POTASSIUM METASOMATISM IN THE NEIGHBOURHOOD OF MÁTRASZENTISTVÁN (W-MÁTRA MOUNTAINS)

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ABSTRACT

In the W-Mátra Mountains, S from Mátraszentistván the Lower-Tortonian andesite series underwent potassium metasomatism to a considerable extent. The plagioclase feldspar of the sometimes compact, sometimes porous but owing to the marked silicification always resistant rock has been replaced by sanidine, easily identified by X-ray investigations. In the course of metasomatism the extent of silicification is so marked that in certain places instead of feldspar even quartz varieties are to be found. The cavities are covered by quartz and chalcedony, rarely by tridymite.

On the N parts of Mátra peaks the medial dacite tuff, appearing on the Helvetian-Tortonian boundary, is missing, here probably the andesite series is also settled immediately upon the Helvetian marly aleurite, thus likely the Burdigalian acidic detrital vulcanic substance may serve as a potassium source for the endometamagmatic potassium metasomatism.

OCCURRENCE

In the course of the detailed study of our mountainous regions newer and newer metasomatic areas are discovered. Such areas in Tokaj Mountains are mentioned by Mrs. V. Fux—Széky [1964], K. Máté—Varga [1961], in Mátra Mountains by J. Kiss [1960], I. Kubovics [1966], Gy. Varga [1959], and A. Vidacs [1962].

The mapping showed that the Lower-Tortonian andesite which had suffered metasomatism occurs in the surrounding of the 821,6 m altitude encircled by the streams Naráď and Hutahely in W-Mátra, S from Mátraszentistván [J. Mezősi, 1968]. In the neighbourhood a younger, dark grey unaltered andesite, the so called capping-andesite is to be found, which closes the Helvetian-Tortonian volcanism. The sketching map *(Fig. 1)* yields some information on the geological built up of this territory.

In the W part of the occurrence on a lower terrain markedly siliceous rock can be found in large blocks. Its colour varies widely: whitish grey, pink, reddish grey, violet grey. Very often it contains smaller cavities with a few mm quarz crystal-

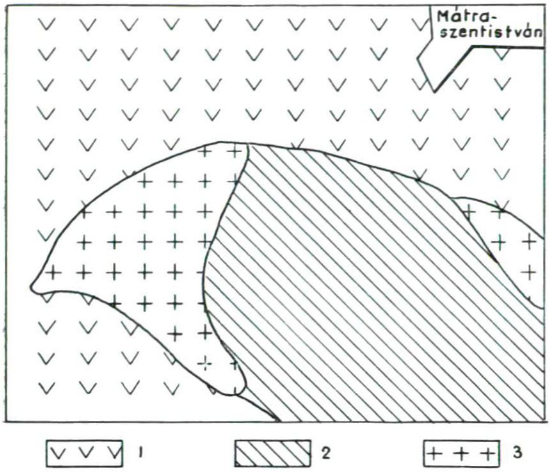

Fig. 1. Geological sketching map of the field investigated.
1. Lower-Tortonian andesite
2. Lower-Tortonian andesitogeneous potassium trachyte
3. Lower-Tortonian capping-andesite

groups or sometimes chalcedony in them. Among the surface rocks strongly leached, stripped rock debris occurs as well, appearing to be a part of some vein, however it does not contain ore minerals. It is especially easy to see in the violet grey rock that merely feldspar occurs in porphyritic form, traces indicating columnar pyroxene can be scarcely found. Owing to the too markde alterations the original texture in the case of the whitish grey rock cannot be detected at all.

Round the 821,6 m altitude a rock similar to the former type appears also in larger blocks, sometimes in stone rivers. In the cavities there are trigonal quartz crystals even as large as 1 cm. At places weak pyrite impregnation can be observed. Quartz crystals sometimes are covered by limonite crust of 1 mm thickness. In the debris similarly striped, chalcedony-opal vein fragments occur, however, without ore minerals. In some vein fragments rarely exsolutions indicating carbonate minerals are observed.

The hypocrystalline structure is well observable by microscopy. The columnar, mostly idiomorphic feldspar of 1—2 mm is always well separated from the matrix. Finer textural variations, however, could not be recognized, owing to the extensive silicification. Feldspar microlites are often replaced by SiO_2 variations *(Fig. 2)*, in some cases the matrix is completely impregnated by the SiO_2 variety *(Fig. 3)*.

