slip faulting in combination with extension and basin subsidence (transtension).

References

BADA G., 1999. Cenozoic stress field evolution in the Pannonian basin and surrounding orogens. Inferences from kinematic indicators and finite element stress modelling. PhD thesis, Vrije Universiteit, Amsterdam, 204 p.

FODOR L., CSONTOS L., BADA G., BENKOVICS L. and GYÖRFI I., 1999. Tertiary tectonic evolution of the Carpatho-Pannonian region: a new synthesis of paleostress data. In: DURAND B., JOLIVET L., HORVÁTH F. and SÉRANNE M. (Editors), The Mediterranean basins: Tertiary extension within the Alpine orogen. *Geol. Soc. London Spec. Publ.*, 156: 295-334.

HORVÁTH F. and RUMPLER J., 1984. The Pannonian basement: extension and subsidence of an alpine orogene. *Acta Geologica Hungarica*, 27 (3-4): 229-235.

TARI G., BÁLDI T. and BÁLDI-BEKE M., 1993. Paleogene retroarc flexural basin beneath the Neogene Pannonian Basin: a geodynamic model. *Tectonophysics*, 226: 433-455.

TARI G., 1994. Alpine Tectonics of the Pannonian Basin. PhD thesis, Rice University, Houston, Texas, 501 p.

Geodynamic Interpretation of Anomalies in the Orientation of the Upper Segment of the Nysa Kłodzka River

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Formation of the river pattern of the Sudetes in the current form started in the late Pliocene. This process was connected to a distinct diversification of the Sudetic area into a mountainous part (the Sudetes) and foreland (Fore-Sudetic Block). The boundary between these two areas is defined by the Marginal Sudetic Fault (MSF), which is an important regional morphotectonic structure (Mastalerz and Wojewoda, 1993). A continuous development of the river pattern was connected to the regional drainage toward the N and the NW and later temporarily was modified by the progression of the Scandinavian ice sheets during the Pleistocene (August and others, 1995; Wojewoda and others, 1995).

In the area of the Nysa Kłodzka-Kraliky Trough of the fluvial system developed in a specific way, reflecting the particular tectonic activity of the region. At the beginning, the drainage of a significant part of the trough took place through Morava toward the Black Sea. However, the tectonic uplift at the turn of the Pliocene and the Pleistocene in the area of Międzylesie did force a change of the drainage direction toward the N and start a continuous development of the Nysa Kłodzka Valley up to the recent stage.

The mountainous segment the Nysa Kłodzka Valley reflects several phases of its evolution, among others a phase of its present position, i.e. close and along the western border of the Nysa Kłodzka Trough. There are several sections in the Nysa Kłodzka Valley from the vicinity of Międzylesie in the south to Gorzanów in the north that seem to be evidently influenced by tectonic activity of the basement. They are two ravines: one in the region of Długopole Zdrój and the other of Bystrzyca Kłodzka, which were caused by the uplift of the Nysa Kłodzka Trough bottom. They are also at least 12 sections showing the anomalous geometry of the river valley bend.

To analyse anomalies in the orientation of the Nysa Kłodzka Valley the method of moving mean vector for axis orientation along the valley every 25 m was used. The axis was laid down basing on topographic maps in scale 1:100000 and on measurements taken with laser distance finder. Anomalies of arch bends are noticed only at bends turning toward the west and located in the vicinity of the major fault zones with orientation of 325°-35° (Fig. 1, 2). It turns out that the only geometric way to correct

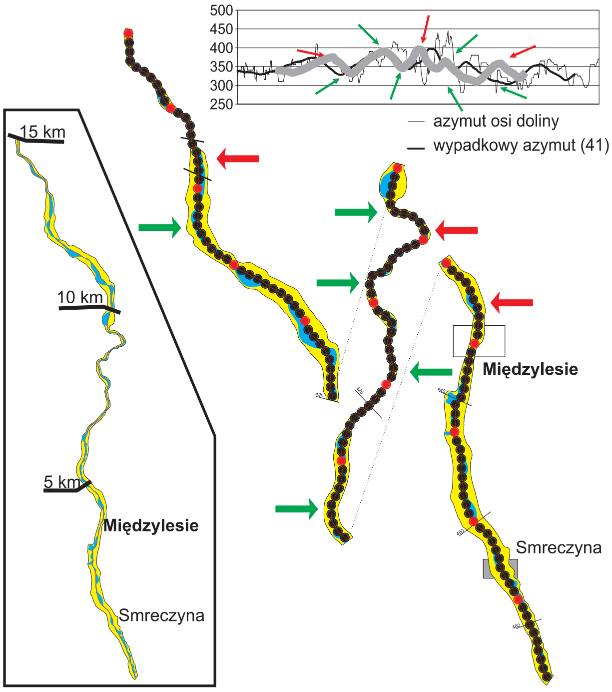

Fig. 1. Anomalies of the Nysa Kłodzka River valley 0–15 km)

