LITHOLOGICAL AND GEOLOGICAL STUDY OF THE PLIOCENE FORMATIONS IN THE DANUBE—TISZA INTERSTREAM REGION

Part II.

by
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In the first part of the paper the deposition, grain size distribution, heavy mineral composition, sources and directions of denudation of the Pliocene formations of the Danube—Tisza Interstream Region were dealt with. The following discussion will be devoted to such chemical characteristics of these sediments as may also contribute to the better understanding of their history of evolution.

CALCIUM CARBONATE CONTENT

It was calculated from the weight of loss of CO_2 as found after attacking 5-gram-samples by hydrochloric acid.

The carbonate content of the *Lower Pannonian* sediments (Table II samples N^os^ 120—129) from the northern part of the investigated area of the region *(Fig. 1)* averages about 25%. Merely two samples (N^os^ 122 and 128) do show striking values (64 and 68%, respectively).

In the SW part of the region (Érsekcsanád, Rém, and Jánoshalma) the average carbonate content of the Lower Pannonian sediments (Table II, samples N^os^ 130—139) is higher, attaining 50%. These samples were taken in a zone, where, as shown elsewhere, the basement has remained in a higher structural position [G. CSIKY 1966, B. MOLNÁR 1966*e*]. L. KÖRÖSSY [1962] believes that in those parts of the Hungarian Basin where Mesozoic limestones occur near-by, the carbonate content of the Pannonian sediments is higher than elsewhere. The highly calcareous ranges of Mts. Mecsek and Mts. Villány extend to the W from the area under consideration. Thus, the higher carbonate content of the Lower Pannonian in the adjacent SW part of the Danube—Tisza Interstream Region may derive from these sources *(Fig. 1)*. Accordingly the heavy mineral analyses have also suggested a denudation direction from W toward E [B. MOLNÁR, 1966*a*, *e*, *f*].

The Lower Pannonian sediments overlying the deeper-sunken part of the basement (Tables I and II, samples N^os^ 140—169) contain less calcium carbonate, averaging from 15 to 30%. Similar results were obtained by M. MUCSI [1967] and I. RÉVÉSZ [1967] for the corresponding layers cut by a borehole near Szeged (Algyő) and by one at Ásotthalma, respectively (1967).

The distance of this area from Mts. Mecsek and Mts. Villány may account for the lower carbonate content. The relatively coarser grain size and its quick

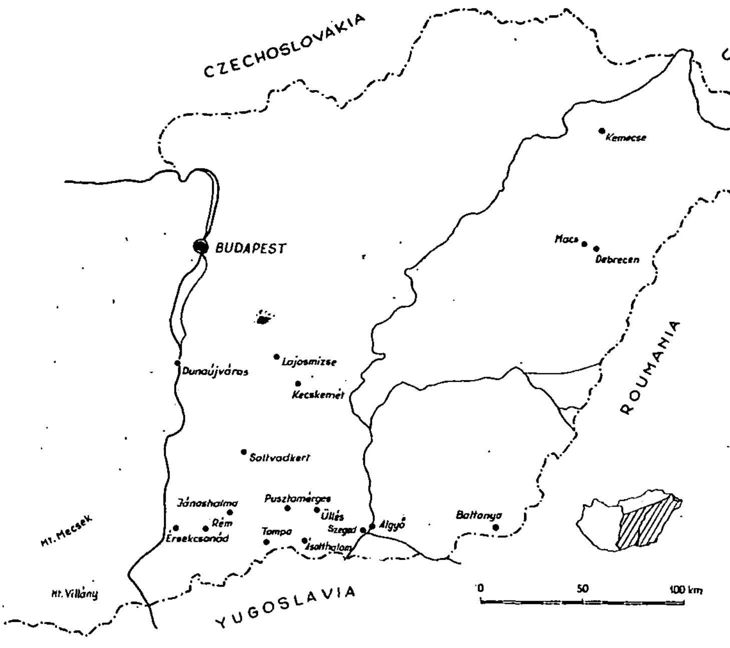

Fig. 1. Layout of the boreholes studied

alternating development, respectively, compared to that of observed in the western part, testifies to shallower depth of sedimentation. This could hardly favour a greater accumulation of carbonates under the less undisturbed conditions of sedimentation.

The carbonate content of the *Upper Pannonian* formation varies between 0 and 39%, attaining, on the average, from 20 to 30% (Tables II—VI, samples N^{os} 20—119.). There is no striking value that found for the Lower Pannonian. In the Mts. Mecsek and Mts. Villány as well as in their vicinity the Upper Pannonian formation is discordantly settled over the Lower Pannonian even surpassing it [GY. WEIN, 1962]. Consequently, the area emerging from the inland sea, accessible for erosion, was reduced, so such an amount of calcium carbonate as in the case of Lower Pannonian could not be dissolved. In addition, the Upper Pannonian sedimentation of the Hungarian Basin took more and more of variable character and the environment did no longer favour the accumulation of carbonate.

