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PALAEOMAGNETISM OF VOLCANIC ROCKS IN VIHORLAT MTS. AND ITS GEOLOGICAL INTERPRETATION

(*Figs. 1—5*)

Abstract: The study of remanent magnetization (RM) in the volcanic Vihorlat Mts. on the transitional zone of East- and West-Carpathians facilitated the division of the volcanic mountain-range into several parts differing by the orientation of RM. The majority of results obtained confirmed geological division and offered the possibility to distinguish the units of different ages in monotonous complexes (Fig. 1, 2, Table 1, 2, 3).

The Upper-Sarmatian hornblende-pyroxene andesite Vinné complex with normal polarity of RM represents the oldest volcanism studied.

The younger (Pannonian s. s) volcanism of garnetiferous rhyodacites displays normal and reverse polarity of RM.

The lower part of the mountain-range under discussion — the stratovolcanic Kyjov-Orechová formation (variegated Pannonian, Pontian) shows normal polarity of RM. It is mostly composed of pyroclastics of pyroxene andesites. Lava flows are of a little importance.

The Valaškovce formation (Levantian) comprises rocks of a rich scale: from dacites to basaltoandesites; pyroxene andesites predominating. The Valaškovce formation may be divided to the following volcanic complexes: a basal complex of pyroclastics and lava flows, terminated with effusions of domes and cumulodomes of acid pyroxene andesites. The higher Petrovce-Choňkovce complex is built up from dark, coarse-grained porphyric dacitoandesites and dacites. Higher-up rests the Koňuš stratovolcanic complex of pyroxene-andesite pyroclastics with a smaller amount of lava flows. The topmost Popričný-Vihorlat complex is mainly formed by effusions of pyroxene andesites, andesites, andesito-dacites and basalto-andesites.

The whole Valaškovce formation except the Petrovce-Choňkovce complex displays reverse polarity of RM. The Petrovce-Choňkovce complex shows normal and reverse RM.

Volcanism in the Vihorlat area faded-out before the commencement of the Brunhes palaeomagnetic stage.

Резюме: Изучением остаточной намагниченности (ОН) в вулканическом Вигорлатском массиве удалось расчленить вулканические породы на несколько частей по различной ориентации ОН. Ресультаты позголяют отличить слои разного возраста в монотонных комплексах.

Самый ранний вулканизм представлен верхнесарматским андезитовым комплексом Винне с нормальной поляризацией ОН.

Младший (паннон с. с.) риодацитовый вулканизм имеет нормальную и противоположную поляризацию.

Кийов-Ореховая формация (паннон, понт) имеет нормальную поляризацию ОН. Образована пирокластиками пироксонических андезитов, лавовые течения имели небольшое значение.

Валашковце-формация (левант) образована городами от основных дацитов до основных андезитов. Эта формация может быть разделена на следующие вулканические комплексы:

основной комплекс (пирокластики, лавовые течения купэлы андеситов)

Петровце-Хоньковце-комплекс (порфировые дацито-андезиты, дациты)

Конюш стратовулканический комплекс (пирокластики, лавовые течения)

Попричный-Вигорлат-комплекс (пироксен-андезиты, андезиты, андезито-дациты и базальто-андезиты).

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Вся Валашковце-формация имеет обратную поляризацию ОН за исключением комплекса Потровце-Хоньковце, который имеет нормальную и обратную поляризацию ОН.

Geological Characteristics

The volcanic massif of Vihorlat Mts. extends over a tectonic zone (a periclippean elevation) separating the Flysch Paleogene geosyncline and the inner Neogene Molasse — the Transcarpathian Inner Deep. The Vihorlat massif consists of the products of some polygene volcanoes, the rocks of pyroxene-andesite composition predominating. Represented are also hornblende-pyroxene andesites, dacito-andesites, dacites, rhyodacites and andesito-basalts.

The monotonous petrographical composition of volcanites impedes considerably the subdivision of volcanic complexes. Systematic geological study during the years 1962—1968 was confronted with the systematic palaeomagnetic measurements during the years 1968—69. The results of geological study and of the study remanent magnetism served for more precise characteristics of the geological structure of the Vihorlat mountain-range, and offered fresh informations about the course of the volcanic activity.

Owing to the short duration of the geological period which Vihorlat Mts. were formed in, and to the possibility of the stratigraphical determination of the formations sharing the structure of the mountain-range, Vihorlat Mts. are particularly favourable for palaeomagnetic measurements. This is why the planar palaeomagnetic research was concentrated in this area. In fact, the palaeomagnetic measurements may serve as a code for the division of volcanogene suites and formations, and when combined with other methods, it may be of a great use in regional geological correlations. The volcanic massif under discussion consists of rocks exposed during Upper Sarmatian and Upper Pliocene (a Vihorlat volcanic-sedimentary group of formations). An Upper-Sarmatian Vinné-Závadka formation (hornblende-pyroxene andesites, agglomerate-tuffite series, M. Brodňan, S. Polášek, J. Slávik 1959), was studied in the western part of Vihorlat Mts. where its was exposed in a form of the Vinné complex of domes and cumulodomes. As for its age, the formation was formed during the period between the zone with *Elphidium hauerinum* and the zone with *Nonion granosus*, in the sense of Grill's stratigraphical division of the Neogene Vienna basin.

The Pliocene volcanism commenced with domes and cumulodomes of garnetiferous rhyodacites, their age being indicated by a sequence of garnetiferous rhyodacite tuffs below evidently Pontian complex of Pozdišovce gravels, and above Upper-Sarmatian Hnojné coal-bearing sequence. Owing to this they may be considered Pannonian (Pannonian s. s., Meotian?). But temporal coincidence of garnetiferous tuffs with lava bodies is not proved till nowadays.

