SEDIMENTOLOGICAL INVESTIGATIONS ON THE NW PART OF THE BROWN COAL BASIN SALGÓTARJÁN

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In the course of the hydrogeological explorations of the side-valley reservoir planned to be constructed in the northern part of the Jégerfő valley near Mihálygerge — one of the versions for solving the problem of water supply to Salgótarján by impounding reservoirs [12] —, detailed sedimentological investigations were made too [13, 14]. Besides supplying basic geological data of greatest importance to the designer of the construction to be, these investigations enriched our knowledge of the Burdigalian and the Lover-Helvetian formations in the NW part of the Salgótarján brown coal basin, by many sedimentological details that were new to us, and, up to the present, could not be found in the special scientific literature in Hungary. On this territory made up from Miocene formations **(Fig. 1.)**, it is for the first time we applied methods that, so far, had only been mentioned by Hungarian special literature as concerning Quaternary formations [4, 5, 6, 7].

GEOLOGICAL CONDITIONS

The geological conditions of the NW part of the Salgótarján brown coal basin are mainly discussed by the papers of J. Noszky [8, 9, 10] and L. Bartkó [1, 2].

In the course of the detailed geological investigation of the Mihálygerge-Jégerfő valley water reservoir [13, 14], we distinguished two layers in the Burdigalian (coal substratum) series of strata.

The first (lower) layer is built from the sequence of clay, silt, rock flour and kinds of sands. The second (upper) layer is built from the same rocks, but bentonitic traces, referring to the fall of rhyolite tuffs, were observed in it too. The boundary of the two layers is marked by thin lignite and brown coal traces. Four fluvial sand layers — with coarser grains, in places — can be indicated in the terrestrial Burdigalian series of strata.

The Lower-Helvetian brown coal bed series is represented by the very thin coal seam and coal hanging. The former was observed only in traces, in the prospecting holes of 1959/1960 too, while from 3 well distinguished series of strata could be detected in the coal-hanging.