Hence, in the Upper Pannonian the various parts of the area studied cannot be plainly distinguished on the basis of the carbonate content. It is alone the surroundings of Szeged that seem to be conspicuous for a somewhat lower carbonate content, compared to the rest of the area. Of course, this figure, 10—20%, can be ascribed to the same causes as was the case with the Lower Pannonian.

Thus, the carbonate content of the Lower Pannonian formation of the region

Table I

Number	Boring		Type of sediment	$CaCO_3$ %	Total salt %	pH (H_2O)	Age	
	Locality	Depth m						
146.	Üllés—1	1480—1486/a	Small sand, medium sand and fine silt alternately settled light gray and yellowish-brown	33,2	0,08	8,7	PLIOCENE	LOWER PANNONIAN
147.	Üllés—1	1480—1486/b	Mudstone, yellowish-brown	19,9	0,09	8,6		
148.	Üllés—1	1586—1589,5	Mudstone, yellowish-brown	24,4	0,09	8,8		
149.	Üllés—1	1652,5—1655	Mudstone with embedded small sand, light gray	15,4	0,03	9,2		
151.	Üllés—1	1782—1783,5	Mudstone, dark gray	17,7	0,10	8,7		
152.	Üllés—1	1828—1830	Mudstone, dark gray	11,1	1,06	8,9		
153.	Üllés—1	1885—1890	Claystone, brownish gray	11,1	0,03	9,0		
154.	Üllés—2	1479—1481,5	Mudstone, gray	22,1	0,07	8,8		
155.	Üllés—2	1638—1644	Small-grained sandstone, light gray	19,0	0,00	8,8		
156.	Üllés—2	1703—1705	Claystone and finegrained sandstone alternately brownish-gray	13,3	0,07	8,8		
157.	Üllés—2	2188,5—2189,5	Mudstone, dark-gray	28,8	0,03	9,1		
158.	Üllés—7	1556,5—1562	Mudstone and fine-grained sandstone alternately, brownishgray	18,5	0,00	9,4		
159.	Üllés—7	1598—1604	Mudstone, light gray	24,4	0,00	9,3		
160.	Üllés—7	1646—1652	Mudstone, with plant rests, gray	19,9	0,00	9,4		
161.	Üllés—7	1705—1706	Mudstone, with plant rests, gray	19,9	0,03	9,2		
162.	Üllés—7	1799—1805	Mudstone with plant rests, darkspotfed gray	13,3	0,03	9,3		
163.	Üllés—8	1624—1627	Mudstone, yellowish-brown	19,9	0,03	9,0		
164.	Üllés—8	1660—1664	Silt with embedded diagenized sandstone, light gray	36,8	0,00	8,8		
165.	Üllés—8	1765—1770	Silt with embedded diagenized sandstone, light gray	24,4	0,03	9,0		
166.	Üllés—8	1842,5—1843	Claystone, greenish-gray	15,5	0,06	8,9		
167.	Üllés—8	2044—2048	Claydtone with plant rests, dark gray	25,7	0,05	9,2		
168.	Üllés—8	2139—2141	Fine-grained sandstone, strongly micaceous, gray	26,6	0,00	9,2		
169.	Üllés—8	2145—2149	Small-grained sandstone with embedded silt, light gray	26,6	0,00	8,8		

