The Direction of Thrusting of the Silesian Nappe (Polish Segment of the Outer Carpathians)

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The Polish segment of the Western Outer Carpathians is a north-verging fold-and-thrust belt mainly composed of Lower Cretaceous to Lower Miocene flysch sediments (Książkiewicz, 1977). The belt comprises several nappes. One of them, the Silesian nappe, extends along the whole belt. This nappe is convex towards NNE (Fig. 1). The study area is located in the central part of the Silesian nappe.

The rocks of the study area are deformed by numerous small thrusts. The direction of thrusting varies from NW across N to NE. Two groups of thrusts were identified: (1) thrusts formed in horizontal beds and (2) thrusts formed in inclined beds. The directions of thrusting from NW to N are very common in the first group of thrusts, while the directions from N to NE characterize the second group of thrusts. Cross-cutting relationships between the thrusts suggest either clockwise (CW) rotation of the regional stress field or counter-clockwise (CCW) rotation of the rocks in a stable regional stress field.

Regional folds are mostly inclined, with vergences towards the north. The northern limbs of the anticlines are mostly cut by thrusts. The hinge lines of anticlines and thrust traces trend

Fig. 1. The modelled curvature of the Silesian nappe based on the northern boundary of the Silesian nappe. The shape of the Silesian nappe after Książkiewicz (1977).

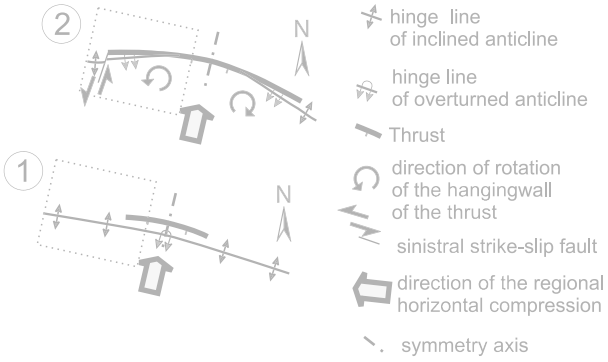

Fig. 2. A sketch of the structural evolution of the regional anticlines in the study area. The study area is marked by dotted rectangles.

WNW–ESE to WSW–ENE. The described orientation of anticlines results from the CCW rotation of the hangingwalls of the western part of thrusts (Fig. 2). Small thrusts could be also CCW-rotated. As suggested by the location of the study area, the rocks underwent also CCW rotation as a part of the western segment of the Silesian nappe arc (Fig. 1). It is therefore postulated that the Silesian nappe was thrust exclusively to the NNE.

Reference

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Outline of the 3D Structure in the Mokrá Quarries

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Three quarries in the limestones of the Moravian Karst were studied in order to constrain the 3D tectonics. These quarries are located on the eastern edge of the village of Morká–Horákov, about 10 km east of Brno. The rocks are represented by the Vilémovice Lst. (Givetian–Frasnian, light grey, massive limestones), and the Křtiny Lst. and Říčka Lst. (Famennian–Tournaisian, dark grey, well bedded limestones). The most promising for the 3D study is the area between the central quarry and the eastern quarry.

The limestones are deformed by two systems of folds, with the older-system folds trending ENE–WSW being refolded by the younger-system folds trending NNW–SSE (Fig.1). The folds are asymmetric and disharmonic, mostly recumbent. Limestones are also affected by brittle fracturing of several generations as well as ductile to brittle-ductile failures (*en echelon* arrays of carbonate veins, ductile shear zones accompanied by pressure solution, etc.). These phenomena make the interpretation of the 3D structure more difficult.

Very interesting and important are thrust faults subparallel to bedding, the cores of which are marked by a black ultracataclasite layer. These thrusts belong probably to the earliest deformation phases, because they are folded together with the bedding and are masked by the numerous eye-catching younger faults.

A detailed field observation revealed the presence of several deformation phases: D1 – the first phase of thrusting subpar-

allel to bedding planes; D2 – folding with fold axes trending ENE–WSW, associated with veining (veins subparallel to axial planes); D3 – the second phase of thrusting towards NE, combined with drag folding trending NNW–SSE (thrust over Culm rocks in the eastern quarry); D4 – several phases of younger (Alpine?) fracturing.

