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On genetic properties of the geltozems of the U.S.S.R. (Results of chemical and micromorphological investigations)

A. I. ROMASHKEVICH and M. I. GERASIMOVA

Institute of Geography, Academy of Sciences, Moscow, U.S.S.R.

INTRODUCTION

Geltozems (yellow earths) in the U.S.S.R. were for the first time described by Akimtzev in the Lenkoran (Southern Azerbeijan) region. Their name was based on the morphological similarity with the krasnozems (red earths) of Western Georgia, developed on yellow-coloured variants of the crusts of wearthering. No genetic characteristic was given.

Later, the Western Georgian geltozems were studied mainly by Sabashvili [10], and the geltozems of Lenkoran — by Klopotovsky [3], Zavalishin [11], Lebedev [6], Sabashvili [9], Kovalev [4, 5] and others.

Now, the name "geltozem" is attributed to soils (developed mainly on sedimentary rocks) with a homogeneous or weakly differentiated profile and with more light than the krasnozems, yellowish hues in the colour. Both soil types are formed in the same zone — humid subtropics, and the same geomorphological conditions — strongly dissected foothills and low mountains.

Many investigators consider the podzolic process peculiar for all the geltozems. According to literature, the geltozems in Western Georgia are acid, highly unsaturated soils with a notable leaching of sesquioxides and correspondingly, with accumulation of SiO_2 in the upper horizons; the Lenkoran geltozems, having some common features with the Western Georgian ones, are saturated or weakly unsaturated, and are, therefore, distinguished as a seperate subtype of saturated geltozems [2]. Some properties of the Lenkoran geltozems, as described by most investigators, are contradictory ones: so the soils are regarded as acid or weakly acid with certain indices of podzolization and ferralitization, and, in the same time, the hard carbonate concretions are considered as connected with the modern soil formation [5]. The greatest part of pedologists explain the main differences between the krasnozems and geltozems by the properties of the parent rocks — less ferralitized in case of geltozems and only approaching to the crusts of weathering with krasnozems.

Aim of the present investigation was to elaborate additional characteristics of geltozems as of a soil type in order to define more precisely their place among soils of the humid subtropics in our country.

Because of scarcity of existing geographical and physico-chemical data on geltozems and of their controversity, to a certain extent (for the Lenkoran region), we decided to investigate geltozems of Western Georgia and Lenkoran and compare them, especially in the micromorphological aspect.

We discuss data, concerning geltozems in the two main areas of their occurrence. But we do not take into account here soils with a geltozemic appearance and differentiated profile — called usually geltozemic-podzolic and gley geltozems.

GELTOZEMS OF WESTERN GEORGIA

In Western Georgia geltozems, shown at the 1:1,000,000 scale map, were studied. Predominant parent rocks are here slates and clays with a rather high content of silica acid (up to 65%) and with moderate amount of sesquioxides (30-35%). As for their molecular ratios in the clay fraction these rocks may be called weakly ferralitic (SiO_2:R_2O_3 equal to 2-2.7), while mineralogical investigations revealed the predominance of kaolinite among clay minerals.

The climate of areas with geltozems differs from that of regions of krasnozem formation by a lower coefficient of annual moistening, higher summer and lower winter temperatures (Table 1). So, the climatic indices prove drier and "more continental" conditions of the formation of geltozems. Vegetation, in those rare places, where it survived, is represented by secondary Kolthidacy forests.

Geltozems of Western Georgia are usually shallow, sometimes moder-

Table 1. Climatic elements of the humic subtropics of the U.S.S.R. (according to Ivanov)

Areas	T of the coldest month	T of the hottest month	Rainfall mm	Annual moistening coefficient	Quantity to arid months	Moistening coefficient for the driest months	Moistening coefficient for the most humid months
Areas with geltozems in Western Georgia	4.7	23.2	1,383	2.01	—	1.09	2.9
Aeras with geltozems in Lenkoran	3.6	25.2	1,364	2.03	2-3	0.16	8.2
Areas with krasnozems in Western Georgia	5.0	21.6	2,220	3.49	—	1.16	5.6

ately deep. Large areas occupied by truncated soils. In the north-western part of Western Georgia soils with geltozemic appearance are restricted to dissected patches on the high terraces; the flat watershed positions are occupied by soils with differentiated profiles.

The upper yellowish-grey horizons of geltozems are gradually substituted by friable yellow, with brown and red stains and bands, horizons of altered slates or clays. The soil profile practically coincides with the profile of weathering. Below a description of a geltozem profile is given.

Profile 7. Okrib depression. Slope 5°, eastern exposition.

Shrubs of Azalea, Rhododendron, Ilex.

A_0	0-1 cm	Dry litter-fall of the previous year.
A_1	0-12 cm	Grey-yellow, sandy loam, fine cloddy structure, dry, roots are abundant, weakly compact, gradual transition.
AB	12-23 cm	Yellow chroma stronger expressed, slightly visible humus tongues, sandy loam, unstable cloddy structure, roots are less abundant, gradual transition.
B_1	23-42 cm	Bright brown-yellow, loamy, large unstable clods, compact, small amount of roots, the transition is gradual, but clearly visible.
B_2	42-52 cm	Bright brown-yellow, loamy, more compact, roots are scarce, large amounts of slates fragments, clear transition.
CD	52-70 cm and deeper	Stratified bright yellow shales with reddish-brown stains and bands of iron hydroxides.

According to the bulk analysis data, the total R_2O_3 content in the geltozems (Table 2, 20-40%) is considerably lower than in the krasnozems (40-55%). During the geltozem formation an active leaching of R_2O_3, especially from the upper horizons, with a corresponding accumulation of SiO_2 takes place. Opposite to the krasnozems Al_2O_3 is leached stronger, than Fe_2O_3. Basing on the values of molecular ratios SiO_2/R_2O_3, it is possible to state, that the intensity of R_2O_3 leaching is stronger in geltozems.

