The correlation between vertical displacements and earthquake swarms was examined with the conclusion that the movements have special homogeneous pattern during swarm periods, contrary to inter-periods. A division line of different displacements (a fault zone?) for the swarms of 1994 and 1997 was determined. This line is subparallel to the epicentral axis of the main seismoactive zone in Western Bohemia (Nový Kostel–Kraslice). A long-term detailed study could contribute to the determination of local tectonic setting and define the character of vertical movements in relation to seismic activity.

Some indications can be also derived from levelling measurements on national networks in adjacent regions (Vyskočil 1986). Unfortunately, the frequency of these campaigns is very low and irregular. Some levelling sections have been measured only two or three times till now.

## References

MRLINA J., 2000. Vertical displacements in the Nový Kostel seismoactive area. *Studia geoph. et geod.*, 44 (in print).

VYSKOČIL P., 1986. The probable symptoms of earthquake swarm occurrence by analysis of repeated geodetic measurements. *Computer processing of data from Czechoslovak seismic network*, SAV, Bratislava, 296-306. (in Czech).

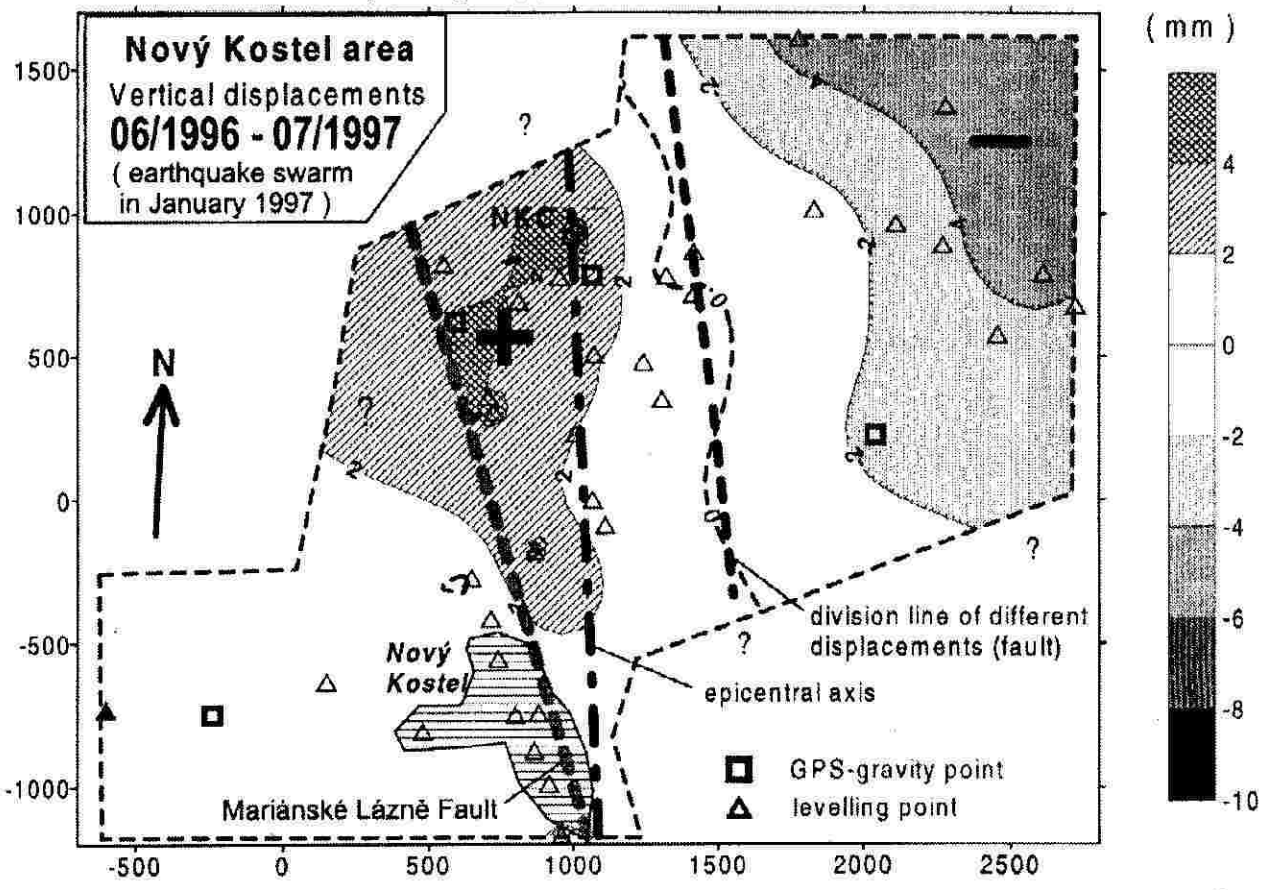


**Fig. 1.** Position of levelling points in the Nový Kostel network. The difference in height from June 1996 to July 1997 indicate relative vertical movements between the two blocks, which are separated by a line (fault) parallel to the axis of the main seismoactive zone. The earthquake swarm occurred in January 1997. NKC = Nový Kostel seismological station.

# Sarmatian Volcaniclastic Supply Dominated Sea-Shore Variations (Danube Basin, Slovakia)

*Alexander NAGY[1] and Ivan BARÁTH[2]*

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

[2] *Geological Institute, Slovak Academy of Sciences, Dúbravská 9, 842 26 Bratislava, Slovak Republic*

The study area is situated at the eastern margin of the Danube Basin at the transition of the Komjatice and Želiezovce depressions.