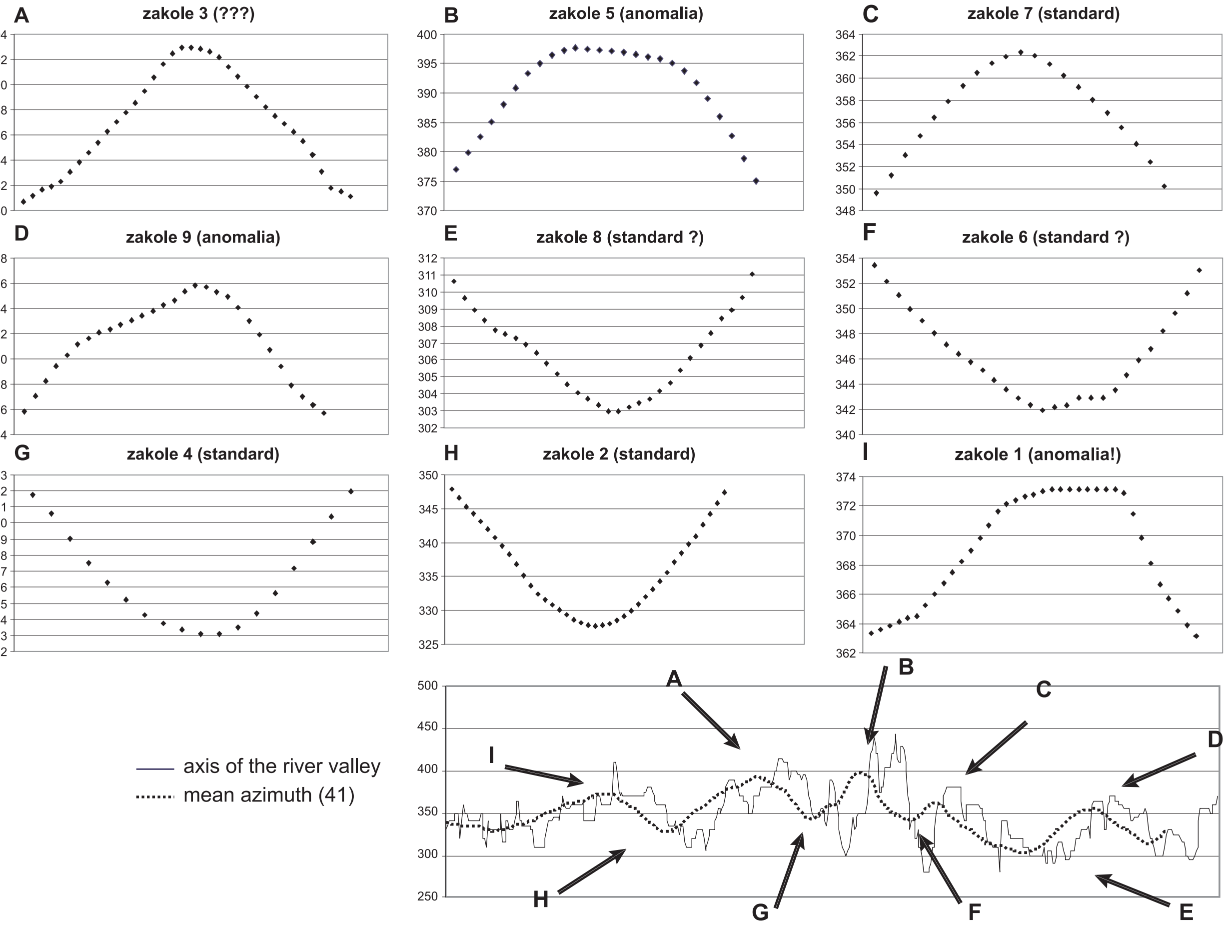

Fig. 2. Characteristics of the Nysa Kłodzka River bends, sectiont 0–15 km)

