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Abstrakt

V předložené studii jsou odvozeny paleomagnetické parametry vzorků spodnoordovických červených silicitů, odebraných ze tří lokalit mílinských vrstev. Použité laboratorní postupy demagnetizace a vícesložková analýza magnetizace byly aplikovány na celé kolekci vzorků. Podařilo se odvodit složky paleomagnetizace, vypočtené paleomagnetické parametry z různých laboratoří jsou shodné a dokazují správnost použitých postupů.

Zusammenfassung

Drei Vorkommen der Mílina-Formation, rote Quarzite bis Quarzschiefer aus dem Barrandium, ČSSR, wurden bearbeitet. Durch den Vergleich der Ergebnisse von drei Laboratorien sollte die Verläßlichkeit von paläomagnetischen Ergebnissen bei komplizierter Magnetisierungsgeschichte überprüft werden. Die Vielkomponentennatur der Magnetisierung war in diesen Vorkommen bekannt und daher ein ausgezeichneter Testfall für moderne Abmagnetisierungsapparaturen. Der Vergleich fiel zur vollsten Zufriedenheit aus.

CORRELATIONS OF PALEOMAGNETIC DATA FROM EASTERN ALPS AND WESTERN CARPATHIANS — DISCUSSION

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Introduction

Our knowledge obtained from the Late Paleozoic of the West Carpathians, presented summarized in this contribution, is a fundament to solution of problems of paleotectonic development of Alpine-formed units. The results of paleomagnetic investigations from the Eastern Alps, West Carpathians and Transdanubian Central Mts., presented in the last time (Selli, R. 1981, Márton, E., 1981, Márton, E. et al. 1987, Muška, P. — Vozár, J. 1987), contribute to solution of problems of paleogeographical development and Alpine tectonics, but at the same time point to different possibilities of their interpretation. One of the main problems is establishing of competence of the principal tectonic units to the northern or southern margin of the Tethys region (confr. Rakús, M. et al. 1989 in press). Assignment of the individual units of the East Alpine-West Carpathian belt to the northern or southern margin of the Tethys region is decisive in correlation of paleodirections with directions of the North European platform or African block (confr. Márton, E. et al. 1987). In our up to present works we correlated all the results of paleomagnetic investigations of Alpine-formed units of the West Carpathians with the statistically processed results from the North European platform only (Krs, M. 1982).

In interpretation of Late Paleozoic paleomagnetic directions of the West Carpathians the results from the correlation project IGCP-198 (Rakús, M. et al. 1989 in press) are determining for us. The units of the Inner West Carpathians are correlated with Austroalpine and ranged to North part of Apulia-African platform in sense of the quoted study. General paleotectonic development of the Eastern Alps and West Carpathians in the Mesozoic, the north-vergent shift of nappe units and pressing of spaces at the contact with units of the northern Tethys margin (Manín and Klippen belts in the West Carpathians) logically tempt to correlation of main paleodirections in relation to the North European platform (Fig. 1). From the whole complex of the observed units and their developments in the Alpine stage we choose the results achieved from Late Paleozoic sequences for correlation, which represent the Late Variscan stage and also were the basis for development of Mesozoic sedimentation areas. The Late Paleozoic, particularly in the West Carpathians, from the point of view of paleomagnetic investigation methods, is a suitable environment, mainly for the reasons of sufficient representation of well stratified volcanic-sedimentary formations.

Inner west Carpathian tectonic units

Tatricum — lithofacial analysis of the studied areas (Považský Inovec Mts. (2) and Malá Fatra Mts. (1)) assumes that both occurrences of the Upper Permian are associated with the formation of separate smaller sedimentation basins in the northern part of the Tatra-Veporide block (Vozárová, A. — Vozár, J. 1988). Declination deviations reflect the primary orientation of the basins. The different inclination deviations are likely to be due to vertical movements of individual sections of the Tatricum.

Veporicum — rather large values of angle α_{95} make difficult the interpretation of results from the northern part of Veporicum. If it is assumed that the studied occurrences of northern Veporicum units, NW-part of Veporské vrchy Mts. (5), Tríbeč Mts. (3), Staré hory Mts. (4), Branisko Mts. (6), reflect the facial evolution in smaller basins, the facies in the south exhibit negative and in the north positive declination deviations (Muška, P. 1987). Substantially larger inclination differences have been observed in south Veporicum units Slovenské rudohorie Mts.) where the "characteristic"orientation attains strikingly large values due to a greater mobility of the margin of the Tatra-Veporide block.