The outcrop-based sedimentological study of the Sarmatian (Middle Miocene) seashore deposits allowed to reconstruct relative sea-level changes, strongly influenced by volcaniclastic supply. As a result of the eustatic sea-level changes, the Badenian/Sarmatian boundary is widely transgressive.

The Sarmatian volcanic activity at the basin margin caused an enormous volcaniclastic supply, as well as periodical earth-

quake-forced instability of both the subaerial and subaqueous slopes. This sediment supply is reflected by normal regressive trends within the Lower Sarmatian sedimentary record.

During the Early Sarmatian, tectonic impulses triggered the mobilization of coarse sandy gravity flows in the frontal part of the shoreface in the southern part of the study area. Mass flows eroded the silty–clayey basinal sediments, thus forming sand-dominated breccias rich in mud clasts, interfingering with the marly–sandy laminated basinal facies. Frequent medium-scale water-escape flame structures can be found at the basal contacts of gravity flows with the basinal facies. Some soft sediment deformations, found in the gravity-flow related bodies originated due to frictional freezing of mass flows. The topographic instability is documented by slump folds. In more flatly lying deposits, seismic activity resulted in the formation of complicated liquefaction disturbances.

The northern part of the study area is characterized by very dynamic sedimentation of sandy and gravelly fan-deltaic system. The principal transport direction was measured from east and southeast, depending on the geometries of particular fans.

However, in areas with decreased terrigenous sediment supply, normal eustatic transgressive trend is visible. Here, the sedimentary record comprisses a deepening-upward setting of temperate-water carbonates, represented by bryozoan–algal–serpulid biostromes, upwards passing into offshore clays.

With respect to the above mentioned effects, the paleogeography of the study area shows prograding shorelines at active volcanic slopes and backstepping shorelines between volcanic centres.

# Correlation of Karpatian Deposits in the Southern Part of the Carpathian Foredeep

*Slavomír NEHYBA[1], Pavla PETROVÁ[2] and Jan ŠIKULA[2]*

[1] *Department of Geology and Paleontology, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic*

[2] *Czech Geological Survey, Leitnerova 22, 658 69 Brno, Czech Republic*

Karpatian period played an important role for the basinal, tectonic and facies evolution of the Outer Western Carpathians. The Carpathian Foredeep (CF) represents a peripheral foreland basin. During the Karpatian, the areal extent of the CF widely stretched along the flysch accretionary wedge from the today´s southern Moravia to Poland (Cicha et al. 1989). The Karpatian deposits are characterised also by considerable thickness. At the eastern margin of the CF (close to flysch nappes) their thickness reached 1,200 m (Čtyroký 1991); therefore, a high sedimentation rate is estimated (Vass et al. 1988). Completely different opinions exist about detailed Karpathian stratigraphy and paleogeography (Jiříček 1995; Cicha 1995, etc.) of Neogene basins on the periphery of Western Carpathians (CF, Vienna Basin). The most complicated situation exists in the southern part of the CF.

The proposed preliminary correlation of Karpatian deposits in the southern part of the CF is based on subsurface data (cores from drill holes, wireline logs, seismic reflection profiles) because of the absence of suitable outcrops.

An unconformity evidently traceable in the Karpatian deposits on seismic reflection profiles in the central part of the basin was formerly interpreted as a result of Upper Karpatian marine transgression (Jiříček 1995); as a result, a completely different evolution of the western and eastern part of the CF basin has been proposed. A revised interpretation of this unconformity as a reflection of a westerly-dipping detachment horizon is proposed in agreement with Tomek (1999). The central part of the Karpatian and Lower Badenian fill of the CF was thrust over the inner part of the basin towards E (thin-skinned thrusting). Inversion of the foredeep is younger than the Lower Badenian and is the evidence with compressional regime.

Erosion and compressional deformation contributed significantly to the relatively narrow shape of the CF. The original, much wider areal extent of the Karpatian and Lower Badenian deposits in the CF is evident. Large volumes of Karpatian and Lower Badenian, especially marginal deposits were eroded. The strong dominance of "basinal" lithofacies (Karpatian schlier, Lower Badenian tegel) also results from this erosion.

Karpatian deposits in the southern part of the CF were deposited in a single basin. Their complicated lithology reflects structural resemblance of the basin during this period. Karpatian fill of the CF can be generally subdivided into several segments traceable across the basin. Multiple evidence of sharp-based sandstones reflecting shoreline deposition in the outer (more distal) part of the basin (Nehyba and Petrová in print) may be also important for industrial exploration. Formation of the accommodation space, stratal geometry and facies distribution within the CF were predominantly governed by tectonic processes within the accretionary wedge. Important role was also played by sea-level changes and sediment supply.

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## References

CICHA I., KOVÁČ M., OSZCZYPKO A., ŚLĄCZKA A., STRÁNÍK Z. and VASS D., 1989. Geodynamic evolution of Western Carpathians in the Neogene. *Miscellanea micropalaentologica,* IV: 9-17. (in Czech).

CICHA I., 1995. Development of Neogene sediments in the Central Paratethys, new results. *Knihovnička ZPN*, 16: 67-71. (in Czech).

JIŘÍČEK R., 1995. Stratigraphy and geology of the Lower Miocene sediments of the Carpathian Foredeep in South Moravia and adjacent part of Lower Austria. *Knihovnička ZPN*, 16: 37-65. (in Czech).

ČTYROKÝ P., 1991. Division and correlation of the Eggenburgian and Ottnangian in the S of Carpathian Foredeep in southern Moravia. *Západ. Karpaty, Sér. Geol.*, 15: 67-109.

NEHYBA S. and PETROVÁ P. Karpatian sandy deposits in