The main mass of the volcanic mountain-range is represented by the younger members of the Vihorlat volcano-sedimentary group of formations confined by a sequence of Pozdišovce gravels (Pontian) almost without any volcanic material at the bottom. Lower of them is : a) the Kyjov-Orechová formation referred to variegated Pannonian (buntes Pannon) followed by the development of b) the Valaškovce formation, referred to Levantian.

The Kyjov-Orechová formation consists of a stratovolcanic sequence, with tuffobreccias and tuffs predominating, and with a subsidiary amount of lava flows of pyroxene andesite. The formation is exposed in the western part of Vihorlat Mts.

among the villages Oreské and Tarnava Laborec r., Kamenica Cirocha r., and Porubka. on the SW foothill of Popričný near the village Orechová.

The Valaškovce formation represents the main mass of volcanic mountain-range from the peak of Vihorlat (1074 m) through Boroľa up to Popričný, where it is passing to U. S. S. R.

The Valaškovce formation consists of four complexes, the bottom complex beginning with xenotuffs and tuffobreccias of pyroxene andesites, the top part of which consists of domes and cumulodomes of acid pyroxene andesites, which are best developed on the NE foothill of Vihorlat Mts., in a lower part of elevation point Sninský Kameň, Feťkov, Roch.

A younger complex — Petrovce-Choňkovce — is petrographically conspicuous, formed by lava flows, pyroclastics of dark coarse- porphyric dacite and andesito-dacite outcropping continuously along the western foothill of Popričný Mts., and incontinuously — in Veľké Okno depression within the volcanic area.

The Koňuš complex is also present in the lower parts of Boroľa and Central Vihorlat Mts. The Koňuš complex — a stratovolcanic sequence of pyroclastics, of pyroxene andesite composition forms a major part of the Popričný volcanic massif.

The youngest volcanic complex is the lava flow sequence of the Popričný-Vihorlat complex forming the apical parts of both mountain-ranges. This one is mainly formed by lava flows of pyroxene andesites.

The complex of Tarnava-Šútova on the western periphery of Vihorlat Mts. determined on the basis of palaeomagnetic measurements, has an uncertain position. It is formed by andesite domes, and formerly was taken for a component part of Vinné complex.

Methods of Palaeomagnetic Measurements

The sites were chosen in agreement with the requirement of planar sampling with respect to informations about geological structure and to the possibilities of geological and palaeomagnetic interpretations, so as to complete and make more accurate the pattern of the division of the separate volcanic suites. In sampling geological compass was used for orientation. The number of samples was controlled by the extent and state of exposures and by the favourableness of rocks. The number of samples fluctuated within 2 and 20. Predominant amount of samples were modelled to cubal shape. Some of the samples were demagnetized by alternating field with the interval 25—100 Oe up to 500 or 700 Oe. The rest of the samples were subject to maesurements of natural RM and RM after demagnetization with 100 and 200 Oe. The measurements were calculated by a computer according to a program including the possibility to exclude samples with extreme orientation in two eliminations. For the definite computing orientations measurements after demagnetization with 200 Oe (exceptionally with 100 Oe, if dispersion of orientations was lower) was used.

The measurements were carried out with astatic magnetometers with sensitivity cca 2×10^{-7} Oe mm, and partly also with rockgenerator magnetometer ION-1. Demagnetization was done either in three mutually perpendicular directions or in a rotation device. Compensation field was controlled with fluxgate magnetometer. Since no distinct differences among measurements on various magnetometers were found neither after demagnetization on various devices, the results may be considered homogeneous from the view of measurements.

The Results of Palaeomagnetic Measurements and Their Evaluation

The character of demagnetization curves (Fig. 3) indicates that magnetization after purification by alternating field 200 Oe is that of TRM type. Still the thermomagnetic analysis which may confirm direct magnetization supposed on the basis of mineralogical composition of rocks, and comparison with analogous rock types and the form of predominant number of demagnetization curves are still necessary.

The data on the situation of the sites sampled (Fig. 1), the average results of measurements and calculations are presented in Table 1 and 2.

Natural remanent magnetization (NRM) is — when compared with Central-Slovakian volcanic rocks — lower and shows an increasing trend from older to younger rocks (with the exception of deviations in the IInd and IIIrd groups, caused by different chemism). The name „group" in the present chapter is not used in geological sense.

