Trabajos de Geología, Universidad de Oviedo, 29 : 164-167 (2009)

Oviedo (Spain) 1-3 July 2008 International Meeting of Young Researchers in Structural Geology and Tectonics
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Touching the detachment (Ockov Fault, Barrandian, Czech Republic)

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Abstract: The Prague Synform (Ordovician to Devonian) was folded and thrusted during the Variscan orogeny. This paper is focused on one of these thrusts: the Ockov Fault. The creation of a stratigraphic separation diagram and detailed study of new tunnel exposures has brought about the recognition of the eastern prolongation of the fault, as well as its flat-ramp-flat geometry and thrusting nature.

Keywords: detachment, fault core, stratigraphic separation diagram, Barrandian, Lower Paleozoic.

Studying orogenic belts, geologists usually face the problem of how to demonstrate autochthonity or allochthonity (Melichar, 2004). It is usually accepted that any allochthonous model of terranes after the orogenic closure of pre-orogenic basins has to be demonstrated, while the hypothesis of autochthonity is assumed without further evidence. From this point of view any recognition of important detachments essential to decipher the orogenic structure. The studied area has been the focus of intense debate on allochthonity for more than one hundred years (Melichar, 2004), but new evidence has now been uncovered since the critical area was cut by a pair of road tunnels (Cerny, 2008).

The studied area is situated in central Bohemia, southwest of Prague (Fig. 1). It belongs to the Prague Synform (Barrandian, Czech Republic), which is formed by an Ordovician to Devonian volcano-sedimentary complex (shales, sandstones, limestones and basalts). The Prague Synform is a small relic (20×90 km) of a large pericontinental basin. Sediments were strongly folded and fractured during the Variscan orogeny and the synform, compressed in SE-NW direction, is now elongated from NE to SW. There are several important faults in this area, but the Ockov Fault is one of the best known. The fault was defined by Woldrich (1914) as an inverse fracture with a repetition of the Ordovician-Silurian sequence in the Ockov Hill area near Karlstejn (SE part of the Prague Synform, figure 1). The fault is accompanied by one or two additional branches, which implies the possible existence of a duplex structure in the area.

Stratigraphic separation diagram of the Ockov Fault

A stratigraphic separation diagram (SSD) of the Ockov Fault (Fig. 2) was constructed using a method previously described by Woodward (1987). Detailed stratigraphic maps of the area under study were used for the construction. Portions of the eastern part of the fault had to be reconstructed. As the synform axis and a surface section are oblique to fold axes and thrusts, the SDD shows oblique views, but close to longitudinal geometry with both frontal and lateral ramps. For further discussion of the possible interpretation of SSD see Wilkerson *et al.* (2002) or Knizek *et al.* (2009).

