Paleostress Analysis in the Region of Western Bohemia

Josef HAVÍŘ

Institute of Physics of the Earth, Faculty of Sciences, Masaryk University, Tvrdého 12, 602 00 Brno, Czech Republic

Paleostress analysis of the fault-slip data is carried out in the area of the western Bohemia. Orientations of fault planes and striae were measured mostly at sites situated in the granites of the Smrčiny pluton and the Karlovy Vary pluton. Preliminary results of the analysis are presented here. First, the fast and simple method of Angelier and Mechler (1977) was used. More detailed results were obtained by application of the numerical inverse method. Program BRUTE3 (Hardcastle and Hills 1991) was used for computation of reduced paleostress tensors.

A heterogeneous population of fault-slip data was found. Two different orientations of principal axes of the post-Variscan paleostress fields were determined but the existence of more than two paleostress fields follows from the analysis of fault-slip data sets. In the case of the first paleostress field found both in the Smrčiny pluton and the Karlovy Vary pluton, s_1 axis (maximum compression) is orientated NE-SW or NNE-SSW and s_3 axis (minimum compression) is orientated NW-SE or WNW-ESE. The second paleostress field was determined at site 36 located in the Smrčiny pluton south of Skalná. s_1 axis dips west, s_3 axis is orientated NNE-SSW in the case of the second paleostress field.

The Recent seismo-tectonic activity is known from the area of western Bohemia. Results of stress analyses of focal mechanisms in the epicentral area of Nový Kostel show the orientation of s_1 axis (maximum compression) in the direction NW-SE and the orientation of s_3 axis (maximum extension) in the direction NE-SW. The discussed results of paleostress analysis therefore markedly differ from the Recent orientations of the stress field.

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Tilting of Devonian Carbonate Platform along Eastern Borders of the Bohemian Massif: Evidence and Possible Explanations

Jindřich HLADIL[1] and Lubomir F. JANSA[2]

[1] *Institute of Geology, Academy of Sciences CR, Rozvojová 135, 165 02 Praha 6*
[2] *Geological Survey of Canada - Atlantic, P.O.Box 1006, Dartmouth N.S., Canada*

1. Main part of the platform. Examination of drilling records for 32 wells at the edge of the Bohemian Massif (Fig. 1) revealed a significant correlation of the high-frequency sequence architecture across the whole carbonate platform. The best data come from continuously cored wells. Strongly expressed lateral continuity consistently results from three methods: well logging, biostratigraphy and petrology. The cyclic development within the carbonate strata suggests that the major lithologic changes result from sea-level changes. Applying the sequence stratigraphy concept, we consider the initiation of the finer part of the cycle, frequently associated with a positive gamma-ray anomaly, as corresponding to the maximum flooding surface. Stromatoporoid–algal platform sediments of highstand to highstand–falling sea-level phases produce low gamma-ray values. Especially the connection of identical highstand phases in late Middle Givetian–early Late Frasnian intervals produces a fan-shaped pattern in cross-sections, which thins landwards. Even in one of the most easterly located well, where the carbonate sequence is highly reduced and represented by less than 100 m of carbonate strata, almost all of the cycles can be recognized. It simply corresponds to rotation of linear array, when increasing thickness and increasing distance seawards show these strictly linear relationships with only little variation. Neither erosion terraces with younger sediments in lower position, nor ramp wedges with deep facies termination were found in these parts of the complex. Thus, the carbonate platform with abundant reef fauna and algae was in close contact with the sea level and, consequently, we must explain very slow tilting of the basement seawards. Relatively high integrity even in high frequencies does not support application of tilting models using the partial synsedimentary faults. This part of the Givetian–Frasnian platform was extremely coherent in these times.
2. Platform margins and slope. Wild and different subsidence patterns occur at different sites along the platform edge. For example, abrupt subsidence events are characteristic for the Middle Frasnian of Hranice n.M. They are reflected by the presence of atoll-like reef structures, as well as its distal ramp cover (sliding of blocks to the basin?). Thinning and fining upwards in the carbonate slope sediments from Konice (Bábek 1996) may indicate almost exponentially bas-

inward-increasing subsidence in distant parts of the carbonate complex. Comparison of local and global eustatic curves indicates discrete movements on faults, which may exceed the data and calculation error bars since the Late Frasnian (Hladil 1998). The Givetian–Frasnian truncated reef facies directly filled by late Tournaisian crinoidal limestone are also different. They occur in allochthonous tectonic slices in the Culm series between Sobíšky and Potštát-1.