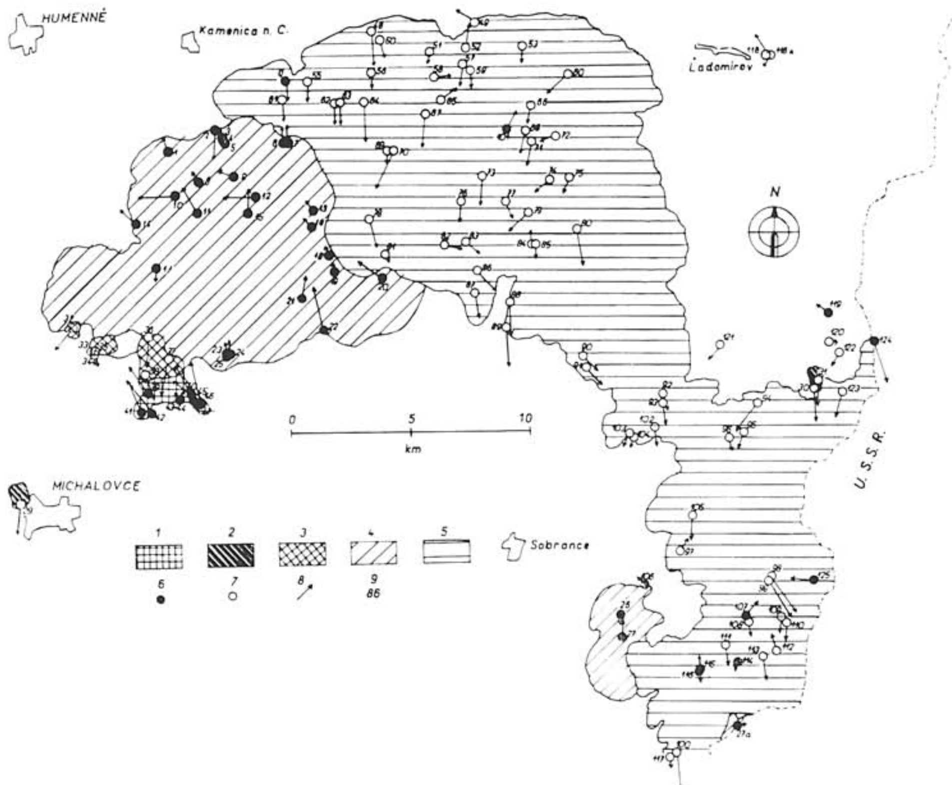

Fig. 1. Schematic geological map of Vihorlat Mts. and a map of RM-courses. 1 — Subvolcanic bodies and domes of Vinné complex (Upper Sarmatian). 2 — Domes of garnetiferous rhyodacites (Pannonian s. s.). 3 — Subvolcanic bodies and domes of Tarnava-Šutová complex (Levantian?). 4 — Kyjov-Orechové formation (variegated Pannonian, Pontian). 5 — Popričný-Vihorlat formation (Levantian). 6 — Positive inclination of RM. 7 — Negative inclination of RM. 8 — The course of declination of RM, length of arrow-heads is proportional to the value of inclination complement. 9 — Number of sites studied.

Table 1. Numeric Results of Palaeomagnetic Measurements

Number of site	Number of samples taken	φ_L	λ_L	J_n	$\varkappa$	Q	D_L	I_L	k	α	λ_p	φ_p	δ_f	δ_n	T_K
Group I															
39	13	48,809	21,974	94,4	1174,2	0,16	319	24	107,6	5	312,6	49,8	2,9	5,3	b
40	6	48,802	22,000	12,0	42,7	0,63	230	49	31	16,8	4,2	—18,8	14,8	22,3	
41	7	48,795	21,970	105,8	1548,1	0,13	342	10	969,4	3,2	276,7	65,5	1,6	3,2	b
42	7	48,794	21,980	86,6	180,4	0,89	338	1,5	12,2	17,98	231,9	38,2	9,0	18,0	d
43	10	48,798	21,992	76,1	852,2	0,18	304	81	257,04	3,8	31,1	31,3	7,0	7,3	b
44	6	48,800	21,996	149,6	124,5	3,0	22	78,5	10,7	21,4	45,4	67,9	38,3	40,5	c
45	10	48,798	22,005	114,0	3483	0,065	331	26	56,5	8,1	306	61,4	4,7	8,8	
46	16	48,798	22,004	714	1998	0,72	339	—17	283,8	2,6	265,6	52,9	1,4	2,7	a
47	4	48,798	22,005	604	584	2,2	341	3	36,7	15,4	226,5	39,9	7,7	15,4	c
Group II															
28	4	48,7912	21,824	83,0	29,0	5,7	317	70	354,3	11,2	14,3	43,9	16,2	19,0	
29	5	48,762	21,900	20,0	10,0	4,0	203	—35	67,8	15,1	324,1	—71,5	10	17,3	
30	5	48,801	22,353	16,0	9,0	3,5	173	—32	50,9	17,5	103,2	—82	11,1	19,7	
31	3	48,85	22,35	16,9	60,1	0,66	187	—46	12,0	37,3	6,01	—60,8	39,4	47,6	a
Group III															
1	4	48,893	21,988	503,0	179,0	5,7	346	69	107460	0,76	32,6	57,6	1,1	1,3	
2	5	48,898	22,019	40,6	122	0,67	209	34	187	9	21	—45	5,9	10,3	d
3	6	48,897	22,019	140,0	349	0,80	350	66	779,4	3,6	37,3	61,8	4,7	5,7	
4	6	48,8965	22,020	155	523	0,59	337	63	3707	1,5	14,7	60,6	1,9	2,4	b
5	8	48,8945	22,021	244	994	0,49	334	58	496,4	3,0	1,0	62,2	3,2	4,4	b
6	5	48,8945	22,055	326	400	1,63	1	57	4981,9	1,8	52,9	74	1,9	2,6	b
7	6	48,8946	22,057	469	370	2,53	359	60	1004	2,9	46,5	71,7	3,3	4,4	a
8	5	48,882	22,007	651	289	4,5	179	—17	1248,5	3,5	53,9	—76,6	1,9	3,6	a
9	4	48,882	22,026	124	284	0,87	307	61	409	7,7	176,6	42,0	9,0	11,9	
10	3	48,876	21,990	321	566	1,13	275	19	870	4,2	326,3	8,3	2,3	4,4	d
11	13	48,878	22,004	270	480	1,12	339	36	526,4	2,3	317,1	70,7	1,5	2,6	b
12	5	48,875	22,037	817	673	2,43	270	32	2742	2,4	335,4	6,3	1,5	2,7	d
13	12	48,866	22,034	4763	504	18,9	2	52	3292,7	0,97	58	79	0,9	1,3	a