It may be easily explained by higher hydratation of iron combinations in geltozems.

The amount of total CaO and MgO is not great in geltozems and rather constant throughout the profile.

The soil reaction is acid — pH in water solution is equal to 4.5-5.2 (Table 3). The exchangeable cations composition is similar in geltozems and krasnozems, although the saturation degree is higher in the first ones. In both soils it depends on the exchangeable aluminium.

The middle and low horizons of geltozems, as well as parent rocks, are unsaturated, and only the upper 10-20 cm layer is more saturated due to the soil formation processes.

Determination of nonsilicate iron by Jackson's method (Table 3) revealed its higher amounts in geltozems in comparison with the krasnozems (60-80% and 40-60% of the total quantity). Mineralogical and micro-

Table 2. Bulk chemical composition of the geltozems of Western Georgia (profile 7) and of Lenkoran (profile 4 and 18)

No. of profiles	Depth, cm	Loss by ignition %	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	$\frac{SiO_2}{Fe_2O_3}$	$\frac{SiO_2}{Al_2O_3}$	$\frac{SiO_2}{R_2O_3}$
7	1-11	13.28	74.17	5.16	17.09	0.65	0.78	40.00	7.00	6.00
	12-22	8.3	75.61	4.35	15.92	0.64	0.64	42.00	7.87	6.63
	26-36	8.80	72.93	5.22	19.09	0.63	0.73	40.00	6.32	5.45
	43-49	11.15	60.25	6.80	23.21	0.60	—	—	—	4.09
	64-70	11.45	65.81	6.46	25.12	0.80	0.96	27.50	—	3.79
4	0-7	14.49	68.68	6.32	18.75	1.83	1.53	29.23	6.19	5.11
	12-18	8.67	68.31	6.69	18.55	0.86	1.14	27.14	6.26	5.09
	20-26	9.18	65.40	8.08	21.60	0.59	1.68	21.30	5.14	4.14
	30-40	10.78	62.70	8.79	25.25	1.06	1.72	18.90	4.21	3.44
	56-66	7.99	60.60	9.47	25.02	0.52	1.49	17.11	4.12	3.32
	90-100	10.49	57.44	10.31	29.97	0.92	0.53	15.00	3.26	2.68
18	0-7	17.29	61.57	7.74	22.33	2.00	2.35	20.04	4.64	3.79
	7-13	13.82	62.38	8.30	23.25	1.42	1.65	20.04	4.43	3.65
	15-19	11.65	60.91	8.76	24.57	1.23	1.33	12.50	4.16	3.13
	20-26	10.01	58.48	9.77	25.77	1.34	1.64	16.67	3.88	3.13
	37-47	10.74	59.86	9.01	25.14	1.60	1.71	16.50	3.82	3.19

morphological investigations explain these differences by a high hydratation of mineral forms of iron in the geltozems.

Important data on main processes in geltozem formation are displayed by micromorphological investigations. They show, that parent rocks of geltozems — shales and clays — consist mainly of finely dispersed clays with scaly-fibrous fabric. The clay plasma may be uneven: stratification of yellowish clay material and iron-containing layers of clay pseudomorphs is observed. Sometimes the distribution of these two types of material has an irregular, stainy pattern. Clay is strongly optically oriented, especially around pores and fissures. On the primary minerals fragments clay skins are visible. Among these fragments quartz, more or less weathered feldspars prodominate; pyroxene, chlorite, muscovite are frequent.

Under the influence of humus substances in the soil horizon some changes in the fabric of parent material take place: platy structures and irregularity disappear. From the rock to the soil horizons the compactness of plasma gradually decreases, the degree and type of orientation change — elements of scaly orientation begin to predominate. Soil forming processes lead to redistribution of iron combinations in the clay plasma, and its even impregnation by iron hydroxides results. In the same time quite definite microconcretions are observed, mainly in the lower horizons, formed at the expense of iron concentration from the clay plasma of the horizon itself and due to its leaching from the upper part of the

Table 3. Chemical properties of the geltozems of Western Georgia (profile 7) and Lenkoran (profile 4 and 18)

No. of profiles,	horizon	Depth, cm	pH H_2O	pH KCl	Exchangeable cations m-equiv. $Ca^{\cdot\cdot}$	$Mg^{\cdot\cdot}$	$Al^{\cdot\cdot\cdot}$	$H^{\cdot}$	Total $Ca^{\cdot\cdot}$ $+Mg^{\cdot\cdot}$	Nonsaturation, %	Humus, %	Fe_2O_3 in Tamm extraction % from the soil	% from the total Fe_2O_3	Fe_2O_3 in Jackson extraction % from the soil	% from the total Fe_2O_3
7	A_1	1-11	4.6	3.4	6.48	4.43	12.88	0.40	10.91	23.1	6.51	not determined		3.04	66.81
	A″	12-22	5.2	4.0	3.88	1.75	3.72	0.08	5.61	40.4	2.05	not determined		3.31	82.75
	B_1	26-36	4.8	3.6	2.81	2.05	8.21	0.12	4.86	63.2	1.25	not determined		3.51	73.13
	B_2	43-49	4.9	3.7	3.24	2.27	11.00	0.80	5.51	68.1	1.39	not determined		5.00	81.70
	parent rock	64-70	4.7	3.8	4.54	4.75	12.00	0.80	9.29	58.0		not determined		4.66	80.34
4	A_1	0-7	5.8	5.1	14.97	4.63	0.16	0.04	10.60	1.01		0.98	17.04	2.12	36.87
	A″	12-18	5.6	4.5	not determined		0.26	0.10	—	—		1.08	17.08	2.37	37.50
	B_1	20-26	5.0	3.8	13.67	6.04	1.54	0.06	19.71	7.1		0.74	9.77	—	—
	B_2	30-40	5.0	3.8	15.68	7.23	2.89	0.08	22.91	11.5		0.87	10.76	2.87	35.52
	C	56-66	5.2	3.9	15.01	8.11	2.64	0.12	23.12	10.6		0.85	9.41	2.97	32.89
	C	90-100	5.3	4.0	20.77	12.01	0.14	0.24	32.78	1.1		—	—	3.25	32.79
18	A_1	0-7	5.5	4.8	27.09	5.73	0.24	0.08	32.82	0.9	9.30	1.73	26.49	5.27	80.70
	AB	7-13	5.2	4.3	29.58	0.89	0.32	0.28	30.47	1.9	6.43	1.34	18.08	5.89	74.08
	B	15-19	5.2	3.6	23.57	7.56	4.87	0.16	31.13	13.8	4.57	0.67	8.31	6.0	74.44
	BC	20-26	5.1	3.5	24.92	4.94	0.80	0.20	29.86	14.4	1.86	0.58	6.38	6.70	73.79
	C	37-47	4.9	3.4	26.88	4.89	4.88	0.36	31.77	14.1	—	0.69	8.32	5.21	62.84

