the Western Carpathians. The Plio-Pleistocene sedimentary cover documents several stage of geodynamical evolution in this area. The Pliocene-Quaternary paleostress field documents a significant change from NE-SW oriented compression (NW-SE extension) to NE-SW extension. In the area we also calculated rate of motion on the faults by slip-rate analysis.

Key words: neotectonics, slip-rate analysis, Western Carpathians, Plio-Pleistocene sediments.

Introduction

The Považský Inovec Mts. is situated in the western part of the Central Western Carpathians and it is one of the external core mountains of the Tatric orogenic belt. The mountains are boundered by the Jastrabie fault off the Strážovské vrchy Mts. on the north and its southern part is surrounded by the Blatné depression on the west and Rišňovce depression on the south-east belonging to the Neogene Danube basin. The geological structure is formed by the Tatric basement (Paleozoic) and its cover sequences (Late Paleozoic to Mesozoic), which is overthrust by the superposed Paleoalpine thin-skinned nappe units. The lower one is the Krížna Nappe (Mesozoic) and the upper one is the Choč Nappe (Mesozoic). These Paleoalpine structures are covered by the Paleogene to Plio-Pleistocene sedimentary sequences. The aim of this paper is to present very young (Pliocene to Quaternary period) geological and tectonic evolution of this area.

Sedimentology and paleontology

The Pliocene and Quaternary sedimentary sequences on slopes of the Považský Inovec Mts. and the adjacent Blatné and Rišňovce depressions represent fluvial, alluvial fan and aeolian deposits.

The Dacian/Romanian boundary is represented by sediments of the Piešťany and Koplotovce Members (Buday, 1962). From sedimentological point of view, they are represented by the braided river deposits of the Paleo-Váh River and its tributaries.

In these deposits, sedimentary facies of channel lags, channel bars and point bars were described. Channel lag deposits consist of clast-supported, medium- to coarse-grained, conglomerate, which form beds 10 to 30 cm thick. The channel bars deposits are formed by structureless or horizontal and planar cross-stratified conglomerates and sandstones. Conglomerates are medium- to fine-grained and matrix up to clast-supported. Sandstones are mainly coarse-grained. The point bar deposits are rare, forming only thin beds with low angle epsilon cross-stratification. Paleotransport was oriented generally from NE to SW and from E to W (Paleo-Váh River tributaries).

During Romanian sediments of the Syslie vŕšky Members were deposited (Kováč et al., 2001), which represent alluvial deposits of the Paleo-Nitra River and its tributaries. Toward the Blatné depression they are gradually passing into the Cífer Member. They are typical example of meandering rivers deposits with different degree of river sinusoidy.

In these deposits, sedimentary facies of channel lags and bars, point bars, natural levees and flood plains were recognized. The channel lag and channel bar deposits are relatively rare; they are typical for low sinusoidy parts of rivers. The channel lags are formed by medium- to coarse-grained, clast-supported gravels. The gravels are structureless or imbricated; claystone clasts originated from eroded floodplain deposits are often concentrated on the bed bottoms. The channel bar gravels are matrix-supported and medium-grained with developed planar and trough-cross stratification. The point bar deposits are typical sedimentary feature of the Syslie vŕšky Mb. and they are formed by coarse- to fine-grained, light coloured sands. In the outcrops there are observable deposits of point bars in the lower parts, which are represented by coarse- to medium-grained sand with large-scale planar and trough-cross stratification. In the upper parts of the point bars there are typical

medium- to fine-grained sands with small-scale planar cross and ripple stratification. Levee deposits are very rare and are formed by horizontally laminated very fine-grained sands and silts. Flood plain deposits are fine-grained, composed of clays and silty clays, often pedogenized. Paleocurrent analysis documents transport from NNE and NE toward SSW and SW, across area of “future” southern part of the Považský Inovec Mts.

The Early Pleistocene sedimentation reflects varying tectonic and climatic condition. On slopes of the Považský Inovec Mts. and Rišňovce depression the Lukáčovce Members (red beds) were deposited (Maglay et al., 1997). They are represented by small braided rivers and streams deposits with channel lags, channel bars and flood plains sedimentary facies. Channel lag and channel bar deposits are dominated, lag deposits are formed by clast-supported coarse- to medium-gravels. Channel bar deposits are formed by structureless and planar cross-bedded gravel and sand. Flood plain deposits are very rare, they are preserved as layers of silty clay or as claystone intraclasts in gravels. Paleotransport direction was oriented from the Považský Inovec Mts. uplifted during the Pleistocene.