Hronicum — the original sedimentation space on southern margin of the Tatra-Veporide block (or between this block and Gemeride block) in the Upper Paleozoic underwent positive i. e. clockwise rotation. The unit was studied mainly in Malá Fatra Mts. (10), Malé Karpaty Mts. (9), Tríbeč Mts. (11), Nízke Tatry Mts. (12, 13) (Muška, P. 1985).

Gemericum — the differences in the lithostratigraphic development of the Upper Paleozoic of North (14, 15) and South Gemericum (16) units are characterized by a complex pattern of paleomagnetic directions due to different paleogeographic conditions in the two separate sedimentation areas (Muška, P. 1987). The data from both Gemeric units indicate a generally positive rotation in the Permian. The data from the upper parts (Permian-Triassic) (14, 16) reflect a negative rotation of the Gemericum as a whole. This motion is associated with the nappe vergence movement of the Gemericum to the north, especially with its thrust on the southern part of the Veporicum.

Eastern Alps

With taking over the results from units of the Eastern Alps (Márton, E. et al. 1987) similarly as in evaluation of the West Carpathians we set out from the results of IGCP-198 Project (Rakús, M. et al. 1989 in press). In correlation of the paleodirections are certain problems resulting from unequal processing of the units of the Eastern Alps. Sporadical, well correlable data are represented by Permian sediments from the area of Christofberg and Saalfelden (in Márton, E. et al. 1987). Other data from the quoted work