Table II

Number	Boring		Type of sediment	CaCO₃ %	Total salt %	pH (H₂O)	Age	
	Locality	Depth						
116.	Szeged, Székelysor	1595–1596,2	Mudstone, yellowish-gray	4,4	0,04	9,2	PLIOCENE	UPP. PANN.
117.	Szeged, Székelysor	1697–1698	Small sand, with medium-grained part, calcareous, light gray	11,1	0,00	8,8		
118.	Szeged, Székelysor	1785–1787,4	Friable small-grained sandstone	6,6	0,00	9,0		
119.	Szeged, Székelysor	1893–1894,5	Claystone, dark greenish-gray	8,9	0,08	9,2		
120.	Dunaújváros–1	777,5–779,5/a	Mudstone with plant rests	19,9	0,14	9,0		LOWER PANNONIAN
121.	Dunaújváros–1	777,5–779,5/b	Claystone, dark gray	6,6	0,14	9,0		
122.	Lajosmizse–3	945–947	Limy marl, gray	64,2	0,20	9,1		
123.	Kecskemét Ny–1	1169–1174	Clayey fine silt, lightly diagenized, greyish-brown	22,1	0,10	8,8		
124.	Kecskemét Ny–1	1182–1186/a	Small sandy fine sand, light gray	33,2	0,00	9,2		
125.	Kecskemét Ny–1	1182–1186/b	Medium sand, with small sand, gray	31,0	0,00	9,3		
126.	Kecskemét Ny–1	1567–1571	Claystone with plant rests, gray	28,8	0,12	9,0		
127.	Kecskemét Ny–1	1594–1595	Claystone shell-like fractured, with mollusc and plant rests, brownish-gray	35,0	0,12	8,9		
128.	Soltvadkert–1	1073–1077	Limy marl, gray	68,6	0,10	9,2		
129.	Soltvadkert–1	1116–1122	Clay, light gray	26,6	0,09	9,4		
130.	Érsekcsanád–1	354–358,4	Mudstone, shell-like fractured, with plant rests, light-gray	52,0	0,08	9,3		
131.	Rém–2	550–554	Fine silty clay, shell-like fractured, with plant rests, light-gray	48,7	0,11	7,8		
132.	Rém–2	574–577	Limy marl, gray	75,3	0,20	7,7		
133.	Rém–2	610–614,5	Limy marl, light gray	66,4	0,15	7,9		
134.	Rém–2	665–669	Clayey marl, light gray	66,4	0,14	7,7		
135.	Jánoshalma–7	450–455	Clay shell-like fractured, light	28,8	0,22	8,1		
136.	Jánoshalma–7	499,5–504	Clayey marl	64,2	0,16	8,2		
137.	Jánoshalma–7	550–555	Fine silt, shell-like fractured, light gray	11,1	0,16	8,4		
138.	Jánoshalma–7	679–684	Clayey marl light gray	51,8	0,10	8,9		
139.	Tompa–7	449,5–455	Coarse silty fine silt	11,1	0,06	9,2		
140.	Pusztamérges–2	526–531	Fine silty coarse silt, badly assorted, brownish-yellow	33,2	0,05	9,1		
141.	Pusztamérges–2	576–581	Lightly diagenized fine silty clay, gray	22,1	0,16	8,4		
142.	Pusztamérges–2	600–605	Lightly diagenized fine silty clay, gray	22,1	0,16	8,7		
143.	Pusztamérges–2	625–629,5/a	Fine silty clay, shell-like fractured	19,9	0,10	8,9		
144.	Pusztamérges–2	625–629,5/b	Clayey fine silt, yellowish gray	35,4	0,12	8,8		
145.	Üllés–1	1371–1376	Claystone, lightly diagenized, light brownish-gray	22,1	0,07	9,1		

Table III

Number	Boring		Type of sediment	$CaCO_3$ %	Total salt %	pH (H_2O)	Age
	Locality	Depth m					
87.	Üllés–2	776–782/a	Coarse silty fine silt, light gray	15,5	0,00	9,6	PLIOCENE LOWER PANNONIAN
88.	Üllés–2	776–782/b	Fine silty clay, light gray	33,2	0,09	9,1	
89.	Üllés–2	870–871,3	Coarse silt, light gray	33,2	0,03	9,2	
90.	Üllés–2	1129–1135	Small sand, with mollusc rests, ligth gray	24,4	0,07	9,0	
91.	Üllés–2	1194–1200	Fine sandy small sand light gray	19,9	0,09	8,5	
92.	Üllés–2	1361,5–1367,5	Mudstone with interbedded fine-grained sandstone, gray	22,1	0,06	9,0	
93.	Üllés–2	1405–1408	Mudstone, light gray	16,5	0,07	8,9	
94.	Üllés–7	1016–1022	Fine silt and small sand alternately, light gray	19,9	0,02	8,6	
95.	Üllés–7	1150–1156/a	Fine silt, with plant rests, brownish-gray	19,9	0,02	8,5	
96.	Üllés–7	1150–1156/b	Fine silt with lignite stripes	0,00	0,06	9,2	
97.	Üllés–7	1186–1192	Clayey fine silt, light gray	24,4	0,06	9,2	
98.	Üllés–7	1232–1237	Small sand with few medium grainned part, light gray	15,5	0,00	9,3	
99.	Üllés–7	1317–1323	Friable small-grained sandstone light gray	15,5	0,00	9,2	
100.	Üllés–8	1155–1161	Mudstone, yellowish-gray	19,9	0,04	9,1	
101.	Üllés–8	1255–1258	Mudstone, yellowish-gray	26,6	0,04	9,1	
102.	Üllés–8	1362–1367	Small sand, light gray	9,7	0,00	9,1	
103.	Szeged, Textil. M.	996–997,5/a	Claystone, greenish gray	33,2	0,10	8,8	
104.	Szeged, Textil. M.	996–997,5/b	Strongly clayey fine silt, gray	13,2	0,07	8,2	
105.	Szeged, Textil. M.	997–1000/a	Coarse silty fine silt with mollusc rests, gray	11,1	0,07	8,7	
106.	Szeged, Textil. M.	997–1000/b	Fine silty coarse silt, gray	8,9	0,06	8,6	
107.	Szeged, Textil. M.	1500	Fine silty coarse silt, gray	0,00	0,00	8,0	
108.	Szeged, Textil. M.	1600	Medium sand, light gray	8,9	0,00	8,0	
109.	Szeged, Székelysor	829,5–831	Silt, dark gray	8,9	0,06	9,2	
110.	Szeged, Székelysor	990–992	Small sand with medium-grained part, light gray	2,2	0,00	8,7	
111.	Szeged, Székelysor	1098–1100	Fine sand, light gray	11,1	0,00	9,1	
112.	Szeged, Székelysor	1193–1194	Fine silty clay, greenish-gray	2,2	0,10	8,7	
113.	Szeged, Székelysor	1294–1295,5	Clay, with interbedded small sand, greenish gray	17,7	0,19	8,3	
114.	Szeged, Székelysor	1490–1491,5/a	Fine silt, with interbedded coarse silty fine sand, gray	31,0	0,00	8,7	
115.	Szeged, Székelysor	1490–1491,5/b	Spotted clay, dark gray, strongly humous	0,00	0,50	4,5	