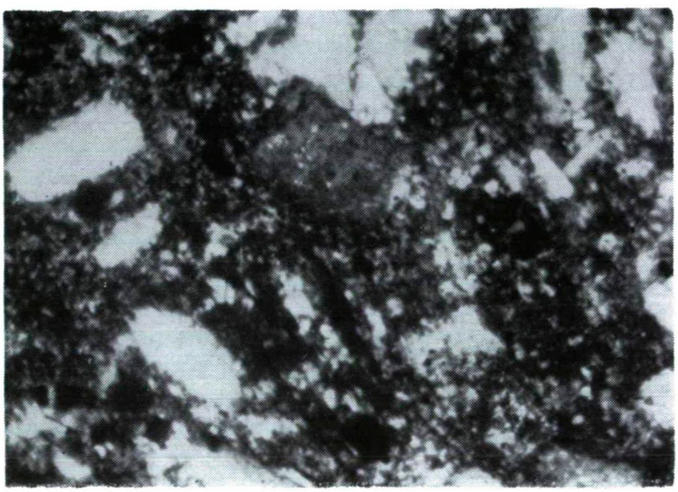

Fig. 2. Feldspar microlites replaced by chalcedony.
Crossed nicols, × 120.

The ore and femic microlites are completely dissolved in the matrix, and are replaced by limonite globules, or rarely by radial-fibrous aggregates of goethite. Unaltered magnetite, pyrite could not be found in the samples investigated, only some traces can be supposed. On the wall of smaller cavities, fissures first of all a thin crust of limonite globules appear then chalcedony follows — sometimes it completely fills the cavity.

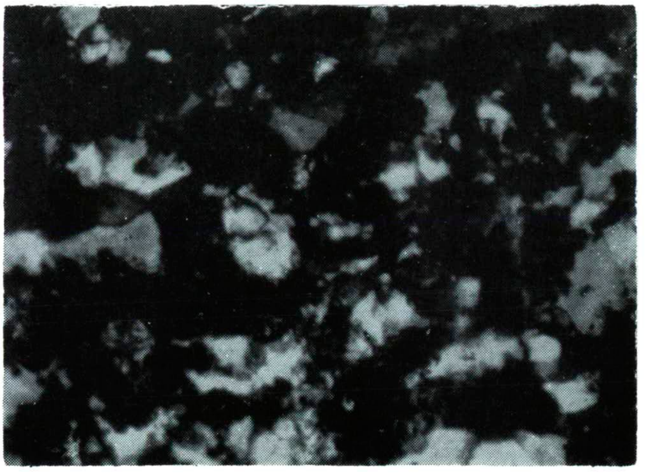

Fig. 3. Matrix of andesitogeneous potassium trachyte impregnated by chalcedony. Crossed nicols, × 120.

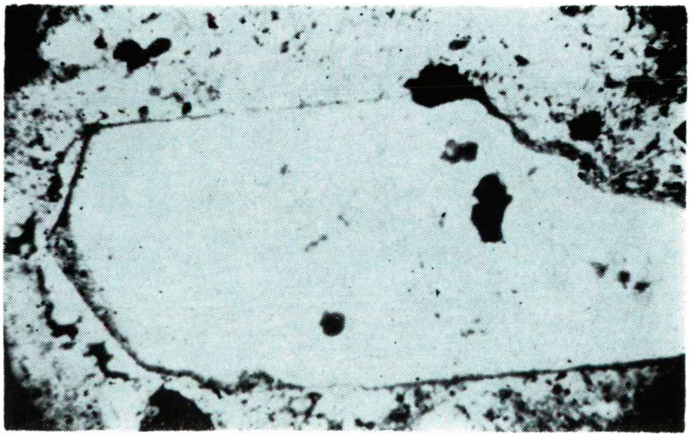

Fig. 4. Silicified feldspar with ramifying ore veinlet. Parallel nicols, × 90.

