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CONTRIBUTION TO THE RELATIONSHIP OF THE PERMIAN VOLCANISM IN THE NORTHERN GEMERIDES AND CHOČ UNIT

(Figs. 1–6)

Abstract: The study of relationship of volcanism of the same age and occurrence in the different tectonic units needs study of all common and different features. This paper is a contribution for solution of this problem on the basis of recent data. The common features of the Permian volcanites in the Northern Gemerides and Choč unit are: age, form of occurrence and certain differentiates of dioritic magma. These are most of all the aspects of our study.

The subject of the study were the common features of Permian volcanism products only in the Choč unit and North Gemeride Permian. The Permian volcanites are known also in the southern part of Gemerides and Veporides, but these are not the subject of present paper.

Резюме: Решать вопросы соотношения продуктов вулканизма одного возраста в разных тектонических единицах является задачей необыкновенной трудности и требует изучения всех общих и отличительных признаков. Предлагаемая работа должна помочь на основании наших предыдущих исследований в решении этой актуальной проблемы.

Мы занимались изучением общих признаков в продуктах пермского вулканизма только в Хочской единице и в северогемеридной перми. Хотя пермские вулканиты известны и из южной части гемерид и вепорид, но мы ими не занимались и поэтому сравнение с ними находится мимо содержания данной статьи.

Stratigraphical division of the Later Paleozoic and Triassic of the Choč unit was proposed most recently by A. Biely (1965). Following from his paper the age of volcanism in the Choč unit is Permian. This view was also confirmed by other authors (E. Drnzík, 1969; V. Ďurovič, 1968, 1970; J. Vozár, 1967, 1968). Moreover, before that synvolcanic sediments had been determined on the basis of palynology study as Upper Carboniferous — Permian (Ž. Hlavská, 1964).

Dyke-forming, intrusive bodies occur as a part of subvolcanic apparatus mostly in gray strata of the Carboniferous complex. Overlaying them is the variegated Permian complex with distinct layer of conglomerates at the base. This is overlain by the oldest effusive rocks. Effusions are related exclusively to the mentioned Permian complex (Fig. 1). There have not been found any volcanic products in Triassic.

Permian volcanism in the Choč units is linear, related to long fault structures in sedimentary basin of trough character. The origin of the Permian sediments indicates subaqueous, shallow environment with considerably unstable bottom. Striking is the variability of sediments in both vertical and horizontal directions and their low degree of textural-mineralogical maturity (V. Ďurovič 1970). For conditions in sedimentary basin, moreover, occurrences of lagoonary facies especially between the first and second eruption phase are typical (J. Vozár 1971). Multiphase character, therefore is another feature of the Permian volcanism in the Choč unit. Particularly the second eruption phase consists of several flows in the sequence and intereffusive sedimentation (tuffs, tuffaceous sediments). Textural-structural features indicate considerable fluidity of lava

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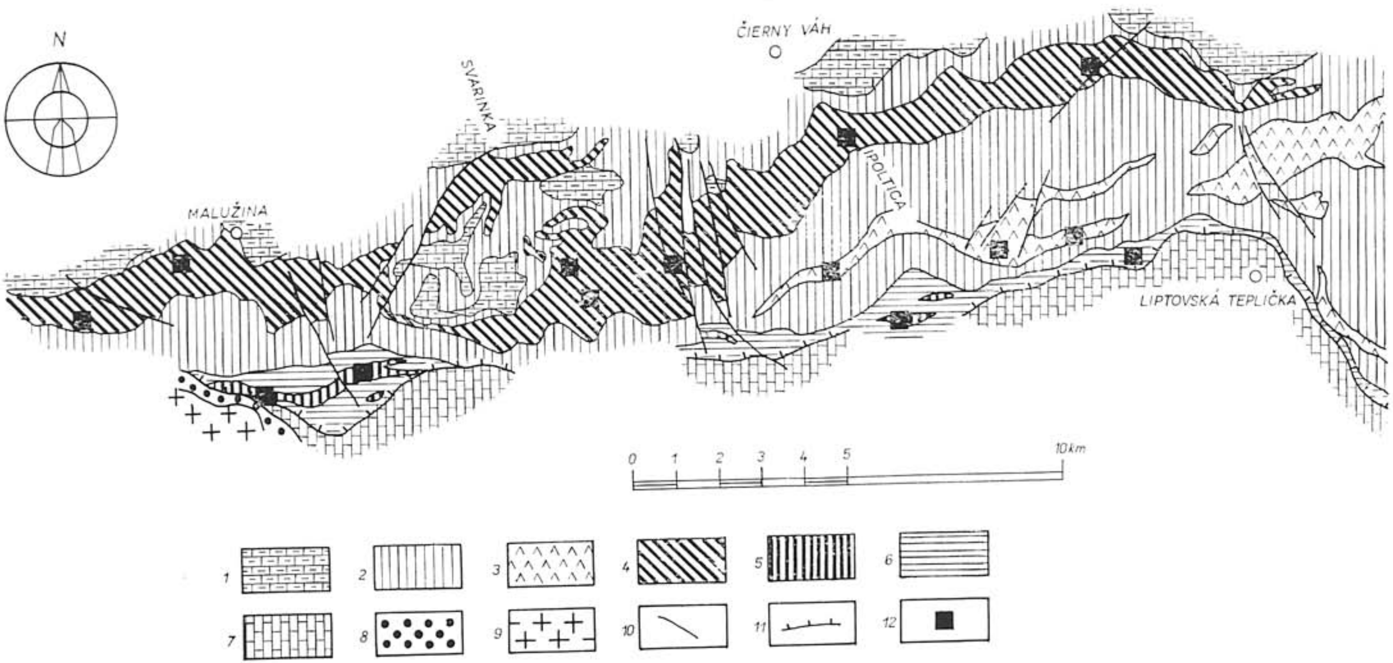