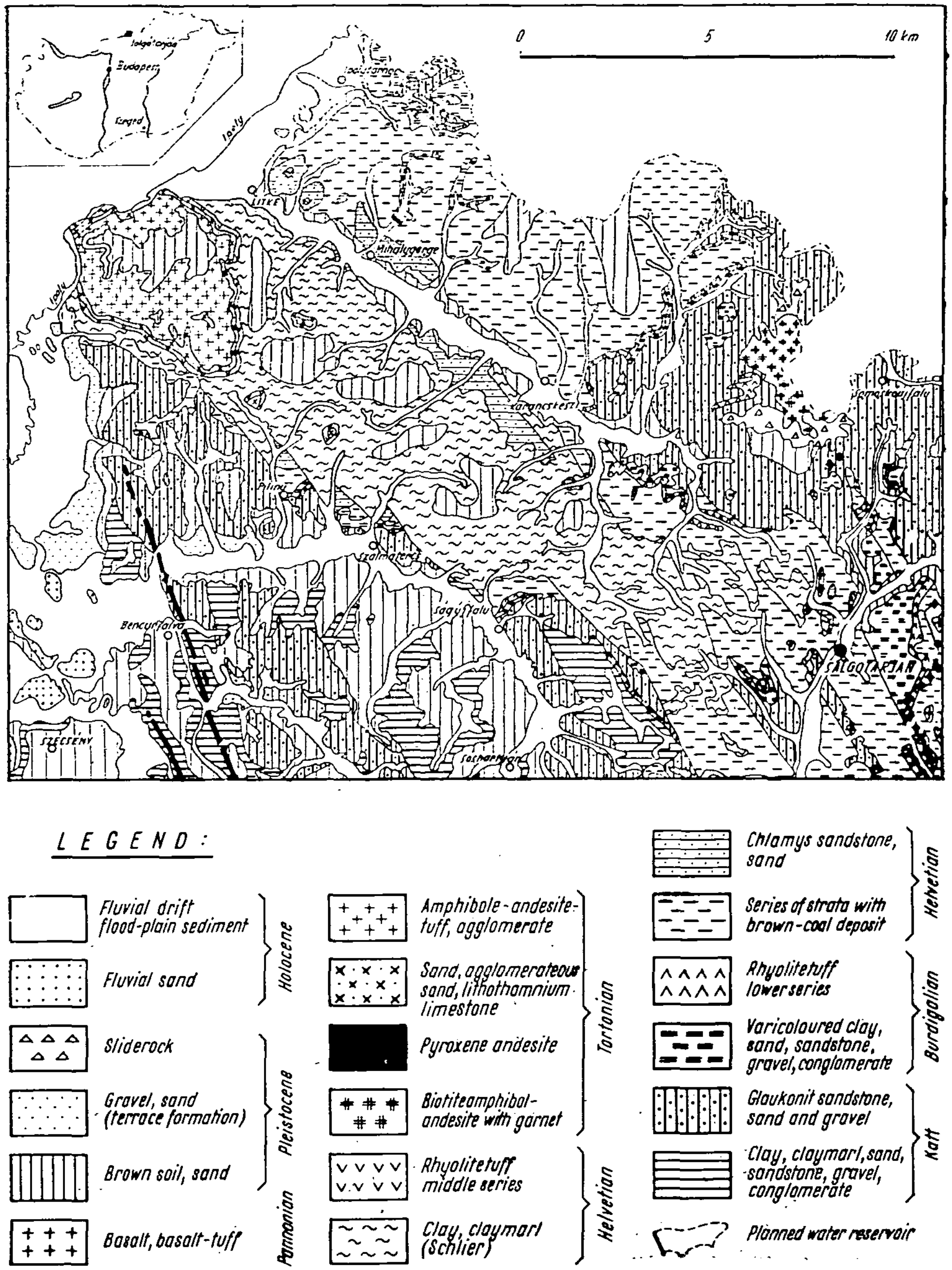

Fig. 1. General geological map of the Salgótarján brown coal basin, NW part (on the basis of the work of Mr. L. Bártkó)

