MICROMORPHOLOGY OF SOME SALT-AFFECTED SOILS FROM TWO SOIL REGIONS IN HUNGARY

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Salinity and alkalinity of soils impede the cultivation in a large area of Hungary. Therefore many of the Hungarian soil scientists have been focusing the attention to the investigation of formation processes, the improvement and the reclamation of these soils. In order to contribute to the study of the salt-affected soils of Hungary, these soils were selected for micromorphological investigation. This investigation was carried out within the soil mineralogical research directed by Gerei /11/. The intention was to widen the knowledge on the micromorphology of Hungarian soils; /Gerei and Szendrei /12/, Rózsavölgyi and Stefanovits /24/, Stefanovits and Rózsavölgyi /26//, and to contribute to the micromorphological study of the salt-affected soils of the world; /Andriakov Yarilova /2/, Gerei-Szendrei /12/ Tursina /35, 36/ Yarilova /41//.

The salt-affected soils in Hungary have been formed under the influence of more or less mineralized ground-water close to the surface. According to Szabolcs /34/, these soils can be characterized by the presence of sodium salts capable of alkaline hydrolysis.

Soils from the regions of Kiskunsag and Hortobagy, where a large area of salt-affected soils occurs were investigated. The region of Kiskunsag is situated along the Danube valley, the region of Hortobagy is located in the Eastern part of the Great Hungarian Plain.

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bolcs /27,31,32/ and Várallyay /37,38/ carried out detailed study on the soils in the region of the Kiskunsag and Hortobágy.

The method preparing thin sections .-

The method is a modification of Rózsavölgyi and Stefanovits's method /24/. The experiences of other micromorphologists were also considered : Altemüller /1/, Bochert /5/, Brewer /6/, Buol-Fadness /8/, Florinsky /10/, Gile /31/, Haarlov-Weis-Fogh /14/, Jongerius Heitzenberg /18/, Kubiena /19,20/, Laughton-Lee /21/, Polskij /22/, Polyakov /23/, Rudeforth /25/, Walsh-Hollingsworth /39/, Wells /40/.

The undisturbed soil samples were taken into sample taking cylinders from each genetic horizons. The samples were dried between 60-70 ºC in a drying oven.

The impregnation was carried out by a diluted Hungarian made polyester resin by adding to 1 part resin, 1 part monostyrene and 0,07 part acetone. Benzoyl peroxide catalysator and diethyl aniline accelerator polimerized the resin.

The excess of diluting agents was evaporated in a fume cupboard.

After the evaporation it was necessary to complete it by keeping the samples at about 60ºC for two or three days.

Plates of thickness 4-6 mm were ground first with 150 siliconcarbide powder by a simple grinding machine having two rotating discs. The fine drinding was carried out with siliconcarbide powder marked 500 and 800 on glass plates. The lubricant was T 30 machine oil.

The thin sections from the soil of Hortobagy region were prepared in small size /0,7-6 cm^2 /, and that from the soils of Kiskunsag region in medium size /5-20 cm^2/.

Classification of soil having been investigated .-

The soils under investigation were formed in typical salt-affected regions of Hungary. The genetic types of soils classified by Gerei et al. /11/ according to the Hungarian soil classification system /33/ are as follows:

Profile No. 1. Alluvial meadow soil. Kiskunság region.

Profile No. 3. Solonchak like shallow meadow solonetz. Kiskunság region.

Profile No. 4. Solonchak . Kiskunság region.

Profile No. II. Strongly solodized crusty meadow solonetz. Hortobágy region.

Profile No. III. Strongly solodized crusty meadow solonetz. Hortobágy region.

Profile No. IV. Solonetz like meadow chernozem - soil. Hortobágy region.

Two non salt-affected soils were selected for a comparative basis of micromorphological phenomena.

Description of micromorphological phenomena .