Table IV

Number	Boring: Locality	Boring: Depth m	Type of sediment	$CaCO_3$ %	Total salt %	pH (H_2O)	Age	
60.	Jánoshalma—7	300—304	Fine sand, light gray	19,9	0,00	8,2	PLIOCENE	UPPER PANNONIAN
61.	Jánoshalma—7	356—357,5	Clayey fine silty coarse silt, light gray, shell-like fractured	22,1	0,10	8,6		
62.	Tompa—7	225—230,5	Fine silt, light gray	31,0	0,00	8,4		
63.	Tompa—7	275—280	Coarse silty fine silt	17,7	0,06	9,1		
64.	Tompa—7	302—307,5	Clayey coarse silty fine silt, ochre-spotted light gray	26,6	0,05	9,2		
65.	Pusztamérges—2	200—205,5/a	Coarse silty fine silt, yellowbrownish gray	22,1	0,10	7,7		
66.	Pusztamérges—2	200—205,5/b	Fine silty clay, gray, calcareous spotted	22,1	0,07	7,9		
67.	Pusztamérges—2	250—255,5	Fine silty, caly brownish-gray	4,4	0,03	9,4		
68.	Pusztamérges—2	351—356	Strongly coarse silty fine silt, spotted with plant rests	11,1	0,09	9,3		
69.	Pusztamérges—2	431—436	Coarse silty fine silt light yellowish-gray	6,6	0,08	9,0		
70.	Pusztamérges—5	350—355	Clay, dark gray (spotted)	13,2	0,10	9,2		
71.	Pusztamérges—5	450—455/b	Fine silty coarse silt, light gray	6,6	0,08	8,5		
72.	Üllés—1	760—766/a	Clayey fine silt, light gray, strongly (calcareous spotted) humous.	27,5	0,18	7,6		
73.	Üllés—1	760—766/b	Coarse silt, light gray	16,4	0,07	9,0		
74.	Üllés—1	833—839/a	Fine silt with interbedded fine sand, light gray	16,4	0,05	8,9		
75.	Üllés—1	833—839/b	Fine silty clay light brownish-gray.	18,6	0,16	8,2		
76.	Üllés—1	915—919/a	Fine silt, light yellow	38,5	0,10	8,3		
77.	Üllés—1	915—919/b	Coarse silty fine silt, light yellowish-gray	25,2	0,07	8,4		
78.	Üllés—1	946—968/a	Fine silty clay with carbonaceous stripes, dark gray	7,5	0,07	8,7		
79.	Üllés—1	946—968/b	Fine silty clay, light greyishyellow	29,7	0,07	8,7		
80.	Üllés—1	1000—1006/a	Clayey silt, lightly diagenized light yellowish-gray	18,7	0,09	8,5		
81.	Üllés—1	1000—1006/b	Clay, carbonaceous mollusc and shell rests, dark gray	0,00	0,16	7,9		
82.	Üllés—1	1064—1070/a	Mudstone, light gray	38,5	0,05	9,1		
83.	Üllés—1	1064—1070/b	Mudstone, light gray	18,7	0,14	8,8		
84.	Üllés—1	1144—1150	Claystone greyish yellowishbrown	15,4	0,12	8,4		
85.	Üllés—1	1217—1223	Fine silty coarse silt light yellowish-gray	23,0	0,07	8,5		
86.	Üllés—1	1310—1315	Small- and fine-grained sandstone, light brown	36,3	0,05	9,1		