3. Transgression – regression. Paleogeographical evidence is based on gradually increasing flooding area from the 1st to 3rd cycles. The 4th cycle is developed to a lesser extent. The platform edge retreated landwards and prograded seawards in the same way. Condensation or lacunas in sedimentation, paleo-karstification and siliciclastics denote cumulative lowstands. Lacunas in sedimentation are strongly developed landwards (Hladil 1994). Orientation of these boundaries in the section is subparallel to the above mentioned fan-shaped structure. The 1st and 2nd cycles (sequences) volumetrically represent a relatively small part of the whole sequence.
4. Discussion. Linear tilting of the whole Givetian–Frasnian platform also corresponds to landwards-thinning of four arbitrary stratigraphical units (Zukalová 1981). It can hardly correspond to the half-graben gentle slope, because the tilting rate was stable and continuous, and effective for a long time (10 to 15 Ma). Compressional bulging (and drowning) caused by paleogeographically distant Frasnian orogenic events can also explain this pattern, of the same reason, with difficulties only, although the increased Late Devonian deepening at Konice or Frasnian open-sea ingressions at Písek-1 (Český Těšín) may correspond to these ideas. Larger conflict of this compressional bulging model exists with the Devonian extension, where the Emsian continental rift near Rýmařov or Ondrášov to Middle–Late Devonian opening of large and deep basins with the Horní Benešov guyots and condensed silica shales (Galle et al. 1995) are very inconsistent facts.
5. Conclusion. Our suggestion is that the documented tilting may result from increased thermal subsidence of a rift margin, which was caused by cooling of abducted lithospheric parts with their increasing distance from the axis of spreading. A transtensional mosaic of faulted blocks occurred below slope sediments, whereas the distant part below the platform was mostly inherent, with no evidence for active faults.