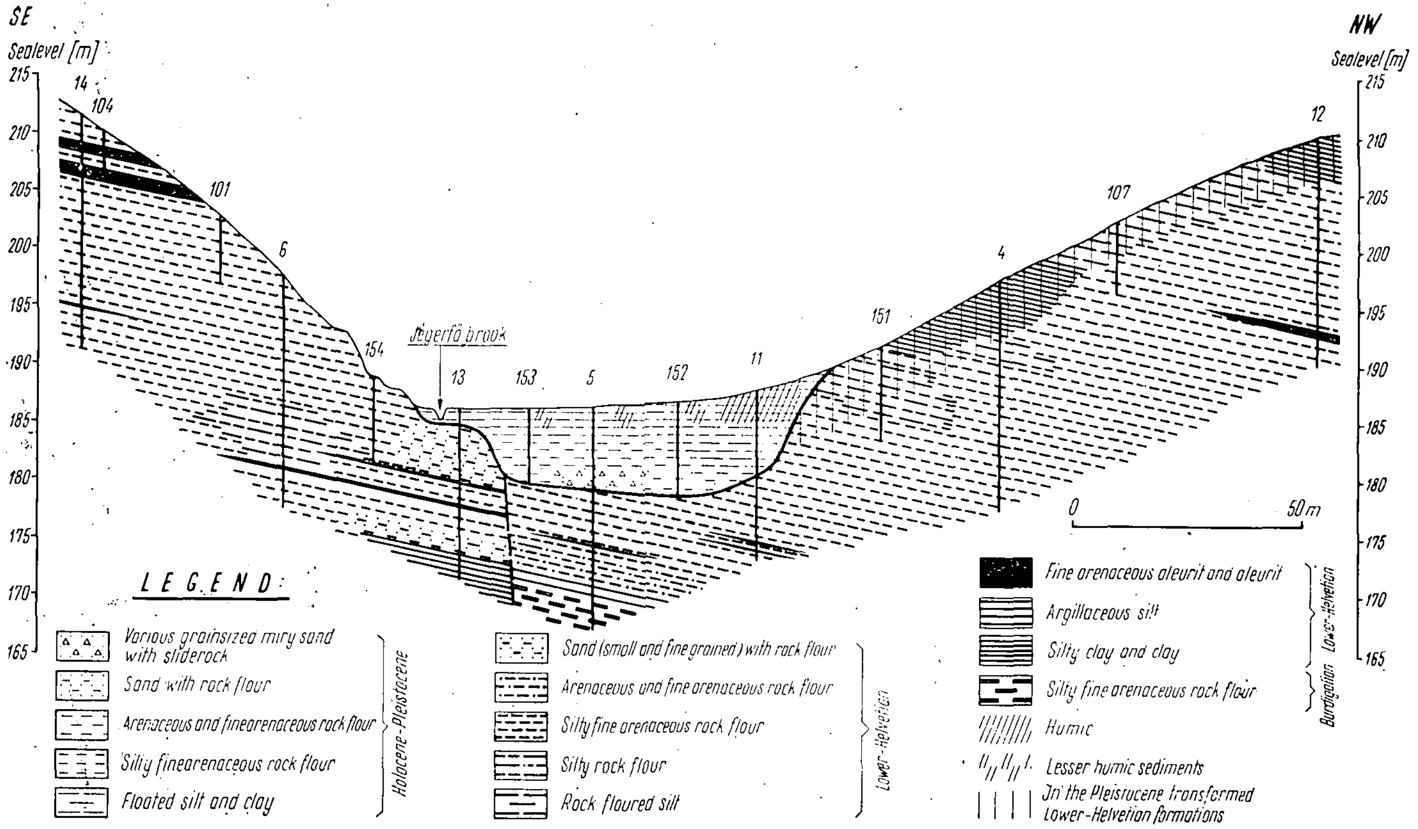

Fig. 2. Geological section of the water reservoir planned in the Jégerfő valley of Mihálygerge

We summed up the most common series of a layer of the coal-hanging, by the name of mostly coagulateing, badly classified rock flour with aleurite banks.

Several rock flour or rock flour types of rocks were determined in this series of strata, during the testing of materials. The somewhat silty, fine-arenaceous rock flour was prevailing there. This stratum was well observed in parts of the prospecting holes bored on the site of the projected dam **(Fig. 2.)**

Less extended is the stratum represented mainly by sandstone with plant rests and the silty-clayey rock.

The lower Helvetian (coal hanging) formations are easy to be distinguished from the Burdigalian sediments, by means of the marine radiolarians.

The weathered and decompcsed rocks on surface of the Burdigalian and lower Helvetian formations — on climatic grounds — were summed by the name: rock altered in the Pleistocene (because the weathering was most sure in the Pleistocene). The detailed petrographic definition of the formations listed here is shown in **Table 2.**

The youngest formations are the Pleistocene-Holocene flood plain sediments covering the valleys and the talus material.

Characteristic for the tectonics of the region is the observed NW — SE cross fault and the perpendicular NE — SW longitudinal rupture, seen everywhere in the Salgótarján basin. The Burdigalian coal substratum and the Lower-Helvetian brown coal stratum dips averagely 14° SW.

RESULTS OF MATERIAL TESTING

During the *mineralogical-petrographical investigations*, micromineralogical and DTA tests were made, with the kindness of MRS. ILONA MIHÁLYI, who did the former, and of DR. AGNES SZÉKELY who did the later.

The Burdigalian and Lower-Helvetian sand and rock flour samples are — on ground of the micromineralogical tests — nearly of similar composition. This refers to the same place of origin or area of ablation **(Table 1.)**.

Biotite and magnetite (or leucoxene) are ruling among the heavy minerals of magmatic origin. The amphibol, enstatite, apatite and the tourmaline originating from pegmatite, are of minor importance. The diopside and zirconium show only in one sample.

Ruling from heavy minerals of metamorphic origin is the garnet and chlorite, of more importance are the tourmaline and epidote, less disthene, andalusite, zoisite and chloritoide. Actinolite and staurolite are only in one sample.

The pyrite, limonite and calcite, representing heavy minerals of epigene origin, are also of minor importance.

Muscovite and quartz are ruling among heavy minerals. More common is the orthoclase, less the quartzite and plagioclase. The submicroscopic mineral grains, cemented with limonite, are quite numerous in some samples.

On base of micromineral tests, it is quite sure that the New-Tertiary arenaceous or rock flour formations building up the area, are to be seen as weathered residues of the „ancient Vepor" — a paleozoic crystalline basement today still on surface, in the northern neighbourhood of the area, on the upper flow of the Ipoly basin.