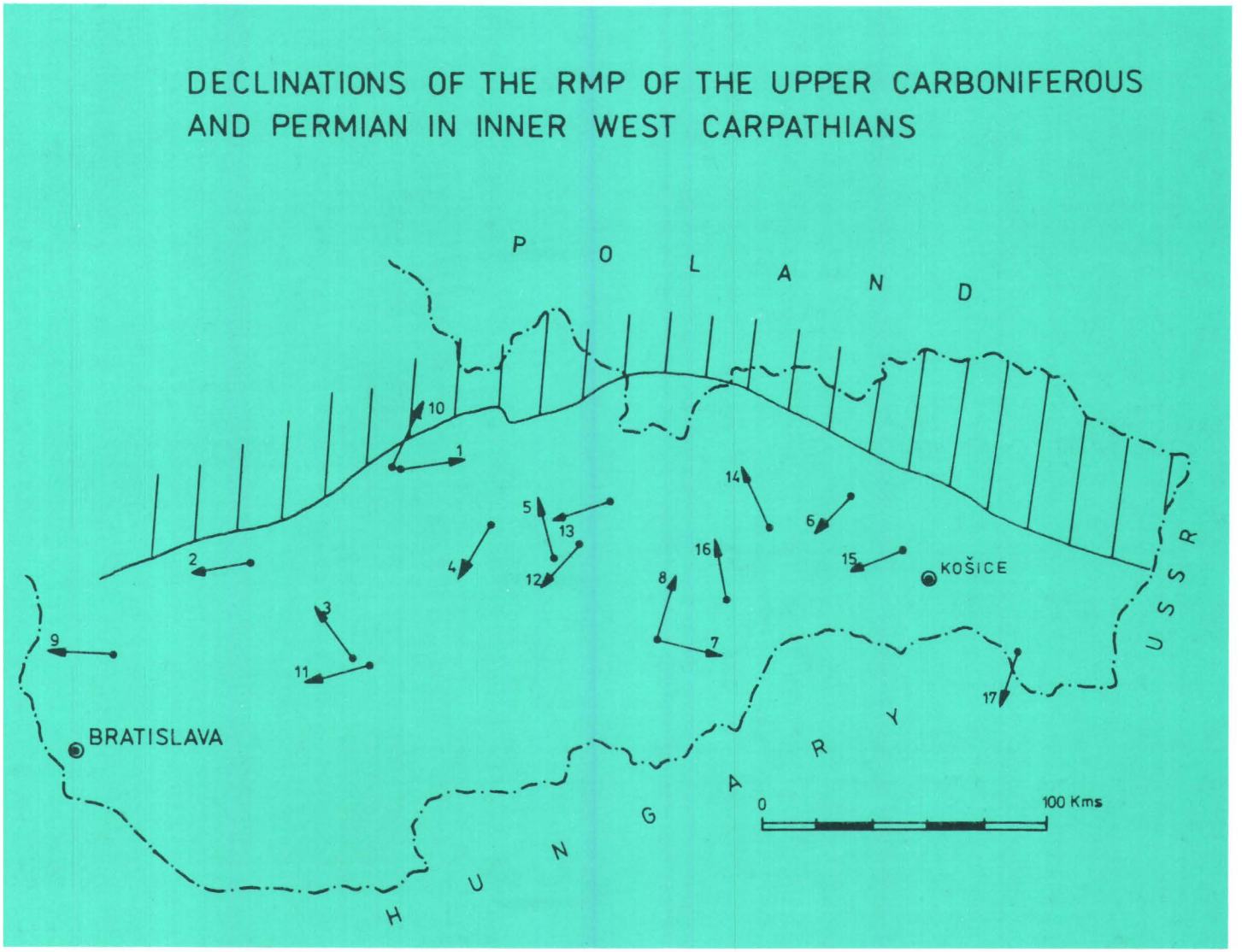

Fig. 1: Declination of remanent magnetic polarization (RMP) of the Upper Carboniferous and Permian of the Inner West Carpathians. Striped zone separates part of the Inner from Outer Carpathians. Numbers 1—17 mark studied orographic units of the West Carpathians and they are identical with numbers in the text (chapter Tectonic units of the Inner West Carpathians). Arrow marks the direction of declination RMP from present direction to the north.

cannot be used for correlation of the Eastern Alps-West Carpathians as they reflect proximity of the contact with the Southern Alps.

Tectonic breaking up (segmenting) of the Austroalpinicum units and their present-day position render the analysis of the measured paleodirection values difficult. From the values obtained from sporadical Permian sequences (Agnoli, Reisinger, Sopfel in Márton, E. et al. 1987) the prevailingly negative deviation of declination in the interval 80—90° in relation to the statistically calculated direction of the North European platform results.

In the West Carpathians the Permian sequences always display a positive deviation of declination, but the intervals of rotation are various for the individual tectonic units (Muška, P. — Vozár, J. 1987). This knowledge distinctly contributed to the paleogeographical analysis of the Late Paleozoic in the West Carpathians and to explanation of some phenomena of the Alpine nappe structure (Vozárová, A. — Vozár, J. 1988).

Particularly it may call attention to the identical direction of declination of Upper Permian sediments from the locality Saalfelden (Northern Alps) and locality Kamenná Poruba (Hronicum nappe) in the Malá Fatra Mts. (West Carpathians). Both display the direction of paleodeclination close to the calculated direction of the Permian of the North European platform. The mutual difference of their declinations is 3° and inclinations 3° too.

When compared with the Eastern Alps essentially more paleomagnetic data also with their interpretation are known from Hungary, from the Late Paleozoic of the Transdanubian Central Mts. (Márton, E. et al. 1987). The obtained values (confr. in lit. l. c.) display a systematic deviation of paleodeclination in the interval 40—80° in counter clockwise direction to the calculated direction of the Permian of the North European platform. Márton, E. (1981) compares this region with the calculated directions of the African platform and considers the Transdanubian Central Massif as a fragment of the African plate. From this view the mentioned directions (in Márton, E. et al. 1987) are manifested as positive deviations of paleodeclinations.

The paleodeclination directions of the West Carpathian Permian, compared with the values from the Transdanubian Central Mts., are shown considerably dispersed, corresponding to the complicated structure of the Alpine units.

Conclusion

In the analysis of paleodirections in the Eastern Alps, West Carpathians, Transdanubian Central Mts., obtained from Permian sequences, it may be pointed to the consid-

erable dispersion of values, mainly in areas with a complicated nappe structure. The Transdanubian Central Mts. are manifested as the most compact whole in relation to the units of the Eastern Alps and West Carpathians (Fig. 2). It is questionable whether comparison of the paleodirections from the Transdanubian Central Mts. in relation to the African platform is purposeful when we compare the units of the Eastern Alps and West Carpathians with the North European platform. For the analysis of the whole wider region of the Alpine-Carpathian belt unification of the methodical approach in interpretation may be recommended. A particularly sensitive approach is required at the north-vergent nappe units of the Eastern Alps and West Carpathians.