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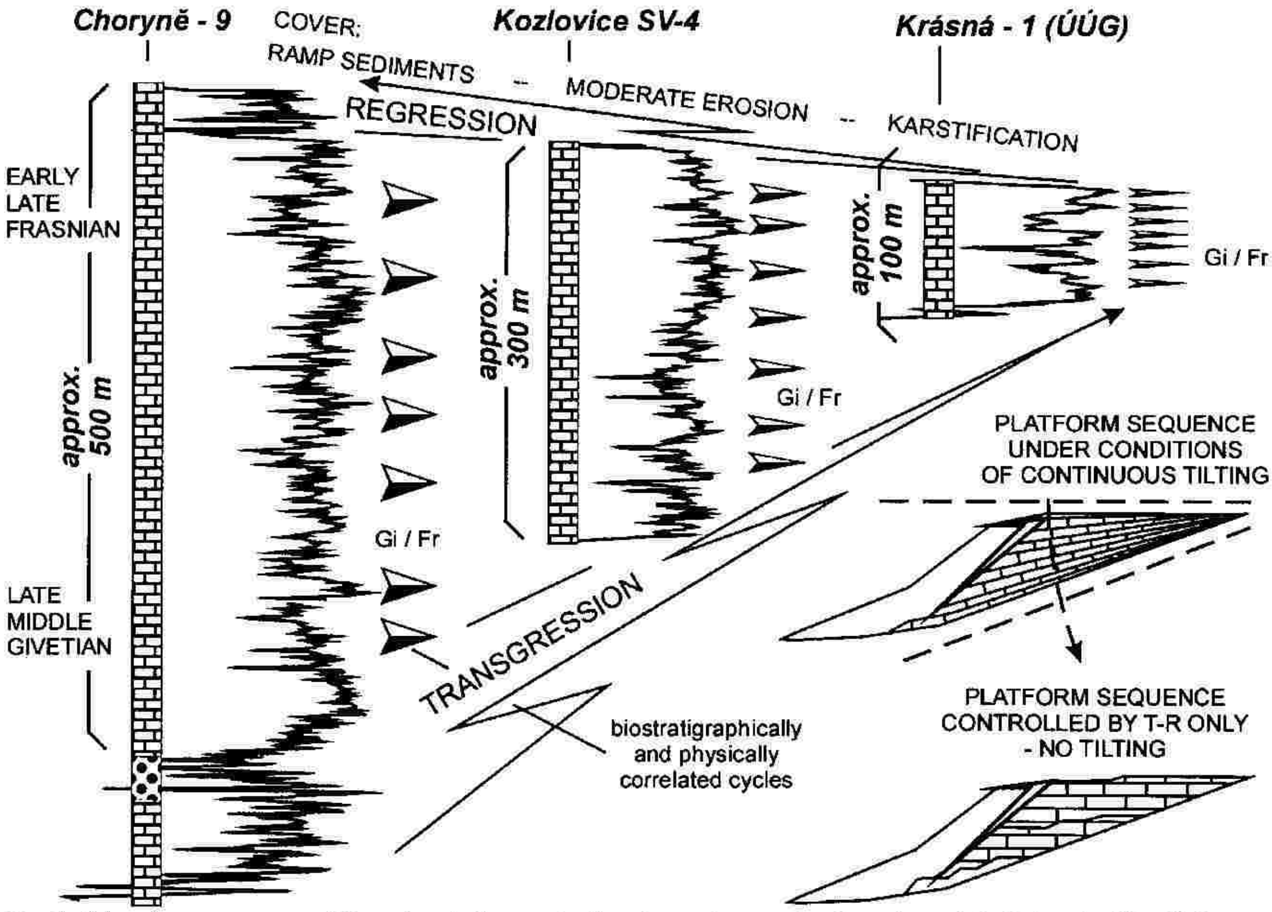

Fig. 1. Subsurface occurrence of Devonian shallow-water limestones along eastern boundary of the Bohemian Massif. Reconstruction of the Givetian-Frasnian carbonate complex is based on drilling surveys and reflection seismic data. Western part of this carbonate complex dips beneath the Late Variscan nappes (Late Carboniferous origin) and the eastern part dips beneath Carpathian nappes (Late Tertiary origin). The maximum traceable depths below nappes are 6–8 km. Openings in the southeastern part of the complex = dissected segments with significant late- and post-Paleozoic erosion. CZ = Czechia, SK = Slovakia, A = Austria, PL = Poland.