The micromorphological descriptions of soils are summarized in Table I. The ferms of micromorphological description are based on Brewer's terminology /6/. The size ranges of skeletons are given according to the Kachinsky's system /cit. 3/. In the table simple cross marks the common features, whereas cross in brackets indicates a less remarkable micromorphological phenomenon. In the headlines of the table the whole nomenclature is not mentioned, only the necassary terms are given.

Comparative micromorphology of soils .-

The micromorphology of Solonchak soil /Profile No. 4/ shows a monotonous picture.The pedological features are very rare. The only exception is the C_2 horizon where nodules around the minerals often occur in connection with a granular basic structure. Some carbonate nodules also occur. The plasmic fabric is mainly crystic except the C_2 horizon, where it is asepic. The most remarkable crystic plasmic fabric caused by microcrystalline carbonates is in the C_1 horizon. The basic structure generally is porphyroskelic or granular as in the C_2 horizon.

In the meadow solonetzes /Profiles No. 3, No. II, and No. III/. The pedological features are more frequent. Cutans along walls of the vughs and planes are common, especially in the B horizons.

In Profiles No. II.-III. The sesquioxidic nodules occur in the whole profile but they are not frequent. In Profile No. 3. the sesquioxidic nodules are absent or scarce, they are common only in the C horizon around the weathered grains. The carbonates are present in three forms: skeleton grains, nodules, and microcrystals. In the Profile No. 3. carbonate grains occur in the whole profile but he microcrystalline carbonate accumulation and carbonate nodules exist only in the deeper horizons.

In the profiles from the Hortobágy region, mainly in the Profile No. II., carbonates can be found in the form os skeleton grains, microcrystals, but these are less frequent. In the soils of the Kiskunsag region plasmic fabric in the Profile No. 3. is asepic, insepic and crystic, in Profiles No. II, III. it is asepic- insepic, in some horizons it is crystic. The basic structure is mainly porphyroskelic, in C_1 horizon of Profile No. 3. it is granular.

The elementary structure is cutanic in the B horizon.

In the solonetz like meadow chernozem /Profile No. IV. /the pedological features are rare. Cutans scarsely occur and the sesquioxidic and carbonate nodules are rare. The plasmic fabric is asepic or crystic. The basic structure is porphyroskelic.

Alluvial meadow soil /Profile No. 1./also has a similar micromorphology. Among the pedological features cutans are rare, sesquioxidic nodules around the grains are common only in the deeper horizons. The carbonate skeletons are common in the whole profile. Carbonate nodules also occur. The plasmic fabric is asepic or crystic. Elementary structure is porphyroskelic except in BC of Profile No. 1. in which it is granular.

The occurence of some micromorphological phenomena is in a close relation whith the soil types. In alluvial meadow soil and in the meadow chernozem soil cutans are very rare. In meadow solonetz soils cutans are common especially in the B horizons. In solonchak soil cutans are again rare. Cutanic elementary structure occurs only in the B horizon of solonetz soils.

Brewer and Sleeman /7/ stated a relation between the degree of plasma separation and salt concentration and Na saturation of expanding lattice clay minerals in soils. This tendency seems to be valid for the occurence of cutans in the soils of Kiskunság and Hortobágy area, too. In the soils having low alkalinity and ESP value /meadow soil and solonetz like meadow chernozem/the cutans occur only very scarcely. In solonetz soils, especially in the B horizons where the exchangeable sodium percentage is high cutans are common. In solonchak soil in which the salt content is high, the cutans are again rare.

Some differences in the micromorphology of the soils were found between the two regions:

1/ The sesquioxides occur as : opaque minerals, nodules around the weathered minerals and nodules. Nodu-

les according to Blümel /4/ reflect to the degree of wa - terlogging as per his experiences in this sections of gleys and pseudogleys.

In the soils of Kiskunság sesquioxide nodules are scare, only nodules around the weathered minerals are common in the deeper horizons having a granular basic structure. In the soils of Hortobágy area nodules are al so rare, whereas they occur in the whole profile. /Fig. 1./.