Fig. 1. Sketch of the Permian volcanites of the Choč unit of the northern slopes of Nízke Tatry. Compiled by J. Vozár (1970). Explanations: 1—16 The Choč unit; 1 — Lower-Middle Triassic: shales, sandy shales, in the upper part dolomite, dolomitic limestone. 2 — Permian: shales, sandy shales, polymictic sandstones,greywackes, arkoses, polymictic conglomerates, Lower Triassic? — quartz sandstones. 3 — I. eruption phase: melaphyres, melaphyre- porphyrites, pyroclastic rocks. 4 — II. eruption phase: melaphyre-porphyrites, pyroclastic rocks. 5 — dykes of melaphyre-porphyrites, diorite porphyrites and porphyrites. 6 — Upper Carboniferous? — Lower Permian?: grey sandy shales, shales, greywacke shales, polymictic sandstones, conglomerates and arkosses; 7 — Mezozoic of the Veľký Bok subunit — Neocomian: light-grey marly limestones. 8—9 — The Ďumbier zone; 8 — Lower Triassic: coarse to medium grained quartzites, partly epimetamorphosed. 9 — Crystalline: Ďumbier granite. 10 — faults. 11 — overthrusts. 12 — occurrences of diorite porphyrites and porphyrites.

Fig. 2. Sketch of the Permian of the eastern part of the Slovanské Rudohorie Mts.
Explanations: (According to J. Bystrický, O. Fusán, M. Maheľ, 1956) 1—2 Quaternary. 1 — alluvial deposits. 2 — loams, débris, terrace gravels. 3 — Paleogene: conglomerates, sandstones, shales. GEMERIDES: 4—8 Mezozoic. 4 — dark grey Reingraben shales. 5 — Anisian, Ladinian, Norian: light limestones (wetterstein). 6 — Ladinian: dolomites. 7 — Lower Anisian: dark (guttenstein) limestones and dark grey dolomites. 8 — Werfenian: variegated marly shales, sandstones and limestones. 9 — Triassic: basic volcanic rocks. 10—12 Permian: 10 — conglomerates, variegated shales and sandstones. 11 — quartz porphyries and their tuffs. 12 — porphyrites, diorite porphyrites, quartz porphyrites. 13—14 Upper Carboniferous; 13 — shales, pyhilites with sandstone layers. 14 — conglomerates. 15 — Lower Carboniferous: shales, phylites, quartzites. 16—18 Rakovec group: 16 — phylites and diabase tuffites. 17 — diabases and their tuffs. 18 — diorites, amphibolites, TATRIDES: 19 — Lower Triassic: quartzites and variegated shales. 20 — mica schists.