solum. In lower horizons coatings of yellow optically oriented clay are observed, penetrating also in the parent rock.

A striking peculiarity of intermediate and lower horizons is their "local" reworking by soil forming processes at the background of conservation of certain indices, peculiar for the parent rock. The latter comprise partial conservation of specific fabric and type of clay orientation.

All the processes of reworking of parent material, typical for the krasnozems (dispersion and reorientation of clays, dispersion, hydratation and redistribution of sesquioxides) are found in geltozems as well.

Also processes of lessivage and initial pseudo-gley are noted with the help of micromorphology in both soil types in the same volume.

We have enumerated certain properties of the geltozems of Western Georgia. Discussion follows after the description of the properties of Lenkoran geltozems.

GELTOZEMS OF LENKORAN REGION

First investigators of the Lenkoran geltozems pointed out the original features in soil formation, but more attention was paid to the searches of similarity in soils of both subtropic regions. Therefore, the opinion of Lebedev [6] that investigators "without sufficient proofs applied to Talysh soils the usual notions on krasnozems and geltozems on the basis of only apparent analogy in climate and vegetation with the Black Sea coast of the Caucasus", is true only to a certain extent.

The comparison of climatic elements of Lenkoran territory with the areas of geltozem soils of Western Georgia (Table 1) exhibits both common features and differences. The annual precipitation and moistening coefficient are the same, but their dynamics during the year is quite different.

Autumn months in Lenkoran have high values of moistening coefficients, 2–3 times higher than in the subtropical regions of Western Georgia. Summer months are very dry (Ivanov's moistening coefficient is up to 0.13), while the temperatures are by 1–2° higher, than in subtropical regions of Western Georgia.

It is doubtless, that these seasonal climatic differences do not exert a certain influence of soil formation.

Parent rocks are represented by tertiary shales, sandstones, clays; sometimes basic eruptive rocks and their deluvium occur. All these rocks have a similar chemical composition — they are rather poor in SiO_2 and rich in R_2O_3.

Examination of exposures and soil profiles brought us to the conclusion of impossibility of weathering crust formation. In such dissected topography ancient weathering products could not have remained, as well as the modern ones can not accumulate in more or less considerable quantities (i.e. the profile of weathering coincides with the soil profile, as in Western Georgia). Parent rocks for the Lenkoran geltozems prove to be friable tertiary sediments.

The molecular ratios in the clay fractions of the Lenkoran sediments (Table 4) do not have any ferralitic features.

Results of the X-ray investigations are the following. Among the clay minerals of parent rocks (Fig. 2a) a mixedlayered structured mica-montmorillonitic mineral absolutely prevails; as admixtures quartz, chlorite, kaolinite, montmorillonite may occur. This mixed-layered mineral has intermediate properties between the kaolinite and mica and, on the