Table V

Number	Boring: Locality	Boring: Depth m	Type of sediment	$CaCO_3$ %	Total salt %	pH (H_2O)	Age	
31.	Dunaújváros–1	551–553/b	Coarse silty fine silt, dark gray, with plant rest	35,4	0,08	8,2	PLIOCENE	UPPER PANNONIAN
32.	Dunaújváros–1	553–557	Coarse silty fine silt, yellow, with plant rests	33,2	0,00	8,3		
33.	Dunaújváros–1	603–605	Coarse silty fine silt, dark gray	26,6	0,08	8,9		
34.	Dunaújváros–1	651–653	Fine silty coarse silt, light gray	27,5	0,00	9,0		
35.	Dunaújváros–1	699,5–701,5	Fine silty coarse silt, dark gray	24,4	0,07	9,1		
36.	Lajosmizse–3	505–510/a	Coarse silty fine silt, light gray	24,4	0,10	9,1		
37.	Lajosmizse–3	505–510/b	Fine silty clay, light gray	26,6	0,10	9,1		
38.	Lajosmizse–3	600–606	Coarse silty fine silt, light gray	31,0	0,16	9,5		
39.	Lajosmizse–3	700–705	Clayey, coarse silty fine silt, light gray	28,8	0,11	9,2		
40.	Lajosmizse–3	750,5–755,5	Clayey, coarse silty fine silt, light gray	35,4	0,18	9,6		
41.	Lajosmizse–3	805–806	Clayey fine silt, shell-like fractured, light gray	22,1	0,16	9,4		
42.	Lajosmizse–3	890–892	Clayey fine silt, shell-like fractures, lightly diagenized, gray	19,9	0,18	9,0		
43.	Kecskemét Ny–1	646–651,5/a	Coarse silt and fine silt alternately, light gray	33,2	0,08	9,1		
44.	Kecskemét Ny–1	646–651,5/b	Coarse silty fine sand, light gray	24,4	0,06	8,5		
45.	Kecskemét Ny–1	760–765/a	Small sand. partly medium-grained. light gray	19,9	0,00	9,0		
46.	Kecskemét Ny–1	760–765/b	Clayey fine silt, shell-like fractured, light gray	24,4	0,10	8,9		
47.	Kecskemét Ny–1	760–765/c	Fine silty coarse silt, greyish brown	28,8	0,09	8,8		
48.	Kecskemét Ny–1	901–907/a	Fine sandy small sand, light gray	28,8	0,07	8,5		
49.	Kecskemét Ny–1	901–907/b	Small sand, with carbonaeous stripes, considerably micaceous, light gray	26,6	0,12	8,2		
50.	Soltvadkert–1	557–562	Clayey coarse silty fine silt, light gray	29,8	0,00	8,9		
51.	Soltvadkert–1	646–651/a	Clayey fine silt, shell-like fractured, light gray	24,4	0,07	8,7		
52.	Soltvadkert–1	646–651/b	Coarse silty fine silt, light gray	24,4	0,07	8,7		
53.	Soltvadkert–1	912–917	Fine silty clay, gray	28,8	0,09	9,0		
54.	Érsekcsanád–1	252–257	Coarse silty fine silt, shell-like fractured, light gray	26,6	0,09	7,8		
55.	Érsekcsanád–1	295–300	Clayey fine silt, shell-like fractured, lightly diagenized	22,1	0,09	7,9		
56.	Érsekcsanád–1	324,5–329,5	Fine silty clay, shell-like fractured, lightly diagenized	26,6	0,14	7,6		
57.	Rém–2	201–206	Clayey coarse silty fine silt spotted gray	6,6	0,00	8,3		
58.	Rém–2	450–455	Fine silty clay, shell-like fractured	26,6	0,20	7,8		
59.	Rém–2	500–505	Fine silty clay, shell-like fractured	39,9	0,18	8,0		

