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Abstrakt

Podloží vídeňské pánve je rozděleno SV linií na dvě základní zóny: vnější flyšovou a vnitřní vápencovoalpskou. Magurský flyš se dále skládá ze dvou jednotek. Vnější z nich má v moravské části račanský příkrov, který je na struktuře u Týnce překryt greifensteinským příkrovem. Týlová část je v rakouském území zastoupena kahlenberským příkrovem a jeho šupinami. Vnitřní část flyšové zóny je charakterizována bělokarpatským a laabským příkrovem. Týl tvoří pieninské bradlové pásmo. Vápencovoalpskou zónu lze rozdělit na tři jednotky. Vnější s frankenfelsko-lunzským šupinovým systémem je oddělena gießhübelskou paleogenní depresí od střední zóny s ötscherským (göllerským) příkrovem. Vnitřní zóna s vyššími alpínskými příkrovy je ohraničena glinzendorfskou křídovou depresí.

Zusammenfassung

Der alpin-karpatische Untergrund des Wiener Beckens erstreckt sich über österreichisches und tschechoslowakisches Gebiet mit den Einheiten der Waschberg-Ždánice-Zone, des Flysches, der Kalkalpen und der zentralalpin-tatriden Zone. Seit der Erschließung desselben ab den 60er Jahren wurde getrachtet, die Gegebenheiten im Untergrund einerseits mit den Beckenrändern und andererseits über die Grenze hinweg zu verbinden. Das Ergebnis dieser Kompilation wird in vorliegender Arbeit zusammengefaßt. Es werden die wesentlichen Strukturelemente und Brüche an der Neogenbasis in Zusammenhang gebracht, der Verlauf der alpin-karpatischen Teileinheiten in einer gemeinsamen Karte und in Profilen dargestellt und eine Analyse der Stratigraphie und tektonischer Zuordnungsmöglichkeiten vorgenommen. Damit wurden die Ansatzpunkte weiterer Untersuchungen und Explorationsmöglichkeiten im Untergrund des Wiener Beckens gegeben.

PALEOMAGNETIC INVESTIGATIONS IN THE CENTRAL PART OF THE BOHEMIAN MASSIF (Barrandian)

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Introduction

During the IAGA-meeting in Praha, three institutes agreed on a comparison program on red silicites of the central part of the Bohemian Massif; so called Barrandium. These institutes were Rennes in France, Geofyzika Brno in Praha and Gams, Mining University Leoben, Austria. The target was a reliability test of individual investigations on the same material. The silicites of the Barrandium were chosen, since earlier investigations of M. KRS (1976) had established a multicomponent origin of the natural remanent magnetization (NRM). The new development of thermal cleaners in Praha and Gams seemed to be a good start of testing this equipment.

Geology of the Investigated Area

The central part of the Bohemian Massif the Barrandian, is divided into at least three different basins. These basins were formed during the cadomian orogeny. A complete sequence of Ordovician, (Tremadocian to Ashgillian) volcano-sedimentary rocks from these basins was described by V. HAVLÍČEK (1980). The age of the rocks is dated by micro- as well as macrofossils. From this sequences the Upper Tremadocian Milina formation was chosen for this work. The rocks are light to dark red silicites, of different grain sizes. Haematite of different particle size and concentration can easily be found in the ore microscope. Beside haematite, goethite and magnetite can be found, and particularly proved by rockmagnetic tests.

Sampling

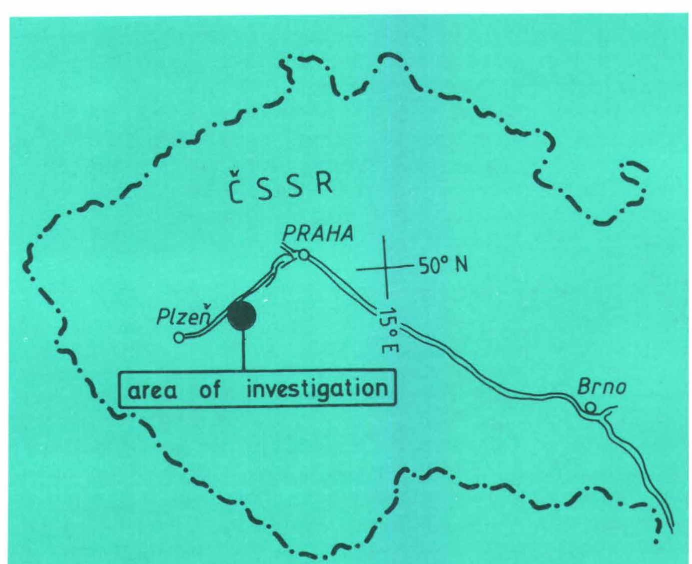
The sampling was done by drilling machines in three occurences. The first was a quarry, north of the road from Komárov to Jivina. 13 cores were taken.

The second was an outcrop along the river Jalový, close to a small bridge. Four sites with six cores each were taken. The third outcrop was near the school in the village Zaječov. Three sites with six cores each were taken there. The cores were very difficult to drill because of the hardness, and were cut into 22 mm long samples.

Rockmagnetic experiments

It was decided from the beginning to demagnetize every individual sample stepwise, in order to find as many details as possible of the magnetization. Since M. KRS's (1976) paper it was well known that a more-component magnetization had to be expected. All that one needs is a thermal cleaner with a magnetic vacuum as good as possible. For the laboratory in Gams, a new system was developed. The samples are placed around a reference sample in a MU-metal shield, which is placed in a Helmholtz coil system. The oven is moved in and out of the shield. The advantage is the permanent position of the samples in the shield, throughout the whole heating and cooling procedure. Up to

Fig. 1: Geographical sketch map of the sampling area.