in sheets. Chemical composition of the first eruption phase is stable without distinct features of differentiation (about 50—51 % SiO_2), but that of the second eruption phase is very variable even for one sheet (within the range 38—60 % SiO_2, rarely more). According to P. Niggli's (1936) classification, the original magma of the Permian volcanites of the Choč unit can be regarded as diorite-gabbrodiorite-gabbro type. The relatively most acid rocks are the oldest affusives of the second erunption phase. Similarly most of the dykes, which are a part of subvolcanis apparatus in the underlaying grey Carboniferous complex as well as in Permian variegated complex are also more acid. Their competence to diorite magma is obvious. This fact should be emphasized because up to present the Permian volcanites of the Choč unit have been exclusively regarded as basic products of gabbro magma. The latest studies pointed out considerable differentation in the sequence and presence of dyke and effusive forms of considerable acidity (porphyrite, diorite porphyrite — described as augite porphyrite by V. Šťastný 1927). Particularly this differentiation factor is one of the common features of the Permian volcanism in the Choč unit and Northern Gemerides.

The volcanism in the North Gemeride Permian occurs in the middle effusive-sedimentary complex (M. Ivanov 1953, 1957, F. I. Žukov 1963). According to all facts known up to now it is represented by effusive rocks accompanied by pyroclastic rocks. Their occurrence and form of the volcanic bodies indicate linear volcanism along the whole basin of sedimentation. Due to type of occurrence and form of volcanic bodies it can be regarded as repeated activity, accompanied by intereffusive sedimentation.

The volcanism in the effusive-sedimentary complex of the North Gemeride Permian is mostly represented by acid differentiates of granodiorite magma-quartz porphyries. In the eastern part of the Northern Gemerides, more basic rocks were described already by previous authors. Near Košické Belá and Nižný Klátov they were described as effusive porphyrites by M. Mahel (1952, 1954). Porphyrites near Krompachy were

Table 1. Planimetric Analyses of the Porphyrites, Diorite Porphyrites of the Choč unit

	30/65	37/65	38/65	62/65	92/65	93/65	25/66	30/68
Plagioclases	49,2	39,0	56,5	—	51,0	62,0	45,0	15,0
Pyroxene	1,9	5,0	7,2	—	10,0	5,0	12,0	—
Volcanic glass	—	15,0	—	25,0	9,0	4,7	4,0	15,0
Sericite	—	11,0	13,2	—	5,0	12,0	10,0	7,0
Chlorite	4,0	6,0	7,1	10,0	6,0	13,0	7,8	12,0
Epidote	0,4	0,5	2,1	—	—	—	4,0	—
Apatite	0,8	0,5	0,6	—	1,0	0,2	0,5	—
Calcite	—	14,0	0,2	19,0	3,0	—	1,6	—
Pumpellyite	4,9	—	—	—	4,0	—	—	—
Prehnite	25,4	—	—	—	1,0	—	—	—
Ore minerals	1,5	5,1	6,0	5,0	5,0	3,0	6,0	8,0
Baryte	—	3,0	—	—	—	—	—	—
Quartz	11,9	0,8	7,0	41,0	5,0	—	10,0	43,0
Sum	100,0 %	99,9 %	99,9 %	100,0 %	100,0 %	99,9 %	99,9 %	100,0 %
Number of points	1.500	5.500	3.000	3.800	4.000	3.000	3.200	4.000

Locality: Explanations in table 3.

described by M. I v a n o v (1953, 1957), who regarded them as equivalent of Triassic diabases near Jaklovce studied by J. K a m e n i c k ý (1955, 1957).

In the easternmost part of the North Gemeride Permian near Košická Belá and Nižný Klátov besides quartz porphyries and their tuffs also effusive porphyrites with pyroclastic rocks of equivalent composition occur in the upper part of the Permian complex (Fig. 2). Near Krompachy the volcanism of quartz porphyries and their tuffs is the most extensive in the North Gemeride Permian. In the uppermost part of the effusive complex are also present more basic tuffs, which correspond by their composition to quartz porphyrites and porphyrites (I. R o j k o v i č 1967). The diorite porphyrites dykes near Krompachy occur in the middle part of the complex. There have not been found any more basic rocks in the western part of the North Gemeride Permian. Near Novoveská Huta two phases of quartz porphyry volcanism have been distinguished, where for quartz porphyries of the first phase higher acidity is typical (I. R o j k o v i č 1969).