In the soils of Kiskunság and Hortobágy area the ground water table is recently high but he mobility of the compounds according to their micromorphology is low, because of the alkaline pH which impeds the migration of sesquioxides.

2./ Carbonate nodules also show hydromorphic in - fluences. The carbonates in the soils of Kiskunság area occur from the surface, the soils of Hortobágy area are calcareous only in some horizons.

In the soils of Kiskunság area carbonate nodules are not common. But carbonate porphyroskeletons occur in the whole profile. Plasmic fabric is often crystic due to carbonate microcrystals. In the deeper horizons crys tic plasmic fabric is more prominent and the carbonate content also higher because of microcrystalline carbona te accumulations. In the soils of Hortobágy region in so me horizons carbonate skeletons, microcrystalline car - bonate accumulation, nodules occur. Hrasko-Bedrna-Cu lik /15/ devided the soil carbonates according to their origin into four groups giving some of their micromorpho logical features as well. Among the autochtonous carbo - nates indicating most informations on soil formation of these groups, in our soils the cement and agglomeration forming carbonates were the most frequent.

Besides the indication on soil genetics, the distri - bution and concetration of carbonates affect the soil pH

as Brewer /6/ states: "the disseminated calcite causes generally high pH throghout the soil material, calcitans causes high pH only in the their vicinity" .

3./ In thin sections being made from the samples of Profile No. III solod stripes and spots consisting of transmiting skeleton and packing voids are visible. Coloured skeletons are rare. S-matrix is absent. /Fig. 2./.

4./ Plasmic fabric is mainly crystic, or in some cases asepic-insepic in the soils of Kiskunság. In the soils from the Hortobágy region plasmic fabric is asepic-insepic, sometimes crystic.

5./ There is a difference also in the basic structure of the soils of the different regions. The soils of the Kiskunság area are heterogenious. In the topsoil basic structure is porphyroskelic. In the deeper layers a carbonate accumulation occur, with a porphyroskelic basic structure and with a crystic plasmic fabric. Some of the C horizons have a granular basic structure, /Fig. 3. and 4./ with a little bit coarser skeletons and with very common packing voids. The soils of the Hortobágy area are more homogenious. Basic structure is porphyroskelic. Sometimes plasmic fabric is crystic due to carbonates microcrystals.

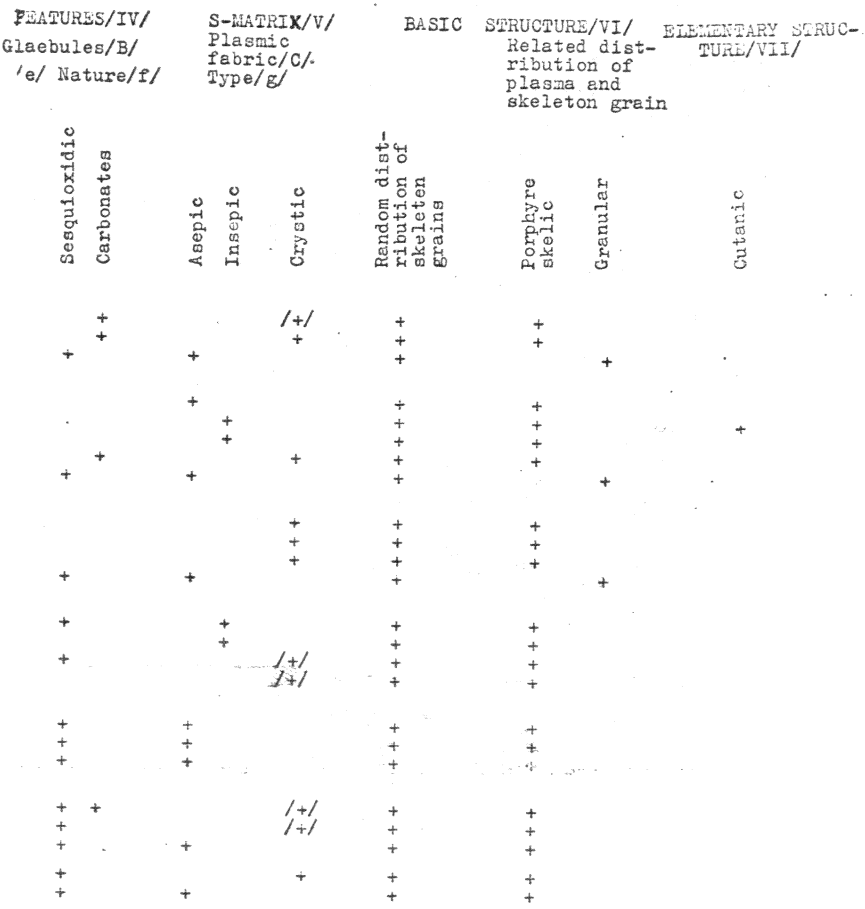
In thin sections being made from the C horizon of soils from Kiskunság, pedorelicts are observed. The pedorelicts have a distinct contour and rounded shape. The compounds and fabric of pedorelicts reflect a more matured stage with finer texture and with common sesquioxidic nodules and plasma separations.