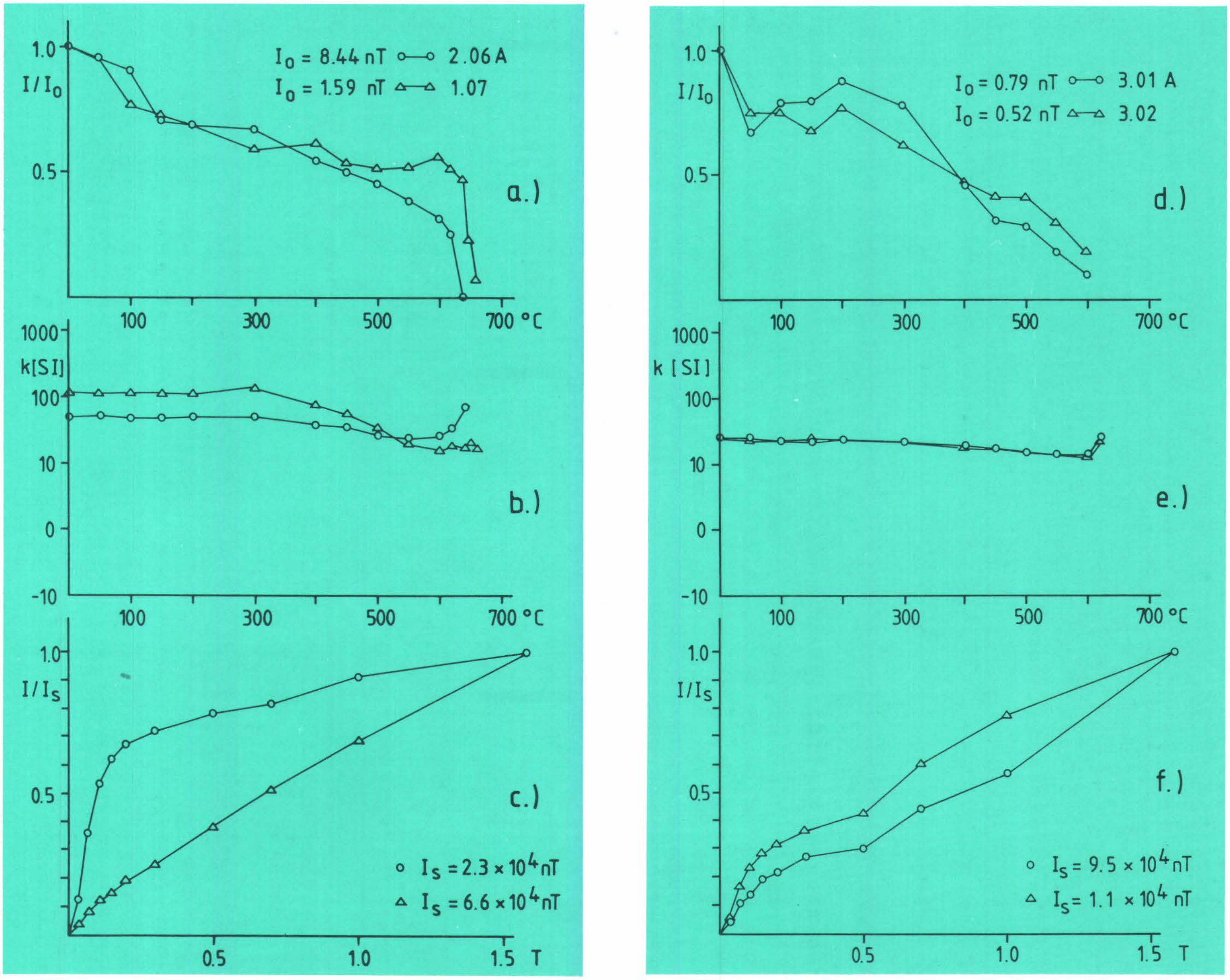


Fig. 2: *a.* normalized intensity of group 1, *b.* susceptibility of group 1, *c* saturation acquisition of group 1, *d.* normalized intensity of group 2, *e.* susceptibility of group 2, *f.* saturation acquisition of group 2, *g.* normalized intensity of group 2, *h.* susceptibility of group 2, *i.* saturation acquisition of group 2.

30 samples can be cleaned at once in a restfield of ± 2 nT.

Similar to M. KRS (1986) this cleaning procedure established 4 groups of cleaning behaviours: In the normalized intensity curves the first group (Fig. 2a—c) shows a small influence of Goethite up to 150 °C. Above that, there exists a plateau up to about 550 °C in case of sample 1.07. The susceptibilities show an oxidizing effect above 450 °C, in case of sample 2.06 A an increase above 600 °C. This is thought to be due to a new formation of magnetite during boiling off the oxygen in this temperature range. Similar to the intensity curves, the saturation acquisition curves show a strong dependence on the particle size of haematite. In the curve for sample 2.06 A, there could also be a weak influence by magnetite up to about 0.3 T.