Petrographic characteristic of diorite porphyrites and porphyrites in the Later Paleozoic of the Choč unit was published in a few papers (J. V o z á r 1967, 1968, 1970). In the next we show only some basic features of the described rocks. First of all it is the textural-structural character. Diorite porphyrites and porphyrites are mostly fine or medium grained. The subvolcanics are enriched in coarse grained pegmatite veins 0.1—1 m thick, of the same mineral association as in the above mentioned rocks. The following textures are typical: porphyritic or porphyritic-amygdaloidal and only rarely amygdaloidal-porous. The most abundant mineral of diorite porphyrites and porphyrites is plagioclase (An_{10-20}), which underwent albitization of different intensity (Table 1). The

Fig. 3. Porphyrite with the laths of plagioclase and chlorite (Košická Belá, crossed nicols, 45 ×, photo H. B r o d ň a n s k á).

Fig. 4. Shred of diorite porphyrite in tuff of quartz porhyry (Kolínovce, crossed nicols, 43 ×, photo C. C h l a d o v á).

other alterations are sericitization, carbonatization and prehnitization. The origin of prehnite is connected with the origin of pumpellyite-prehnite-quarz facies of minerals, as evidence of load metamorphism of the Later Paleozoic of the Choč unit (S. Vrána, J. Vozár 1969). Mafic minerals are represented by augite, which is mostly perfectly replaced by chlorite or epidote. Brownishgreen hornblend is preserved only very badly and underwent chloritization. Its limonitization is also common. Titanium minerals (rutile, ilmenite, titanomagnetite) were identified in many samples. Apatite and zircon are present in accessory quantities. Ore minerals: pyrite, chalcopyrite and magnetite are mostly coated with limonite. From the mentioned metamorphic alternations epidotization and chloritization prevail and their maximum effects can be observed for several tens metres in the field. Generally the chloritization alters groundmass, mostly mafic minerals and also volcanic glass is present.

Porphyrites diorite porphyrites and quartz porphyrites of the North Gemeride Permian are massive dark-green or greyish-violet rocks depending on disseminated ore minerals. Two types of texture were observed:

a) ophitic (in porphyrites and diorite porphyrites) — plagioclase laths have the same size approximately up to 0.5 mm (Fig. 3).

b) porphyritic (in quartz porphyrites and partly in porphyrites) — in the groundmass plagioclase phenocrysts approximately 1 mm large occur.

Porphyrites and diorite porphyrites differ from the quartz porphyrites in lower contents of quartz and more abundant chlorite and ore minerals. Plagioclases of oligoclase-andesine composition form the essential part of the porphyrites and diorite porphyrites as well as quartz porphyrites (Table 2). Inclusions of quartz

Table 2. Planimetric Analyses of the North Gemeride Porphyrites, Diorite Porphyrites and Quartz Porphyrites

No	362	367	432	433	448	454	553	573	643
Plagioclase	86,13	83,13	—	—	—	76,98	81,29	81,10	33,84
Groundmasse	—	—	69,65	88,36	97,26	—	—	—	—
Plagioclase phenocryst	—	—	11,39	5,57	1,37	—	—	—	5,83
K-Folspar phenocryst	—	—	4,02	—	0,11	—	—	—	—
Quartz	+	3,82	2,36	3,85	0,05	0,21	0,50	4,61	—
Chlorite	12,36	10,10	—	—	0,32	18,87	14,83	3,53	54,13
Biotite	—	—	0,06	—	—	—	—	—	—
Sericite	+	+	+	+	+	+	+	3,49	+
Carbonate	—	—	12,20	0,23	—	0,15	0,22	5,64	3,95
Ore minerals	1,50	2,96	0,33	1,99	0,90	3,36	3,16	1,55	2,24
Apatite	+	+	—	—	—	0,41	+	—	—
Turmalin	—	—	—	—	—	0,83	—	—	—
Rutile	—	—	+	+	—	—	—	+	—
Zircon	+	+	—	—	—	—	—	—	+
Epidote	+	+	—	—	—	+	—	—	—
Magnetite, hematite, ilmenite	+	+	+	+	+	+	+	+	+
Leucoxen	+	—	—	—	—	—	+	—	+
Sum	100,01	100,01	100,01	100,00	100,01	100,01	100,00	100,00	99,99
Number of points	3.124	2.436	3.311	2.207	1.893	3.397	2.602	2.322	2.228
Rock	Pt	Pt	QPt	QPt	QPt	DPt	DPt	DPt	DPt

Explanation: + present, — absent, Pt — porphyrite, QPt — quartz porphyrite, DPt — diorite porphyrite. Locality: Explanation in table 8.

occur in them. Besides albitization the other alterations of plagioclases were caused by sericitization and less by carbonatization. Chlorite is alteration product of the mafic minerals and the second abundant mineral in porphyrites and diorite porphyrites where it mostly fills up interspaces between the plagioclase laths. In the quartz porhpyrites it is less abundant, on the contrary, K-feldspars occur there. Quartz forms allotriomorphic grains between plagioclase laths and also corroded relics of phenocrysts. Common are magnetite, hematite, ilmenite and limonite, particularly in porphyrites and diorite porphyrites. Epidote occurs only scarcely. Common accessories are rutile, tourmaline, apatite and less zircon.