From our view we propose to carry out a confrontation of the results of paleomagnetic investigations from equivalent tectonic units of the Eastern Alps and West Carpathians on the basis of equal stratigraphic horizons and with general evaluation of the results to introduce also cooperation with Hungary, especially with stress laid on the particular tectonic position of units in the Szendrö, Bükk, Mecsék, Villány and Transdanubian Central Mts.

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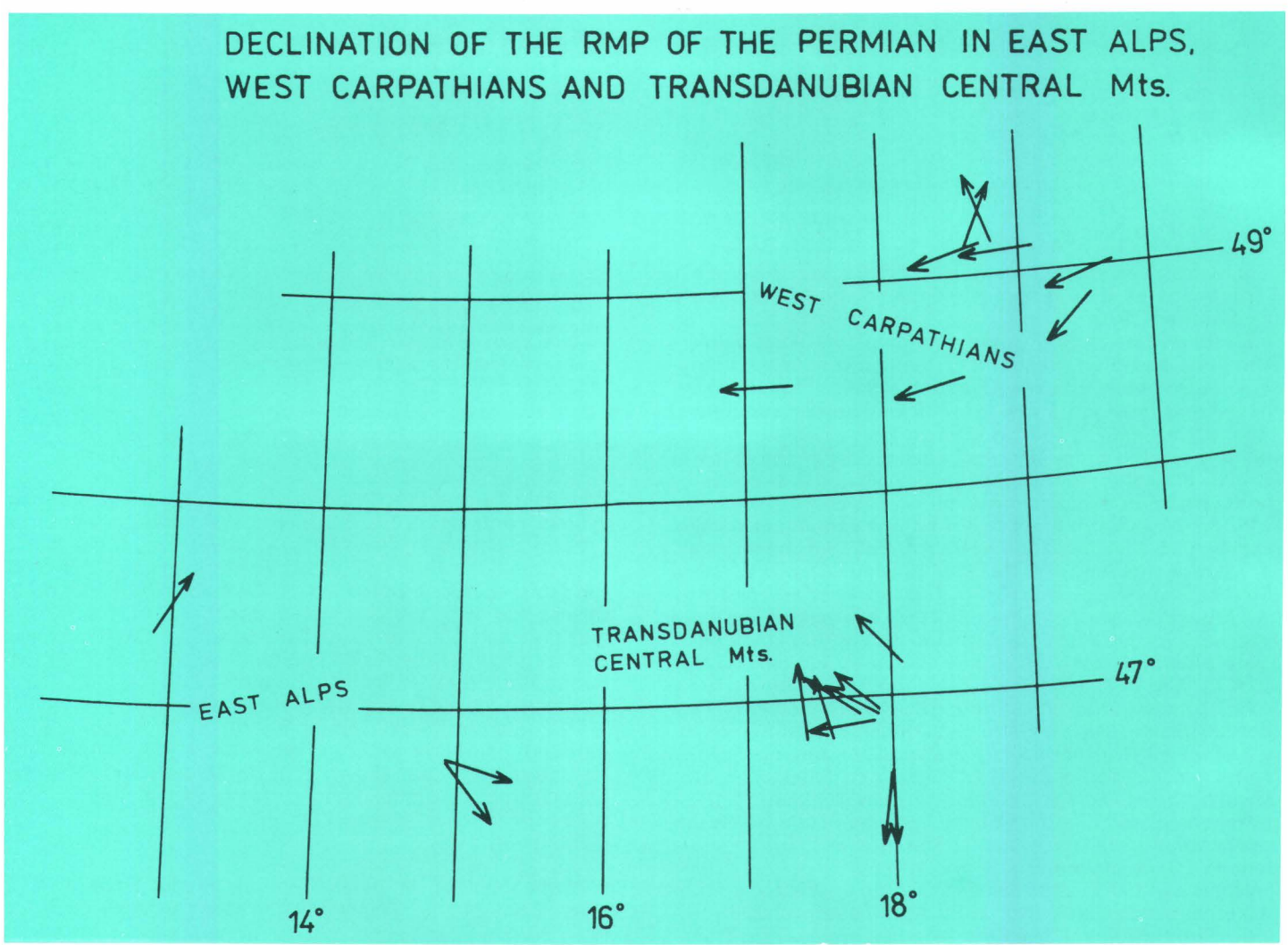
Abstrakt