Table VI

Number	Boring: Locality	Boring: Depth m	Type of sediment	$CaCO_3$ %	Total salt %	pH (H_2O)	Age
1.	Érsekcsanád – 1	30–35	Fine sandy loess, light yellow	30,9	0,00	7,9	PLEISTOCENE
2.	Rém – 1	57–62	Fine sandy small sand, yellow	15,5	0,00	8,0	PLEISTOCENE
3.	Tompa – 7	50,5–57,0	Fine silty loess, gray	18,9	0,00	8,4	PLEISTOCENE
4.	Pusztamérges – 2	55–56	Loess, humous, gray	22,1	0,03	7,8	PLEISTOCENE
5.	Pusztamérges – 2	100–100,5	Small sand, light gray, chalky	28,8	0,00	7,8	PLEISTOCENE
6.	Érsekcsanád – 1	95–100	Fine silt, light gray	4,4	0,00	7,8	PLIOCENE – LEVANTINE
7.	Rém – 2	150–155/a	Fine silty, fine sandy coarse silt, light gray	15,5	0,00	7,9	PLIOCENE – LEVANTINE
8.	Rém – 2	150–150/b	Smaall sand and fine sand light gray	15,5	0,00	7,9	PLIOCENE – LEVANTINE
9.	Jánoshalma – 7	200–204,5	Clayey, coarse silty fine silt, dark gray, considerably humous	17,7	0,08	8,0	PLIOCENE – LEVANTINE
10.	Pusztamérges – 2	148–153	Coarse silty fine silt, light greenish-gray	19,9	0,03	7,9	PLIOCENE – LEVANTINE
11.	Pusztamérges – 5	250–255,5/a	Fine silt, light bluish-gray	15,5	0,05	9,4	PLIOCENE – LEVANTINE
12.	Pusztamérges – 5	250–255,5/b	Fine silt spotted humous	15,5	0,04	9,4	PLIOCENE – LEVANTINE
13.	Üllés – 1	280–286/a	Clayey fine silt, light gray, with mollusc rests	14,2	0,04	8,0	PLIOCENE – LEVANTINE
14.	Üllés – 1	280–286/b	Clayey fine silt, light yellow, calcareous spotted	9,7	0,03	8,0	PLIOCENE – LEVANTINE
15.	Üllés – 1	350–356	Fine sandy coarse cilt, light gray	15,0	0,02	8,5	PLIOCENE – LEVANTINE
16.	Üllés – 1	556–562	Coarse sandy fine silt, gray with brown dots	21,0	0,08	9,0	PLIOCENE – LEVANTINE
17.	Üllés – 1	718–723/a	Fine silty coarse silt, kight gray	20,8	0,10	8,8	PLIOCENE – LEVANTINE
18.	Üllés – 1	718–723/b	Clayey fine silt, light gray	25,2	0,08	8,9	PLIOCENE – LEVANTINE
19.	Üllés – 2	563–568	Clayey fine silt, light gray	20,2	0,07	9,0	PLIOCENE – LEVANTINE
20.	Dunaújváros – 1	103–105/a	Fine sandy clay, brownish-gray, with plant rests	0,00	0,00	8,2	PLIOCENE – UPPER PANNONIAN
21.	Dunaújváros – 1	103–105/b	Silty fine sand, yellow, with limonitic stripes	20,8	0,00	8,0	PLIOCENE – UPPER PANNONIAN
22.	Dunaújváros – 1	152–154	Clayey fine silt, light gray	31,0	0,00	8,1	PLIOCENE – UPPER PANNONIAN
23.	Dunaújváros – 1	200,5–202,5	Coarse silty fine silt, light gray	35,4	0,03	8,1	PLIOCENE – UPPER PANNONIAN
24.	Dunaújváros – 1	251–253	Clay, iron-stainy light gray	22,1	0,00	8,1	PLIOCENE – UPPER PANNONIAN
25.	Dunaújváros – 1	302–304	Fine silty coarse silt, light gray	34,1	0,00	8,5	PLIOCENE – UPPER PANNONIAN
26.	Dunaújváros – 1	351–353	Fine silt, light gray	26,6	0,00	8,3	PLIOCENE – UPPER PANNONIAN
27.	Dunaújváros – 1	451–453	Small sand, partly fine frained and medium grained	17,7	0,00	8,3	PLIOCENE – UPPER PANNONIAN
28.	Dunaújváros – 1	500–502/a	Fine sandy small sand, light gray	17,7	0,00	8,5	PLIOCENE – UPPER PANNONIAN
29.	Dunaújváros – 1	500–502/b	Fine silt, small sand and fine sand, light gray	17,7	0,00	8,5	PLIOCENE – UPPER PANNONIAN
30.	Dunaújváros – 1	551–553/a	Coarse silty fine silt, light gray	18,6	0,08	8,2	PLIOCENE – UPPER PANNONIAN

is higher than that of the Upper Pannonian. Analogous conditions in the rest of the Hungarian Basin are only known to the E, near Battonya (Fig. 1). In the NE of the Basin, region of Kemecse—Macs, the carbonate content is markedly lower (averaging some 5—6%) [B. MOLNÁR, 1966 *b, c, d*].

The carbonate content of the *Upper Pliocene* („Levantine" formation) varies between 4 and 25% (Table VI, samples N^os^ 6—19), averaging 16—17%. Thus some additional decrease is observed.