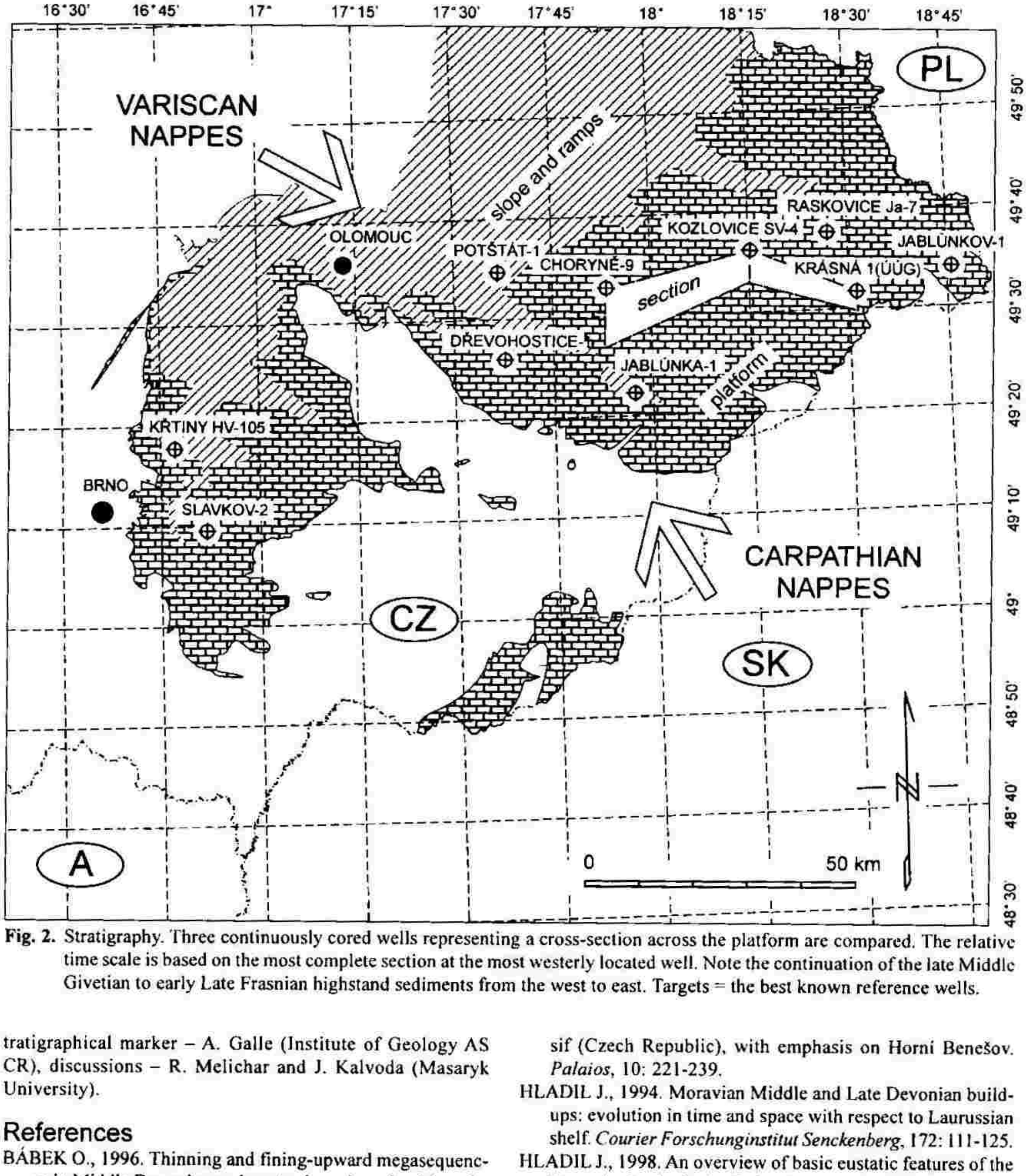

Fig. 2. Stratigraphy. Three continuously cored wells representing a cross-section across the platform are compared. The relative time scale is based on the most complete section at the most westerly located well. Note the continuation of the late Middle Givetian to early Late Frasnian highstand sediments from the west to east. Targets = the best known reference wells.

tratigraphical marker – A. Galle (Institute of Geology AS CR), discussions – R. Melichar and J. Kalvoda (Masaryk University).