It is well known that the oxygen activity depends on the alkali content of the solutions. In the case of potassium metasomatism since iron has a higher oxidation degree, all the minerals, containing Fe^{2+}, are displaced. According to SCHELLMAN's investigations [1959], at pH 4—5 or in presence of Mg^{++} or Ca^{++} hematite is formed already at usual temperature, and in presence of SO_4^{2-} goethite, in the neutral region. It is an explanation of the fact that in these rocks the above minerals can be found instead of magnetite. Hematite plays a role in the colouring of the rocks, too.

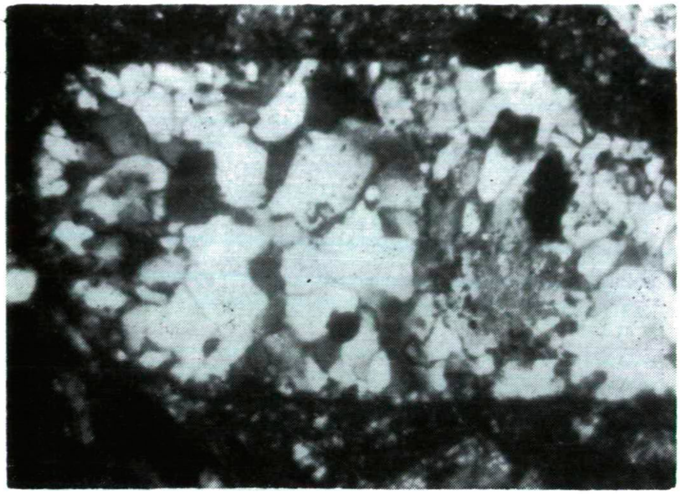

Fig. 5. Totally silicified feldspar.
Crossed nicols, × 90.

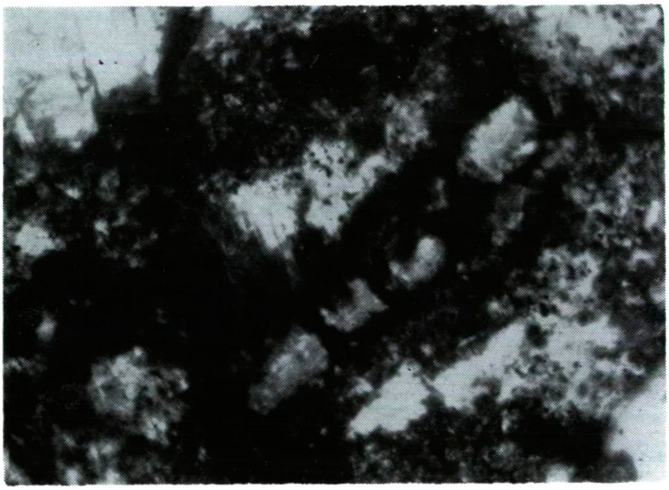

Fig. 6. Mineralized hypersthene.
Parallel nicols, × 60.

Original feldspar phenocrysts were mostly of columnar habit. Twinning and zonal development have either faded or completely disappeared, so their kind cannot be accurately determined in an optical way. In the initial stage of the alteration the crystal becomes mottled. A similar phenomenon has been experienced by

MRS. FUX—SZÉKY [1964] and KUBOVICS [1966] in feldspars of andesites suffered metasomatism. In other cases feldspar is completely replaced by quartz *(Figs. 4* and *5)*. In this case the amount of the ore mineral is minimal in the rock and a thin ore frame is to be found at the border of feldspar.

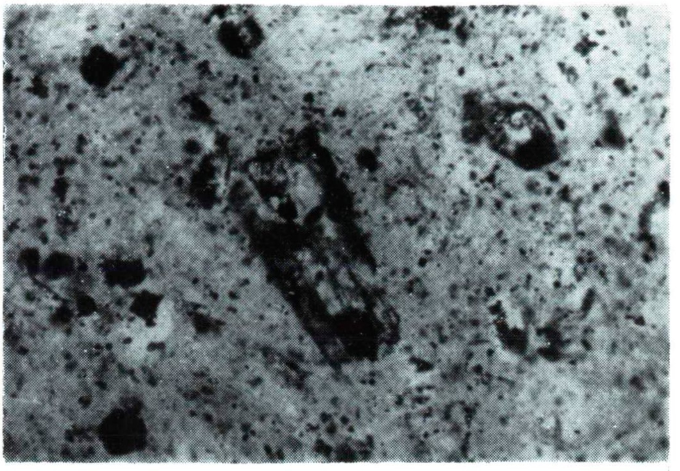

Fig. 7. Mineralized and seladonitized pyroxene.
Parallel nicols, × 90.