Table. 1. *Results of the micromineralogical tests*

			Heavy minerals of																								Light minerals						
			Igneous									Metamorphic										Epigenetic											
			origin																														
Number of sample	Number of boring and depth of sample in — m	Name and geological age of rock	Magnetite	Leucoxene	Biotite	Amphibol	Enstatite	Diopside	Apatite	Zircon	Tourmaline (pegm.)	Andalusite	Actinolite	Distene	Epidote	Zoisite	Garnet	Chlorite	Staurolite	Tourmaline	Chloritoid	Pyrite	Limonite	Calcite	Number of pieces	Heavy mineral weight percent (related to the measured material)	Quartz	Quartzite	Orthoclase	Plagioclase	Muscovite	Submicroscopic with limonite cemented grains	Number of pieces
1.	1/9,1—11,8	Medium and coarse grained sand (Burdigalian)	4	—	16	7	2	—	1	—	3	1	—	1	4	—	26	18	—	9	—	5	—	3	100	0,55	14	9	12	—	14	51	100
2.	17/15,6—17,2	Somewhat silty medium and fine grained sand (Burdigalian)	15	3	5	—	2	—	3	2	—	—	—	3	5	4	40	4	—	6	1	2	5	—	100	3,70	73	—	6	1	11	9	100
3.	3/9,5—11,2	Fine arenaceous rock flour (Lower Helvetian)	—	12	30	—	5	—	—	—	—	3	—	—	—	—	5	40	—	3	—	—	2	—	100	0,98	18	—	—	—	63	19	100
4.	4/9,6—13,2	Somewhat silty, fine arenaceous rock flour (Lower Helvetian)	5	—	30	5	—	3	2	—	—	2	—	2	5	2	23	18	—	—	—	—	—	3	100	0,87	16	—	7	—	48	29	100
5.	5/13,2—15,0	Fine arenaceous rock flour (Lower Helvetian)	12	—	8	3	2	—	3	—	3	3	3	4	3	4	29	9	1	10	2	1	—	—	100	0,60	57	2	16	—	17	8	100
6.	6/5,0—11,6	Somewhat silty fine arenaceous rock flour (Lower Helvetian)	2	—	40	—	—	—	3	—	2	—	—	1	2	—	13	30	—	—	—	—	5	2	100	2,80	14	—	7	2	61	16	100

Differential-thermal quantitative tests were made from some typical samples of the silty-clayey rock formations building up the area **(Fig. 3.)**. The samples investigated from the coal bottom series, listed to the Burdigalian **(Fig. 3., 1—8)** are from the same character. They contain mainly montmorillonite

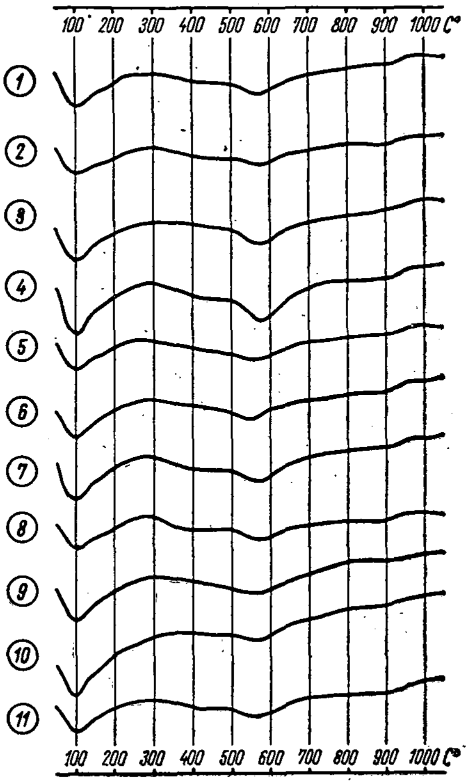

Fig. 3. D. T. A. curves: 1. borehole 1. 15,2—16,1 m, *silty clay;* 2. borehole 1. 16,1—17,1 m, *silty rock flour;* 3. borehole 7. 12,5—13,4 m *somewhat bentonitic silty clay;* 4. borehole 15. 9,8—10,2 m, *bentonitic clay;*. 5. borehole 17. 10,4—11,8 m, *slightly bentonitic silt;* 6. borehole 17. 11,8—13,7 m, *somewhat bentonitic clay;* 7. borehole 17. 17,2—18,1 m, *bentonitic clayey silt;* 8. borehole 17. 18,1—19,2 m, *slightly bentonitic silt;* 9. borehole 132. 3,5 m, *silty rock flour;* 10. borehole 133. 4,0 m *strongly silty fine arenaceous rock flour;* 11. borehole 134. 3,0 m, *fine arenaceous clayey silt;* (The samples 1—8 are of the Burdigalian age, 9—11 Lower-Helvetian)

and a little kaolinite. The samples originating from the Lower-Helvetian coal-bed **(Fig. 3., 9—11)** contain, based on the D. T. analysis, some clay minerals of the montmorillonite type. The montmorillonite contents of some rocks mark only the beginning of clay-mineralization.