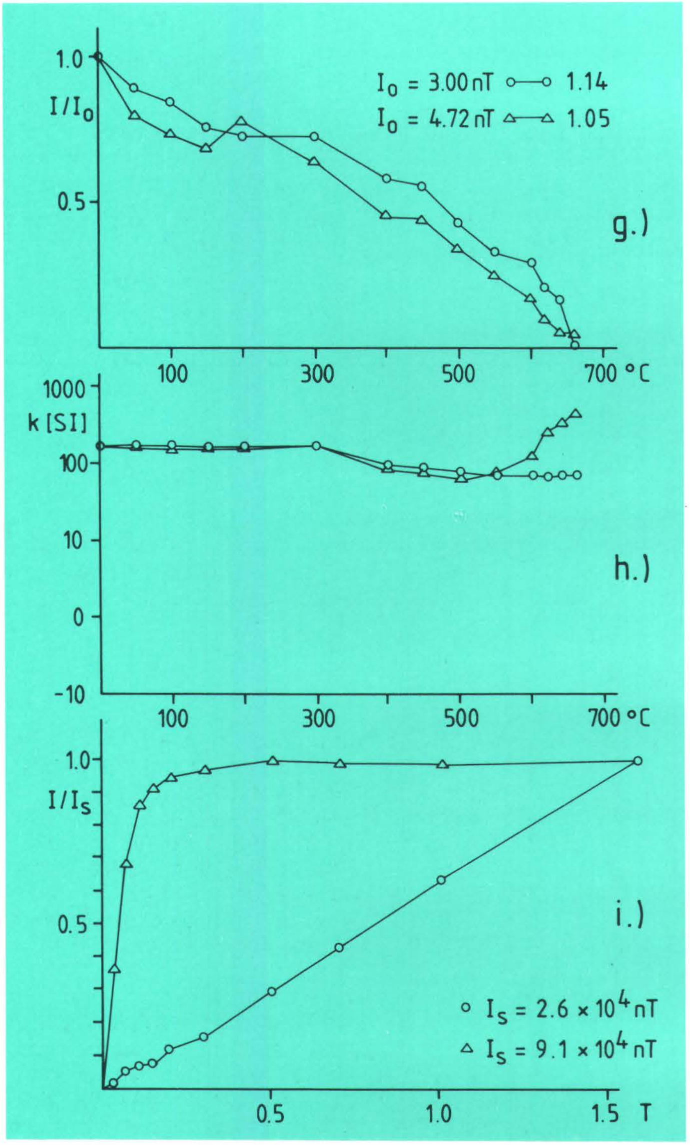
The second group is characterized by a stronger influence of magnetite. After a weak influence of Goethite the intensity curves (Fig. 2d—i), show magnetite up to about 450 °C—550 °C. The susceptibility remains stable up to 600 °C. The saturation curves prove the influence of magnetite, beside the dominating behaviour of haematite. In the case of sample 1.05, magnetite is obviously dominating. Above 600 °C this sample shows again a new formation of magnetite from the small haematite content shown in Fig. 2g and Fig. 2h.

The third group shows a characteristic influence of Goethite at the beginning, and a flat plateau up to the blocking temperature for haematite. Again in sample 2.02 A an increase of the susceptibility (Fig. 3) above 450 °C can be seen. The decrease of the susceptibility in the other cases, indicates a weak oxidizing process, which is thought to be due to a small content of secondary magnetite.

The fourth group demonstrates a stable plateau up to about 300 °C. Above a drop down in the intensity can be noticed and understood as wide range of blocking temperatures. Whereas the intensity curves don't show very clearly the presence of magnetite, this is proved by the saturation acquisition.

With these rockmagnetic properties of the rocks in mind one can start to interpret the remanence directions. To show these NRM-directions, a modified Zijderveld diagram (1967) was used. Instead of plotting x, y and z the declination and the inclination were plotted in dependence on the normalized intensity.

The two diagrams for the group one clearly demonstrate the distinct difference in the magnetization history, even when rockmagnetic results are very similar. The example of sample 1.07 in Fig. 4a, shows a four component magnetization; from NRM—100°; 100°—400°; 400°—600° and 600°—660°. Sample 2.06 A, the example of sampling site 2, shows



more or less a two component magnetization; NRM — 550° and 550° — 640°. The scatter in the declination results from the very steep inclination in the bedding corrected state.

The samples of group two, 1.05, 1.14, 3.01 A, 3.02 show again very different magnetization histories. Sample 1.05 in Fig. 4c shows a two component magnetization from NRM to 300 °C, resp. 620 °C.

Sample 1.14, from the same site than the previous ones, shows a three component magnetization; from NRM to 300°; 300° — 620° and 620° — 660°. Whereas the first two components show positive inclinations, which are due to overprints, the high temperature component becomes negativ. The very last vector seems to be primary since it is in a suitable arrangement with other reliable samples.