During the Middle and Late Pleistocene river network similar to present day were created. On western slopes of the Považský Inovec Mts. were deposited sediments of small alluvial fans and area has been covered by eolian loesses. In humid periods were formed paleosoils horizonts.

Biostratigraphy of the Upper Miocene, Pliocene and Quaternary terrestrial sediments is based mainly on mammals in studied area. The actual founds of fossil remains are very pure in studied region and adjacent areas, but some localities as e.g. Ivanovce near Trenčín, Koliňany, Žirany, Strekov were studied yet (Fejfar 1990, Fejfar and Heinrich 1985, Fejfar and Horáček, 1990, Holec, 1996). Some new localities with preserved fossil mammal fauna are elaborated just now (Ceroviny, Nová Vieska, Borský Svätý Jur). Also some old localities are revised (Ivanovce). The results of paleontological research on the field of fossil mammals on mentioned localities are included in Tab. 1.

The localities Ivanovce near Trenčín, Žirany and Kolíňany are represented by system of karstic fissure fillings in the Triassic limestones. The infill of karstic fissures or caves is typical red, reddish brown or brown clays, often with karstic breccias. The age of infill is different on each locality. On the locality Ivanovce, there are two groups of fillings (older horizontal, younger vertical) both with the Late

Ruscinian assemblages of large and small mammals. The age of locality is MN 15a (Fejfar and Heinrich, 1985). The Kolíňany outcrop is karstic site with the Latest Pliocene (Villanyian) small mammalian assemblages of MN 17 zone. On the locality Žirany are preserved the Late Biharian mammal assemblages.

The remains of large mammals from localities Nová Vieska, Strekov, Veľké Bielice and Cerovíny were found in fluvial sediments of meandering river. The age of sediments is the Late Pliocene, MN 16b and MN 17 (Holec, 1996; Brestenská, 1961).

Neotectonics

We present results of the neotectonic research in the paper, which are selected into two aim. The first one forms results of the structural paleostress analysis and second one forms results of slip-rate analysis on the main faults segmenting the area.

We collected and analysed structural data of the observed fault planes from the several localities (Veľké Ripňany, Dolné Trhovište, Lukáčovce, Ducové). The structural measurements were very complex in the field because tectonic slickenside quality on the fault planes were worse. Kinematics of many faults were identified on account of their shape and structure. These data sets were recalculated and used at the paleostress analysis (Angelier's inverse method), which enabled us to separate two individual fault groups (Fig. 1). During the Pliocene to Middle Pleistocene was studied area under the older deformational stage characterizing generally by the NE-SW compression and perpendicular NW-SE tension. After the Middle Pleistocene was paleostress field totally reorganized and principal maximum stress axes rotated counter clockwise on ca 70° which is documented on the localities with the Pliocene to Quarternary sedimentary sequences (Joniak et al., 2001).

The second part of the structural research was oriented at the degree of tectonic activity of the main fault zones (Hlohovec, Malé Karpaty, Čachtice, Kátlov, Madunice-Kostolany, Dudváh-Trakovice, Považský Inovec faults) during the Pliocene to Quaternary period. Using slip-rate analysis we quantified rate of motion on the faults which neotectonic activity formed geomorphology, drainage network and sedimentation of the area. Generally, the average rate of motion on the main fault zone was computed as 0,01-0,1 mm per year, but fault activity was different during the Pliocene-Quaternary (Kováč et al., 2001).

Geodynamical model and conclusions

In the Danube basin the Pontian sedimentation continued during the Pliocene (7.1-2.4 Ma) with gradual change from lacustrine to the alluvial deposition at the Dacian/Romanian boundary (3.6 Ma; Piešťany and Koplotovce Mb.). The tectonic inversion was associated with red beds deposition in this time and following basin subsidence was controlled by NW–SE extension (3.6-2.4 Ma; Ivanovce, Hlohovec).

During the Late Pliocene and Early Pleistocene alluvial environment dominated (2.4-1.8 Ma; Syslie vŕšky Mb.). Still lasting subsidence of the area was controlled with changed paleostress field of the NE-SW oriented extension. The tectonic inversion at the end of this time is also associated with red beds deposition (Lukáčovce Mb.).

The Late Pleistocene evolution was influenced by climatic changes; river terraces and loessial formations were deposited (0.6-0.01 Ma). Tectonic inversion was followed by modification of paleogeography: Danube river crossed the Devín gate, northern margin of the Danube basin was elevated, slow subsidence continued only in the Gabčíkovo depression.