Table I

Number of site	Number of samples taken	φ_L	λ_L	J_n	$\varkappa$	Q	D_L	I_L	k	α	λ_p	φ_p	δ_f	δ_n	T_K
14	7	48,862	21,972	169	362	0,93	318	51	182,1	5,7	342,2	51,8	5,2	7,7	b
14a	9	48,862	21,972	313	925	0,68	257	29	242,6	3,9	338,04	−5,9	2,4	4,3	d
15	8	48,869	22,071	398	1916	0,42	308	78	100	6,7	26,3	35	11,8	12,6	c
16	8	48,863	22,069	27	905	0,065	308	77	4,6	35,2	25,8	35,2	61,6	65,8	
17	6	48,847	21,982	65	588	0,22	206	68	192,5	6,6	32,4	−13,8	9,3	11,1	b
18	3	48,852	22,080	124	249	1,0	344	84	440,3	5,9	44,8	33,7	11,4	11,6	b
19	6	48,847	22,081	116	112	2,07	347	81	1012,7	2,9	44,1	38,6	5,4	5,6	a
20	4	48,842	22,105	1234	2259	1,09	311	38	1477	6,5	326,9	45	4,5	7,5	b
21	5	48,836	22,066	61	274	0,45	25	59	657,6	5,4	93,8	62,9	5,7	7,8	a
22	14	48,824	22,077	43	243	0,36	348	4	7,6	18,7	261,4	66,5	9,4	18,7	c
23	15	48,816	22,002	135	514	0,53	341	73	138	3,9	32,6	51,5	6,2	6,9	b
24	8	48,815	22,023	757	299	4,8	354	65	156,2	4,4	271	85,8	5,8	7,2	c
25	13	48,812	22,092	749	657	2,28	352	62	326,3	2,9	33,8	67,5	3,5	4,5	b
26	6	48,717	22,243	315	609	1,04	203	82	2432,9	1,9	42,5	7,5	3,5	3,6	b
27	8	48,710	22,231	128	2275	0,11	13	49	21,1	14,9	100,8	76,2	13,1	19,8	
27a	5	48,676	22,304	547	398	3,33	189	83	70,2	9,2	19,6	35,7	17,7	18,0	b
0	10	48,918	22,058	13847	1739	15,92	176	58	853,7	5,0	51,1	−26,9	5,3	7,2	
Group IV															
32	4	48,823	21,930	160	776	0,41	230	−39	6471,5	3,1	308,4	−43,7	2,2	3,7	a
33	7	48,817	21,940	466	430	2,17	175	−74	1542	2,0	224,5	−52	3,2	3,5	b
34	9	48,817	21,949	280,4	226	2,6	167	−64	97	5,25	101,6	−80,6	6,7	8,4	d
35	6	48,817	21,942	148	654	0,45	167	−56	1275,8	2,6	211,9	−60	3,6	4,3	b
36	9	48,824	21,979	1839	373	3,4	183	−29	30,3	10,2	18,3	−56,7	6,2	11,3	c
37	5	48,815	21,989	1027	476	2,7	192	−10	89,7	8,12	5,55	−44,8	4,1	8,2	b
38	10	48,8068	21,974	166	418	0,79	165	−40	837,5	2,09	145,6	−74,2	1,5	2,5	b
Group V															
48	6	48,937	22,105	219	356	1,23	185	−19	214,3	6,3	28,7	−77	3,4	6,6	f
49	4	48,938	22,166	33,3	282	1,74	307	−55	220,1	16,9	271,4	13,7	16,8	23,9	h
50	20	48,933	22,109	490	246	3,99	164	−58	286,2	2,3	192,8	−68	2,5	3,34	f

