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Olivine tholeiites of the North German-Polish depression — sign for an initial rifting?[1]

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(3 figures and 1 table in the text)

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Оливинические толеиты северной части Гемерско-польской депресии — свидительство инициального рифтинга?

Пермские простые толеииты (нормативный оливин) северной части Германско-польской депресии были пробурены скважинами на глубине 2—4,5 км. И вопреки тому, что они расположены в континентальной среде, имеют черты низкокалиевых толеиитов океанического дна, или толеиитов среднеокеанических хребтов. Являются продуктом начальной фазы рифтинга континентальной среды.

Olivine tholeiites of the North German-Polish depression — sign for an initial rifting?

Permosilesian primitive Ol-normative tholeiites of the North German-Polish depression were penetrated by bore holes (depth 2—4,5 km). Even situated within continental environment, basalts have features of low-K tholeiites of the ocean floor or those of MORB. Being products of beginning stage of continental rifting, which does not reach mature stage.

A volcanic series of olivine basalts with extreme substantial features has been discovered by boreholes in the northern part of the North German-Polish depression (North Mecklenburg). These tholeiitic rocks belong to a succession of Permosi-

[1] This contribution is likewise connected with investigations to IGCP — Projekt № 86: Eastern European Platform (S. W. border).

lesian greywacks, sillstones and sandstones as well and have been found in a depth of 2 to 4.5 kilometers.

The basalt bodies predominately form sills, a smaller part erupted subaeric as lavaflows. The summarized thickness of all volcanics in the profile may amount up to 1000 meters. Two main structural varieties occur, aphyric (fine to small grained) and plagioclase porphyritic, both ophitic to poikiloophitic and frequent amygdaloidal.

These rocks are situated within an about 30 kilometers wide fault zone in

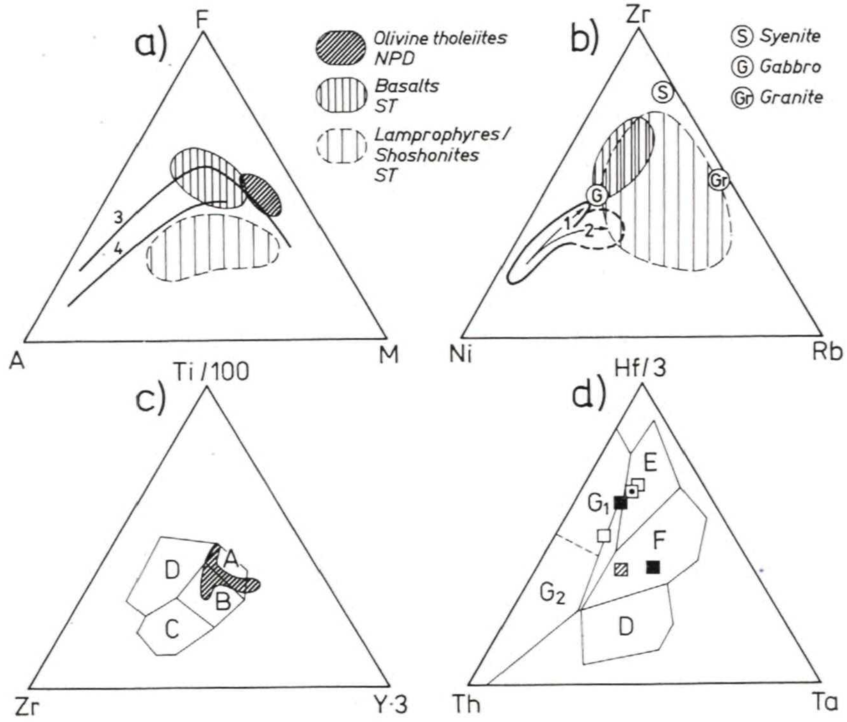

Fig. 1. Petrochemical and trace element diagrams of olivine tholeiite. The hatched fields represent 20 samples (olivine tholeiites), 30 samples (basalts, ST) and 60 samples (lamprophyres) shoshonites). NPD — North German-Polish depression; ST — Saxothuringian zone)

a) A-F-M diagram with distinctive lines tholeiites/calc-alkalic basalts after Irvine — Baragar, 1971, (3) and calc-alkalic basalts/alkalic basalts after Baker — Arth, 1976, (4). The olivine tholeiites of NPD are significant discriminated from other Permosilesian basaltoid rocks,

b) Ni-Zr-Rb diagram for basaltoid rocks of Permosilesian. The well discriminated olivine tholeiites show trends for aphyric (1) and porphyric (2) varieties,

c) discrimination diagram after Pearce — Cann (1973),

d) discrimination diagram after Wood (1983). Legend cf. fig. 2.

