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THE MINERAL COMPOSITION OF LAKE MUD IN SEVERAL HYPERSALINE LAKES OF THE DANUBE-TISZA INTERFLUVE, SOUTH HUNGARY

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ABSTRACT

The radioactivity of young sediments of some lakes on the Danube-Tisza Interfluve is remarkably high compared to their environment. We have performed X-ray diffractional and bulk chemistry analyses on two typical examples to determine their mineral composition and major element content, and to examine how close the relation between the radioactive element content and the mineral composition of the lake mud is.

We have found that the boundaries of radioactive element rich areas are in accordance with the changes in mineral composition. Thus, mineral composition is also responsible for radiological conditions. In both lakes the mineral set originates from the break down of rocks of granitoid composition.

INTRODUCTION

The two lakes which were chosen to examine more detailed regarding radiological features, the permanent Vadkerti Lake (Soltvadkert) and the temporary Kolon Lake (Izsák) are located on the blown sand covered Danube-Tisza Interfluve, where in the lakes, according to MOLNÁR (1980), in an alkali environment hypersaline carbonate formation takes place. This process is characteristic in the first place in case of the bottom of the Kolon Lake, which is covered by water temporarily. Here a more than 0.5 m thick sediment with a carbonate content higher than 50% can be observed some 10 cm under the muddy-sandy water of the lake. Under this sediment blown sand can be found. In case of the Vadkerti Lake this carbonate-rich layer is thin and it can be observed only in some places. Hidrodinamically, the basin of the Vadkerti Lake is a part of the territory dominated by ascending ground waters, therefore, it is filled with water permanently and there is even an outflow for the excess water (ERDÉLYI, 1990). Years ago in the SW corner of the lake on the territory of the beach the lake mud was dredged.

METHODS

Two samples were collected from each points of sampling with an instrument constructed specially for this occasion. One of the samples was taken from the surface of

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the bottom, the other from beneath the surface from a depth of 40-50 cm. Samples were collected from points 25, 50 and 100 m far from each other along the longitudinal and the cross axis of the lakes, from under a 1.4-3.0 m deep water. Since the past two years have brought a rainy weather the basin of the temporary Kolon lake was pretty full, therefore, only its shores were handled as areas of periodic water cover, and sampling was restricted to these areas. In all, 75 samples were collected from the two sites.

Radiographs were taken with DRON-UM 1 diffractometer in a 3-63 degree 2θ angular field to determine mineral composition. The radiation source (Cu-tube) was operating with a LiF monochromator, with a 35 KV excitation voltage and with a 20 mA anode current. We appraised the results by measuring peak heights and peak areas with a software named Super Visor. All samples were X-rayed.

Since major element examinations have never been done yet in the case of these formations, we performed these examinations on the average samples of the two stratigraphic levels. Average samples were derived from samples of similar mineral composition on the basis of X-ray diffractional analyses. Bulk chemistry examinations were made in the Geological Institute of Hungary.

DISCUSSION

On the basis of radiographs, made of all collected samples, we could separate 7 mineral groups and as an eighth group an X-ray amorphous fraction due to both its quality and quantity features. Separated minerals (groups) are the following: dolomite, calcite, feldspar in general, quartz, kaolinite-chlorite, muscovite-illite, montmorillonite-chlorite and the amorphous fraction composed of ferrioxihidroxides, humin acids and vegetal debris.

The examined territories can be characterized both by the vertical and the horizontal spread of each mineral (group). Boundaries displayed by the mineral compositional changes correspond well to the boundaries drawn with the help of radiological analyses, i.e., mineral composition is also responsible for radiological conditions. Radiologically active components of the sediment are feldspars, clay minerals and the amorphous fraction.