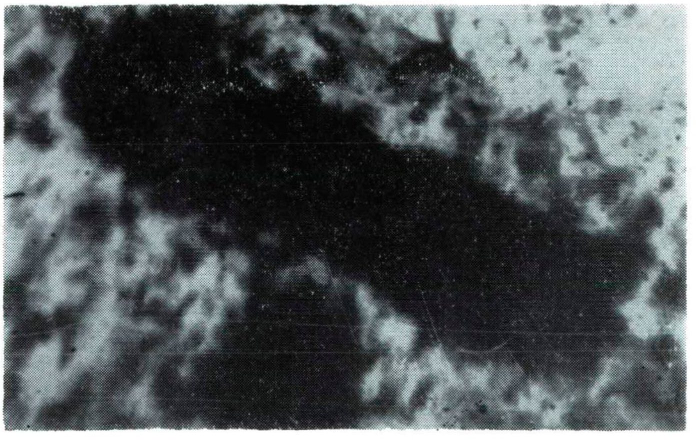

Fig. 8. Place of pyroxene crystal filled by limonite.
Parallel nicols, × 120.

In its present state the rock does not contain unaltered pyroxene, but its traces are detectable. When only mottled feldspars are observable in the rock, seladonite or perhaps a few quartz appear in the place of dark constituents. Sometimes the columnar pyroxene crystal is surrounded by an ore frame and even the cleavage directions parallel to the 001 plane are marked by limonite *(Figs. 6* and *7)*. Sometimes in the places of smaller crystals pseudomorphs consisting of limonite globules are found *(Fig. 8)*.

At larger cavities it is easy to observe that quartz crystal groups of trigonal habit are settled on chalcedony, on the walls of cavities *(Fig. 9)*.

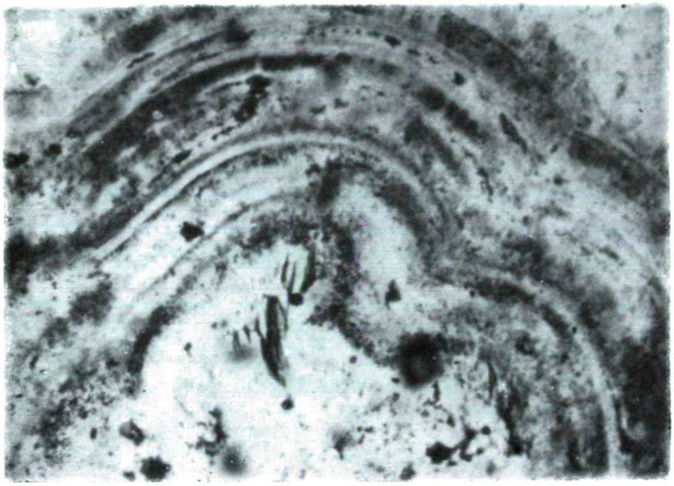

Fig. 9. Silica gel rhythmically separated.
Parallel nicols, × 30.

CHEMICAL INVESTIGATIONS

In view of the marked alterations the SiO_2 and alkali content of some of the samples has been investigated. Results are summarized in Table 1.

Table 1

Sample number	Description of sample	SiO_2	Na_2O	K_2O
1.	pink compact rock	64,34%	0,35%	7,11%
2.	faded pink compact rock	n.d.	0,10	7,29
3.	greyish white compact silicic rock	96,37	0,14	0,19
4.	compact flint rock	n.d.	none	none
5.	greyish yellow porous rock	n.d.	0,10	8,10
6.	light pink porous rock	n.d.	0,25	7,90
7.	rock of flesh-red colour	n.d.	0,20	7,91
8.	pink compact rock	n.d.	0,20	7,30
9.	pink, slightly porous rock	n.d.	0,20	7,90
10.	violet greyish rock,	n.d.	1,12	7,85
11.	unaltered Lower-Tortonian pyroxene andezite in the neighbouring territory	57,19	2,78	2,47

n. d. = not determined

The alkali percentage of rocks suffering potassium metasomatism in the Tokaj and Mátra Mountains are summarized in Table 2.