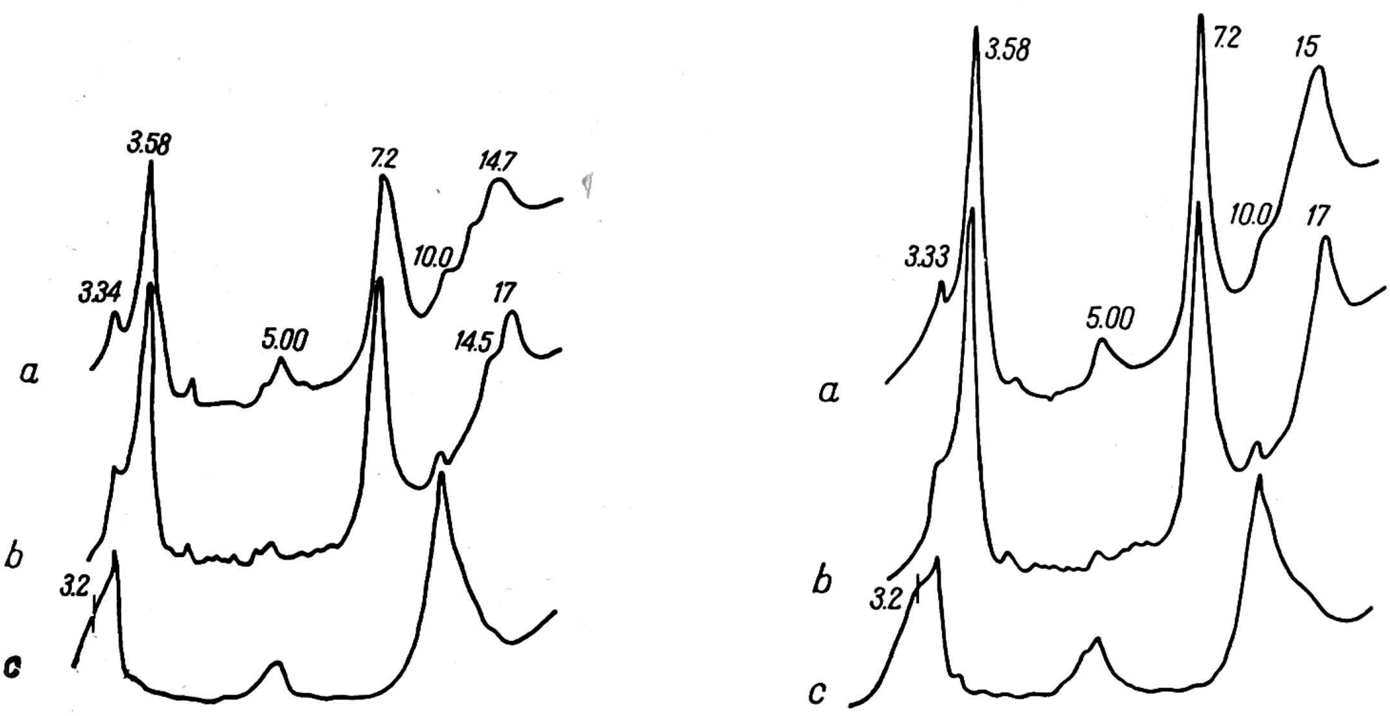

Fig. 1. Difractograms of oriented samples of a geltozem (I) of Western Georgia and of its parent rock (II), (*a* — air dry, *b* — with ethylene glycol, *c* — after ignition by 500°).

Table 4. Bulk chemical composition of the clay fraction of the geltozems of Western Georgia (profile 7) and of Lenkoran (profile 18 and 24)

No. profiles	Depth, cm	Loss by ignition, %	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	$\frac{SiO_2}{Fe_2O_3}$	$\frac{SiO_2}{Al_2O_3}$	$\frac{SiO_2}{R_2O_3}$
7	1-11	26.28	51.80	10.70	36.24	1.29	1.85	—	—	—
	12-22	22.58	52.00	11.43	35.80	1.21	—	12.30	2.46	2.10
	26-36	18.54	51.71	10.13	36.29	0.89	0.62	12.30	2.40	2.00
	64-70	17.60	50.18	14.09	34.24	1.00	1.12	4.33	2.47	1.97
18	0-7	21.64	54.99	9.94	30.31	0.72	2.24	14.71	3.07	2.54
	7-13	18.47	54.97	9.98	29.30	0.69	1.49	14.62	3.18	2.66
	13-19	16.30	54.92	9.81	30.41	0.68	1.94	14.91	3.06	2.55
	20-26	16.35	55.77	9.89	29.85	0.56	0.96	15.00	3.16	2.62
24	9-17	18.37	54.65	11.22	28.61	1.06	1.66	12.96	3.25	2.60
	parent rock	16.75	55.47	12.00	28.38	0.91	2.77	11.50	3.28	2.55

other hand, — the montmorillonite. It accounts for a high exchangeable capacity, observed by many parent rocks in the Lenkoran region.

The mixed-layered mineral in the sedimentary rocks is inherited. But, as other clay minerals are absent in soil profiles (the mineralogical composition of soils and rocks is identical, Fig. 2), we may conclude that the modern weathering has the same trend with the tertiary one.

Beside specific climate and mineralogy of parent rocks, the Lenkoran region has a peculiar vegetation — relic forests of Hirkan type restricted mainly to the foothills and low mountains. The principal standformers are *Parrotia persica* and *Quercus castaneifolia.* According of Parfenova [7] the leafy fall-off is twice richer in CaO and 5-10 times poorer in Al_2O_3 in the Hirkan forests in comparison with the Colthidacy forests of Western Georgia.

The Lenkoran geltozems, being formed under strongly dissected topography conditions, are mainly shallow. As example we give the following description.

Profile 4. Alekseevka, foothills, 100 a.s.p., fallow.

A_1	0-10 cm	Cinnamonic-brown, sandy loam, indistinct clods, compact, with inclusions of shale and sandstone debris, roots present, transition is gradual.
A_1''	10-18 cm	Yellowish-brown, loamy compact, with roots, indistinct clods, the transition is gradual, but clearly visible.
B_1	18-27 cm	Yellow-brown, loamy, cloddy, the amount of roots is considerably less, compact, gradual transition.
B_2	27-44 cm	More bright, yellow-brown with a reddish hue, less compact, moist, roots are scarce, loamy, indistinct cloddy, transition is clearly visible.
C	44-110 cm and below	The redeposited material of shales and sandstones, yellow brown with reddish hue, irregular, with abundant manganese stains, compact.