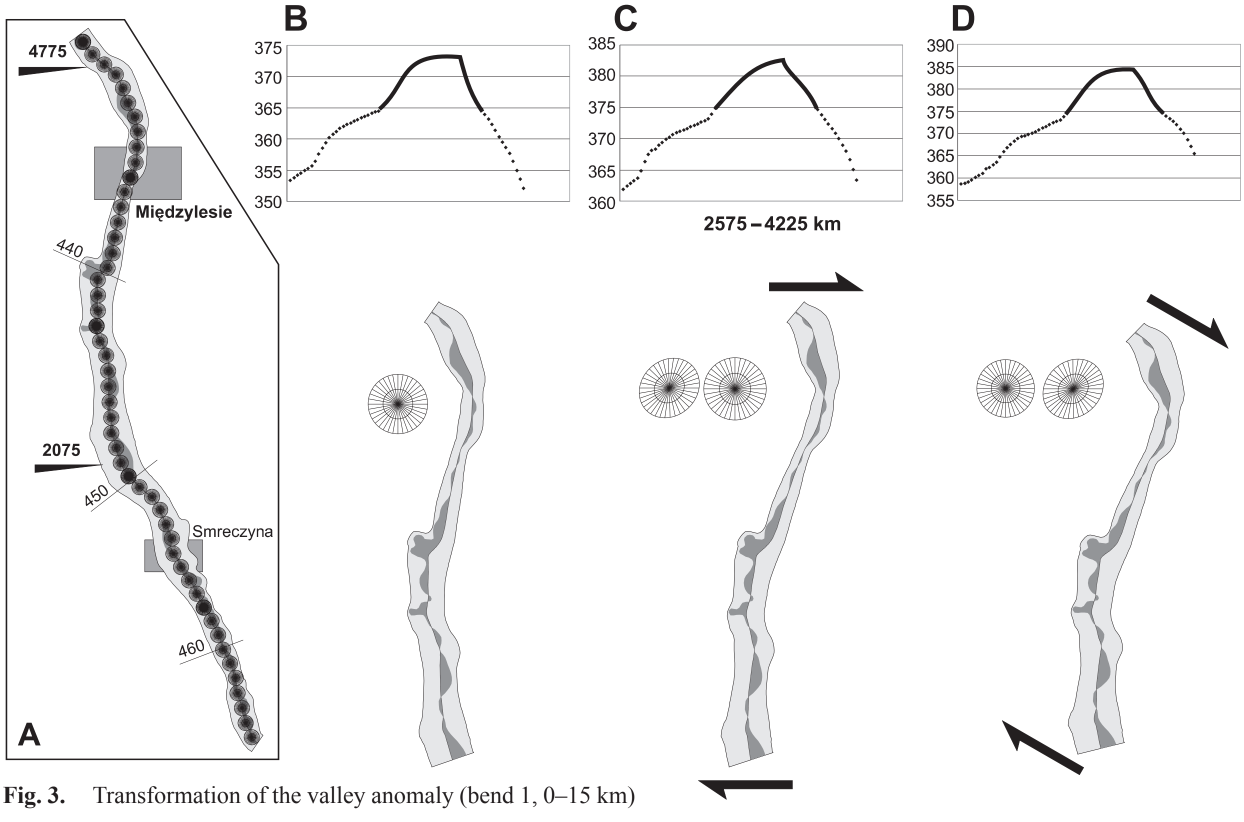

Fig. 3. Transformation of the valley anomaly (bend 1, 0–15 km)

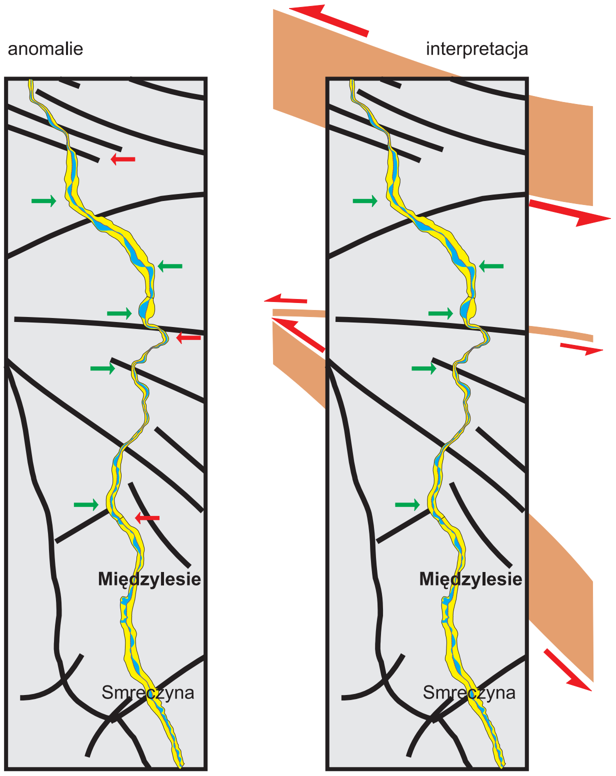

Fig. 4. Structural interpretation of the anomaly of the Nysa Kłodzka River valley (bend 1,0–15 km)