We made, in frame of the *sediment-geological* or *sedimentpetrographical and engineering geological* investigations, tests for the granulometric composition, plasticity, natural moisture content, shrinkage and carbonate content. These tests were made chiefly by MRS. E. BAJTAY and MR. L. TAKÁCS.

The 140 granulometric tests were grouped on ground of sediment types and geological series. It was possible to determine several distinctive sediments or types of sediment rocks from the various geological epochs. The border-curves of the individual types are shown on **figures 4—6**.

If we have a look at the border-curves of **figures 4—6**, it can be seen that — with a few exceptions — the tertiary- and quaternary formations are very badly classified sedimentologically. The unclassified state of rocks refers to an origin from a quiet water.

The grain size composition border curves of *Burdigalian* rock sorts **(Fig. 4.)**, belong mainly in the range of sand and rock-flour. The border curves of the somewhat silty, small gravel, medium and coarse grained sand and silty coarse sand marked 1, in comparison with the clays altered in Lower-Helvetian and Pleistocene, show one of our worst sorted kind of rock. The medium and coarse grained sand deposits, marked 2, belong in an exact, from the younger formations well distinguishable ralm of grains. The border curves of the somewhat silty, silty or rock floured medium small or fine grained sand, marked 3, and the somewhat silty and very silty fine sanded rock flour with mark 4, enclose a well discernible — from one another and from the former ralms — grain sort.

We cleared the origin of the Burdigalian sand sorts, disclosed with bore holes after the system of I. MIHÁLTZ [7]. We observed in the examined samples chiefly grains with sharp breakings, characteristic for fluvial sands belonging to *type I.* [7, p. 18]. The *II. type* intermediate grains were secondary. The *III. grain-type,* characteristic for drift-sand, was not found by us. The Burdigalian sand samples are therefore qualified by us for *fluviatile origin,* because sharp, chipped grains are dominant.

Among the Lower-Helvetian formations corresponding **(Fig. 5.)** with the shallow sea formation — fine grain stuffs are dominant. Only the well separated, quite unqualified small and medium grained or aleuritic sand-ralm (marked 1.) contains coarser grains, in comparison with the others.

The *fine-arenaceous rock flour* marked 3, from the Lower-Helvetian rocks is prominent with better sorted grains than by the others. The *somewhat silty and silty fine arenaceous rock flour* (marked 4.) is characteristic too for this ralm. A somewhat selected ralm is the little silty, rock floured fine and small grained sand (**Figure 5**, marked 2.) and the fine arenaceous (**Figure 5**, marked 5.) silty and very silty (clayey) rock flour.

We can distinguish, on ground of the grain size, 3 types of aleurite bedded between the rock flour formations. Relatively coarser grains too are in the sandy aleurite — and at last, finest is the fine — arenaceous somewhat clayey aleurite. (See **figure 5**, mark 6, border curves of grain size composition.)

For a sure determination of the cementing material of aleurites, some thin sections were made from the aleurites of the borings 8 and 15. In the mineral composition of the examined samples — after the investigations of MRS. SZÉKY, DR. VILMA FUX — quartz grains play a role with more muscovite (sericite) filaments with less importance. The filaments are parallel settled. The size of quartz-grains in the thin sections is different, average size of the greatest are 60—80 μ. In the cementing sericite stuff — between the mineral grains — are muscovite filaments from the length of approx. 50 μ. But the greatest part of the cementing is stained with a fine grayish brown, disperse organic stuff.