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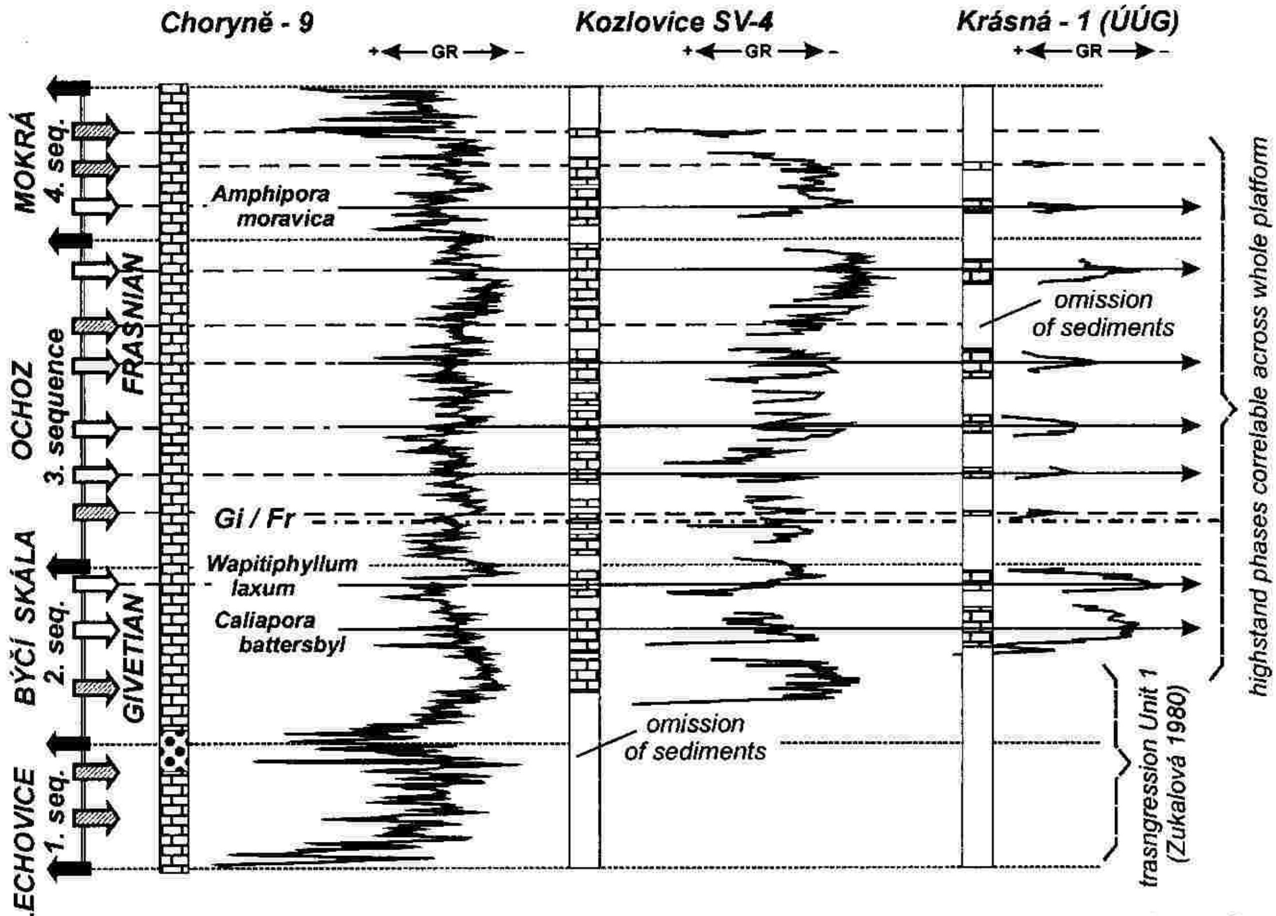

Fig. 3. Sequence. The same drilled sections are shown with natural thickness of the sequence. Initial transgression and final regression wedges are slightly developed, whereas the thin partial sequences of the Givetian-Frasnian are continuous. They compose a fan-shaped pattern with thinning eastwards. Thus, the sedimentation on the platform was controlled by continuous tilting of the entire platform, where the maximum angular tilting rate calculated for the Frasnian is approximately 0.1 degree per million years.

Neotectonic Character of Slovakia

Jozef HÓK[1], Miroslav BIELIK[2], Peter KOVÁČ[1] and Martin ŠUJAN[3]

[1] *Geologická služba Slovenskej republiky, Mlynská dolina 1, 817 04 Bratislava, Slovakia*
[2] *Geofyzikálny ústav SAV, Dúbravská cesta 9, 842 28 Bratislava, Slovakia*
[3] *EQUIS Ltd. Račianska 57, 831 02 Bratislava, Slovakia*

Proposal for definition of neotectonics is presented and discussed. Neotectonics for the territory of Slovakia and the Western Carpathians has been defined as a set of tectonic events and processes that occurred in post-Miocene times and continue till the present. Neotectonic character of Slovakia is estimated from the following aspects, which are herein discussed: i) fault pattern, ii) Recent stress field, iii) Recent vertical movement tendencies related to crust thickness and heat flow, iv) position and character of seismotectonic zones (Klippen Belt Zone, Čertovica Zone and Rába-Hurbanovo Zone); v) Slovak territory was divided into neotectonic regions on the basis of the aspects above.