In the *Pleistocene* aeolian formation (Table VI, samples N^os^ 1—5) the amount of $CaCO_3$ is higher again from 20 to 25% [B. MOLNÁR, 1961, 1966*e, f*].

DETERMINATION OF THE TOTAL AMOUNT OF SALTS SOLUBLE IN WATER

The method is based on the electric conductivity of the soil as found for given conditions of humidity. The higher the concentration of soluble salts (electrolytes) in the sediment the lower its resistivity, i. e. the higher its electric conductivity [R. BALLENEGGER—J. DI GLERIA 1962].

In addition, conductivity is dependent on temperature; for this reason, to obtain values suitable for comparison, the resistivity values measured have to be converted with reference to so-called normal temperature (15.5°C). To facilitate this work, such an instrument has been used as shows automatically the percentage concentration of total salts in the soil sample [D. MUSZKA, 1959]. Thus the readings obtained represent corrected values already.

The method is suited to routine work but it yields only relative values of informative character.

For the analysis, a sample of 17,5 g weight diluted in 46,2 cm^3 of distilled water was stirred and then kept for 24 hours. Diagenized samples were first ground and then analysed.

The serial analyses under consideration, serving primarily to investigate saline soils, were carried out for experiment. For, it was supposed that the one-time inland sea had undergone additional freshening in the Pannonian and that this fact might be reflected by corresponding changes in the salt content of the sediments. Some information on the chemical composition of waters from aquifers of different ages in Hungary is already available. Accordingly, younger subsurface waters are less saline [K. KORIM, 1955; G. SZUROVY, 1957; Ö. SCHULHOF, 1957]. The question may arise how much does the original salt content change at the current technology of boring with flushing mud treated by various reagents, bearing in mind that the warm flushing mud may leach planty of substances from a core sample while reaching the surface.

In the more northerly part of the region the total percentage of water-soluble salts in the *Lower Pannonian* sediments cut by boreholes at Dunaújváros, Kecskemét, and Soltvadkert varied between 0.0 and 0.2% (Table II, samples N^os^120—129). The highest value, 0.20, was obtained for a sample from Lajosmizse (sample N° 122). For the rest, the salt content observed ranged, as a rule, from 0.11 to 0.12%.

For the S of the region, between Érsekcsanád and Pusztamérges (Table II, samples N^os^ 130—144), similar average values were obtained, though one sample gave a value as high as 0.22% (Table II, sample N° 135). Samples from Üllés and Szeged, area East of the Pusztamérges Fault, already show a lower salt content, averaging as low as 0.06—0.07% (Tables II—III, samples N^{os} 87—145). Sands or sandstones near Szeged are more common than in the areas hitherto discussed. Nor these are salty. Comparatively high salt content (0,50%) was, however, found in a sample from a humic bed lying at 1,490 m depth at Szeged (Table III, sample N° 115).

It can thus be concluded that the Lower Pannonian sediments overlying a higher-seated basement in the W of the region have a higher salt content, whereas those lying above deep-sunken basement portions in the E are less saline. Carbonate-bearing and humic sediments sometimes yield conspicuously high values, while sands and sandstones do usually contain no water-soluble salt. In the latter case, salt is likely to have been dissolved by flushing mud.

In contrast with 0.14% obtained for the Lower Pannonian, the percentage of water-soluble salts in the *Upper Pannonian* formation at Dunaújváros has dropped to a few hundredths per cent. Many samples other than sand also lack salt. Irrespectively, the salt content was, as a rule, found to decrease upwards in the geological section (Tables V—VI, samples N^{os} 36—42). The Upper Pannonian samples from the borehole of Lajosmizse show rather a high salt content — 0.15 on the average (Table V, samples N^{os} 36—42). The Kecskemét and Soltvadkert samples have shown an upward decrease in salinity, the same holds true for the Upper Pannonian sediments of the Érsekcsanád—Pusztamérges area.

In the Upper Pannonian of the Üllés and Szeged areas, no marked change compared to Lower Pannonian has been observed, except for a slight increase of salt percentage in the lower part of the Upper Pannonian of drilling Üllés—1 (Tables III—IV, samples N^{os} 72—102).

The salt content of the *Upper Pliocene* („Levantine") sediments is low, from 0.9 to 0.1%, the average values being even lower: 0.04—0.05% (Table VI, samples N^{os} 6—19). Of the *Pleistocene* samples alone the loess of Pusztamérges was found to contain 0.03% of salt (Table VI, samples N^{os} 1—5).

Thus, it may be concluded that in the western part of the region, the salinity of the Lower Pannonian sediments is higher, showing a gradual decrease eastwards. The salinity of the Upper Pannonian sediments shows lower values for all the western area but the drilling at Lajosmizse, while in the surroundings of Üllés and Szeged no marked change occurs. The Levantine sediments, and particularly the Pleistocene ones, are of very low salinity, if at all. In assessing water-soluble salt content, particular attention must be paid to sands and sandstones of high humus and carbonate content and of high porosity.