The Permian age of porphyrites: diorite porphyrites and quartz porphyrites is suggested by the following data:

1. Conformable position and their effusive character at most of the occurrences. Obviously later in relation to wall-rocks are the occurences near Krompachy, which intersect the Permian rocks in the middle part of the complex.

2. Occurrences of more basic tuffs in the upper part of the complex near Krompachy and Košická Belá.

3. Age of diorite porphyrites cutting the Permian rocks near Krompachy (mentioned above) is not so obvious. However, similarity of mineralogical and chemical composi-

Table 3. Silicate Analyses (in percent) of the Choč Porphyrites and Diorite Porphyrites
Analyst: Dvonč

No	30/65	37/65	38/65	25/66	92/65	93/65	30/68	62/65
SiO_2	56,26	57,26	58,04	56,01	60,63	64,64	68,38	68,56
TiO_2	1,13	2,26	0,75	1,39	1,15	0,86	0,44	1,10
Al_2O_3	16,59	16,08	20,80	14,08	15,84	14,21	13,58	9,41
Fe_2O_3	0,91	0,50	1,24	2,33	2,55	1,55	3,99	5,21
FeO	6,01	5,31	4,99	5,49	2,35	1,69	1,44	2,30
MnO	0,13	0,03	0,08	0,07	0,09	0,07	0,02	0,12
MgO	3,71	6,92	2,13	3,52	1,54	1,30	1,96	1,11
CaO	5,66	1,12	1,70	4,83	4,21	4,89	0,98	3,59
Na_2O	3,64	4,52	2,08	4,16	3,74	4,42	2,84	0,54
K_2O	1,80	0,79	3,76	0,56	2,20	0,77	3,50	2,43
P_2O_5	0,42	0,23	0,12	0,19	0,40	0,16	0,04	0,26
H_2O^+	2,88	4,94	4,41	6,71	2,69	1,60	2,35	0,23
H_2O^-	0,40	0,16	0,36	0,19	0,45	0,16	0,27	0,34
CO_2	—	—	—	—	1,90	3,16	0,35	4,54
SO_3	—	—	—	—	0,05	—	—	0,17
S	—	—	—	—	—	0,03	trace	—
Sum	99,54	100,12	100,46	99,53	99,79	99,51	100,14	99,91

Explanations: 30/65 diorite porphyrite, Nižná Boca, roadcut near the viaduct along road Čertovica-Kráľova Lehota. 37/65 dyke of diorite porphyrite, Nižná Boca, Malužiná valley, 1.500 m SE from its tributary. 38/65 medium grained diorite porphyrite from dyke in Carboniferous complex, Nižná Boca, Malužiná valley, 350 m SE of its junction with Chorupniansky creek, roadcut. 25/66 finegrained porphyrite, Nižný Chmelenec valley 100 m N from altitude 837,5, 92/65 finegrained porphyrite, Svarínka valley, near altitude 815,0, outcrop close to the join with Toryse valley. 93/65 finegrained porphyrite, Svarínka valley, 900 m NW from altitude 815,0. 30/68 finegrained porphyrite, Čierny Váh valley, near altitude 818,2. 62/65 porphyrite with quartz-chalcedony veinlets, 1.000 m SW from join with Boca valley, Malužiná quarry.

tion in comparison with effusive porphyrites as well as their shreds in quartz porphyry tuffs (Fig. 4), overlaying the above mentioned occurrences, suggests that they represent subsurface equivalents of porphyrites in the upper part of the complex.