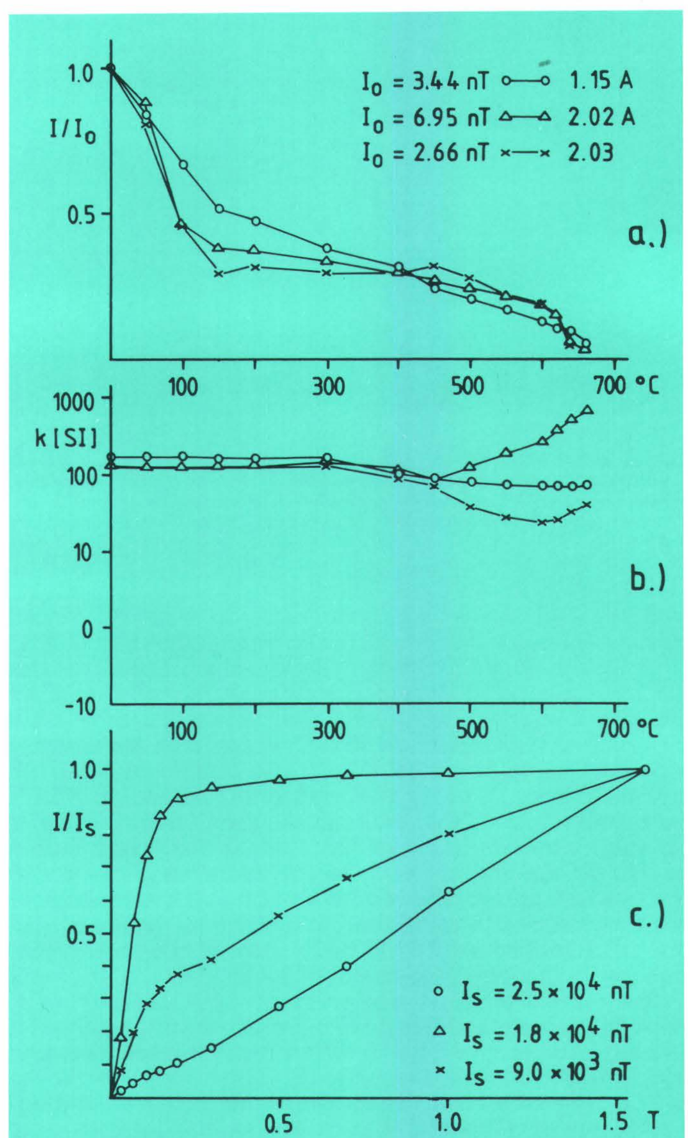
Group three, represented by the samples 1.15, 2.02 and 2.03, again proves the multicomponent magnetization. All samples show at least three components. Whereas 1.15 in Fig. 5a and 2.03 in Fig. 5c show a very soft viscous component at the beginning, sample 2.02 in Fig. 5b remains stable up to about 200 °C. The viscous component is thought to be carried by very coarse grained magnetite since the saturation acquisition curve clearly indicates magnetite at the beginning. An exception is sample 1.15 where only haematite can be seen. The viscous influence in this case seems to be due to Goethite.

The high temperature component, comes close to upper Paleozoic directions in the Variscan of Europe except the last one or two points.

Name	Treatment °C	F_{Dec}	F_{Inc}	B_{Dec}	B_{Inc}	Int.
1.08A	NRM	204.1	-38.4	200.3	-37.4	1.11
1.08A	T 50	210.5	-29.6	207.7	-29.2	0.91
1.08A	T100	210.9	-38.2	207.0	-37.8	0.84
1.08A	T150	205.4	-41.3	201.1	-40.5	0.77
1.08A	T200	200.0	-44,2	195.4	-42.8	0.67
1.08A	T300	166.2	-52.4	162.2	-48.7	0.44
1.08A	T400	95.4	-7.2	95.6	-2.8	0.33
1.08A	T450	82.8	-1.1	82.7	+2.7	0.30
1.08A	T500	66.6	-7.4	67.1	-4.6	0.22
1.08A	T550	32.3	+22.3	30.2	+22.2	0.26
1.08A	T600	40.4	+2.7	38.3	+23.2	0.27
1.08A	T620	24.0	+26.1	21.6	+25.2	0.29
1.08A	T640	23.9	+39.2	19.9	+38.3	0.25
1.08A	T650	31.3	+17.3	29.7	+17.1	0.14

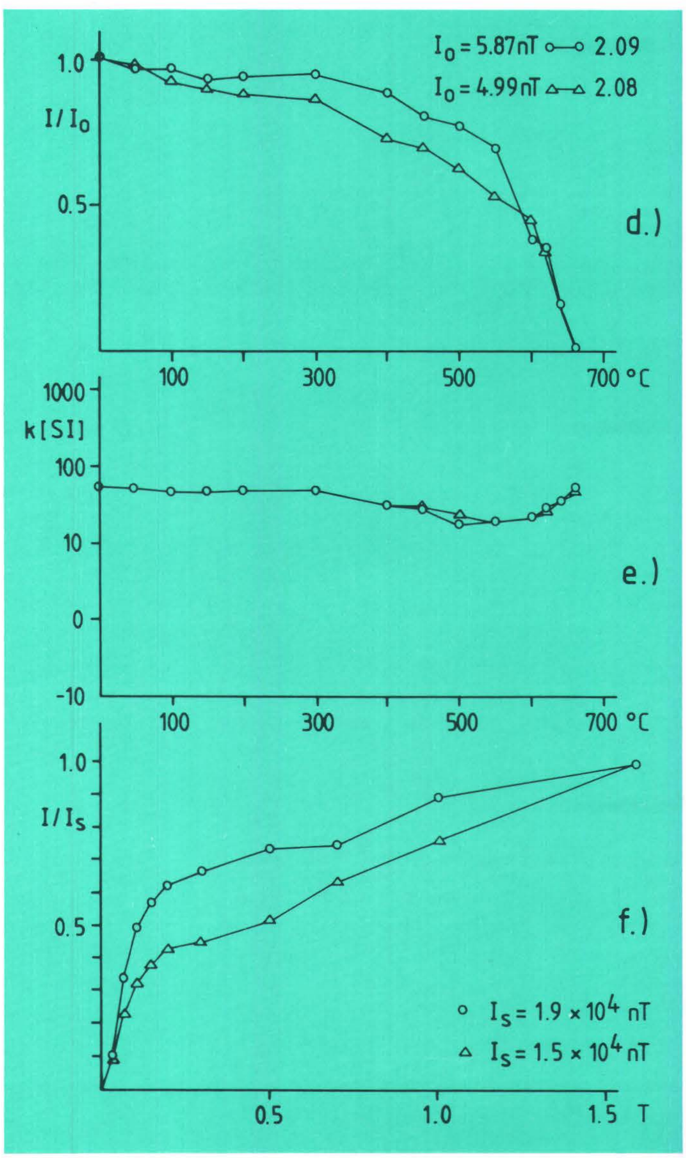
Tab. 1: Demagnetization steps of a typical sample of site 1 (Fig. 6a).

