Resurrection of the Barrandian Nappe Structures (Central Bohemia)

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An almost finished theory on Variscan nappe tectonics in central Bohemia was frozen for forty years until new attempts to explain these structures appeared. These attempts are based on geophysical and tectonic data (Tomek 1997, unpublished) as well as juxtaposition of dismembered Devonian sequences (Hladil et al. 1996, Hladil and Kalvoda 1997). However, these new contributions involved vaguely defined facts and were often marginalized by the geological public.

The present paper enumerates old documents and alleges other reasons to support this idea.

Three reasons for nappe structures in the central Bohemian Paleozoic are particularly significant.

1. Asymmetrical compressive tectonics is reflected by recumbent folds, thrusts, etc.
2. Bedding-parallel faults (detachments) are bound to be limited to certain stratigraphic horizons.
3. Different facies of the same age were brought together.

Deformations

Barrande (1852) suggested a simple brachysynclinal shape of the central Bohemian Paleozoic and did not admit any other tectonic deformations. J. Krejčí in Krejčí and Feistmantel (1885) defined several principal faults in the area (Praha F., Koda F., etc.). He considered them to be very steep. To cultivate this draft of parallel faults, Suess (1903) suggested a stepwise-shaped graben with Ordovician to Devonian sediments; a model reflected even in recent papers (Havlíček 1981).

Within a short time, many attempts for explanation of the Alpine-style deformations in the central Bohemia were made (Seemann 1907, Čermák, Kettner and Woldřich 1914, Nowak 1915, Wähner 1916) and a strong discussion followed this series of publications (Kettner 1916, 1917, 1920, 1923 etc., Kodym 1919a, 1919b, 1921, 1924 etc., Moscheles 1921, 1922, Wähner 1917, 1921 and Sokol 1923). As a consequence, both the above mentioned ideas were rejected and an axial horst structure was introduced. This direction was exquisitely supported when two stratigraphically different quartzite horizons were recognized in two limbs of Kettner's isoclinal fold (Matějka 1920).

R. Kettner and O. Kodym argued for the origin of divergent thrust faults, which reflected symmetrical shortening in the inner part of a bent synform; however, some fingerprints of Alpine-style deformations and south-vergent movements on faults in the NW limb of the synform (not fitting their concept) were found (Kodym 1924).

Papers after the World War II (Svoboda and Prantl 1947, 1953 or Petránek 1950) refined the documents for asymmetrical folding and thrusting towards the south. Havlíček and Šnajdr (1955, p. 487) reintroduced the statement about the Alpine style of tectonics in central Bohemia.

According to the new field revision, the thrust faults on both sides, i.e. on the NW and SE, are accompanied by asymmetrical structures which indicate north-over-south tectonic movement. According to the shape of the nappe relicts we can assume that it is not a single component of their kinematics. Frontal parts of the nappes consist of structural fans and every slice is marked by a narrow anticline. Southern borders of these anticlines in the SE flank are connected with thrust faults. Locally, inverted limbs of these anticlines were changed into duplex structures. This is the reason for the observed duplications of thrust fault planes in geological maps.

Detachments

The existence of bedding-parallel movements was suggested by Purkyně (1915, 1917) and mainly by Wähner (1916), who observed frequent bedding-parallel striae on some oblique faults. Kodym (1921, p. 4; S of Beroun) documented terminations of small oblique dislocations on bedding-parallel joints. The same model was applied also for the explanation of large-scale faults (Kodym 1921, Petránek 1950).

Barrande (1852, 1865) found some localities with the third (= Silurian) faunas enclosed in a certain horizon of the second (= Ordovician) faunas and explained them in agreement to uniformitarian theory as colonies of different but contemporaneous fauna. Krejčí and Helmhacker (1879) and also Katzer (1892) suggested tectonic explanation for these colonies as down-moved tectonic blocks. Today, tectonic setting of the Barrande's colonies is also accepted beyond any question, but the ideas about oblique thrusting do not explain Barrande's note about the existence of specific stratigraphic zone of colonies.