51	3	48.929	22.139	10020	730	25,8	196	—72	7,2	499	244,6	—77,2	78,1	88,3	a
52	8	48.930	22.158	9388	582	32,26	35	—40	2346,5	1,4	189,6	33,7	1	1,7	a
53	10	48.930	22.191	730	345	4,24	192	—64	5168,2	0,8	248,8	—65,2	1,1	1,3	a
55	4	48.918	22.069	471	257	3,66	172	—54	13442	2,2	203	—75,6	2,1	3,0	a
56	6	48.920	22.105	1699	407	8,36	184	—64	6820,5	1,1	236,2	—66,5	1,4	1,8	d
57	5	48.926	22.158	406	308	2,64	203	—53	7069,3	1,5	285,6	—66,7	1,4	2,0	h
58	4	48.921	22.141	2090	389	10,75	83	—63	17994	1,9	183,7	— 8,7	2,3	2,9	h
59	7	48.923	22.166	315	370	1,7	164	—61	978,5	2,5	198,9	—65,8	2,9	3,8	c
81	8	48.854	22.110	651	569	2,29	148	—87	2056,7	1,5	225,4	—27	2,9	2,9	h
82	6	48.857	22.145	119	115	2,2	103	—65	546,7	3,9	181,7	—24,5	5,1	6,3	
83	7	48.858	22.161	154	14	22,35	158	—56	617,4	3,1	181,6	—65,8	3,2	4,5	a
84	8	48.854	22.196	351	174	4,04	354	—68	1403	1,8	232,9	16,4	2,5	3	h
85	6	48.856	22.197	349	146	4,6	181	—65	168	5,2	5,8	—88,1	6,8	8,4	a
86	7	48.844	22.164	284	496	1,04	157	—45	2513,3	1,5	155,7	—69	1,2	1,9	a
87	4	48.839	22.165	801	215	7,5	90	—23	841	8,6	150,2	— 4,3	4,9	9,2	
88	6	48.835	22.183	108	596	0,36	186	—33	1929,2	2,1	353,5	—82,7	1,3	2,4	h
89	6	48.824	22.179	120	729	0,33	176	—13	3352,4	1,6	62,5	—74	0,83	1,6	a
90	14	48.813	22.223	232	659	0,7	138	—55	373,3	2,5	167,5	—51,2	2,5	3,5	a
91	7	48.808	22.224	355,7	649	1,1	144	—55	447,8	3,6	170,4	—55,6	3,7	5,2	h
92	7	48.801	22.269	425	214	3,98	158	—64	4995,8	1,1	196	—60,7	1,4	1,7	b
93	4	48.798	22.270	675	671	2,0	189	—50	559,7	10,8	268,5	—76,9	9,15	14,1	
94	11	48.797	22.322	512	85	11,87	226	—29	535,6	2,4	319,3	—46	1,5	2,6	g
95		48.784	22.305	266	666	0,81	207	—61	7,7	48	300,4	—70,1	56,8	73,8	c
96	7	48.784	22.307	533	261	2,95	160	—65	325,5	5,4	209	—60	7,3	8,9	
98	3	48.730	22.328	35,2	212	0,32	138	— 7	74,8	14,4	74,3	—32,3	7,3	14,4	f
99	6	48.731	22.328	47	166	0,56	138	—15	29,6	17,2	125,2	—47,3	9	17,6	f
100	5	48.674	22.276	540	122	8,8	169	—12	9165,4	1,3	70,7	—59,5	0,67	1,3	c

Group VI

101	7	48.899	22.182	112	33	6,82	39	55	57,6	10,2	108,4	53,6	10,3	14,4	
102	5	48.784	22.305	580	931	1,24	171	—59	146,3	6,3	59,8	—79,1	7,1	9,5	a
103	3	48.783	22.250	2706	359	12,1	206	—76	176,4	9,3	236,8	—69,9	15,8	17,1	a
104	8	48.787	22,249	864	1580	1,09	213	—72	859,9	2,3	254,7	—47,5	3,6	4	a
105	5	48.754	22.283	2626	522	8,9	190	—46	11,3	23,8	358,3	—66,8	19,3	30,3	c
106	2	48.729	22.254	51	247	0,43	325	74	35	43,5	335,1	67,3	70,8	78,5	
107	9	48.718	22.317	302	2836	0,21	59	64	170,3	4,6	97	37	5,9	7,4	c
108	4	48.716	22.316	1031	868	2,37	170	—76	375,7	12,9	222,2	—48,3	22	23,8	c
109	3	48.717	22.332	1925	996	3,87	188	67	1487,3	3,2	239	—61,7	4,4	5,3	a

Number of site	Number of samples taken	φ_L	λ_L	J_n	$\varkappa$	Q	D_L	I_L	k	α	λ_p	φ_p	δ_f	δ_m	T_K
110	2	48,715	22,337	459	935	0,98	196	−59	467	11,6	263	−68,1	12,9	17,3	b
111	6	48,707	22,301	1737	824	4,22	165	−57	4485,2	1,4	190,4	−70,3	1,4	2	b
112	3	48,705	22,339	530	94	13,0	321	−40	119,9	51,3	270,1	25,3	52,2	72,9	
113	4	48,703	22,323	4516	1196	7,5	168	−51	1401,1	6,7	181,7	−75,6	6,1	9	
114	4	48,701	22,308	311	984	0,63	222	81	773,9	9	28,3	8	16,6	17,3	a
115	13	48,697	22,288	119	1342	0,18	323	78	48,7	7,5	30,6	40	13,1	14	
116	5	48,697	22,288	436	673	1,30	197	77	505,6	5,5	41,6	− 1,4	9,5	10,2	a
117	9	48,667	22,273	2863	639	8,96	161	−77	2241,6	1,3	217,1	−45,6	2,2	2,4	b
97	3	48,743	22,278	2642	582	9,08	45	−65	140,1	10,5	199	9,8	13,5	16,8	b
Group VII															
118	7	48,925	22,330	309	6024	0,1	324	−49	11	24,2	263,8	27,5	21,1	32	a
118a	7	48,925	22,339	56	771	0,22	222	−74	14,3	16,5	263,2	−66,7	27,1	30	c
119	3	48,827	22,363	202	402	1,36	305	67	2,2	120,4	314,9	55,9	166	200	c
120	3	48,816	22,362	242	171	2,42	83	−79	3,3	82,9	173,1	−42,9	149,4	157,3	b
121	4	48,817	22,299	588	691	1,9	214	−59	30,5	16,9	339,7	−63,8	18,6	25,1	c
122	2	48,814	22,365	117	110	2,13	209	−67	303,1	14,4	261	−54	19,8	23,9	
123	5	48,848	22,366	6918	618	15,5	216	−45	3,8	39,5	318	−54	31,3	49,7	b
124	7	48,8188	22,3825	5007	313	32,0	149	13	84,1	8,4	99,2	−47,7	4,4	8,6	a
125	2	48,729	22,353	2002	266	26,4	282	49	7	117,1	305,2	29,9	102,8	155,1	b

φ_L, λ_L — geographic coordinates of the sites, J_n — natural RM in 10^{-6} CGS, $\varkappa$ — magnetic susceptibility in 10^{-6} CGS, Q — Königsberg's coefficient, I_L, D_L — inclination and declination of RM after demagnetization by alterning magnetic field H = 200 Oe, k — coefficient of dispersion, α — semiangle of the probability cone for P = 0,95, λ_p, φ_p — geographical coordinates of paleomagnetic pole of a site, δ_f, δ_m — dimensions of the oval of reliability of pole positions, T_K — type of demagnetization curve (cf. Fig. 3).