Table 2

	1.	2.	3.	4.	5.	6.	7.	8.
SiO_2	65,25%	65,20%	65,93%	68,75%	57,76%	57,39%	62,08%	67,92%
Na_2O	3,56	0,48	2,25	1,18	2,62	0,36	0,81	0,57
K_2O	6,07	9,67	6,00	4,36	7,82	11,28	11,69	11,27

1. Hidegkút Mt. According to I. KUBOVICS
2. Fekete-Lake. According to GY. VARGA
3. Világos Mt. According to A. VIDACS
4. SE from Világos Mt. According to A. VIDACS
5. Aranybánya-flow. According to J. KISS
6. Telkibánya, 2. drilling. According to MRS. FUX—SZÉKY
7. Telkibánya, peak Nagyhasdat. According to MRS. FUX—SZÉKY
8. Rudabányácska, Mt. Nagyszava. According to MRS. K. VARGA—MÁTÉ

The results show that both in the Mátra and Tokaj Mountains the alkali content as compared with the unaltered rock suffered considerable changes. The prevalent plagioclase feldspars were displaced in the course of metasomatic processes and were replaced by potassium feldspars. According to KORZSINSZKIJ [1965] in the intermediary rocks first alter the plagioclases and the femic components, the Ca^{++} and Mg^{++} content is displaced. Thereafter alkalies (Na^+ and K^+) are dissolved. The acting hydrothermal solutions were very rich in potassium and silicic acid, thus the Si/Al substitution and the degree of order, respectively, were changed too, together with the original triclinic feldspar structure. With the progress of Si/Al substitution a monoclinic structure developed.

X-RAY INVESTIGATIONS

Owing to the marked changes the kind of secondarily formed alkali feldspar could not be decided by microscopy. In view of earlier data in literature, partly formation of sanidine and partly of adularia has been pointed out in the course of metasomatism. Thus X-ray diffraction patterns of samples (except sample N° 6) enlisted in Table 1, were prepared with Cu Kα-radiation and Ni filter. Data are summarized in Table 3.

On the basis of microscopical investigations the strikingly large amount of SiO_2 varieties was surprising. A large part of this was chalcedony, a smaller low-quartz. Tridymite was possible to be pointed out merely in the greyish yellow porous rock No. 5. Cristobalite was absent in all the samples. According to FLÖRKE's studies [1954] carried out at higher temperatures the presence of K^+, starting from silica gel leads to formation of tridymite. It is likely that the lack of cristobalite was due to the presence of high K^+ content.

By microscopic investigations it could not be decided which mineral is the high K_2O content-bearing one. Therefore for sake of comparison X-ray patterns of pure sanidine and adularia have been taken. Since data of adularia could not be recognized in the material investigated, Table 4 does not contain them.

Table 4 shows that concerning the sanidine there is a fairly good agreement with data in literature, however, the number of values indicating plagioclase feldspar is low. According to WRIGHT's investigations [1968] from 2Θ angles belonging to *d* values corresponding to the reflexions (201), (060) and (204) it is possible to estimate the amount of Or molecules. Data suggest 70 per cent Or content what is in harmony with results of chemical analysis.

Taking into consideration SZÁDECZKY-KARDOSS's principles of rock systematization, the Mátraszentistván andesitogeneous potassium trachyte can be regarded as an endometamagmatic formation where the original orthomagmatite was altered by solutions moving upwards through breaks and fissures. The strike of this trend is near to NW-SE thus is in agreement with trends around Nagybátony and with the direction of the tectonic valley of the upper part of Csörgő stream. Regarding that the Mátraszentistván mineralized area is near, (about 2—3 km,) by all probability the formation of this metasomatic area can be coupled with Gyöngyösoroszi mineralization both in respect of time and place. This is also indicated by spectrographic data showing that each sample contained Pb and Zn most of them Sb as well.