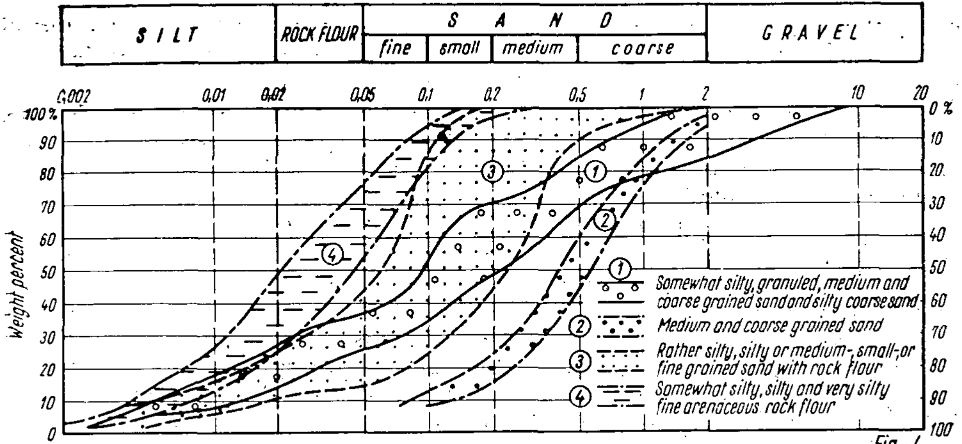

Fig. 4

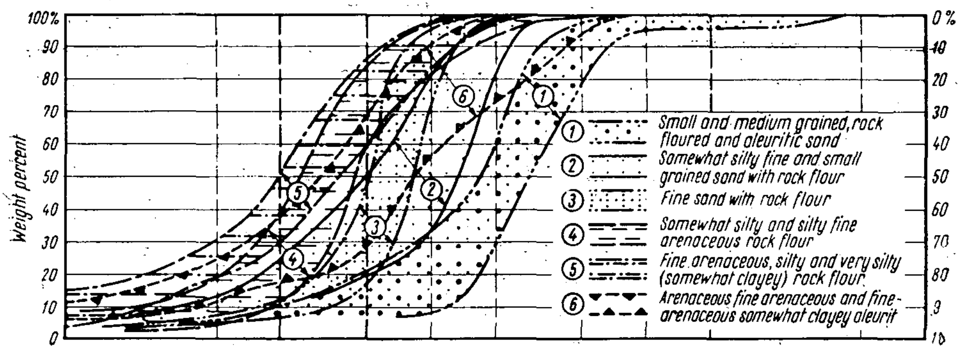

Fig. 5

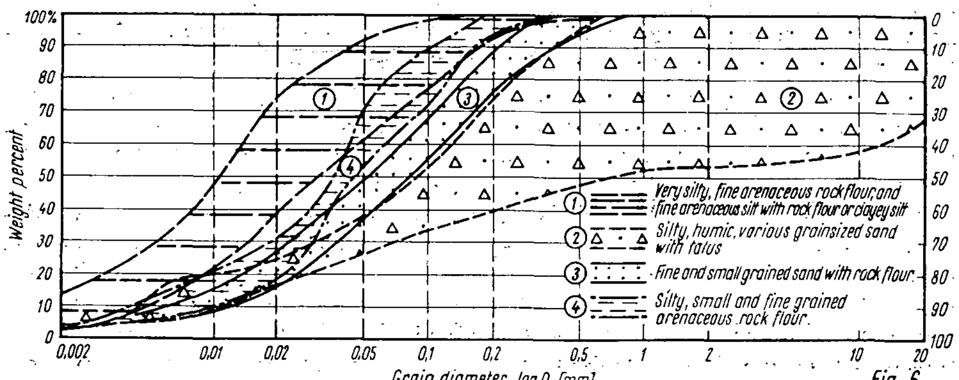

Fig. 6

Fig. 4—6. Grain composition border curves of the rock sorts from Burdigalian **(Fig. 4.)**, Lower-Helvetian **(Fig. 5.)**, altered in Pleistocene and Pleistocene-Holocene **(Fig. 6.)**.

In some places there is also a limonitic cementing beside the mainly sericitic material.

We observed several sponge spicules too, in the thin section, but no radiolarias.

The grain composition border curves of Burdigalian or Lower-Helvetian *rock sorts transformed in Pleistocene* (**Fig. 6**, sample 1.) enclose the very silty fine sanded rock flour, fine sanded rock floured silt and the clayey silt types of sediments. These are in connection with the Burdigalian, Lower-Helvetian formations, on base of the grain composition too.

The grain composition border curves of badly classified Pleistocene-Holocene sediments originating from the valley bottom (**Fig. 6.**) are, except of the talus, humic sands of various grain size (**Fig. 6**, sample 2.) to be sorted easily into the grain composition ralm of Lower-Helvetian rocks, because these originate from the weathering of older rocks.

The grain composition border curves, shown on **figures 4—6** of rocks building up the NW part of the brown coal basin Salgótarján give precious good comparable and base data to the UNGÁR [11] sample curve classification, which is easy to use in practice.

166 plasticity, 88 shrinkage, 177 water and 73 carbonate content tests were made during *engineering geological* testings.

By comparing the results of the plasticity tests with the macroscopic petrographic tests and the grain composition, we determined the key of classification for the rocks of the area, on ground of the plasticity index. As the following list shows.