Table 2. Mean Values of Palaeomagnetic Parameters for the Separate Groups

Group	used samples	D	I	J	$\varkappa$	Q	φ_p	λ_p	k	α	δ_f	δ_m
I	70	332,2	21,5	266,2	1296,9	0,81	45,8	243,2	8,8	4,7	4,9	9,3
II	14	356,4	51,1	40,1	27,3	3,78	72,8	212,5	11,4	13,1	10,5	15,5
III	175	335,7	66,8	1512,3	699,3	3,24	74,2	303,5	4,3	7,2	5,8	7,1
IV	40	359,6	47,8	669,4	416,1	2,08	70,0	203,3	6,9	11,6	5,9	9,0
V	244	352,6	58,2	1049,6	366,9	5,70	78,8	233,1	6,8	8,3	4,1	5,4
VI	76	5,0	76,0	1197,2	966,6	4,67	75,1	30,9	5,1	10,9	8,8	9,5
VII	37	11,5	69,3	2055,0	1243,9	8,95	81,7	78,1	13,7	3,9	19,9	23,4
SUM	656	347,4	59,6	1119,1	669,5	4,32	77,7	253,6	2,5	5,7	2,9	3,8

Explanations see Tab. 1.

but only for the population of data on remanent magnetization corresponding to geological complexes distinguished in the geological map.

Owing to their simplicity, the demagnetization curves were classified according to their shapes to several characteristic types (Fig. 3). A respective type is presented in Table 1. The majority of sites shows that RM is comparatively stable (TRM), only some curves are more complicated due to greater viscous magnetization.

Differences in the shape of curves are perhaps due to a certain variableness of mineralogical composition, size and shape, and orientation of ferromagnetic minerals, the presence of secondary magnetization (mainly viscous, in partly metamorphosed rocks — chemical magnetization, and in exposed sites — isothermal).

The central position of palaeopoles for the single groups (Table 2) are not too dispersed, the central position of palaeopole for all the sites (78° N, 254° E) is distinctly different from the pole of Kremnické hory Mts. (75° N, 132° E P. Pagáč 1968), still well corresponding with the present position of geomagnetic pole.

Geological Interpretation of the Results of Measurements

The interpretation of measuremetns of RM and confrontation of the results obtained with the geological observations enabled us to find the criterii for more detailed division of Vihorlat Mts., different from the earlier conception (V. Hano, J. Seneš 1953, J. Slávik 1956, M. Kuthan in A. Matějka 1964).

The Vinné complex of subvolcanic bodies, domes and cumulodomes is evidently palaeomagnetically different from the rest of volcanic suites (Figs. 1, 2) and may be still more detailly specified to a part near the quarry Lancoška (sites 40, 43, 44) and peripheral parts with approximately zero inclination of remanent magnetisation.

Palaeomagnetic measurements led to the separation of Tarnava-Šútová complex considered before as a chronological and petrographical equivalent of the Vinné complex. Its only difference is in reverse polarity of RM and considering the fact about the