The vertical difference between diffractionally measured sediment components is represented (with only a few exceptions) in all areas by the higher radioactive element content of samples collected from a deeper layer. The reason for this is the more compact form of deeper sediments than that of the mud of the bottom. According to mineral composition, the bottom of the Vadkerti Lake can be divided into three units. However, the ratio of minerals is not the same in different parts of these units:

a) The Vadkerti Lake has a characteristic floor of blown sand, thus, the dredged SW beach area can be separated easily from the blown sand floor by its higher quartz-content and by its unusually high feldspar-content. In the middle unit of the lake (have not been dredged) the major role of blown sand have remained. Areas North and East (mainly covered by reeds) of the previous unit differ in their higher clay mineral and amorphous fraction content. In the sediments, similarly to other hypersaline lakes of the Alföld region, carbonate minerals formed by evaporation processes are presented evenly in a 1:1 dolomite-calcite ratio. Nevertheless, the total carbonate-content is less than in the case of other hypersaline lakes. This can be explained with the temporal water exchange (outflow) of the Vadkerti Lake.

TABLE 1

Average mineral composition, based on X-ray diffractional analyses (in %)

Area			Sampling point	Dolomite	Calcite	Feldspar	Quartz	Chlorite, Kaolinite	Illite, Musco-vite	Montmoril-lonite Chlorite	Amor-phous
Vadkerti Lake (Soltvadkert)	**SW unit**	upper samples	16	7,5	6,4	5,0	69,9	0	5	0	7,2
		lower samples	16	7,8	7,0	5,5	71,9	0	3,2	0	4,6
	Middle unit	upper samples	12	7,3	6,6	6,5	65,6	0	4,4	0	9,6
		lower samples	12	7,6	7,2	4,8	72,5	0	3,0	0	4,9
	NW, N and E unit	upper samples	26	5,5	5,2	3,6	53,6	3,2	3,8	2,5	22,6
		lower samples	26	6,8	6,5	3,8	58,1	2,4	3,5	2,8	16,1
Kolon Lake (Izsák)		upper samples	21	19,3	10,6	2,2	51,1	0	3,7	2,7	10,4
		lower samples	21	33,5	17,1	2,8	34,5	0	1,8	1,6	8,7

Note: methods provided base data with 5% limit of errors, thus, there was no point in examining dispersion

b) Due to the rainy weather of the past two years, the basin of the temporal Kolón Lake is almost full of water. Thus, we could find areas of temporal water cover (still not flooded) only along a 2 km long section of the Eastern shore. That is why all measurements provided only linear, not areal results, and these hardly differ from each other in a mineralogical and radiological sense. However, a significant difference can be observed vertically in the sediments' carbonate-content. Under the soil level carbonate-rich sediments can be found, which, according to MOLNÁR (1980), is the result of hypersaline sediment formation under arid climate.

The major element content of average samples of the bottom sediments of each examined lakes is presented in Table 2. If the results are converted into a volatile-free form and the extreme carbonate-content is smoothed as well, then the major element composition of sediments of the Vadkerti Lake and the Kolon Lake is closest to that of very acidic granite.

TABLE 2

The mean major element content of examined sediments

Major Element	Vadkerti Lake		Kolon Lake	
	upper	lower	upper	lower
SiO_2	58,1	59,81	53,16	49,10
TiO_2	0,45	0,50	0,18	0,10
Al_2O_3	12,8	13,04	11,02	8,69
ΣFe_2O_3	3,22	3,32	1,82	1,10
MnO	0,05	0,05	0,04	0,04
MgO	2,16	2,20	3,82	9,96
CaO	4,54	4,55	7,29	8,77
Na_2O	3,18	3,30	2,64	3,16
K_2O	2,96	3,01	1,82	0,54
P_2O_5	0,08	0,09	0,05	0,15
Loss of Ignition	14,32	10,7	18,10	18,25
Σ	99,86	100,04	99,94	99,86

appraised by: ***Mrs Nagy I.***

We have found that the boundaries of radioactive element rich areas are the boundaries of mineral compositional changes at the same time. Namely, mineral composition is also responsible for radiological conditions. In both lakes the set of minerals originates from the break down of rocks of granitoid composition.

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