The considerably large amount of potassium moving towards the surface together with the solutions can be derived from Burdigalian „lower rhyolite tuff", since in Mátraszentistván the middle dacite-tuff is lacking, the Lower-Tortonian andesite series is deposited direct on the Helvetian marly aleurite. Further migration of potassium during metasomatism, the mechanism of displacement of Na^+ and Ca^{++} ions hat already been cleared by SZÁDECZKY-KARDOSS's investigations.

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Table 3

1.		2.		3.		4.		5.		7.		8.		9.		10.	
d	I	d	I	d	I	d	I	d	I	d	I	d	I	d	I	d	I
		6,654												6,628	1		
		6,531	1							6,580	1					6,531	1
								6,064	1	6,126	1						
		5,983	1							5,962	1	5,893	1	5,943	1		
								4,926	1								
						4,704	1	4,768	1								
		4,504	1					4,515	1								
		4,299	4					4,309	7			4,309	4				
4,268	5					4,247	8			4;279	5			4,268	3	4,247	3
				4,160	9												
3,966	1	3,993	1					3,985	2	3,958	1	3,985	1	3,958	1	3,941	1
3,791	3	3,832	5					3,832	5	3,800	4	3,816	3	3,800	3	3,784	5
						3,698	1			3,720	1					3,690	1
		3,653	1	3,616	1			3,661	1	3,631	1	3,662	1	3,631	1	3,660	1
		3,581	1							3,588	1						
		3,498	2					3,504	3			3,491	2				
3,465	2									3,477	3			3,477	2	3,456	3
3,344	10	3,344	10			3,344	10	3,374	10	3,356	10	3,356	10	3,350	10	3,325	10
3,229	8	3,241	8	3,277	10			3,277	6	3,247	7	3,252	6	3,252	5	3,224	10
								3,259	6		3						
2,997	2	3,011	4					3,026		3,006		3,026	2	3,006	2	2,986	3
2,907	1	2,920	2					2,939	3	2,907	2	2,935	1	2,920	1	2,892	2
2,778	1	2,778	1					2,795	2	2,822	1	2,795	1				
		2,650	1						1	2,770	1			2,775	1	2,762	1
2,608	1															2,697	1
2,591	2	2,584	2					2,598	2	2,591	2	2,598	1	2,584	1	2,584	2
2,552	1															2,527	1
2,527	1											2,473	1	2,460	1		
2,466	1	2,454	1	2,477	4	2,460	4	2,473	1								
		2,391	1					2,407	1	2,403	1			2,323	1		
		2,280	1	2,295	4	2,291	3	2,297	1	2,291	1	2,297	1	2,280	1		
		2,229	1	2,250	2	2,244	2			2,247	1	2,252	1	2,239	1		
2,174	2	2,159	2					2,182	1	2,179	1	1,182	1	2,169	2	2,167	2
2,133	1	2,116	1	2,140	3	2,136	3	2,140	1	2,140	1	2,150	2	2,128	1	2,126	1
2,017	1	2,005	1					2,022	1	2,022	1	2,024	1	2,011	1	2,013	1
1,984	1	1,976	1	1,992	2	1,984	2	1,988	1	1,988	1	1,980	1	1,976	1	1,980	1
		1,964	1														
		1,921	1									1,936	1	1,928	1	1,938	1
		1,880	1									1,858	1	1,850	1	1,851	1
1,823	1	1,837	1	1,829	9	1,823	8	1,825	2	1,829	1	1,823	1	1,817	1		
1,802	1	1,803	1					1,803	1	1,807	1	1,803	1	1,796	2	1,800	2
		1,782	2														
1,676	1	1,654	1	1,680	2	1,676	2	1,674	1	1,680	1	1,674	1	1,671	1		
		1,621	1														
1,545	1			1,550	5	1,543	4	1,543	2	1,548	1	1,544	1	1,543	1	1,578	1
1,503	1	1,522	1					1,500	1	1,510	1	1,501	1	1,501	1	1,505	1
		1,480	1	1,457	1	1,454	1					1,458	1			1,457	1
		1,430	1									1,440	1	1,440	1		
		1,421	1														
1,384	1			1,385	2	1,381	3	1,386	1	1,387	1	1,388	1	1,385	1		
1,376	1	1,369	1	1,378	4	1,373	4	1,378	1			1,379	1	1,376	1		
		1,357	1														
				1,291	1	1,287	1			1,299	1			1,291	1		
		1,273	1														
		1,261	1	1,259	1	1,256	1	1,260	1	1,267	1						
				1,229	1	1,228	1										
				1,201	1			1,201	1								
				1,183	1												
		1,153	1	1,154	1												
				1,083	1												
				1,048	1												
				1,047	1												
				1,037	1												
				1,018	1												
				0,979	1												
				0,963	1												
				0,917	1												