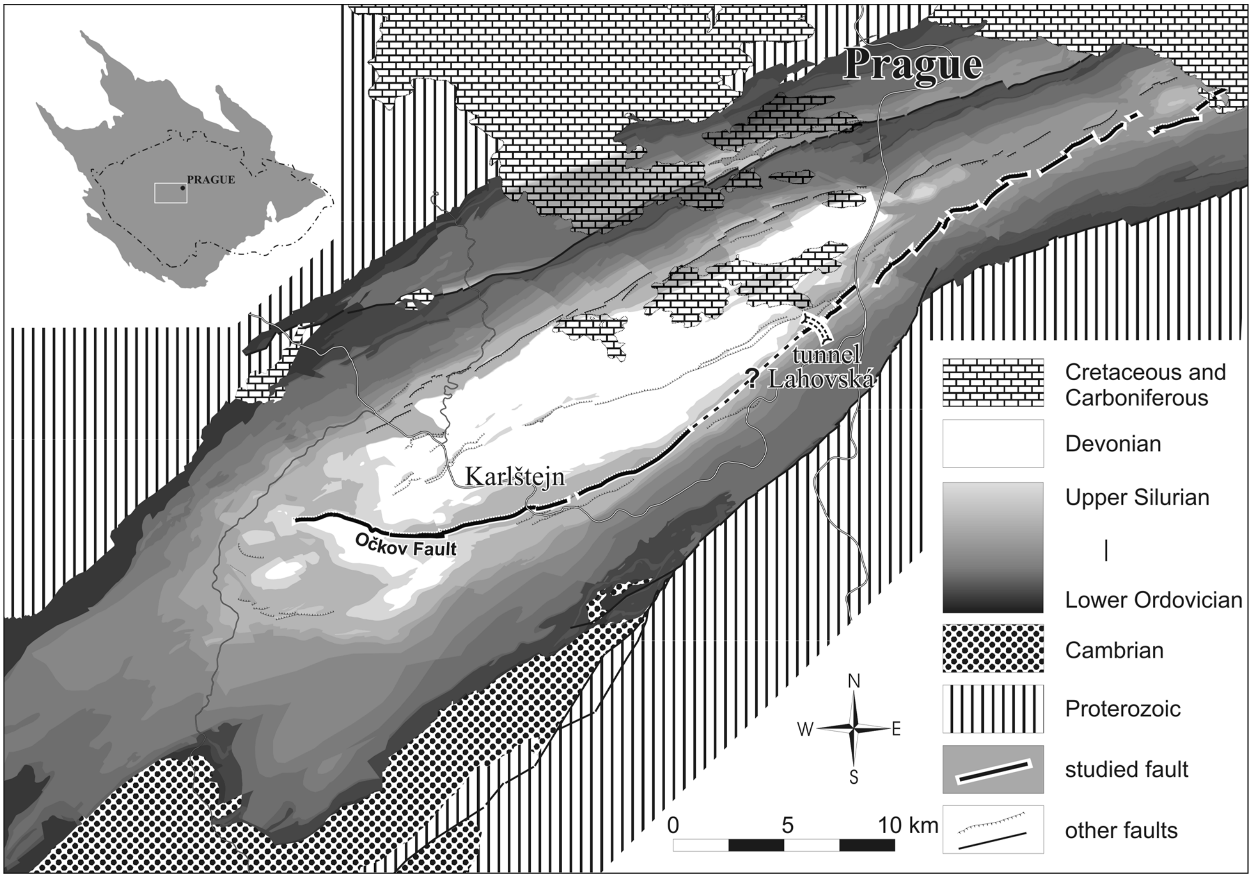

Figure 1. Schematic stratigraphical map of the Prague Synform. The Ockov Fault is situated in the SE limb of the synform.

The SSD of the Ockov Fault (Fig. 2) shows evident flat-ramp-flat geometry of the fault surface. Flats are situated in the Upper Ordovician shales (the Bohdalec and the Kraluv Dvur formations) and in the Lower Silurian graptolitic black shales, which represent most ductile rocks of the whole stratigraphic sequence. Main ramps cut competent layers of the uppermost Ordovician quarzites (Kosov formation) and the Upper Silurian and Devonian limestones. The length of flats is 10-20 km, which is in contrast to short ramps (2-4 km).

New exposures of stratigraphic inversion in tunnels

New tunnels for the Prague circular expressway have been constructed since 2004. The tunnel