A + B — "low-K" basalt
B — "ocean floor" basalt
C + D — "calc-alcalic" basalt
D + — "within plate" basalt

E — "normal" type MORB
F — "enriched" type MORB
G — destructive plater margin basalts
G_1 — primitive arc tholeiites
G_2 — "calc-alkalic" basalts

continental environment in the western border of the Eastern European Platform. Already during Late Carboniferous this fault zone included considerable depression areas (Rost — Schimanski 1967).

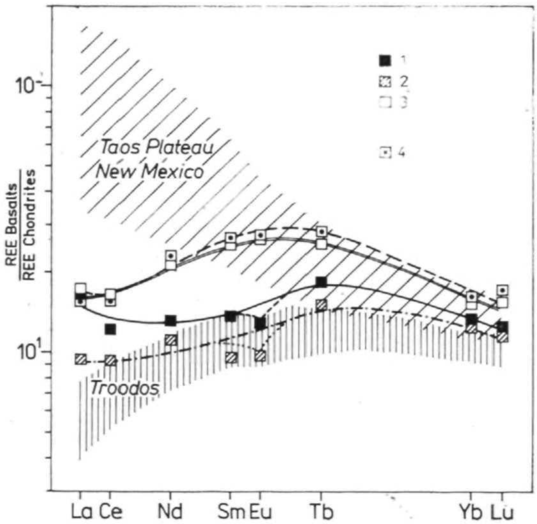

Fig. 2. Rare earth element pattern of olivine tholeiites in northern part of the North German-Polish depression in comparison with Troodos-trend of ophiolitic basalts (Kay — Senechal 1976) and continental rift basalt-pattern (Toos Plateau, cf. Basaltic volc. study etc. 1981). Subeffusive: 1 — aphyric, 2 — aphyric, Cr-rich, 3 — porfyc; Effusive: 4 — porphyric

The following diagrams (fig. 1 and 2) and the table shell demonstrate the remarkable geochemical features of North Mecklenburgian basalts which all are olivine normative rocks.

— In the alkali-iron-magnesium diagram the rocks belong to tholeiite region without exceptions (fig. 1a).
— The Ni-Zr-Rb diagram shows an extreme shortage of Zr and Rb and a small degree of differentiation for the NPD basalts (fig. 1b).
— The attaching of the representative, fresh samples in discrimination diagrams follow unequivocal to tholeiitic basalts ("low-K") "ocean floor", fig. 1c) respectively to mid-ocean ridge basalts (MORB), fig. 1d.
— Fig. 2 shows a trend similar to this of Troodos basalts for chondrite normalized REE pattern, that is the trend typically for "normal"-MORB. The difference between aphyric and plagioclase porphyritic varieties may be caused by weak fractional crystallization.
— Finally the comparison of incompatible

Table of the contents (in ppm) of some incompatible (refractory) elements in olivine basalt (data by instrumental neutron activation analysis) for comparison with Red Sea-central trough (averages after F. Barberi et al. 1978)

Tab. 1

	North German-Polish depression			Red Sea, central trough		
	x̄	n	range	x̄	n	range
La	3.7	5	2.3 — 4.2	3.8	14	1.1 — 14.8
Ce	8.3	5	6 — 10	8.1	8	3.8 — 15.0
Eu	1.08	5	0.52— 1.5	1.08	16	0.69— 1.65
Tb	0.64	5	0.45— 0.85	0.72	16	0.44— 0.97
Zr	94	5	40 —150	71	12	20 —100
Hf	1.9	5	0.9 — 2.5	2.1	11	0.99— 3.48
Ta	0.25	5	0.20— 0.46	0.3	11	0.04— 0.99
Th	0.35	5	0.26— 0.53	0.4	11	0.05— 1.37
Rb	13.0	5	1.8 — 46	4.6	5	1 — 15