6./ The most common skeleton minerals are similar in the soils of both area. A remarkable difference can be realized in the frequency and distribution of carbonate mineral skeletons and in the size of skeletons. In the soils of Kiskunság region the carbonate minerals are common

in the whole profile and the size of skeletons is bigger / mainly fine sand and loess, in some horizons moderate sand/ than in the soils of Hortobáry region where the size of skeletons is mainly in the size range of loess and the carbonate skeletons occur only in some horizons .

Table 1. MICROMORPHOLOGICAL DESCRIPTION OF THE SOILS

/I/ Sign of the profile. Genetic horizons. Sampling depth /cm/	SKELETONS/II/ Nature/a/					VOIDS/III/ Size/b/			Types/c/		PEDOLOGICAL Cutans/A/ Type/d/		Type,
	Quartz	Feldspars	Ferric minerals+micas	Carbonates	Opaques	Medium fine sand	Fine sand	Loess	Packing voids	Vughs	Planes	Vughs	Plane	Nodule
Profile No.1.														
A horizon	+	+	+	/+/	+		+	/+/		+	+	/+/	/+/	/+/
B horizon	+	+	+	+	+		+	/+/		/+/	+	/+/		/+/
BC horizon	+	+	+	+	+	+	+	/+/	+	+				+
Profile No.3.														
A horizon	+	+	+	+	+		+	/+/		+	+	+		
B_1	+	+	+	/+/	+		+	/+/		/+/	/+/	+		
B_2	+	+	+	+	+		+	/+/		+	+	+	+	
BC	+	+	+	+	+		+	+		+	+	+	+	/+/
C_1	+	+	+	+	+	+	+	/+/	+	+				+
Profile No.4.														
A horizon	+	+	+	/+/	+		+	/+/		+	+	/+/	/+/	
B horizon	+	+	+	/+/	+		+	/+/		+	+	/+/	/+/	
C_1 horizon	+	+	+	+	+		/+/	+		+	+	/+/		
C_2 horizon	+	+	+	/+/	+	+	+	/+/	+					+
Profile No.II.														
A horizon	+	+	+		+		/+/	+		/+/	+	/+/	/+/	/+/
B horizon	+	+	+		+		/+/	+		/+/	/+/	/+/		/+/
BC horizon	+	+	+	/+/	+		/+/	+		+	/+/			/+/
C_1 horizon	+	+	+		+		/+/	+		/+/				
Profile No.III.														
A horizon	+	+	+		+		/+/	+		+	/+/	+	+	/+/
AB horizon	+	+	+		+		/+/	+		+	/+/	+	+	/+/
B horizon	+	+	+		+		/+/	+		+	/+/	+	+	/+/
Profile No.IV.														
A horizon	+	+	+	/+/	+		/+/	+		+	/+/	/+/		/+/
B_1	+	+	+		+		/+/	+		+	/+/	/+/		/+/
B_2	+	+	+	/+/	+		/+/	+				/+/		/+/
BC	+	+	+		+		/+/	+		+	+			/+/
C	+	+	+		+		/+/	+		+	/+/			/+/