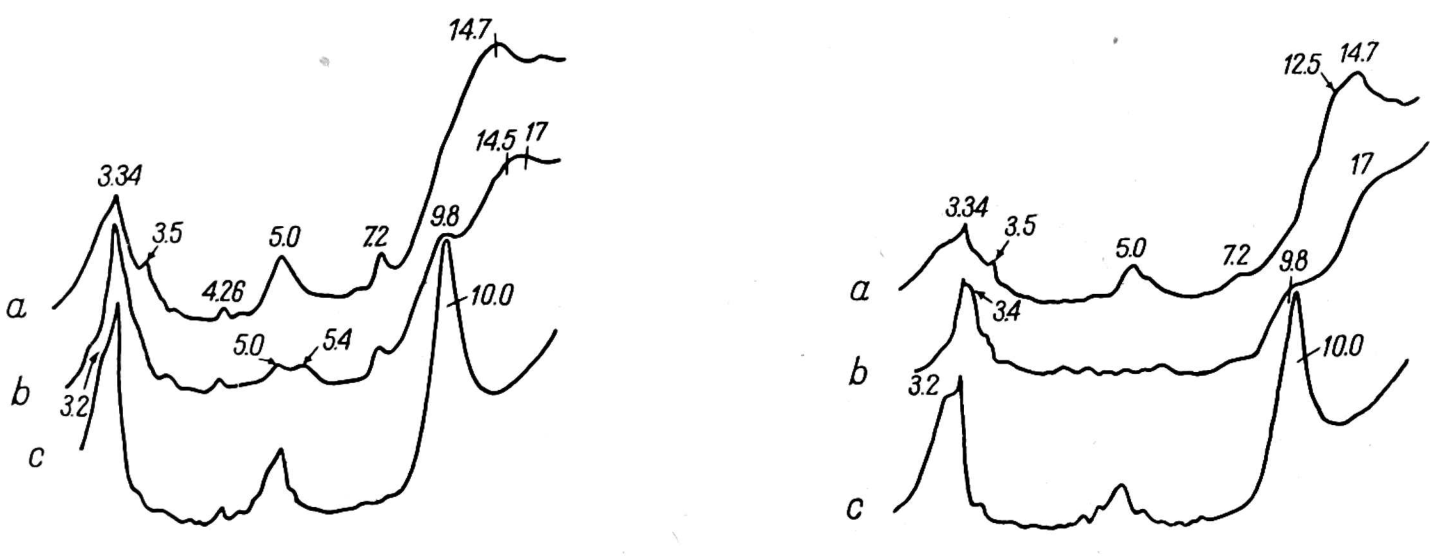

Fig. 2. Difractograms of oriented samples of a geltozem of the Lenkoran (I) and of its parent rock (II), (*a* — air dry, *b* — with ethylene glycol, *c* — after ignition by 500°).

Reaction is acid in mineral horizons (Table 3, pH_{H_2O} 4.9-5.4; pH_{KCl} 3.5-4.5) and slightly acid in the humus ones (pH_{H_2O} 5.5-6.1 and pH_{KCl} 4.8-5.2).

In cases, when geltozems are formed on carbonatic rocks, the reaction of upper soil horizons approaches the neutral, pH_{H_2O} is about 6.0-6.5.

The absorbed $Al^{\cdot\cdot\cdot}$ and $H^{\cdot}$ do not play significant role in the absorption complex (not surpassing 15-30% of the exchangeable capacity). The exchangeable capacity ranges between 20-50 m-equiv. (Table 3). The amount and composition of absorbed cations are due to peculiarities of clay minerals and humus.

According to Kovalev's data [5], in the humus fractions of Lenkoran geltozems the humic acids linked with Ca are important (Ch.a/Cf.a. $>$ 1), while in the soils of Western Georgia humus is mobile, mainly fulvic and is combined with sesquioxides.

The amount and distribution of humus in the Lenkoran geltozems do not differ greatly from those in Western Georgia geltozems and krasnozems. The upper horizons are relatively enriched (up to 9%), large amounts may be observed in B and BC horizons (up to 4.5%).

The distribution of nonsilicate iron, determined by Jackson's method, is irregular (Table 3). Probably, it reflects more the inheritance of iron combinations from parent rocks, than the actual soil-forming processes.

The upper horizons are also enriched by mobile iron of the Tamm extraction (up to 12-13% of the total). There are iron-organic combinations.