According to the classification of P. Niggli (1936) the studied North Gemeride porphyrites and diorite porphyrites belong to the diorite, quartz diorite and quartz porphyrites to trondhemite group of alkaline-calcareous magma. The contents of macroconstituents in the described rocks of the North Gemeride and Choč unit Permian are presented in tables (Table 3, 4, 5, 6) and diagrams (Fig. 5, 6). The most obvious difference between the North Gemeride porhyrites, diorite porphyrites and quartz porphyrites is

Table 4. Silicate Analyses (in percent) of the North Gemeride Porphyrites, Diorite Porphyrites and Quartz Porphyrites

No	362	387	432	433	448	454	553	573	643
SiO_2	61,74	59,27	60,09	69,80	69,08	54,33	55,42	66,87	49,38
TiO_2	0,86	0,91	0,84	0,47	0,61	1,58	1,07	0,30	1,16
Al_2O_3	13,39	17,98	17,98	16,74	13,84	18,24	16,32	13,99	16,69
Fe_2O_3	0,73	3,38	3,50	1,78	3,48	1,79	3,05	3,79	0,95
FeO	5,00	4,11	1,94	1,41	1,11	6,94	5,09	0,82	7,83
MnO	0,06	0,20	0,04	0,03	0.03	0,05	0,06	0,10	0,10
MgO	3,36	1,76	2,53	0,81	1,31	2,94	2,18	0,96	7,86
CaO	1,54	4,32	1,65	1,15	1,62	2,24	4,54	2,87	2,38
Na_2O	5,90	4,04	4,68	5,40	4,17	6,00	3,93	4,72	4,06
K_2O	0,75	1,02	2,75	1,15	2,13	0,75	2,35	1,85	0,78
P_2O_5	0,21	0,38	0,30	0,17	0,06	0,46	0,34	0,14	0,17
CO_2	—	0,75	1,47	—	1,04	1,20	2,84	2,18	—
SO_3	—	0,01	0,01	—	0.01	0,01	0,01	0,03	—
H_2O^-	0,20	1,03	0,19	0,11	0,22	0,14	0,20	0,36	0,22
H_2O^+	3,55	1,93	2,02	1,10	1,02	2,80	2,20	1,34	7,80
Sum	100,29	101,09	99,99	100,12	99,73	99,47	99,60	100,32	99,38
Rock	Pt	Pt	QPt	QPt	QPt	DPt	DPt	DPt	DPt

Analyst: Jirásková, Hemžalová, Pt-porphyrite, QPt-quartz porphyrite, DPt-diorite porphyrite. Locality: Explanation in table 8.

Table 5. Average contents of SiO_2, CaO, Na_2O, K_2O in the Permian volcanites of the Choč unit.

	1.	2.	3.
SiO_2	50,0 %	53,8 %	55,7 %
CaO	7,9 %	5,1 %	5,5 %
Na_2O	3,7 %	3,4 %	3,0 %
K_2O	1,2 %	1,5 %	2,1 %
	20	8	10

1. Melaphyre, melaphyr-porphyrite of the northern slopes of Nízke Tatry. 2. Porphyrite and diorite porphyrite of the northern slopes of Nízke Tatry. 3. Porphyrite and diorite porphyrites of the southern slopes of Nízke Tatry.

Table 6. Average contents of macroconstituens of North Gemeride volcanites

	Pt-DPt	QPt	QP
SiO_2	56,03	66,32	71,76
TiO_2	1,12	0,64	0,24
Al_2O_3	17,12	16,19	12,52
Fe_2O_3	1,98	2,92	1,85
FeO	5,79	1,49	1,86
MnO	0,09	0,03	0,05
MgO	3,62	1,55	2,40
CaO	3,00	1,47	1,48
Na_2O	4,79	4,75	0,90
K_2O	1,13	2,01	2,63
P_2O_5	0,31	0,18	0,11
Co_2	(1,60)	(1,26)	(1,67)
SO_3	(0,01)	(0,01)	(0,16)
„H_2O^+“	4,62	2,22	3,96
H_2O^+	(3,66)	(1,38)	(2,83)
H_2O^-	0,36	0,17	0,27
Sum	99,96 (100,61)	99,94 (100,37)	100,03 (100,73)
Number of analyses	5 (3)	3 (2)	26 (16)

Pt-DPt — porphyrites and diorite porphyrites
QPt — quartz porphyrites
QP — quartz porphyries

the content of SiO_2. Due to more abundant chlorite and iron ore minerals in porphyrites and diorite porphyrites the contents of MgO, FeO and TiO_2 are increased. Slight increase show also MnO and due to more abundant apatite also P_2O_5. Lower contents in the

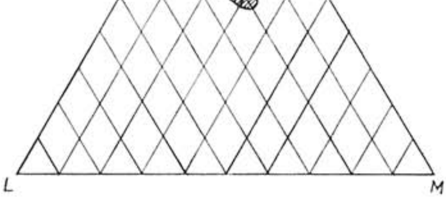

Fig. 5. Diagram of Niggli's values Q-L-M of the Choč porphyrites and diorite porphyrites.