Fig. 3: *a.* normalized intensity of group 3, *b.* susceptibilities of group 3, *c.* saturation acquisition of group 3, *d.* normalized intensity of group 4, *e.* susceptibility of group 4, *f.* saturation acquisition of group 4.



Study	Lithology	Geographic Coordinate		Paleomagnetic Direction tectonic corrected		α'_{95}	k	n	Paleomagnetic Poleposition	
		Lat	Long	Dec	Inc				Lat	Long
Krs et al. 1986	red silicites	49.75	13.63E	126.7°	-41.7°	3.63°	24.8	64	41.52S	91.82° E
this study calculated	red silicites	49.75	13.83E	131.0	-32.0	11.7	13	13	38.8S	82.1E
large circle reconstruction				150	-22					
overprinted direction for sampling site 2	red silicites	49.75	13.83E	56.0	58.0	16.5	11.5	8	49.3N	97.1E
site 2 at 600° C		49.75	13.83E	126.1	-36.7	10	31.7	8	38.55N	89.33E

Tab. 2: Calculated paleomagnetic directions for the Milina formation (sampling site 1).
The direction, observed by large circle reconstruction is shown as well as the overprinted direction of sampling site 2.



The fourth group with hard magnetic properties is represented by the samples 2.08 and 2.09. Again a three component magnetization can be seen (Fig. 5d and 5e), from NRM to 300°, 300° — 550° and 550° — 660°. The low temperature component could be carried by magnetite, which is proved as well in intensity as in the saturation acquisition curve. Haematite, mostly finegrained, carries the high temperature components. These components are very close to present earth field again. A recent overprint has therefore to be expected.

Summarizing these results, one can clearly notice that sampling sites 2 and 3 are strongly to completely overprinted. Whereas in site 2 mainly the direction close to the present earth field can be seen, site 3 shows random distribution within this small occurence. All samples clearly show large circle behaviour (Tab. 1) during cleaning, which again proves multicomponent magnetization (Fig. 6b). Furthermore it can be seen, that a certain cleaning temperature for all samples would be unsuccessful. In looking carefully through all individual samples, one can find two main directions, one in the first quadrant with positive inclination and one in the second with negative inclinations (Tab. 2).

Tab. 3: Chosen vectors which are thought to be primary.

Name	Temperature range	F_{Dec}	F_{Inc}	B_{Dec}	B_{Inc}
1.01	0 — 300°	105	−17	105	−11
1.06')	450 — 600°	149	−41	147	−35
1.08	0 — 300°	166	−52	162	−49
1.10	0 — 300°	135	−28	135	−23
1.11')	200 — 550°	124	−60	124	−55
1.12')	100 — 300°	133	−47	132	−42
1.14	660°	178	−23	173	−18
1.18	100 — 450°	123	−12	123	0
1.22')	100 — 550°	132	−52	129	−40
1.23')	500 — 620°	121	−42	121	−30
1.24')	400 — 450°	128	−26	127	−14
1.25')	300 — 450°	114	−54	115	−42
1.26')	300 — 500°	113	−44	114	−32

') The direction always remains in the second quadrant with negative inclinations.