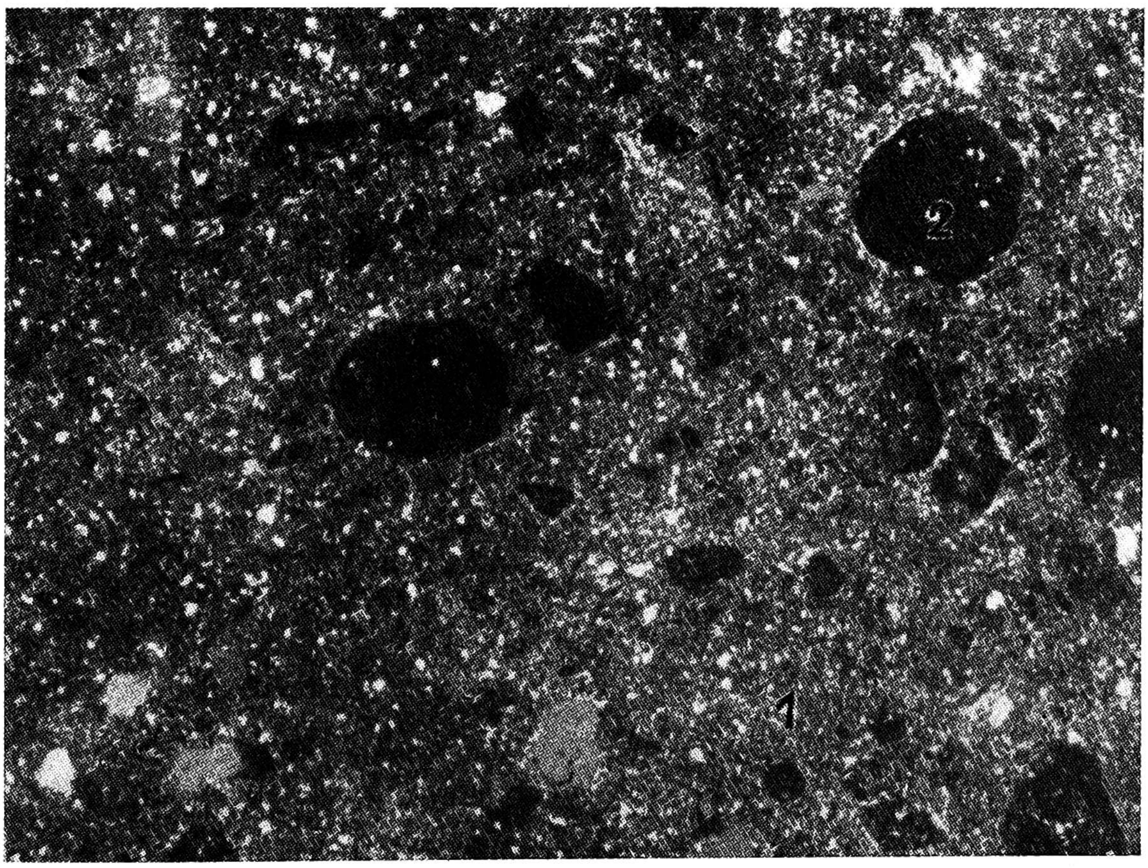

Fig. 3. Microfabric of the upper horizon of the Lenkoran geltozem. *1* — fibrous-scaly fabric, *2* — iron microconcretions, N +.

Sesquioxides are leached during the soil formation (Table 2). Iron is leached mainly at the expense of hydroxide forms without any disturbance of crystalline structures. This conclusion results from micromorphological observations, that had proved the predominance of hydroxide forms. A small amount of iron is leached at the expense of iron, weathered from iron-containing minerals.

The former notion "podzolization" for all the soils in question represents now an interrelated complex of processes — lessivage, leaching of R_2O_3 at the expense both of hydroxide forms and by weathering of primary minerals. More probable sources of R_2O_3 are the lattices of sec-

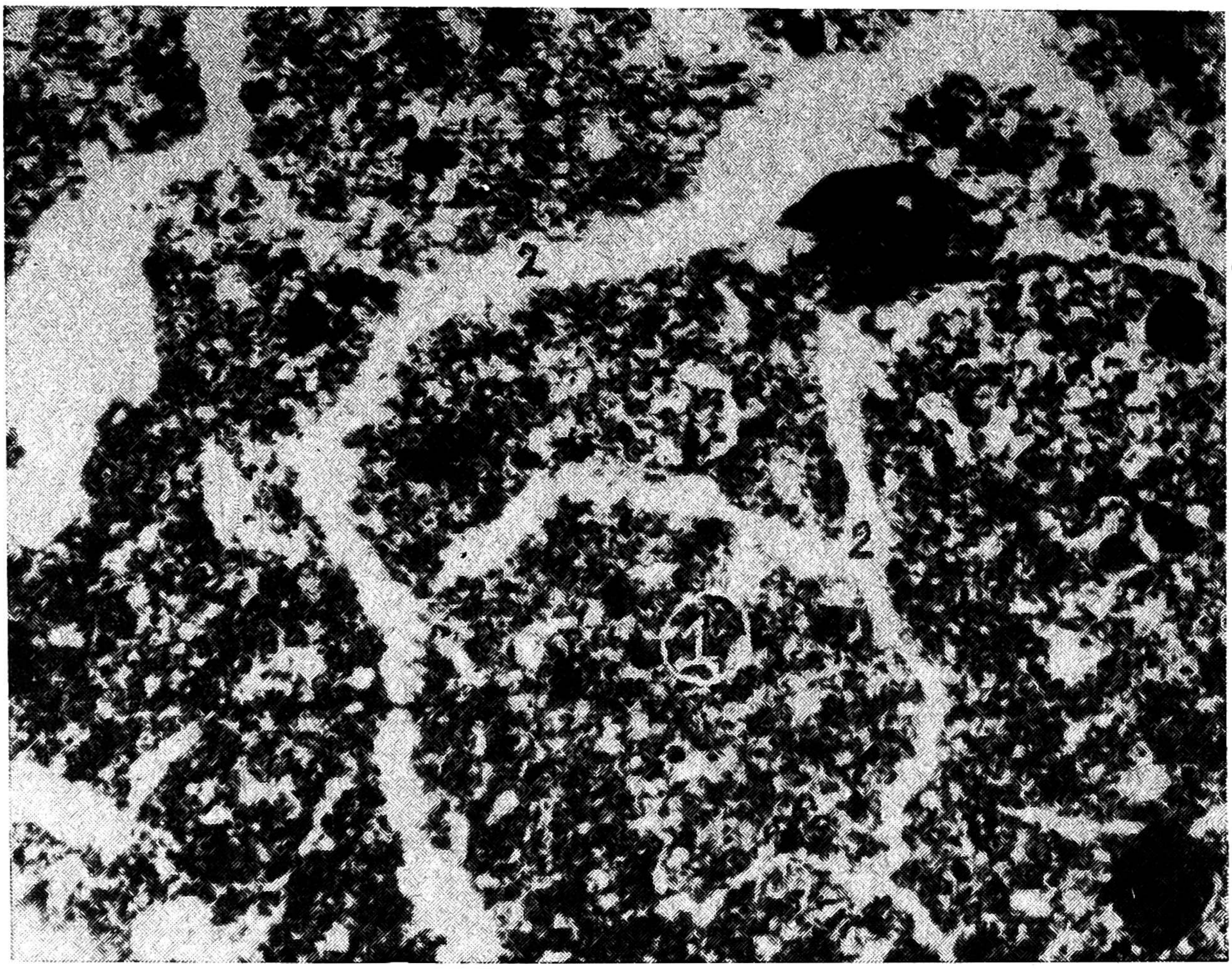

Fig. 4. Microfabric of the transitional B horizon. *1* — fragmentary patches, *2* — pores-fissures.

ondary minerals, where R_2O_3 are lost from the surfaces of weakness and, rather improbably, they result from the total decay of clay minerals (i.e. classical "podzolization").

The micromorphological investigations reveal some peculiarities in the geltozem fabric.