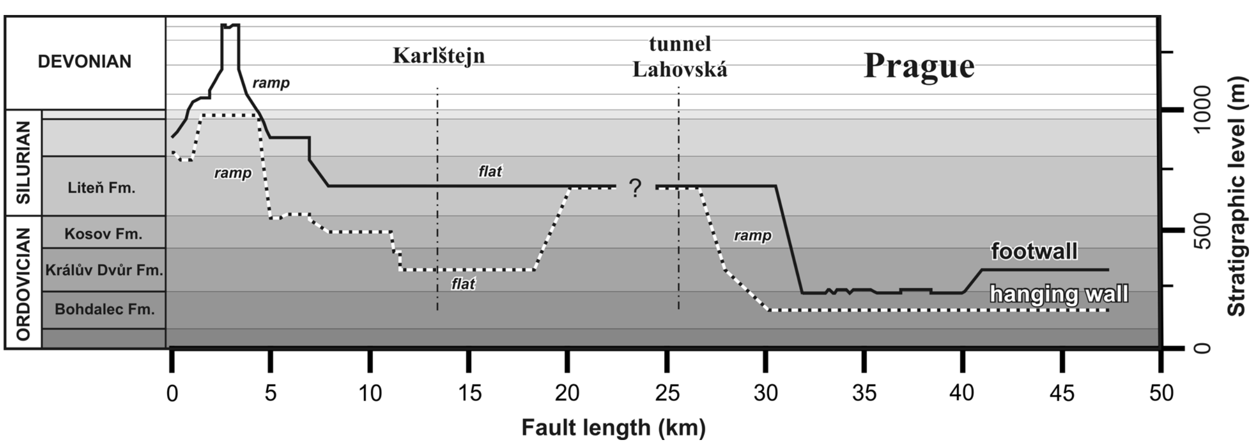

Figure 2. Stratigraphy separation diagrams of the Ockov Fault. There are two levels of long flats separated by short steep ramps.

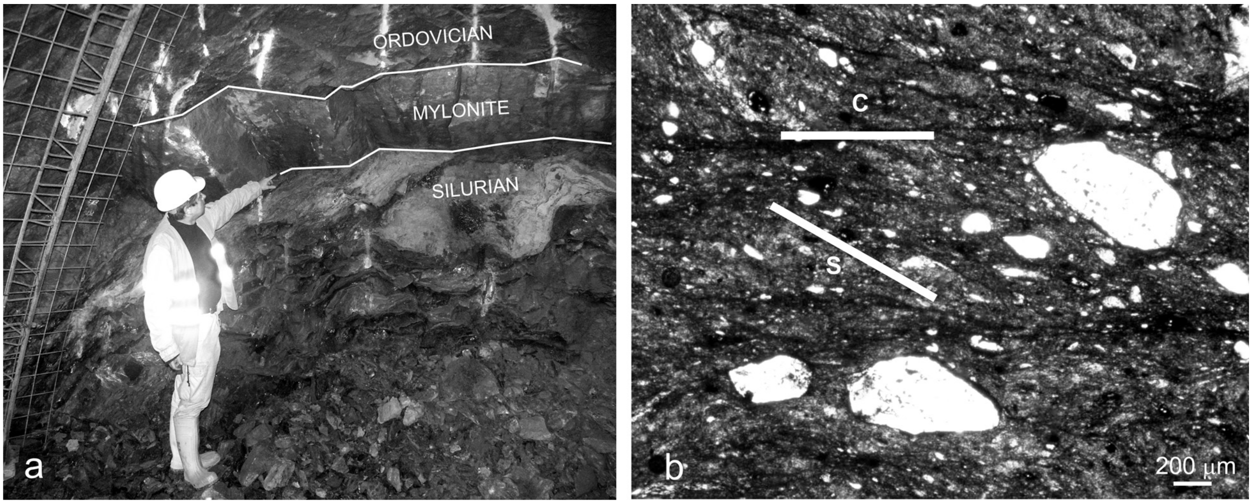

Figure 3. Fault core of the Ockov Fault: (a) forehead of the tunnel with thrust, (b) S-C structure and clasts in the boundary mylonite indicating SE movement of the top.

"Lahovska" crosscuts an area on the SW edge of Prague and shows repetition of Ordovician and Silurian shales. Two stratigraphic repetitions with Ordovician rocks over Silurian were documented in the tunnel. Consequently, the possible eastern prolongation of the Ockov Fault is anticipated here.