Name of rock	Plasticity index (Pi %)
Somewhat silty, fine sanded and silty rock flour	15—25
Silt with rock flour	25—30
Clayey silt	30—35
Silty clay	35—40
Clay	over 40

Naturally, the above list is of general aspect. The somewhat big fluctuation of values of the rock-flour is the result of the badly classified state of stuffs. The characteristic components of materials can be better defined because of the failing of coarser grains, in the case of the silt-clay rocks, which are badly classified in the area too.

With this new system of classification — at least in the NW part of the Salgótarján brown coal basin — we see a way to list the rock sorts tested and classified by others, with the rock classification terms used in this paper. This is important because several engineering-geological and soil mechanical explorations were also made in the neighbourhood of the area. This classification makes easier the geological evaluation of these, if plasticity tests are at hand.

We make our observation on this place, that the $CaCO_3$ contents of the rocks of small plasticity index in the area, are somewhat greater than those of other materials.

The natural water content values of the tested samples are mostly identical for the various rock sorts.

Table. 2. *Average and extreme values of sediment and engineering geological tests, made on characteristic rock material of the area*

Name and geological age of rock		Uniformity coefficient	Liquid limit	Plasticity index	Natural moisture content	Linear shrinkage	Carbonate content $CaCO_3$%
Silty rock flour (Burdigalian)	Aver.	—	38,2	20,3	16,2	5,7	—
	Max.	—	43,6	23,6	22,8	6,2	—
	Min.	—	32,5	15,0	13,1	5,3	—
Somewhat silty, silty and very silty *finearenaceous rock flour* (Burdigalian)	Aver.	9,5	34,5	15,5	14,7	6,0	0,36
	Max.	12,5	41,8	20,8	19,1	6,2	0,62
	Min.	6,1	30,8	12,5	10,1	5,9	0,14
Somewhat bentónitic *silt with rock flour* and silt, *bentonitic silt* (Burdigalian)	Aver.	—	47,8	25,9	17,1	9,2	—
	Max.	—	50,2	27,5	24,5	—	—
	Min.	—	42,5	24,9	12,0	—	—
Clayey silt, bentonitic (Burdigalian)	*	6,2	51,4	31,3	14,1	—	—
Somewhat bentonitic silty clay (Burdigalian)	*	—	57,6	35,6	29,9	10,4	—
Silty clay (Burdigalian)	Aver.	—	59,9	36,8	14,4	—	—
	Max.	—	62,0	38,5	17,0	—	—
	Min.	—	56,0	34,8	10,4	—	—
Bentonic clay (Burdigalian)	*	—	66,6	42,4	—	9,9	—
Somewhat silty, fine and small *sand* with rock flour (Lower Helvetian)	Aver.	10,4	36,4	13,9	27,4	—	—
	Max.	13,0	37,2	14,0	28,9	—	—
	Min.	7,8	35,7	13,9	26,0	—	—
Fine sand with rock flour (Lower Helvetian)	Aver.	3,1	—	—	22,0	—	—
	Max.	6,0	—	—	29,8	—	—
	Min.	1,8	—	—	8,0	—	—
Somewhat silty, fine arenaceous rock flour (Lower Helvetian)	Aver.	5,4	44,1	16,4	26,3	4,0	1,51
	Max.	9,3	50,4	25,1	36,0	6,4	5,76
	Min.	2,5	31,2	6,4	16,5	0,8	0,08
Silty and very silty small and *fine arenaceous rock flour* (Lower Helvetian)	Aver.	9,2	45,4	18,2	25,4	3,8	0,56
	Max.	13,4	46,7	20,2	33,8	5,1	2,24
	Min.	4,9	43,7	13,3	19,7	1,6	0,03
Silty and very silty rock flour (Lower Helvetian)	Aver.	—	51,1	21,6	29,9	5,2	0,1
	Max.	—	57,0	23,4	33,5	7,6	0,2
	Min.	—	29,3	11,8	24,5	3,5	0,0
Humic and fine arenaceous silt with rock flour and somewhat *clayey silt with rock flour* (Lower Helvetian)	Aver.	12,3	54,8	25,8	26,7	7,2	1,1
	Max.	15,0	70,0	29,3	33,4	9,7	3,1
	Min.	10,0	44,4	15,7	21,4	3,5	0,1
Rock floured and somewhat clayey silt, and *clayey silt* (Lower Helvetian)	Aver.	7,8	67,5	32,7	30,7	7,9	0,22
	Max.	8,0	69,8	35,3	34,6	9,0	0,39
	Min.	7,6	65,6	28,6	27,4	7,0	0,03
Aleurite (Lower Helvetian)	*	—	40,1	9,6	10,9	1,0	5,42
Fine arenaceous, somewhat clayey aleurite (Lower Helvetian)	*	—	52,5	29,6	31,6	5,8	—
Humic and *fine arenaceous clayey silt* with *rock flour* and *clayey* silt (altered in the Pleistocene)	Aver.	9,7	59,6	32,8	27,7	8,1	0,21
	Max.	11,2	65,8	35,7	34,3	10,7	0,76
	Min.	8,7	49,8	28,0	20,0	6,0	0,04
Fine arenaceous very silty rock—flour and *silty rock flour* (altered in the Pleistocene)	Aver.	17,9	35,7	19,8	18,3	—	—
	Max.	20,9	38,0	22,6	20,9	—	—
	Min.	15,0	31,9	16,5	16,0	—	—
Arenaceous and fine arenaceous *silt with rock flour* (altered in the Pleistocene)	Aver.	12,6	47,3	27,8	26,0	9,9	0,04
	Max.	13,3	50,0	28,7	31,7	10,6	0,10
	Min.	12,0	44,7	25,6	18,0	9,0	0,00
Humic and silty *wood soil* (altered in the Pleistocene)	Aver.	—	48,8	30,0	26,2	10,1	0,09
	Max.	—	55,4	37,3	29,0	12,4	0,11
	Min.	—	38,8	20,1	24,2	7,3	0,16
Humic silty clay and humic clay, — *clay* (altered in the Pleistocene)	Aver.	—	78,0	42,2	—	—	—
	Max.	—	81,2	47,2	—	—	—
	Min.	—	75,0	35,5	—	—	—
Somewhat silty, silty, fine and small arenaceous *rock flour* (Pleistocene — Holocene)	Aver.	7,6	36,1	17,4	—	6,1	—
	Max.	12,5	43,4	21,2	—	7,1	—
	Min.	1,9	31,0	14,8	—	5,2	—
Humic and fine arenaceous *poured silt,* somewhat clayey *silt* (Pleistocene — Holocene)	Aver.	—	40,4	20,8	24,6	8,9	0,15
	Max.	—	45,2	25,1	29,2	10,1	0,15
	Min.	—	36,2	17,1	21,4	7,8	0,14