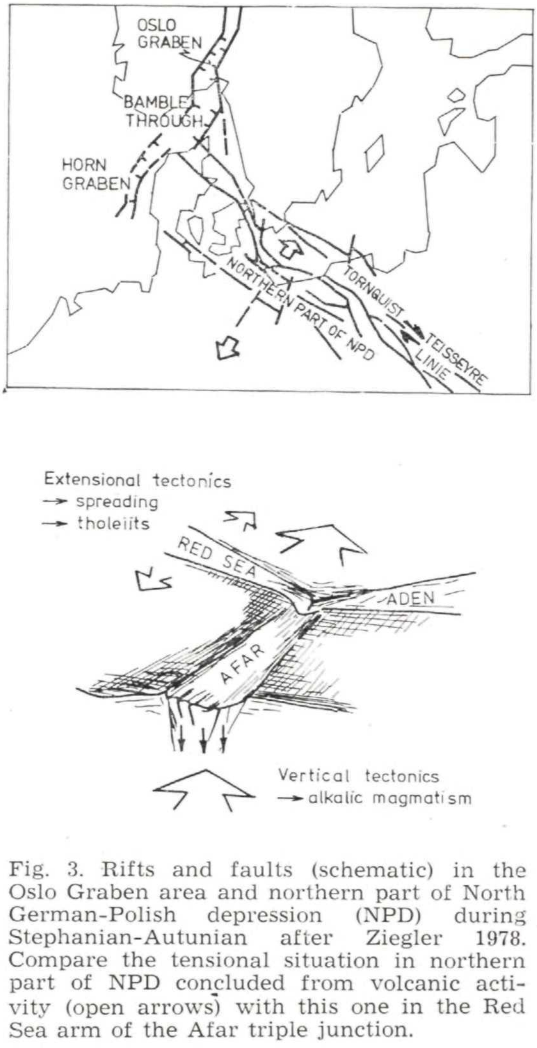

Fig. 3. Rifts and faults (schematic) in the Oslo Graben area and northern part of North German-Polish depression (NPD) during Stephanian-Autunian after Ziegler 1978. Compare the tensional situation in northern part of NPD concluded from volcanic activity (open arrows) with this one in the Red Sea arm of the Afar triple junction.

elements between NPD basalts and Red Sea (central trough) rocks shows a very high correspondence (cf. table).

Concluding remarks

The Permosilesian tholeiitic rocks of the northern part of the North German-Polish depression have the typical features of "normal" MORB, despite of their continental geotectonic position. They are "primitive" and only few developed.

In the case of such geochemical-extreme basaltic volcanism we can suppose a fragmentation of continental crust and a beginning rift process. Extensional forces caused a tholeiitic volcanism characterized by quick magma rise and intrusion respectively effusion according to Kramer (1977).

Thus the tensional tectonic connected with crustal attenuation should have been alternating in time with the — described by Ziegler (1978), cf. fig. 3, above — transcurrent movements along the Thornquist-Teisseyere Lineament. Soon this initial rifting has been stopped.

In the same time a highly alkalic magmatism (Oftedal 1968) is constated in the Oslo Trench area.

Inter alia Barberi et al. (1975) reported about synchroneous tholeiitic volcanism in Red Sea and alkali-basaltic magmatism in the Afar region of the Afar triple junction during Miocene to present (cf. the rough scheme in fig. 3, below). May be, in the northern Middle Europe in Permosilesian time we have a triple junction situation comparable with the Red Sea-Afar system.

This example "between continental and oceanic rifting" should underline the difficulties facing us, if we try to identify oceanic relicts in recently continental position.

REFERENCES

Barberi, F. — Cioni, R. — Santacroce, R. 1978: Upper Miocene submarine basalts from the western margin of the Red Sea (Secca Fawn-1 hole, Massawa Channel). *Geol. Rdsch., 2, S. 598—614.*

Barberi, F. — Ferrara, G. — Santacroce, R. — Varet, J. 1975: Structural evolution of the Afar triple junction. *In: Pilger — Rösler (Ed.). Afar depression of Ethiopia. Vol. 1. Inter-Union Commission on Geodynamics. Rep. (Stuttgart), 14.*

Barker, F. — Arth, J. G. 1976: Generation of trondhjemitic-tonalitic liquids and Archean bimodal trondjemite-basalt suites. *Geology, 4, pp. 596—600.*

Basaltic volcanism study project-members: Basaltic volcanism on the terrestrial planets. 1981. *New York, Pergamon Press Inc.*

Irvine, T. N. — Baragar, W. R. A. 1971: A guide to the chemical classification of the common volcanic rocks. *Canad. Earth Sci., 8, pp. 523—548.*

Kay, R. W. — Senechal, R. G. 1976: The rare earth geochemistry of the Troodos ophiolite complex. *J. Geophys. Res. (Washington), 81, 964 p.*

Kramer, W. 1977: Vergleichende geochemisch-petrologische Untersuchungen an permosilesischen basischen Magmatiten der Norddeutsch-Polnischen Senke und ihre geotektonische Bedeutung. *Z. geol. Wiss. (Berlin), 5, 1 ,S. 7—20.*