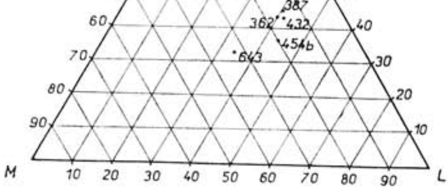

Fig. 6. Diagram of Niggli's values Q-L-M of the North Gemeride porphyrites, diorite porphyrites and quartz porphyrites.

North Gemeride porphyrites and diorite porphyrites show, on the contrary, Fe_2O_3 and K_2O. Increased content of CaO in porphyrites and diorite porphyrites is caused by its higher content in plagioclase and carbonatization of some samples.

The number of analyses of trace elements does not permit statistic evalution of their distribution, particularly in the Choč unit (Table 7, 8). However, analysed samples of

Table 7. Analyses of microelements (in ppm) of the Choč porphyrites and diorite porphyrites

No	30/65	25/66	30/68
Pb	tr.	210	210
Ca	12	12	15
Cu	20	—	21
V	148	209	230
Zr	324	447	851
Ni	13	20	17
Co	26	19	210
Cr	89	39	26
Ba	447	41	309
Sr	251	209	120
Sn	—	0	—

Analyst: Cubínek, Locality as in table 4.

Table 8. Analyses of microelements (in ppm) of the North Gemeride Porphyrites, Diorite Porphyrites and Quartz Porphyrites

No	362	387	388	432	433	448	453	454b	553a	553b	573	574	643
U	15,7	62	1,2	1,5	1,3	1,9	1,8	0,6	—	2,7	1,6	0,7	0,7
Pb	0	0	0	0	0	0	0	0	0	0	0	0	30
Ni	tr	tr	tr	0	0	0	0	0	0	0	0	0	79
Co	20	43	37	0	0	0	0	15	0	16	0	0	24
Cu	3,5	1,5	1	5	17	6	10	52	6	16	7	12	158
V	148	170	155	87	43	30	93	148	0	95	0	0	178
Zr	389	224	195	675	467	346	426	660	563	575	692	757	141
Cr	0	0	0	0	38	0	0	0	0	0	0	0	46
Ba	141	158	117	162	87	218	60	32	214	257	105	118	10
Sr	112	95	425	33	36	0	59	78	81	74	15	10	10
Sn	15	19	19	0	0	0	0	0	0	0	0	0	10
Ga				14	13	16	15	20	18	17	15	19	13
Rock	Pt	Pt	Pt	QPt	QPt	QPt	DPt	DPt	DPt	DPt	DPt	DPt	DPt

Explanations: Analyst — Cubínek, Pt-porphyrite, QPt-quartz porphyrite, Locality: 362 — Košická Belá, valley of the creek SE from village, 70 m N of the road, 387 — Nižný Klátov, valley of Vrbica creek, S of altitude 510,0, tributary 40 m N, 388 — as 387, 5 m N, 432 — Kolínovce, cut of the creek north from the church, at height 395 m, 433 — as 432, 4 m N, 448 — Štefanská Huta, Petrova hora, abandoned gallery to SE, 20 m SE from altitude 390,0, 1 m from entrance, 453 — Krompachy, outcrop N of the bridge on the lake, 454b — Krompachy, slope N of power-station, at height 445 m, 553a — Krompachy, quarry E of the town, easternomst part of quarry, 553b — as 553b, 10 m NW, 573 — Krompachy, outcrop NW from the lake, N of the road, 574 — Krompachy, outcrops N of power-station, at height 402 m, 643 — Štefanská Huta, Petrova Hora, abandoned gallery NE of altitude 608,0 m, at height 505 m, sample from a dump.

North Gemeride rocks show some relations between porphyrites, diorite porphyrites and quartz porphyrites and these can be compared to quartz porphyries (I. R o j k o v i č 1969). For example, different ratio of plagioclases and K-feldspars in these rocks is reflected in the contents of Ba related mainly to K-feldspars and Sr related to Ca-constituents of plagioclases and as mentioned partly to carbonates. Due to more abundant occurrence of magnetite, ilmenite and hematite in porphyrites, diorite porphyrites and quartz porphyrites the content of vanadium is 5-times higher than in quartz porphyries. Zirconium shows similarly as in more basic tuffs higher content than in quartz porphyries and their pyroclastics. Local increase of Cu, Pb and Ni in the sample from Petrova hora (No. 643) is hydrothermal.