A combination of precise stratigraphic and structural data allowed to interpret the 3D tectonics of the area as thrust-separated tectonic slices several hundreds of metres thick (first hundreds). During thrusting, limestones in the nearest vicinity of these thrusts were folded by dragging. The 3D structure is comparable to that described from the Němčice–Vratíkov Belt (NE margin of the Brno massif) by Melichar and Kalvoda (1997) and from Adamov (tectonic slices of Devonian rocks within granodiorites of the Brno massif) by Rez and Melichar (2002)

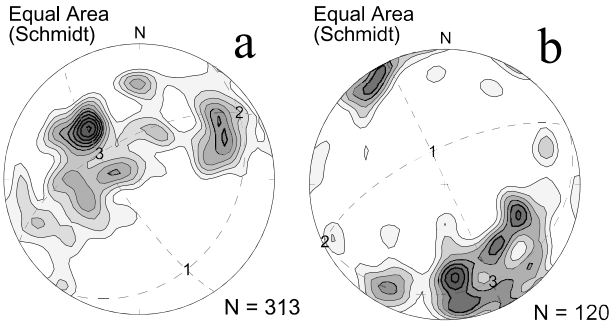

Fig.1. Equal-area projections of directional structural elements from the area under study: a) poles to bedding planes – at least two systems of folds could be recognized: the younger one forming a great arc (defined by points 2 and 3) and the older one forming two kidney-shaped maxima in the upper half of the plot; b) fold axes.

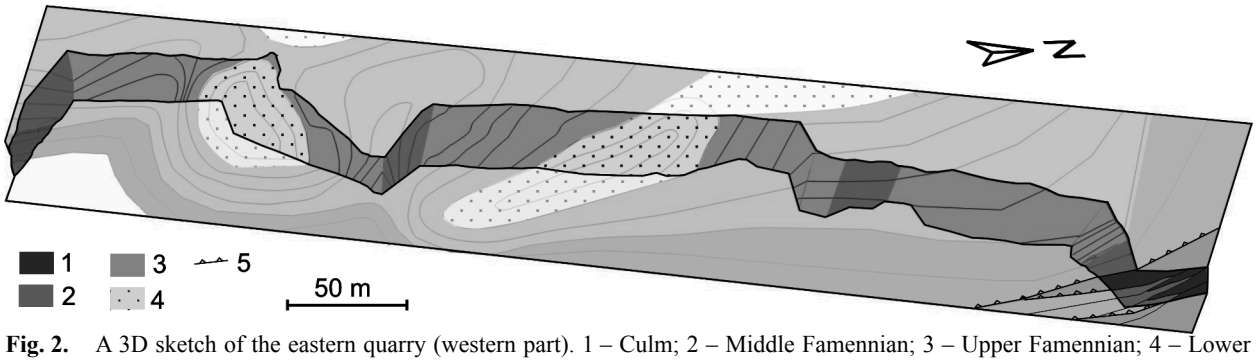

Fig. 2. A 3D sketch of the eastern quarry (western part). 1 – Culm; 2 – Middle Famennian; 3 – Upper Famennian; 4 – Lower Tournaisian; 5 – thrusts.

References

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Preliminary Data on Mafic Rocks from the Kotusz-1 Borehole (Western Part of the Polish Rotliegend Basin)

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Intensive Permian volcanic activity in NE Germany (*Southern Permian Basin*) described by Benek et. al. (1996) has continued in the area of W Poland (*Polish Rotliegend Basin*). Lava flows described from the area of the Fore-Sudetic Monocline are composed of rhyolite, rhyodacite, dacite, trachyte, lathite, andesite and basalt (Siemaszko, 1981; Kłapciński et al., 1988). Volcanic rocks may be accompanied by hypabyssal rocks, which are represented by microdiorite and microgabbro, and scarcely by plutonic rocks – granites (Jackowicz 1994).

In the northern part of the Fore-Sudetic Monocline, within the Wielkopolska Basin, hypabyssal and abyssal mafic rocks were found in the Kotusz-1 borehole. They are represented by strongly altered gabbroides spot-drilled at an interval between 2301.3–2357.0 m. The drilling of the borehole was stopped at a depth of 2357.0 m without reaching the bottom-side of the gabbroids. The mafic complex (2301.0–2301.3 m) is overlain by Zechstein transgressive breccia. The upper part of the magmatic complex is constituted by grey-black, fine-grained gabbro. Medium-grained gabbro, which we focus on, is located near the bottom of the borehole. Gabbroids, present in the Kotusz-1 borehole, show signs of alteration of various intensity.

Hand specimens of these rocks are grey-green in colour, massive and medium-grained. Gabbro is microscopically fine-grained. Chlorite and actinolite prevail in the rock. Rocks