Oftedahl, C. 1960: Permian rocks and structure of the Oslo region. *Norg. geol. Unders., 208, pp. 298—343.*

Pearce, J. A. — Cann, J. R. 1973: Tectonic setting of basic volcanic rocks determined using trace element analyses. *Earth planet. Sci. Lett. (Amsterdam), 19, pp. 290—300.*

Rost, W. — Schimanski, W. 1967: Übersicht über das Oberkarbon und das Rotliegende im Nordteil der DDR. *Ber. Deutsch. Gessel. geol. Wiss., A, 12, 3/4, S. 201—221.*

Wood, D. A. 1980: The application of a Th-Hf-Ta diagramm to problems of tectonomagmatic classification and to establishing the nature of crustal contamination of basaltic lavas of the British tertiary volcanic province. *Earth planet. Sci. Lett. (Amsterdam), 50, 1, pp. 11—30.*

Ziegler, P. A. 1978: North-western Europe: Tectonics and basin development. *Geologie en Mjnb., 57, 4, pp. 589—626.*

Pokračovanie zo strany 352

má iba prvú podobu, ale napr. umožňuje od mena Brno tvoriť adjektívum brniansky aj brnenský; druhá podoba sa používa v recenzovanom slovníku na s. 49). Nevedno, prečo je těšinský vápenec, ale už těšínske bridlice (s. 63; náležitý tvar je těšínsky). Rovnako nie je jasné, prečo sa má hovoriť či písať euxinovobrakický, keď zostáva aj kaspibrakický (s. 78).

Slovník nerieši ani náhradu termínu séria, ktorý je u nás veľmi rozšírený. Názov skupina nemôže byť východiskom, lebo napr. čorštynská skupina sa sama skladá zo skupín. Vhodnejšie by bolo používať sled, súbor, sukcesia, ako to uvádza K. Birkenmajer (1977).

Kapitola Základné črty stratigrafie a paleografie rad paleografických otázok ani nenastoľuje. Nespomína sa v nej klapská jednotka ani silicikum, aj keď sa v tabuľkách objavuje.

Nezasvätený čitateľ zrejme stotožní Bukové hory s Bukovskými vrchmi, lebo iba ony sú na schéme na predchádzajúcej strane (s. 43). Brnenská žula nie je kaledónska, lež kadomská (asyntská, s. 49). Nemetamorfovaný stredný devón s tentakulitmi a palinomorfami z vrchu Zelený háj (Hurbanovo; Biely — Kullmanová, 1979; Snopková, 1979) sa nespomína (s. 50), a to ani pri hesle devón, čo ťažko pochopiť, veď A. Biely slovník recenzoval. Rovnako v slovníku niet vulkanickej fácie devónu s palinomorfami z vrtu Blhovce (Snopková), dôkazy devónu v kryštaliniku Nízkych Tatier (komplex Prednej hole, Jánovho grúňa, ale to je aspoň vložené do tab. 7). Viac nelogickostí je aj v hierarchii stratigrafických pojmov v tab. 7. Uvádzajú sa tam napr. lúžňanské *vrstvy*, ale meďodolské *súvrstvie*. Na s. 51 má byť zrejme hrušovské, nie hodrušské pásmo. Obliaky vulkanitov z bradlového pásma sa označujú ako permské melafýry a kremenné porfýry (s. 52) napriek tomu, že majú napospol mezozoický rádiometrický vek.

Na s. 53—56 niet v rámci triasu ani zmienky o prítomnosti wettersteinských fácií, reiflinských a iných vápencov v obliakovom materiáli zlepencov bradlového pásma, tatrika a fatrika. Aj keď v tabuľke triasu (tab. 8) sa objavuje silicikum, v texte sa píše iba o gemeriku („... pre trias sú charakteristické svetlé wettersteinské vápence...“). O Slovenskom krase sa uvažuje ako o nepresunutej jednotke mezozoika gemerika. Kým v texte sa kordevol uvádza často, v tabuľke tohto podstupňa niet. Trias meliatskej jednotky (gemerika) je, zdá sa, z územia Slovenska „vyhostený“. V tab. 8 chýbajú litologické vysvetlivky (napr. + v kampile, ○ v tisovských vápencoch).

Pri jure (s. 60) sa reprodukuje stratigrafická tabuľka stará 25 rokov a pri kriede súborná tabuľka chýba, aj keď sa tu v ostatnom čase definovalo najviac členov (je iba z vonkajšieho flyšového pásma). Pritom tre-