The ballanced cross–section construction: The use of the geomechanical rock–character for a creation of the structural folds' model based on the flat–ramp–flat geometry in the Western Carpathians (Pavlovské vrchy, Czech Republic)

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Introduction

Pavlov Hills (klippen belt) are situated in the central Europe in the westernmost part of the outer Western Capathians. Studied area went through the various tectonic progressions during the younger phase of the Alpine orogenesis. The Pavlov Hills are on the borderline between Carpathians foredeep and flysh napes which belong to Western Carpathians. The autochtonous subsoil is represented by the Varsican Bohemian Massif and Jurassic platform units. The Pavlov Hills are created from Mezozoic rocks which were incorporated from the basement into mainly Paleogeneous Ždánice nape. The limestone sheets are arranged into N–S lineament. The mezozoic rocks are formed by two floors of sediments: the Upper Jurassic and the Upper Cretaceous. Jurassic sedimets can be divided into 3 units: Klentnice Formation, „nodular limestone" and Ernstbrunn Limestone. The Klentnice Fm. consists of grey claystones and dark limestones which prograde into competent shallow water Ernstbrunn limestone. Cretaceous are divided into 2 units.

The Pavlov Hills have been the aim of research for a long time. In the last published map (Čtyroký *et al*. 1995) the detected orientation of bedding of Jurassic rock dips to SE and the faults were supposed to be mainly in the N–S a W–E directions. By excecuting the borehole Pálava–1 (Stráník *et al.* 1962) there was verified the stratigraphic inversion of Klentnice Fm. on Ernstbrunn Lm. and Cretaceous sediments and also a duplication of layers. This event was explained by rhytmic sedimentation (*e.i.* Eliáš 1992).

The interpretation may differ according to the brittle thrust tectonics – the true thickness of rock type varies through the influence of fault–bend folding and rotating of layers. Thinnig of layers could be also explained by their extending.

Methodics of fault–bend folds

The flat–ramp–flat geometry comes out from the mechanism of origin of the fault–bend folds with large detachments (Suppe 1983). Detachment – flats' origin in the fine layered or soft rock. Ramps are created in hard and homegenous rock according to specific laws for brittle deformation (*e.i.* Mohr–Coulomb model). In the places of detachment there is an intralayer slideslip in motion. The flat–ramp–flat geometry appears as step–like geometry of beds, which creates big anticline structures. The structure of fault–bend fold could be very complicated with one or more ramps. The older thrusts are always further from the stress generator. The younger thrusts originate under previous anticlines. During the creation of a new thrust, older structures deform and rotate according to the new–formed fold–bend.

Outcrop research

By means of a terrain research there were found two prevailing orientations of bedding that dip to NW and also to SE, which is in contrast with publicated facts (Čtyroký *et al.* 1995). The orientation of the trusts is mainly NE–SW and strike–slips with orientation to NW–SE.

There was also revealed the stratigraphic inversion (tectonics) in numerous localities (in disaccord with Eliáš's model, 1992). The shear zone (verified, Stráník *et al.* 1962) on the Děvín Hill is made up of Cretaceous sediments (stratigraphic inversion of the Klentnice Fm. on the Upper Cretaceous). The movement vector of thrusting is paralell with the average orientation of detachment. This is in accord with the model of flat–ramp–flat geometry. The structure of klippen is anticlinal, crosscut by thrusts and strike–slips. The orientation of bedding on the N slopes leans to NW, opposingly S slopes are leaning to SE.

The stratigraphic inversion can be found also on the western part of Děvín Hill. The strike–slip canyon, which is called Soutěska, dissecting Děvín body perpendicularly to bedding orientation, shows us a cross–section of this structure. The tectonic structure is made up by 4 ramps and flats (thrusts which are paralell to the bedding) and also by strike–slips with oriantation to the NW–SE direction (see Fig. 1). The anticline axis calculated from the bedding data is plunging to the NE.

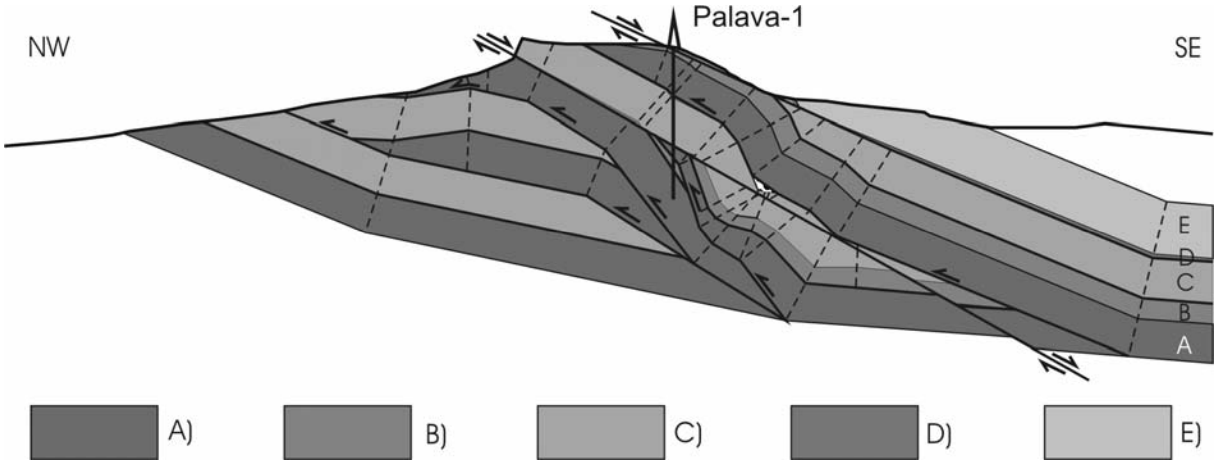

Fig. 1: A flat–ramp–flat thrust geometry model: cross–section though the Děvín Hill, A – Klentnice Fm., B – Nodular Lm., C – Ernstbrunn Lm., D – Klement Fm., E – Palava Fm.

Conclusions

– Thrusts are paralell with orientation of bedding and striking to NE–SW direction
– Detachments are parelell to bedding, situated in Klentnice Fm., nodular limestone and on the top of the Ernstbrunn Lm.
– Competent limestone are cross–cut by ramps with angle 20°
– The movement vector of thrusting is paralell with the average dip of detachment.
– Strike–slip faults divide the limestone body into several blocks in N–S en–echellon arrangement
– The model was confirmed with the seismic section, borehole and outcrop data (new created tectonic–geological map)
– The model is in accord with flat–ramp–flat geometry model

Literature

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