The first inverse sequence is located in the lower part of the complex. Upper Ordovician grayish shales were thrusted over Lower Silurian graptolitic black shales along a bedding-parallel fault (Fig. 3a). The boundary is marked by 0.5 m thick highly strained chloritic mylonites containing many gray or black shale xenoliths accompanied by asymmetric pressure shadows indicating top-to-the SE displacement. Though the mylonites behaved as a tectonic lubricant, now this rock is compact and very hard. The surrounding shales were sheared parallel to their bedding, but some of them close to the isoclinal fold were recognized as well as small-scale S-C structures implying the same sense of movement (Fig. 3b).

The second inverse sequence situated above the first one shows a markedly different character. All the Silurian rocks were incorporated into Ordovician shales as a small tectonic sheet. The sheet is bounded by steep oblique faults and its thickness is only 1 m. Rocks in the sheet, as well as surrounding rocks, were highly strained, folded and foliated. Bedding of the surrounding sediments is folded and oblique to the fault surface.

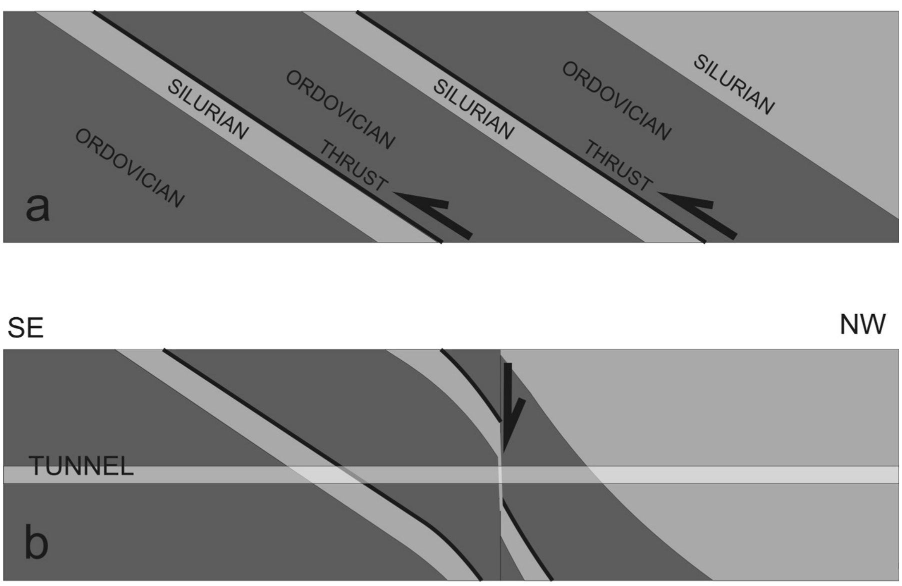

Figure 4. Interpretation of two Silurian sheets incorporated into the Ordovician: (a) two branches (flats) of the Ockov Fault, (b) the Upper Silurian sheet is sheared after younger faulting.

Discussion and conclusions

The first stratigraphic inversion can be easily compared with one of the flats of the Ockov Fault, while the interpretation of the second one is not so easy. We assume two phase faulting: 1) thrusting of the Ordovician rocks over the Silurian ones, and 2) subsequent oblique faulting during which the Silurian rocks were dragged along the young fault planes producing a very narrow sheet (Fig. 4).

Summarizing, the studied exposures bring new evidence for the eastern continuation of the Ockov Fault. The bedding-parallel orientation of the fault in this area predicted by SSD was confirmed. Two occurrences of the Silurian rocks in the Ordovician complex could be interpreted as two branches of the fault; the first branch is uninterrupted and the second one was disrupted by a younger steep oblique fault.

Acknowledgements

We have benefited from cooperation with Mr. Jakub Bohatka (SG Geotechnika) and MSc. Libor Sila (PUDIS, a.s.). Thanks to Matthew Nicholls for his proofreading. The study was supported in part by the grant project MSM 0021622412 and by GA AVCR, the grant IAAA3013406.

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