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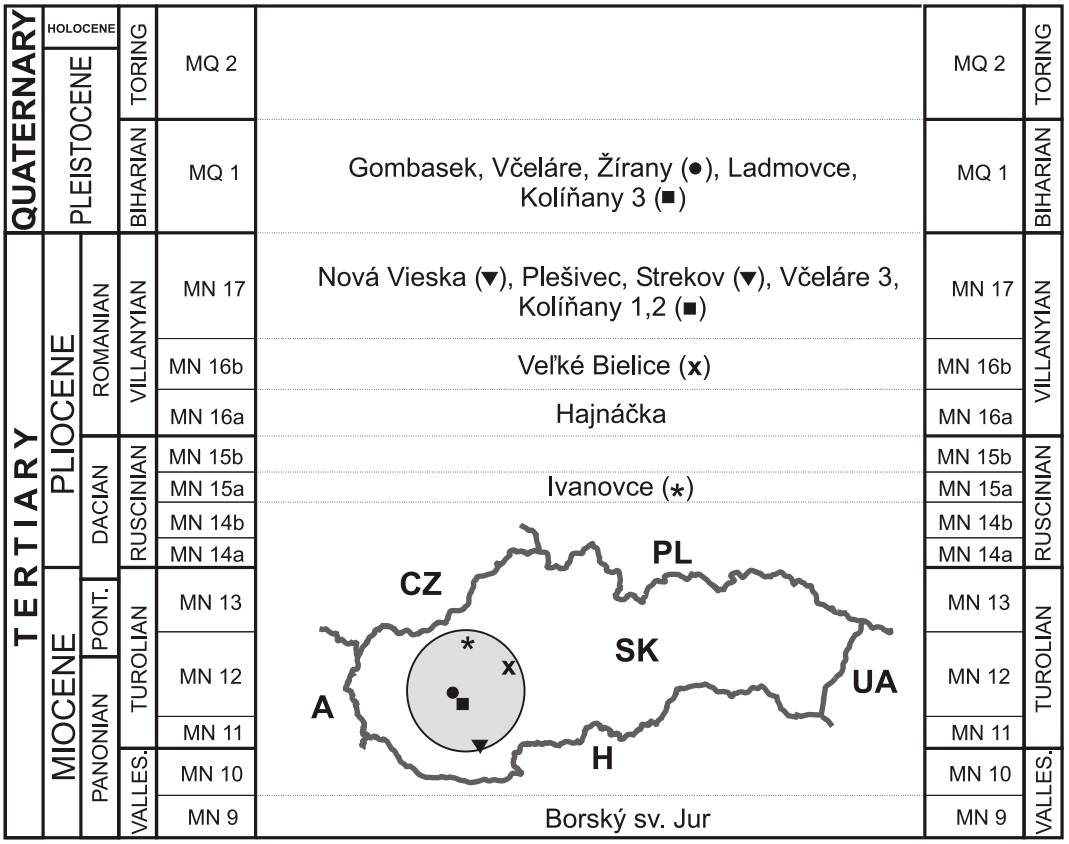
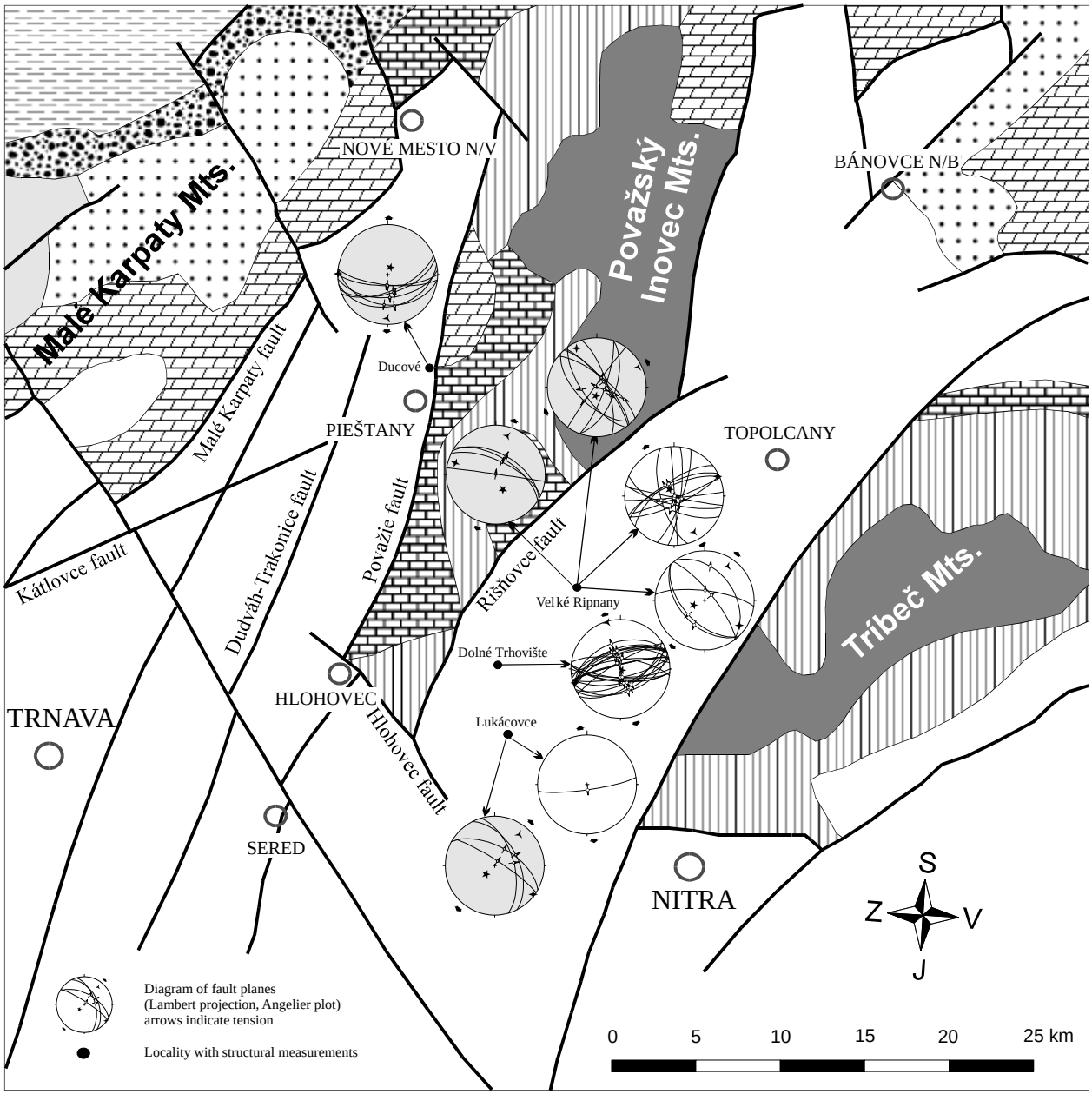
Tab. 1 Biostratigraphy of the Upper Miocene, Pliocene and Pleistocene based on the fossil mammals. Localities in studied area are marked in the grey circle.