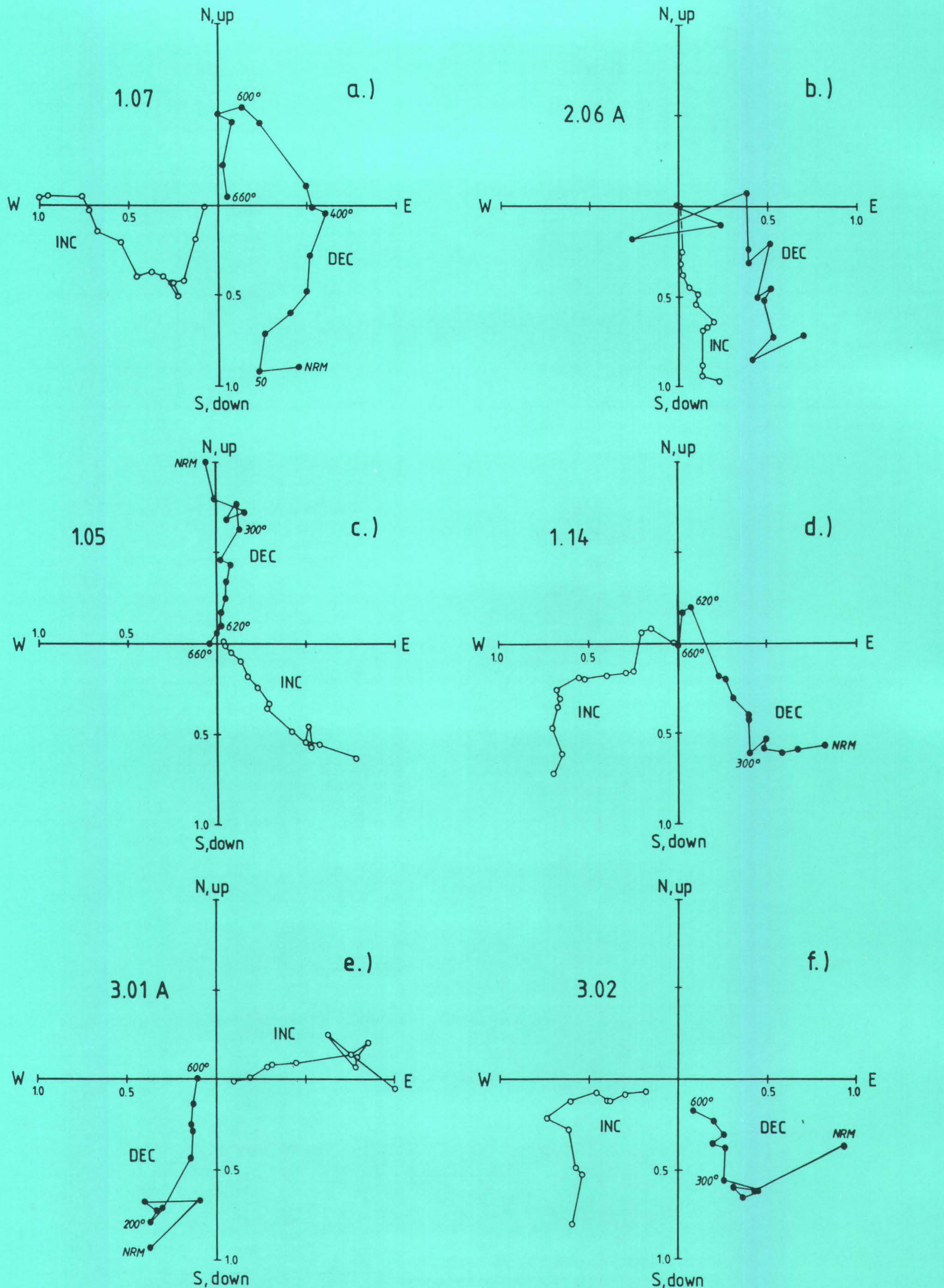


Fig. 4: Modified Zijderveld diagrams of group 1 and 2.

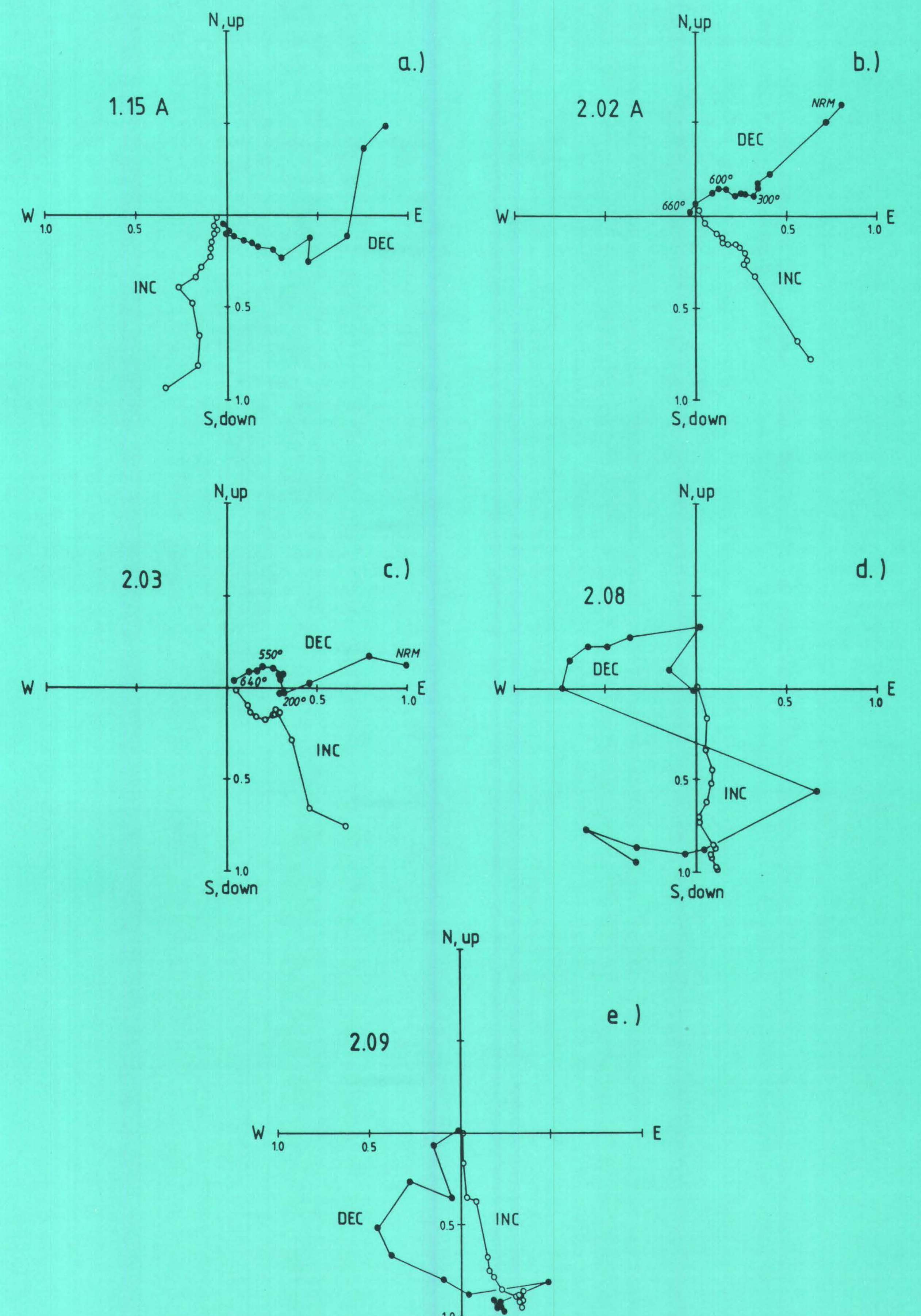


Fig. 5: Modified Zijderveld diagrams of group 3 and 4.