From the new tectonic point of view, two main décollements are distinguished here. The first one occurs mostly in the Upper Ordovician black shales (Bohdalec Shale in the NE and Králův Dvůr Shale in the SW) and the second is set in the Early Silurian shales. The evidence for the position of these décollements was derived from stratigraphical investigation of the Barrande's colonies, for example A. Přibyl in 1940, as well as detailed maps, where these bedding-parallel tectonic contacts are very long in comparison with other tectonic contacts, which are oblique and remarkably short. V. Havlíček in Havlíček et al. (1987) provided a very good explanation in a section 1-2 on the map sheet Černosice 12-414, scale 1 : 25,000, where three flat segments of allochthonous Ordovician rocks several kilometres long were recognized. Small but evident décollements climb also to higher stratigraphical levels, being observed also in clayey and thin-bedded parts of the Devonian.

Juxtaposition of different facies

Bouček (1934) distinguished two time-correlative facies of the Silurian, i.e. the shaly and volcano-carbonate facies. In 1941, he found the latter one tectonically superimposed over the shales and suggested an existence of nappes (Bouček 1941). This idea was adopted by Horný (1955, p. 358, pl. VII; and 1965), who suggested tectonic contacts within the Silurian rocks W of Tetín (unnamed fault) and particularly on the prominent Tachlovice Thrust Fault. It is significant that even the relatively uniform and generally highstand Silurian sediments show these contrasts on thrust faults.

Of course, the lowstands of the Pragian and Emsian times were reflected by high variability of facies and thus the distribu-

tion of the facies yields a chance to understand the magnitudes of tectonic movements. A contrast between the underlying and overlying facies on the Koda Fault was observed as early as by Svoboda and Prantl (1947). I. Chlupáč in Chlupáč et al. (1992), fig. 58, show a series of facies sections of the Praha Formation. Sequences of one or more stratigraphical stages (several millions of years) typically stretch across longer distances in the W-E (WSW-ENE) direction but are considerably brought together in the transverse direction. Both the disjunctions and bringing together of facies regularly indicate the nappe structures, incl. the Barrandian (Hladil et al. 1996, Hladil and Kalvoda 1997).

The nappe-related specifics are observed if these simplified stratigraphical sequences are mounted on the outcrops in sheets of geological maps 1 : 25,000. This pattern was even more visible on the basis of microfacies, where the following belts were separated: 1. A regular sequence with the Řeporyje Lmst. and the graptolite shale interval within the Dvorce-Prokop Lmst., ramp and slope, Řeporyje – Svatý Jan (and Damil). 2. A sequence with higher amount of the Slivenec Lmst. and stromatolite structures in their upper part, elevations, Dívčí hrad (Slivenec and Zadní Kopanina) – Srbsko South. 3. A condensed sequence consisting mainly of the Dvorce-Prokop Lmst., slope and foot of slope, Hradinovský kopec (and Karlické údolí) – Karlštejn (Javorka) and NE of Strážiště. 4. A very thick sequence consisting almost exclusively of the Dvorce-Prokop Lmst., depression fill, Barrandov – Třebotov, close to the previous type. 5. Shallow-water sediments building almost exclusively the Vinařice and particularly Koněprusy Lmst., shoals, cliffs, reefs, platforms and ramps, crinoid-bryozoan debris, Koněprusy area. 6. Grey rhythmic calciturbidites, well-sorted calcisiltites, with almost no resedimented crinoids, a different slope of ocean type, Bacín Hill.

Conclusions

Three main units are defined on the basis of the enumerated facts on tectonic structures and juxtaposition of the facies.

1. Upper allochthonous unit is characterized by volcano-carbonate Silurian and Pragian with large proportion of "ammonitico rosso" facies. Fairly regular sequence of several stratigraphical members of the Praha Formation also marks this unit. Main tectonic boundaries are the Koda Fault in the SE and the Tachlovice Fault in the NW.
2. Lower allochthonous unit consists mostly of the Silurian shale facies and grey to dark grey Dvorce-Prokop Lmst. (Pragian, Devonian).
3. Lowermost paraautochthonous unit consists mainly of the Ordovician, Silurian shale facies and Pragian reef to ocean-slope facies (Devonian).

Directional shortening of formerly wide facies transitions requires at least several tens of kilometres in cumulated translation. Secondary thrusts are numerous also within the nappe units, as observed at Holý vrch Hill or S of Koněprusy, a.o.

A poster extending this abstract is enclosed in this volume as a separate printed enclosure.

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