FEATURES/IV/
Glaebules/B/
'e/ Nature/f/
S-MATRIX/V/
Plasmic fabric/C/.
Type/g/
BASIC STRUCTURE/VI/
Related distribution of plasma and skeleton grain
ELEMENTARY STRUCTURE/VII/
Sesquioxidic
Carbonates
Asepic
Insepic
Crystic
Random distribution of skeleten grains
Porphyre skelic
Granular
Cutanic

SUMMARY

Six profiles/alluvial meadow soil, solonchak-like shallow meadow solonetz, solonchak, two strongly solodized crusty meadow solonetz/characterizing a large area of salt-affected soils in two soil regions were investigated. A modification of the method impregnating the soil with a diluted polyester resin was used to prepare thin sections. The micromorphological phenomena were described in Brewer's system.

Differences were found in the distribution and size of skeletons, in the pedological features, S-matrix, basic and elemantary structures among the soil types and soils of the two regions.

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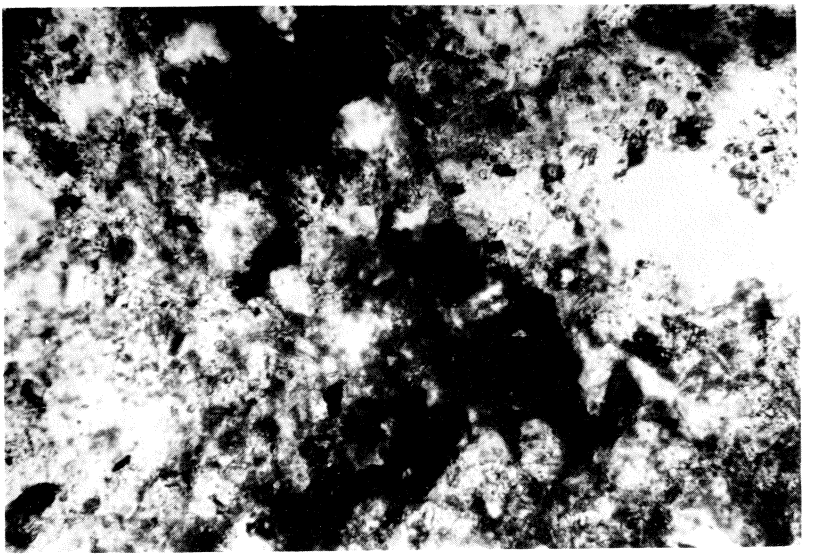

Fig. 1. Sesquioxidic nodules. Profile No. III. AB horizon. Magnification 216 x || N.