Remarks: The maximal and minimal extreme values, presented in the table are not always datas of the same rock samples.
* = only 1 test.

The linear or edgewise shrinkage values of the different kinds of rocks give information for the possibility of building into a projected dam.

The carbonate content in the rocks of the Jégerfő valley is very poor. It is varying between 0,00 and 5,76%, determined with calcimeter.

From the sediment- and engineering-geological investigations made on the rocks of the area, based upon the tests of characteristic samples, geological age and formation of sediments, the summarized average maximal and minimal values were summed up in **Table 2.**

From the various kinds of rocks of the area, for filling of an earth dam and for its clay fill the following sorts can be used.

The most convenient *to be built into the planned dam,* as for compactibility as for watertightness, are the kinds of rock flours and silts of the area. The most prominent from these is the Lower-Helvetian, somewhat silty, fine arenaceous rock flour; the silty and very silty small and fine arenaceous rock flour; the silty rock flour; and the fine arenaceous rock floured silt. The listed rock formations are suitable, in general, for their value of uniformity coefficient, their liquid limit or their plasticity index **(Table 2.).**

The rock sorts for filling the dam are those [3] with a uniformity coefficient below or above the value 5, the liquid limit between 65% and 15%, the plasticity index between 33,6 and 3,6%. The value of linear shrinkage is below 5%.

The fine arenaceous very silty rock flour, the arenaceous and fine arenaceous rock floured silt, transformed in Pleistocene, are convenient too for the former purpose.

Rocks with greater plasticity and linear shrinkage as the former values, can be used too, for the *clay-fill of the dam.* These are the rock floured or fine arenaceous clayey silt and the clayey silt, the silty clay and clay altered in the Pleistocene, and at last the Lower-Helvetian rock floured and somewhat clayey silt or clayey silt **(Table 2.).**

We can find among the Burdigalian (coal bottom) formations materials (rock flour, silt, clay etc.), convenient for the purposed norm of dam building, too. Because of the alternating stratification, however, rock material of similar composition could be assured only with the opening of new pits. The use of these is, therefore, not economic.

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