these anomalies is counter clockwise translation in the same direction as the orientation of the fault zones. Dimensions of the translation differ for individual anomalies range from 50 to some 200 m (Fig. 3).

A high efficiency of such corrections of distinguished anomalies suggests that a possible cause of anomalies' formation could have been counter clockwise shifts in the ground, which the Nysa Kłodzka Valley had been developed on. In the same way the correction made enables to reflect the geodynamic activity of the ground of the Upper Nysa Kłodzka in the period, when the lowest recent valley terrace of the Nysa Kłodzka was created (Fig. 4). As this terrace is covered with muddy flood sediments, dated about 800 to 900 years B.P. and is connected to mass timber production on this area, it must have been created in the time prior to this period. In the literature predominates an opinion that the time of formation as well as morphologic stability of the river valley bedforms ranges usually between 1,000 and 100,000 years (e.g. Schumm, 1985; Leeder, 1993; Miall, 1996), as a consequence it should be expected that the velocity of horizontal displacements of the basement during the formation of the Nysa Kłodzka Valley should vary between 25 cm (?!) and 0.5 mm per year. Whereas, the former value is absolutely wrong, the latter one seems to be probable and close to the current neo-tectonic displacements being evidenced for the Nysa Trough area.

It should be, however emphasised that some of anomalies found out in the upper segment of the Nysa Kłodzka River can also be induced by human activity. For sure, however, significant influence of structural anisotropy of the basement as well as differentiation of lithology can be excluded.

References

AUGUST C., AWDANKIEWICZ M., WOJEWODA J., 1995. Trzeciorzędowe bazaltoidy, wulkanoklastyki i serie osadowe wschodniej części bloku przedsudeckiego. (in Polish, English summary). Przewodnik do LXVI Zjazdu PTG, pp. 241-254.

LEEDER, M.R., 1993. Tectonic controls upon drainage basin development, river channel migration and alluvial architecture: implications for hydrocarbon reservoir development and characterization. In: North C.P., Prosser D.J., (Editors), Characterization of fluvial and aeolian reservoirs. Geol. Soc. London Sopec. Publ., 73, pp. 7-22.

MASTALERZ K., WOJEWODA J., 1993. Alluvial-fan sedimentation along an active strike-slip fault: Plio-Pleistocene PreKaczawa fan, SW Poland. Spec. Publs Int. Ass. Sediment. (1993) 17, 293-304.

MIALL A.D., 1996. The Geology of Fluvial Deposits. Springer-Verlag, Berlin.

SCHUMM S.A., 1985. Patterns of aluvial rivers. *Ann. Rev. Earth Planet Sci.*, 13: 5-27.

WOJEWODA, J., MIGOŃ, P., KRZYSZKOWSKI, D., 1995. Rozwój rzeźby i srodowisk sedymentacji w młodszym trzeciorzeciorzędzie i starszym plejstocenie na obszarze środkowej części bloku przedsudeckiego: wybrane aspekty. (in Polish, English summary). Przewodnik do LXVI Zjazdu PTG, pp. 315-331.

WOJEWODA J., 2003. Tensional evolution of the Złotoryja-Jawor zone in Neogenie. (in Polish, English summary). In: Ciężkowski W., Wojewoda, J. & Żelaźniewicz, A. [Editors] – Sudety Zachodnie: od wendu do czwartorzędu, 127-136, WIND, Wrocław

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Are the Malé Karpaty Mts. Composed From Three Granite Massifs?

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Granitic rocks of the Malé Karpaty Mts. are generally divided into two groups: Bratislava and Modra Massif. Lower Carboniferous granite/granodiorite of Bratislava Massif showing affinity to S- type granitic rocks and Upper Carboniferous granodiorite/tonalite of Modra Massif, considered as the I-type granitic rocks (Vilinovič, 1981; Cambel et al., 1982a). Granitic rocks of the Modra Massif forms two bodies in tectonic position, divided with thin belt of Triassic quartzites.