Whereas the directions in the first quadrant seem to show a certain affinity to the present earth field in the field coordinate system, the second group is well documented to be of possible primary origin.

Interpretation and conclusion

Starting with the worst outcrop this is outcrop 3 near the school in Zajecev. In this case 3 sites with 6 samples were drilled. The samples within an site as well as the site means between each other, show random distribution. No meaningful average direction was found. The sampling point 2 occurs strongly overprinted in a recent earth field. Again no primary information was found. Only sampling spot one, the quarry north of the road from Komarov to Jivina, seems to be suitable to carry some primary information.

The interpretation was tried in two ways; firstly by great circle reconstruction and secondly by collecting direction intervals of the individual sample. The large circle reconstruction (Fig. 6b) gives the primary direction as pole of the large circle through all the large circle poles of the individuals. The scatter of the individual poles is quite high, because of the different extent of overprinting in the individuals. This depends on the chemical composition and in particular on the grain size distribution in case of monomineralization of haematite. The observed magnetite is understood as secondary mineralization, occurring through the variscan orogeny. As one can easily see (Tab. 2), the direction observed by large circle distribution, occurs shallower and more clockwise deviated, compared with the calculated one and M. KRS's direction. The reason may be, that short vectors are lost in this reconstruction. That was the same with the line find technique.

Individual collected vectorparts (Tab. 3) resulted a reliable mean direction for sampling site 1, which is more or less indentical with M. KRS's result.

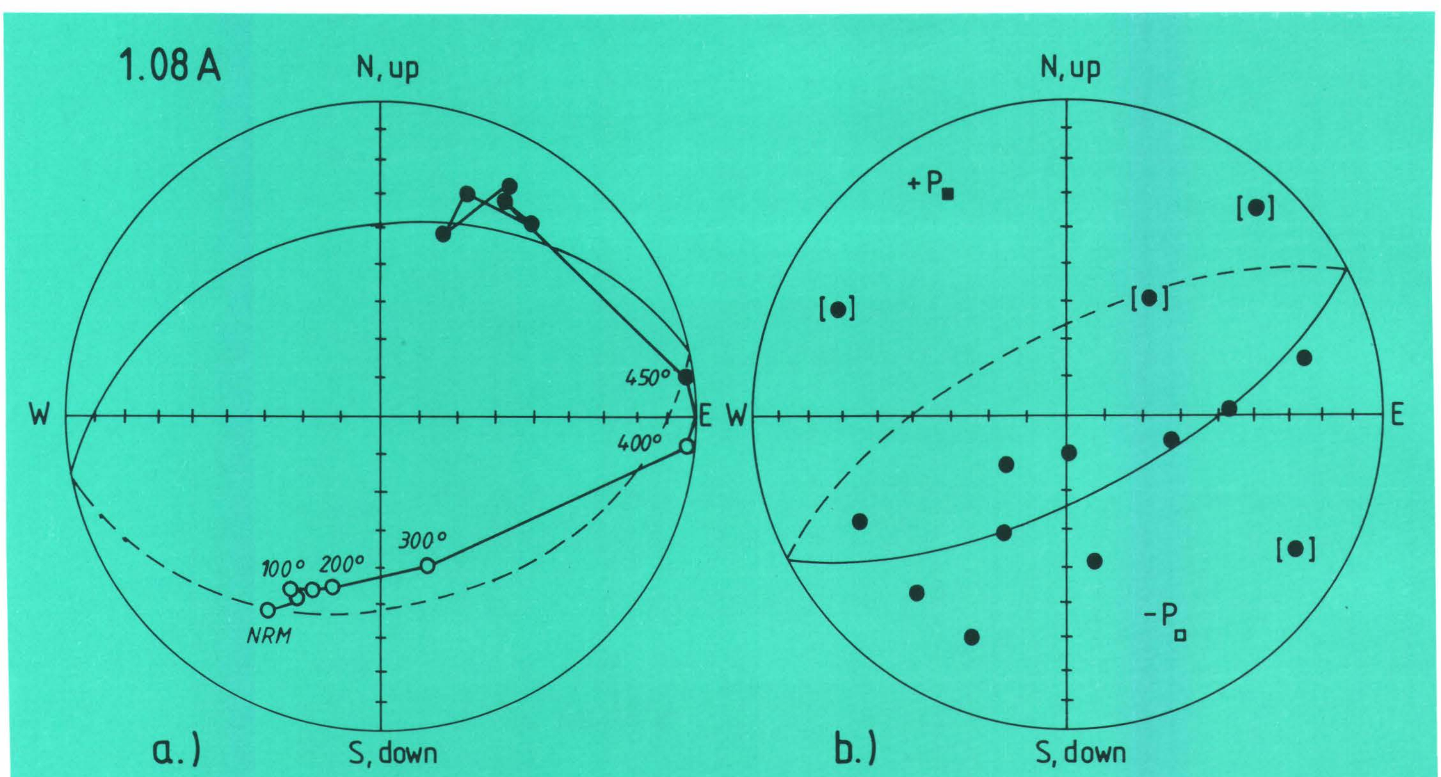
Fig. 7: Tectonic corrected sample directions during cleaning for all three sampling sites. In the right column just the field corrected directions are given. T 50—620 means cleaning temperature. F_{corr}- means directions in the field coordinate system; B_{corr}-means directions after tectonic correction. ▶