In conclusion, the method under consideration seems to be suitable as a complementary one to other kinds of investigations for distinguishing sediments of different ages within a smaller area. Its further application, however, requires a large-scale additional experiment series.

pH MEASUREMENTS

The measurements to be discussed here were performed by using an electric pH-meter. 12,5 g of bore sample was diluted in 31,2 cm^3 of distilled water. The measurement was performed having kept the sample for 24 hours. Diagenized materials were previously subjected to grinding.

The *Lower Pannonian* sediments have rather a higher pH value (from 8.8 to 9.4%, averaging about 9.0; Table II, samples N^{os} 120—129) in the N of the region (between Dunaújváros and Soltvadkert). In the S marked fluctuations could be observed (7.7—9.3) but its average was lower (8.6—8.7). Particularly low pH (with an average of 7.8) were obtained for bore-samples from Rém, remarkable for high carbonate and salt contents (Table II, samples N[os] 131—134).

In the Üllés and Szeged areas the value of pH is rather high (between 8.6 and 9.4), averaging 8.8—9.0. Of course, the same samples show rather low carbonate and salt contents (Tables I—II, samples 145—169).

In terms of pH, the Lower Pannonian formation of the Danube—Tisza Interstream Region can thus be split up into two zones — that of Dunaújváros—Soltvadkert— Üllés—Szeged conspicuous for higher pH and that of Érsekcsanád—Pusztamérges showing lower pH.

The pH values (like the amount of soluble salts) of the *Upper Pannonian* of Dunaujváros show an upward decrease (still 9.1 at the base of the Lower Pannonian, they drop gradually, through 9.0—8.9—8.3—8.2, to a minimum of 8.0).

At Lajosmizse, where the total salt hardly changes from Lower toward Upper Pannonian, no change of the pH has been observed either. At Kecskemét and Soltvadkert, however, a slight decrease of pH was observed.

In the SW of the Region the low pH of the Lower Pannonian showed an additional decrease in the Upper Pannonian (7.6—9.4, with a marked frequency of values lower than 8.0; Tables IV—V, samples N[os] 54—71).

In the *Upper Pannonian* of the Üllés and Szeged areas the value of pH varies within the range of 4.5—9.4, its average being higher than farther W (Tables II—IV, samples N[os] 72—119). The value 4.5 and the two 8.0 readings were respectively yielded by a humic, pyrite-bearing sediment and by one slightly acid due to alteration of the former (Table III, sample N[o] 115; Table IV, samples N[os] 72—81).

The areal distribution of the pH values of the *Upper Pliocene* (Levantine) is similar to that found the Upper Pannonian, while the pH of the *Pleistocene* formation varies between 7.8 and 8.4.

The pH values can be applied only within areas of smaller geographic units. For, as shown by the measurements under consideration, those of the Lower Pannonian are high in the N of the Danube—Tisza Interstream Region, but very low in the SW.

The value of pH of the Upper Pannonian sediments of the N area (except for Lajosmizse) decreases from bottom to top, remaining, however, higher than in the SW. In the Szeged Basin it shows marked fluctuations, though its average is higher than farther W.

CONCLUSIONS

1. The average $CaCO_3$ content of the Lower Pannonian sediments of the Danube—Tisza Interstream Region was found to vary largely in the N, to be higher in the SW, lower in the Szeged Basin, yet mostly exceeds that of the average of the Upper Pannonian.

The lower carbonate content of the Upper Pannonian seems to be connected with the more variable sedimentation as well as the transgression of the Upper Pannonian inland sea resulting that only smaller areas of Mts. Mecsek and Mts. Villány with carbonate sediments remained emerged from the inland sea. So, the amount of $CaCO_3$ transported from these sources into the Upper Pannonian sedimentary basin was reduced.

2. The amount of the total water-soluble salts of the Lower Pannonian formations is greater in the western part of the region, whereas it decreases toward E. The total salt content decreases in the western part of the region in the Upper Pannonian layers — except the bore-hole at Lajosmizse — whereas it does not change substantially in the area of Szeged Basin. The Upper Pliocene sediments especially the Pleistocene ones, show low salinity, if any. Added to other kinds of investigations, the present method can be used for distinguishing formations of different ages within a smaller areal unit.

3. The pH of the Lower Pannonian is high in the N of the region and in the Szeged area, being lower in the SW. That of the Upper Pannonian shows an upward decrease all over the N but Lajosmizse, yet it remains higher than was found for the SW area. In the Szeged Basin it shows marked fluctuations, though its average is higher than farther W.

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