Humus horizons consist of highly dispersed clay with low birefringence and scaly-fibrous orientation, impregnated by humus (Fig. 3). It consists of large aggregates and of small faunal ones. Weakly decomposed plant tissues and dark brown organic cutans occur. Iron concentrations are frequent in form of rounded microconcretions, various flakes, skins on mineral grains and rock fragments, indistinct stains and diffusional rings. Skeletal grains may be abundant.

A specific feature of fabric of the B-horizon is the combination of parent rock and properly soil indices. Plasma is compact and highly oriented. Narrow small fissures divide it into large fragmentary micro-aggregates with rounded and angular pores. The clay matrix has a complicated and irregular fabric. Patches with a homogenous compact scaly-fibrous fabric are characteristic for the "reworking" by soil processes. Other patches have both scaly-fibrous orientation and net, cross or flow disposition of small and large bright optically oriented clay fibres and coatings, reflecting the unchanged structure of the parent rocks (Fig. 5), clays and shales. The orientation of clay matrix increases around pores, fissures, skeletal grains — fibrous films appear. The latter fact proves considerable moistening of the clay matrix during the year, favourable for its dispersion (with a consequent orientation) and also considerable "potential mobility". Occurrence of pathes, rather "leached" from fine earth proves again the ability of clay particles to move. One more proof are the coatings in the pores and fissures in the B horizon. The amount of iron microconcretions decreases considerably. Among the forms of iron concentration indistinct flakes, stains, diffusional rings and incrustations along the pores prevail. Humus is finely dispersed, linked with mineral particles, other forms are absent.

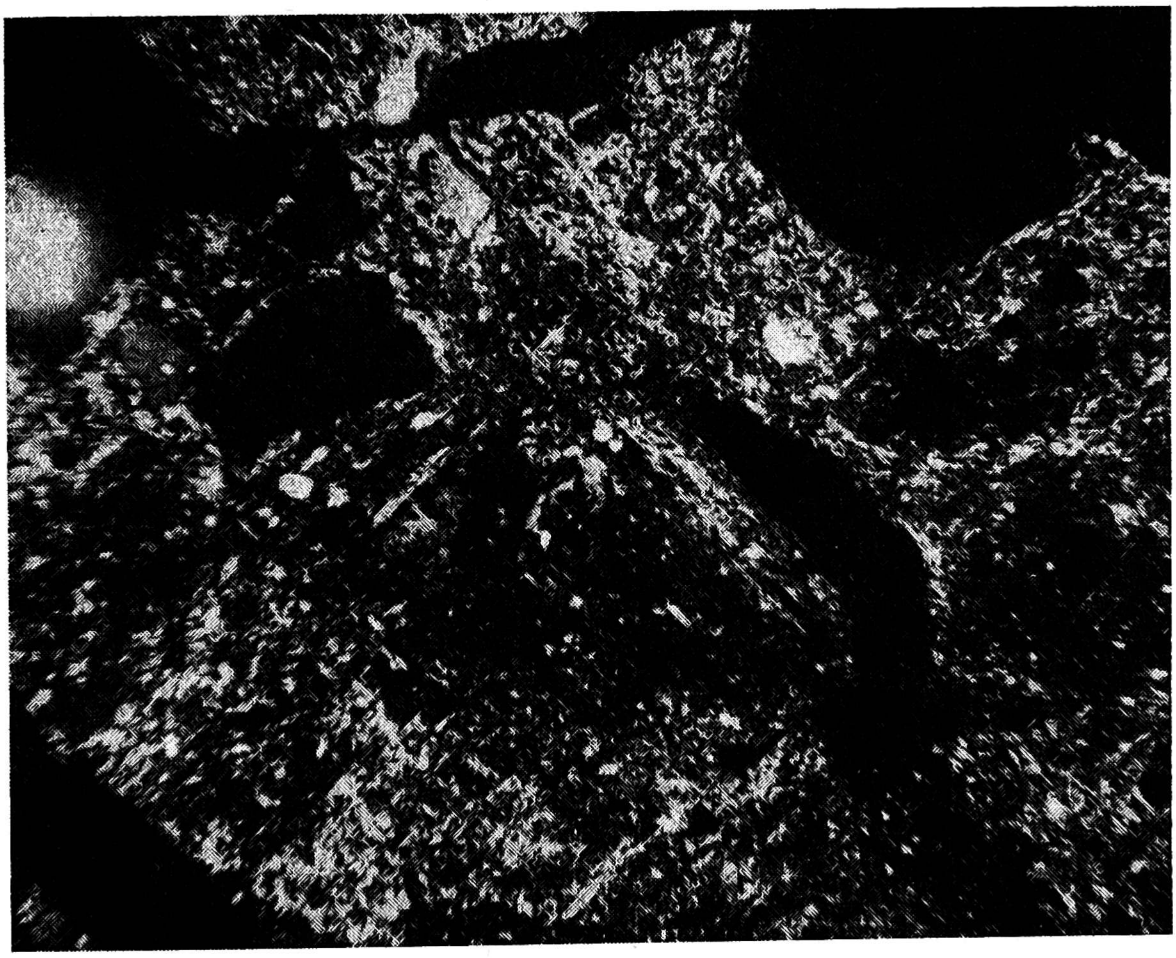

Fig. 5. A part of transitional B horizon with fabric, inherited from the parent rock, N +.

In the fabric of BC horizons the parent rock indices sharply increase. Here we find more patches with the initial rock fabric — strongly oriented clay and strong birefringence. The clay orientation increases especially along pores and fissures. The amount of coatings is the largest here, and sometimes stratification of iron and clay coatings may be stated. Forms of iron concentration are the same, as in the B horizon. The matrix is divided into large fragments, consisting mainly from clay, shales, clay minerals pseudomorphs on primary minerals.