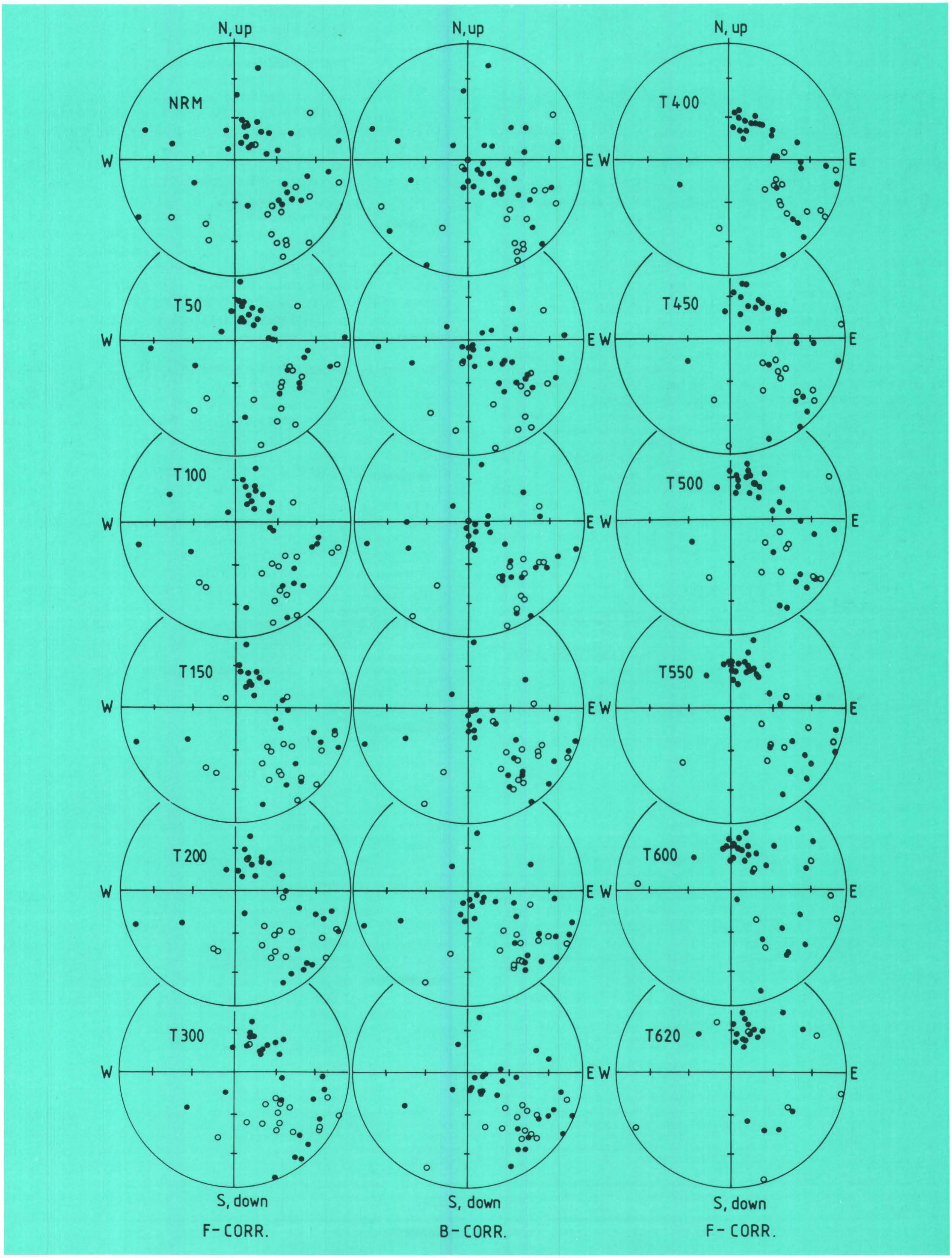
Whereas the direction without an asterisk (Tab. 3) occur a bit speculative because of the short interval and the low temperature, the ones with an asterisk seem to be very reliable. They remain in the same quadrant throughout the whole cleaning procedure (Fig. 6).

Looking at the poleplots, where all three occurences are shown, a decrease in scatter with increasing temperatures can easily be noticed. The grouping of negative inclinations belong to site 1, the ones with positive inclinations to site 2. The scattering points belong mainly to site 3. At about 300 °C the scatter of the inverse directions seem to be a minimum i. e. after eliminating softer overprints. The scatter in the positive directions is further decreasing and reaches a minimum at about 600 °C. In this range it can easily be seen that the direction groups very well around the present earth field in the field coordinate system, whereas the tectonic correction deteriorates the result. An overprint in the present earth field is proved. The stable inverse direction of site 1 keeps around a fixed position, but with increasing scatter, which is again due to the broad variety of particle sizes of the carrier mineral. One can conclude that multicomponent magnetization can deliver reliable paleomagnetic results, if one has the opportunity to use a reliable thermal demagnetizier. Not automatic interpretation techniques, but individually collected vector directions are the basis of a successful interpretation.

The paleogeographic interpretation was given by M. KRS et al. in 1986, since he was using 26 sites instead of three as in this comparison.

Fig. 6: *a.* Typical large circle behaviour of a sample of site 1. *b.* Large circle reconstruction of a primary magnetization




N, up
N, up
N, up
W
E W
E W
E
NRM
T50
T100
T150
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T300
T400
T450
T500
T550
T600
T620
S, down
S, down
S, down
F- CORR.
B- CORR.
F- CORR.

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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