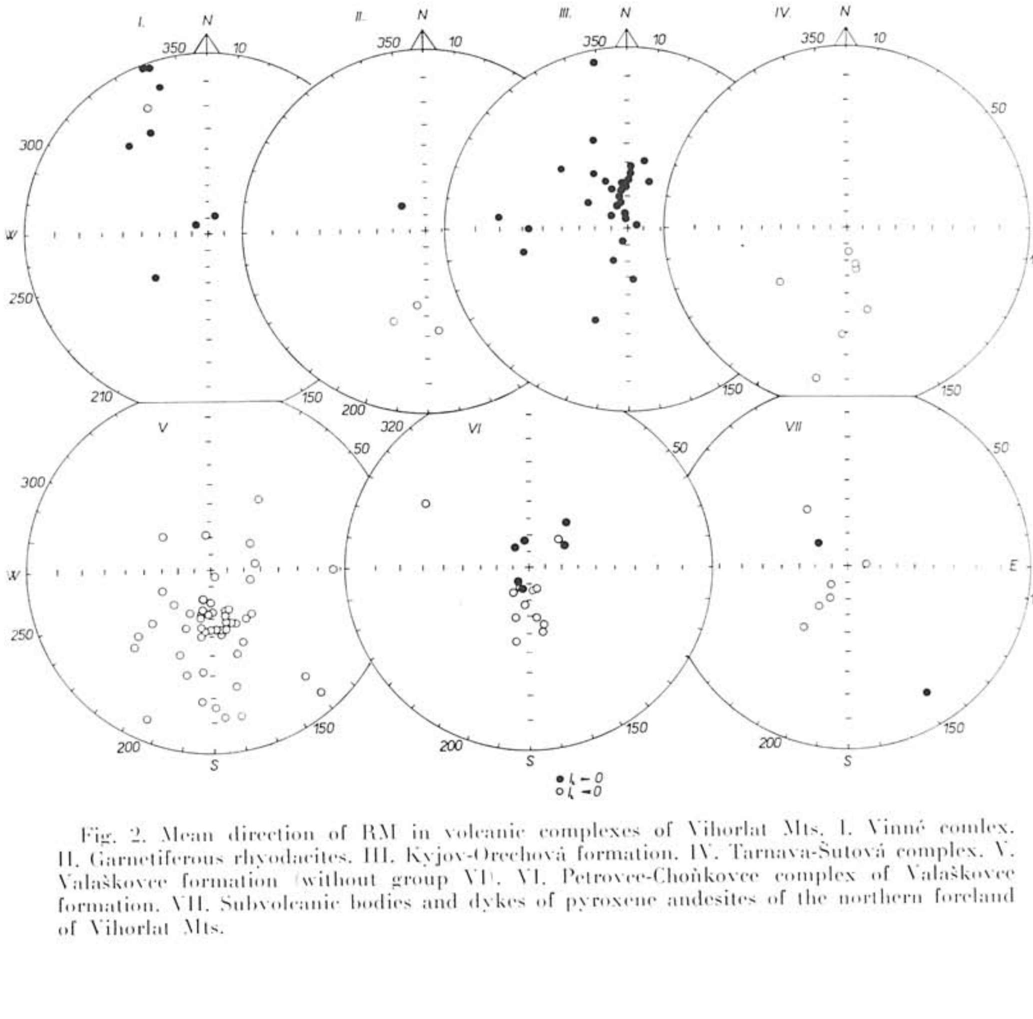

Fig. 2. Mean direction of RM in volcanic complexes of Vihorlat Mts. I. Vinné comlex. II. Garnetiferous rhyodacites. III. Kyjov-Orechová formation. IV. Tarnava-Šutová complex. V. Valaškovce formation (without group VI). VI. Petrovce-Choňkovce complex of Valaškovce formation. VII. Subvolcanic bodies and dykes of pyroxene andesites of the northern foreland of Vihorlat Mts.

palaeomagnetically stable rocks (Fig. 3) we cannot take the rocks for chronologically related to each other.

The most important geological results of palaeomagnetic measurements is the necessity to separate the Kyjov-Orechová formation, which was considered an equivalent of Koňuš complex. The positive polarity of RM in Kyjov-Orechová formation and its position below coarse-porphyric dark dacites and andesito-dacites of the Petrovce-Choňkovce complex evoke an idea about the formation representing an older volcanic structure parallelizable with pyroclastics bored in sub-Vihorlat coal-basin between a sequence of Pozdišovce gravels and a sequence of andesite gravels.

Important is also a set of informations about the relationship among the separate units inside the Valaškovce formation. Basal parts of the latter were originally considered as equivalent to volcanism of variegated Pannonian. This is, however, upposed by the negative polarity of RM of the sites 49, 71, 74, 75 with the exception of the

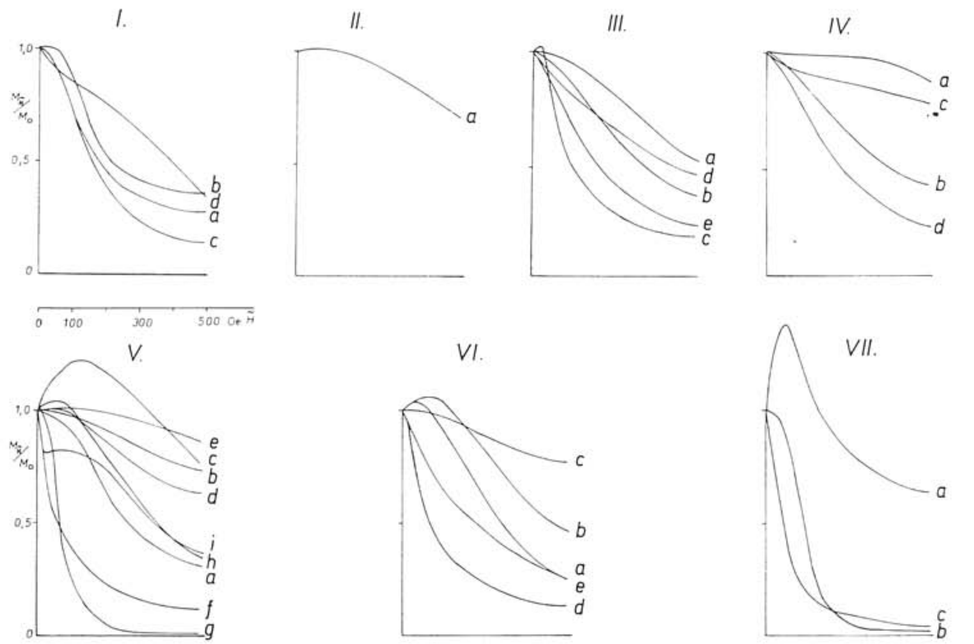

Fig. 3. Characteristic types of demagnetization curves within the separate groups.

site 27 a, which confirms and older age of volcanic rocks exposed in the stream Močidlá and this occurrence is therefore referred to the Kyjov-Orechové formation.

A specific phenomenon in the Valaškovce formation is the Petrovce-Choňkovce complex forming an important leading horizon. Rocks of this suite have normal and reverse oreintation of RM. The causes of alternating polarity within the suite could be determined after a detailed palaeomagnetic study as is also showed by the excentric position of palaeomagnetic pole (Fig. 5, 4, Table 2, 3).

The youngest volcanic suite Popričný-Vihorlat is formed almost completely by effusions. It its whole extent reverse polarity of RM predominates, but great dispersion of declinations on the single sites is characteristic. Perhaps, some parts (the youngest ones) of the suite may also have positive polarity of RM as indicated by two dates on the Popričný Mts.: one from northern slopes of the elevation point Holica, another from the vicinity of the Haseník elevation point.