Predložený článok diskutuje výsledky paleomagnetického výskumu z Východných Álp, Západných Karpát a transdanubického centrálneho masívu. Cieľom je prispieť k riešeniu otázok paleogeografického vývoja a alpínskej tektoniky, ktoré sú interpretované rôznymi autormi (Selli, R. 1981; Marton, E. 1981; Marton, E. et al. 1987; Muška, P. — Vozár, J. 1987).

Zusammenfassung

Im vorliegenden Beitrag werden Ergebnisse paläomagnetischer Untersuchungen in den Ostalpen, Westkarpaten und im Donau-Zentralmassiv erörtert, womit zur Lösung der Fragen der paläogeographischen Entwicklung und der alpinen Tektonik ein Beitrag geleistet werden soll, die von verschiedenen Autoren behandelt wurden (Selli, R. 1981; Marton, E. 1981;

Fig. 2: Declination RMP of the Permian in the Eastern Alps, West Carpathians and the Transdanubian Central Mountains. Arrows mark the direction of declination RMP from present direction to the north (from Marton, E. et al. 1987).



Hlavný problém pri ich interpretácii predstavuje príslušnosť hlavných tektonických jednotiek k severnému, alebo južnému okraju Tethys. Dôsledkom toho je potom aj korelácia smerov remanentnej magnetickej polarizácie so štatisticky spracovanými smermi príslušnej stratigrafickej úrovne severoeurópskej, alebo africkej platformy. Mladopaleozoické jednotky Západných Karpát sú vzťahované k severnému okraju Tethys a logicky korelované s paleosmermi severoeurópskej platformy a vykazujú rotácie v smere hodinových ručičiek, na rozdiel od výsledkov z transdanubického centrálneho masívu, ktorých rotácie v smere hodinových ručičiek sú vzťahované k africkej platforme.

Marton, E. et al. 1987; Muška, P. — Vozár, J. 1987). Das Hauptproblem der Interpretation besteht in der Zugehörigkeit tektonischer Haupteinheiten entweder zum Nord- oder zum Südrand der Tethys. Demnach werden auch Richtungen der remanenten Magnetisierung mit statistisch bearbeiteten Richtungen vom entsprechenden stratigraphischen Niveau der Nordeuropäischen bzw. der Afrikanischen Plattform korreliert. Die jungpaläozoischen Einheiten der Westkarpaten werden auf den Nordrand der Tethys bezogen, und ihre Rotationen im Uhrzeigersinn mit den Paläorichtungen der Nordeuropäischen Plattform korreliert, zum Unterschied von Ergebnissen aus dem Donau-Zentralmassiv, dessen Rotationen im Uhrzeigersinn auf die afrikanischen Richtungen bezogen werden.

THE MIROSLAV HORST — MOLDANUBIAN KLIPPE OR AUTOCHTHONOUS MASSIF

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Introduction

An old enigma exists in the tectonic interpretation of the Miroslav (Misslitzer) horst at the eastern boundary of the Bohemian Massif (Fig. 1). The horst itself is in its southern part formed by typical Moldanubian granulites and amphibolites (Dudek, 1963; Němec, 1980). In the northern continuation of the Miroslav horst mostly Moravian and probably also Brunnian rocks crop out.

Three totally different units (terranes) existing at the eastern boundary of the Bohemian Massif — catazonal Moldanubicum, mesozonal Moravicum and Brunnia deformed and sheared basement — occur in the very small and complicated territory of the Miroslav horst together. The Miroslav horst is bounded by the Diendorf (Boskovice) fault in the west and by the Miroslav fault in the east.

Because the horst is situated east of the Boskovice furrow, tectonic problems of the emplacement of the Moldanubian and Moravian complexes have existed since the end of the last century. Suess (1912) considered Moldanubian relicts as tectonic remnants of the huge "Moldanubische Überschiebung". Following the Austrian and Czech workers (Preclik, Zapletal etc) the Miroslav horst was interpreted in a similar manner until Dudek (1963) proposed that the Moldanubicum could be autochthonous in the Miroslav horst.