Table 4

1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.	
d	I	d	I	d	I	d	I	d	I	d	I	d	I	d	I	d	I	d	I	d	I
6,555	1			6,65	0,6					6,580	1									6,531	1
6,483	1	6,37		6,51	0,9	6,48	2														
		5,85		5,869	0,9	5,806	0,3			5,983	1			5,962	1	5,893	1				
		4,59								4,504	1	4,515	1								
4,188	2			4,241	5	4,118	2,5					4,075	1	4,169	1			4,121	1		
				3,947	2			3,966	1	3,993	1	3,935	1	3,958	1	3,985	1	3,958	1		
3,923	1	3,86		3,870	0,3	3,880	1,2													3,941	1
3,776	3	3,74		3,789	8	3,746	3,5	3,791	3											3,784	5
3,595	1	3,59		3,623	1,5	3,600	0,4											3,631	1		
				3,557	1,2																
3,465	2	3,49		3,459	5	3,453	1,2	3,465	2					3,477	3			3,477	2	3,456	3
				3,328	10																
				3,287	6																
3,241	10	3,24		3,258	3,5	3,245	10,0	2,229	10	3,241	8	3,259	6	3,247	7	3,252	6	3,252	5		
				3,223	8	3,212	4,0													3,224	10
2,997	2	3,00		2,995	5			2,997	2	3,011	4			3,006	3	3,026	2	3,006	2	2,986	3
		2,96		2,932		2,962	1,2					2,939	2			2,935	1				
2,910	2	2,92		2,905	2	2,900	1	2,907	1	2,920	2			2,907	2			2,920	1		
		2,88		2,889																	
2,770	1	2,77		2,766	1,5	2,757	0,5	2,778	1	2,778	1	2,795	1	2,770	1	2,795	1	2,775	1	2,762	1
		2,61		2,608				2,608	1												
2,582	2			2,582	3			2,591	2	2,584	2	2,598	2	2,591	1	2,598	1	2,584	1	2,584	2
		2,52				2,547	1,5														
						2,50	0,4														
2,422	1	2,44				2,41	0,4							2,403	1						
2,373	1	2,34				2,334	0,3											2,323	1		
		2,30												2,291	1	2,297	1	2,280	1		
		2,21								2,229	1										
2,174	3	2,18		2,171	2	2,161	3	2,174	1	2,159	2	2,179	1	2,179	1	2,182	1	2,169	2	2,167	1
		2,12						2,133	1	2,116	1							2,128	1	2,126	1
		2,09																			
2,064	1	2,06																			
2,000	1							2,017	1	2,005	1	2,022	1	2,022	1	2,024	1	2,011	1	2,013	1
1,967								1,984	1	1,976	1	1,988	1	1,988	1	1,980	1	1,976	1	1,980	1
1,911	1	1,93								1,921	1					1,930	1	1,928	1	1,938	1
1,853	1	1,82						1,823	1			1,825	1	1,829	1	1,823	1	1,850	1	1,851	1
		2,81												1,807	1			1,817	1		
1,800	2	1,80		1,793				1,802	1	1,803	1	1,803	1			1,803	1	1,796	2	1,800	1
1,767	1																				
		1,70																			
1,626	1	1,64								1,621	1										
		1,63																			
		1,59																			
1,565	1	1,57						1,545	1			1,54	2	1,548	1	1,544	1	1,543	1	1,578	1

Samples of Table 4 are as follows:

1. Sanidine, Vesuvio [Wright, 1968]
2. Sanidine, Vesuvio [Wright, 1968]
3. ASTM 10—353.
4. ASTM 10—357.
5. Mátraszentistván 1.
6. Mátraszentistván 2.
7. Mátraszentistván 5.
8. Mátraszentistván 7.
9. Mátraszentistván 8.
10. Mátraszentistván 9.
11. Mátraszentistván 10.

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