Fig. 1 Tectonic sketch of the Považský Inovec Mts. and adjacent area. Paleostress field was computed by the Angelier's method. Older tectonic regime is shown at the white diagrams and younger one is shown at the grey diagrams. 1) Tatric crystalline; 2) Tatric cover sequences; 3) Fatric Unit; 4) Hronic Unit; 5) Pieniny Klippeen Belt; 6) Flysch Belt; 7) Upper Cretaceous and Paleogene sediments; 8) Neogene sediments.


QUATERNARY
HOLOCENE
PLEISTOCENE
TERTIARY
PLIOCENE
MIOCENE
ROMANIAN
DACIAN
PONT.
PANONIAN
TORING
BIHARIAN
VILLANYIAN
RUSCINIAN
TUROLIAN
VALLES.
MQ 2
MQ 1
MN 17
MN 16b
MN 16a
MN 15b
MN 15a
MN 14b
MN 14a
MN 13
MN 12
MN 11
MN 10
MN 9
Gombasek, Včeláre, Žírany (●), Ladmovce, Kolíňany 3 (■)
Nová Vieska (▼), Plešivec, Strekov (▼), Včeláre 3, Kolíňany 1,2 (■)
Veľké Bielice (x)
Hajnáčka
Ivanovce (⁎)
Borský sv. Jur
CZ
PL
SK
UA
A
H


Malé Karpaty Mts.
Považský Inovec Mts.
Tríbeč Mts.
NOVÉ MESTO N/V
BÁNOVCE N/B
PIEŠTANY
TOPOLCANY
TRNAVA
HLOHOVEC
SERED
NITRA
Malé Karpaty fault
Dudváh-Trakonice fault
Kátlovce fault
Považie fault
Hlohovec fault
Rišňovce fault
Ducové
Veľké Ripnany
Dolné Trhovište
Lukácovce
S
Z
V
J
0 5 10 15 20 25 km
Diagram of fault planes
(Lambert projection, Angelier plot)
arrows indicate tension
Locality with structural measurements

1 2 3 4 5 6 7 8