Unsolved remains the question of the preparated volcanic diatremes in Paleogene and Mesozoic environments of Podhorod-Beňatiná depression and around Ladomírov (Form. 7, Fig. 2). Measurements displayed normal and reversed polarity of RM as well as great dispersion of directions. On the basis of geological data, they are preliminary referred to a basal suite of the Valaškovce formation.

Conclusion

The present article deals with RM of the rocks under study, as an identification means for more detailed age division of petrographically monotounous volcanic com-

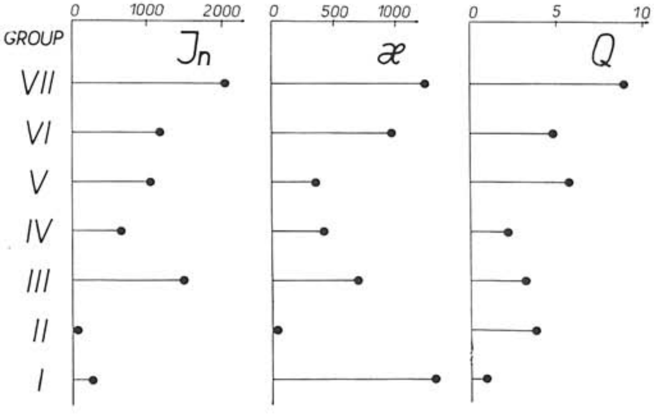

Fig. 4. Diagram of natural RM (J_n), magnetic susceptibility (ϰ) and Königsberg's coefficient (Q).

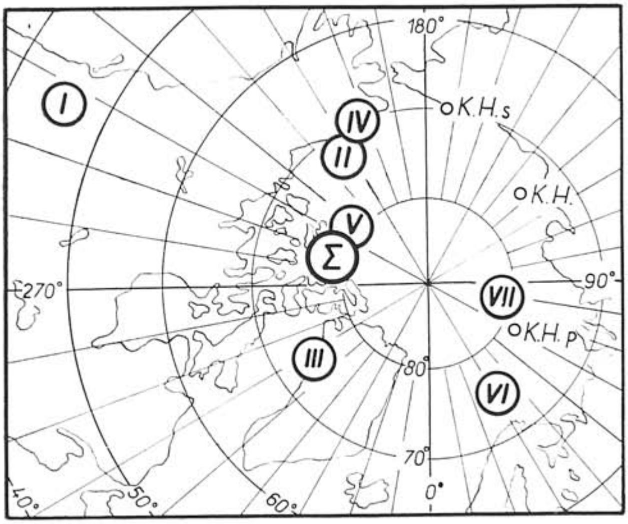

Fig. 5. Diagram od mean palaeomagnetic poles for the separate groups Σ — Mean position of palaeomagnetic pole for all sites. KH — Kremnické hory Mts. KHs. — Kremnické hory Mts. — Sarmatian. KHp — Kremnické hory Mts. — Pliocene.

plexes. This is supported by the separation of the Tarnava-Štutová complex from the Vinné-Závadka formation in Vihorlat Mts., and by the division of the proper volcanic Vihorlat Mts. into the Kyjov-Orechové and Valaškovce formation.

Vihorlat Mts. is an example inspiring the necessity of the study of planar distribution of RM in the rocks of all volcanic mountain-ranges.

When the study of RM will be completed by the study of absolute ages, then a

Table 3. Geological and Palaeomagnetic Distribution of Vihorlat Mts. Volcanic Rocks

Stratigraphy			Formation division			Nr of group from fig. 2	Geol.-petrograph. characteristics	Polarity of RM	Coordinates of paleopole	
									φ_p	λ_p
PLIOCENE	Levantian	Upper Pliocene	Group of Volcanic formations of Vihorlat Mts.	Valaškovce formation	Popričný-Vihorlat complex	V	lavas of pyroxene andesits	R	78.8	233.1
					Koňuš complex		stratovolcanic deposits of pyroxene andesite	NR		
		Middle Pliocene			Petrovce-Choňkovce complex	VI	dark coarseporphyric andesitodacites	NR	75.1	30.9
				Tarnava-Šutova complex		IV	andesite domes	R	70.0	203.3
	Variegated Pann.	Pliocene		Kyjov-Orechová formation		III	stratovolcanic deposits of pyroxene andesite composition	N	74.2	303.5
	Pannonian ss	Lower		Sequence with garnetiferous rhyodacite tuffs		II	domes? cumulodomes?, tuffs of garnetiferous rhyodacite tuffs	NR	72.8	212.5
MIOCENE	Sarmatian	Zone with *Nonion granosum*		Vinné-Závadka formation	Vinné complex	I	domes and cumulodomes of hornblende-pyroxen andesite	N	45.8	243.2
		Zone with *Elphidium hauerinum*			Závadka complex		mainly pyroclastics of hornblende-pyroxene andesite	?		

palaeomagnetic scale may by created with stratigraphical appliance, which may serve a complement to biostratigraphical and chronostratigraphical scales.

For theoretical and applied geology of Eastern Slovakia (and other areas) the study and correlation of RM of the rocks in Prešov-Tokaj Mts. and in volcanic areas on the southern periphery of East-Slovakian lowlands seem inevitable. Thus a new means for volcanologic and tectonic regional interpretations will be offered.

There is a need of extension in the existing laboratory methods: to study TRM by means of high- and low-temperature termomagnetic analyses. The methode suggested will lead to more objective and reliable opinion about the origin of RM, and offer further criterii for a more detailed specification of rocks or whole geological suites.

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