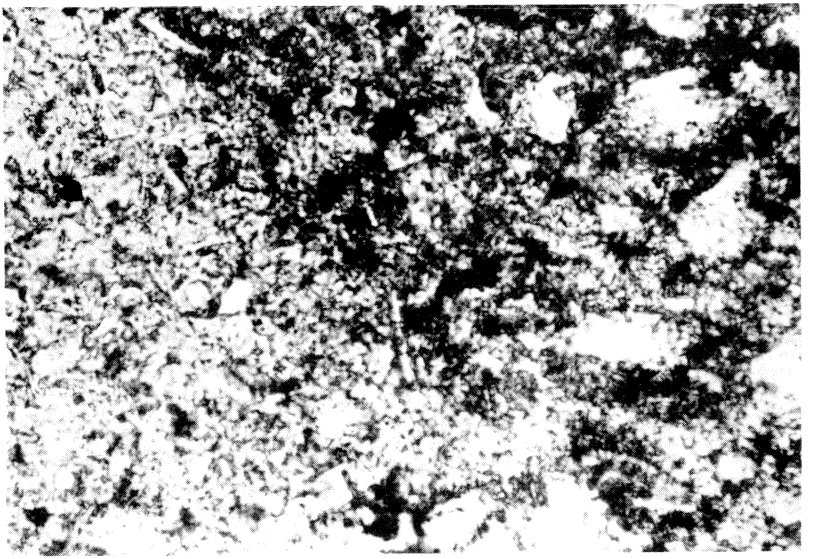

Fig. 2. Solod stripe. Profile No. III. AB horizon Magnification 216 x || N.

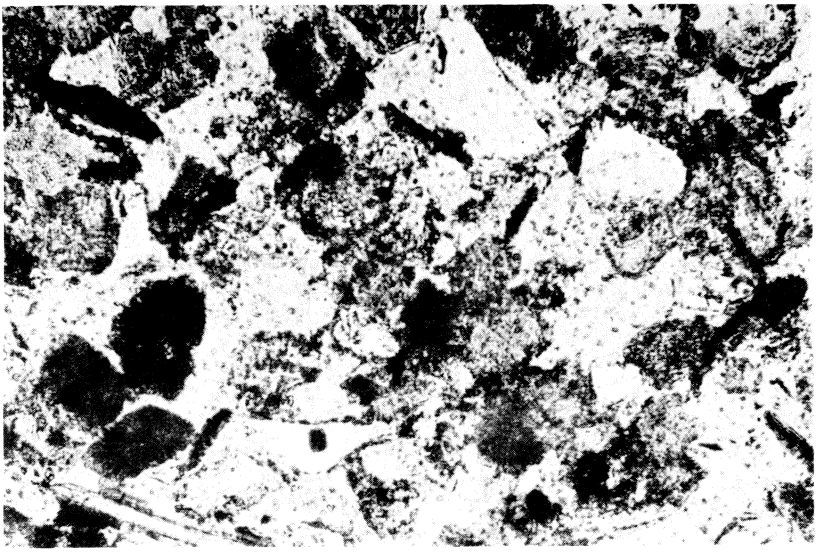

Fig. 3. Granular basic structure. Profile No. 3C horizon. Magnification 272 x || N.

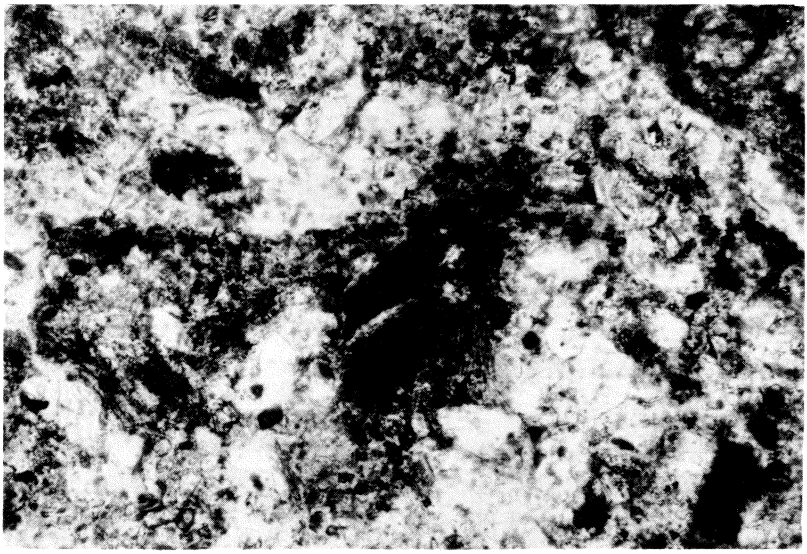

Fig 4. Porphyroskelic basic structure with nodule. Profile No. III, AB horizon. Magnification 216 x || N.

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