Several years ago we prolonged one Carpathian foredeep seismic line (287A/84) to the West and passed the Miroslav horst (Figs. 1 and 2). The field technique employed to obtain the seismic reflection data examined at Geofyzika Brno was standard VIBROSEIS practices used for oil exploration. The compressional wave source in this survey consisted of three vibrators operating synchronously and transmitting a sweep signal with the frequency varying linearly from 15 to 60 Hz. The duration of each sweep was 11 s with the total recording time of 14 s, resulting in 3 s of correlated reflection data. A 48-channel recording system was used with a 25-metre station spacing, producing offset of 1 175 m. Vibrating every second station resulted in nominal 12-fold data.

Interpretation

The section displayed (Fig. 3) is not migrated, and so dipping reflections on the time sections are not in their true positions. A final geologic section (Fig. 7) is constructed using hand migrations of more than 40 reflections. In this short contribution I will concentrate on the Miroslav horst itself between km 3.8 (the Diendorf fault) and km 8 (the Miroslav fault).

In Fig. 3 we see the line drawing of the unmigrated time section. Reflections B and C are strongly inclined (35° — 38°) after hand migration. I consider them thrust faults features (duplexes) beneath the 1 km Moldanubicum overthrust fault. These duplexes are typical of deformed Brunnia rocks elsewhere in the Brno Massif. Because south of the horst the Culm rocks have been drilled (Batík, Skoček 1981), which are always deformed together with the Brunnia rocks, this hypothesis seems to be reasonable.

In the upper part of the section I interpret the easterly dipping reflections D as Moldanubian overthrust over the Brunnia complex. This hypothesis is supported by migration of seismic data, gravity interpretation and mainly by structural geologic observations.

The hand migration of the reflections enabled us also to observe that no reflections cross steeply the Diendorf and Miroslav faults. These faults behaved probably during the post-collisional Upper Carboniferous — Lower Permian times as left lateral strike-slip faults bringing southern blocks to the North.

In that case, the Miroslav horst was probably present during the collisional thrusting between the Moldanubicum and the Brunnia in the direction opposite to the central part of the Thaya window. Němec (1980) noted that the Miroslav granulites are more similar to the Austrian than to the Moravian ones, which is in favour of our hypothesis.

Conclusion

The final simple geologic section (Fig. 4) illustrates the view presented above. Amphibolite bodies have been interpreted from the gravity data. Beneath the Moldanubian overthrust, the Brunnia (with Devonian and Culm sediments) rocks are strongly sheared and tectonized, and form typical duplexes mapped geologically in other places. The western and eastern segments west and east of the Diendorf and Miroslav faults are similar. Significant thrusting

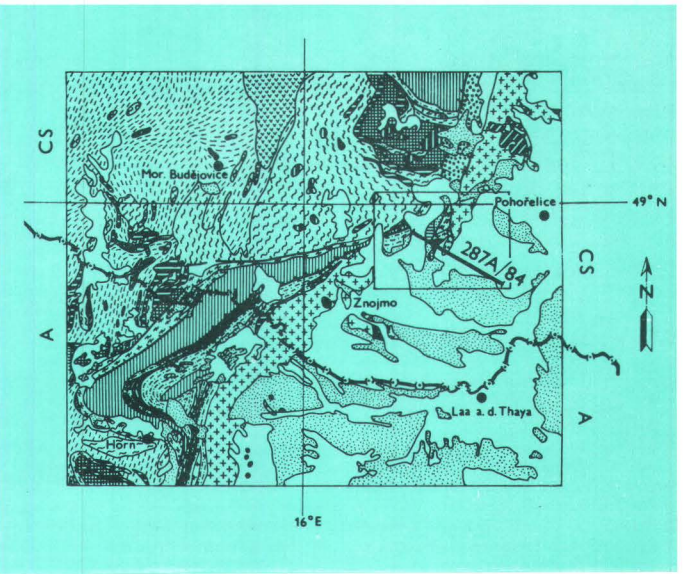

Fig. 1: Simplified geological map of the eastern boundary of the Bohemian Massif between Horn and Pohořelice with the position of the seismic line 287A/84.