As it was shown in the characteristic of the Permian volcanites in the Northern Gemerides and Choč unit, there are many common features as the linear character of volcanism and repeated eruptions etc. Later data confirm wide differentiation scale in both units, with basic products predominating in the Choč unit and acid products in the Northern Gemerides.

REFERENCES

BIELY, A., 1965: K paleogeografii spodného triasu chočského príkrovu. Geol. práce, Správy *34*, p. 71—74.

DRNZÍK, E., 1969: O zrudnení typu meďnatých pieskovcov v perme melafýrovej série na východných svahoch Nízkych Tatier. Miner. Slovaca *1*, p. 7—30.

ĎUROVIČ, V., 1968: Petrografia — litológia a sedimentológia melafýrovej série na SV svahoch Nízkych Tatier. Manuscript. Kat. petr. PF-UK, 180 p.

ĎUROVIČ, V., 1970: Petrografia, litológia a sedimentológia melafýrovej (vulkanogénno-sedimentárnej) série CZK. Manuscript. Kat. petrografie PF-UK, 189 p.

HLAVSKÁ, Z., 1964: Sporen und Hystrichosphaeritiden aus dem Karbon der Niedere Tatra. Geol. zborn. Slov. akad. vied *15*, 2, p. 227—232.

IVANOV, M., 1953: Geologicko-petrografické a rudné pomery v severnej časti Spišsko-gemerského rudohoria medzi Kľuknavou a Žakarovcami. Geol. zborn. Slov. akad. vied 4, 3/4, p. 705—750.

IVANOV, M., 1957: Permské vulkanity v Spišsko-gemerskom rudohorí. Geol. práce *45*, p. p. 213—240.

KAMENICKÝ, J., 1955: Petrografia ofiolitového vulkanizmu severnej časti Spišsko-gemerského rudohoria. Manuscript. Archiv GÚDŠ, 45 p.

KAMENICKÝ, J., 1957: Serpentinity, diabázy a glaukofanické horniny triasu Spišsko-gemerského rudohoria. Geol. práce *45*, p. 3—108.

MAHEĽ, M., 1952: Správa o geologickej stavbe a o rudných pomeroch územia západne od Košíc. Manuscript. Archiv GÚDŠ, 75 p.

MAHEĽ, M., 1954: Príspevok ku stratigrafii východnej časti gemeríd. Geol. zborn. Slov. akad. vied 5, 1—4, p. 183—197.

NIGGLI, P., 1936: Die Magmentypen. Schweiz. Min. Mitt. *16*, p. 340—399.

ROJKOVIČ, I., 1967: Mineralogicko-geochemická charakteristika U-Mo-Cu zrudnenia v perme Spišsko-gemerského rudohoria. Manuscript. Archiv GÚ SAV, 290 p.

ROJKOVIČ, I., 1969: Petrography and geochemistry of permian quartz porphyries in relation to U-Mo-Cu mineralization. Geol. zborn. Slov. akad. vied *20*, 1, p. 87—114.

ŠTASTNÝ, V., 1927: Studie o takzvaných melafýrech v Nízkých Tatrách na Slovensku. Rozpr. II. tř. ČA *36*, 29, p. 1—32.

VOZÁR, J., 1967: Der permische Vulkanismus in der Choč-Decke (Westkarpaten). Geol. práce, Správy *42*, p. 79—83.

VOZÁR, J., 1968: Der perm-mesozoische Vulkanismus in der Westkarpaten und Ostalpen. Geol. práce, Správy *44/45*, p. 149—165.

VOZÁR, J., 1970: Permské vulkanity chočskej jednotky na severných svahoch Nízkych Tatier. Manuscript. Archiv GÚDŠ, 185 p.

VOZÁR, J., 1971: Viacfázový charakter permského vulkanizmu chočskej jednotky v Nízkych Tatrách. Geol. práce, Správy *55*, p. 131—136.
VRÁNA, S., VOZÁR, J., 1969: Minerálna asociácia pumpellyit-prehnit-kremennej fácie z Nízkych Tatier. Geol. práce, Správy *49*, p. 91—99.
ŽUKOV, F. I., 1963: Jedna z variant rozdělení svrchnepermských sedimentů Spišsko-gemerského rudohoří. Geol. práce, Správy *30*, p. 39—46.

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