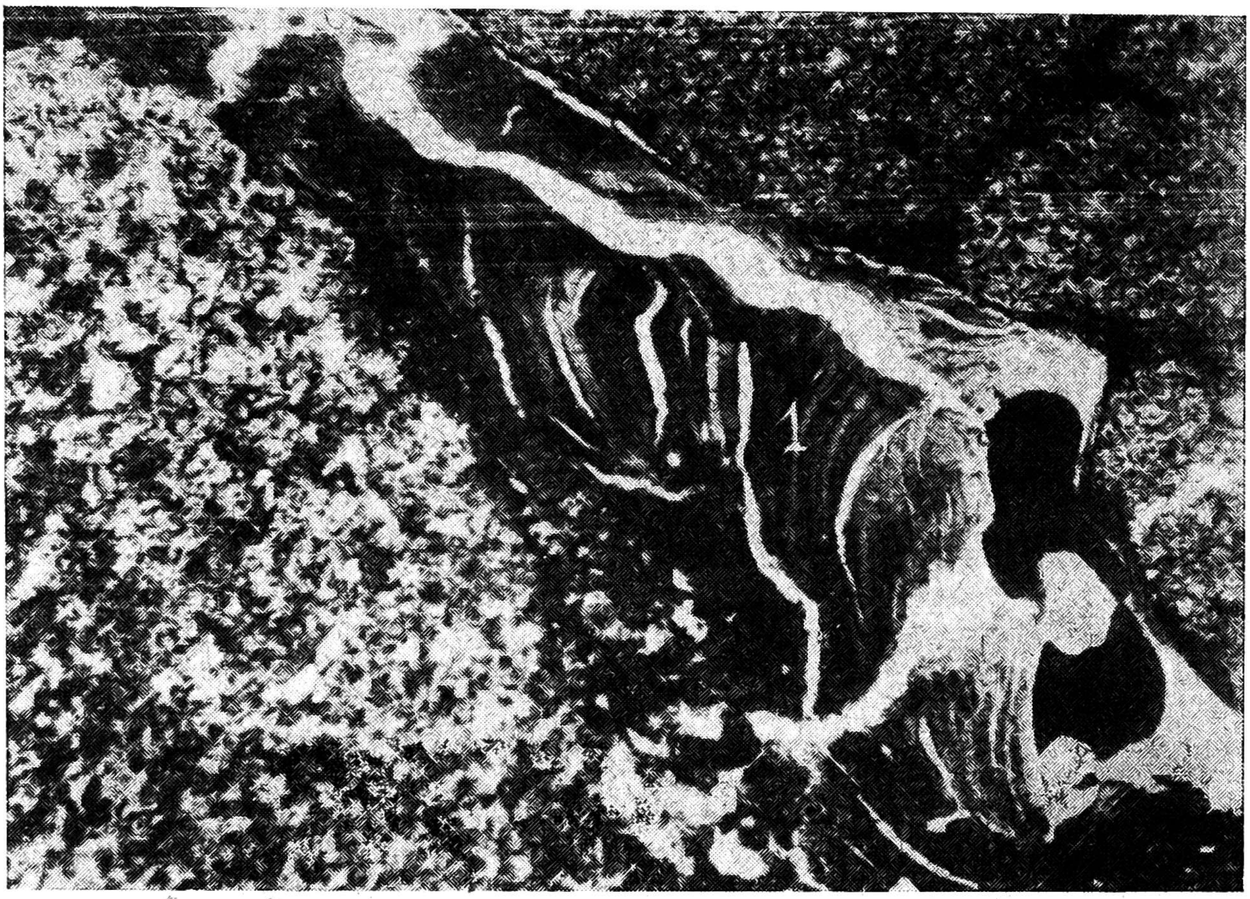

Fig. 6. Clay coatings in the rock fissures (I).

Parent rocks — clays and shales — are characterized by a compact fabric with a complicated scaly-fibrous orientation of clay, or, sometimes, flow-stratified. Iron individualizations are represented by bands or stains (dark brown flakes). In pores and fissures a considerable amount of sinters of optically oriented clay is observed (Fig. 6).

Main elements of sandstones' fabric are fragments of primary minerals (feldspars, pyroxenes, amphiboles, chlorites, clay aggregates of clay pseudomorphs on primary minerals).

So, the micromorphological investigations demonstrated a high degree of alteration of rock material in the pedogenetic processes. This alteration comprises dispersion and reorientation of the clay matrix, resulting in its homogenity in humus horizons. During the soil formation clay acquires mobility throughout the profile, and its leaching takes place in the humus and transitional horizons. Clay suspensions and colloidal solutions are partly retained in horizons B and C, and partly leached out with lateral flow. This conclusion results from the discrepancy of amounts of "leached from clay" patches in upper and intermediate horizons and of clay coatings in B and BC horizons.

The fact of existence of iron microconcretions proves the periodical reductive processes, especially in upper horizons.

We considered also the possibility of $CaCO_3$ formation in pedogenesis, supposed by many investigators. The micromorphological observations revealed $CaCO_3$ forms only in lower horizons of soils on calcareous rocks (calcareous shales and clays). These forms are sure to be inherited from the rocks. There are large fragments of primary calcite, frequently with clay coatings. Any secondary dispersed carbonates in pores and fissures or in the matrix, where they should have been observed first of all, if formed now, were absent.

During the soil formation leaching of the primary $CaCO_3$ develops, but the intensity of leaching is hindered by clay coatings on its fragments, together with the denudation, constantly rejuvenating the soil profile.

GENETIC AND CLASSIFICATIONAL POSITION OF GELTOZEMS AMONG THE SOILS OF THE HUMID SUBTROPICS OF THE U.S.S.R.

The Lenkoran geltozems occupy a quite specific place. We think they have much more rights to be distinguished as independent bioclimatic soil type.

Opposite to the soils of Western Georgia, the Lenkoran geltozem have fulvic-humic, or even humic type of humus formation, quite a different nature of secondary clays, and consequently, a specific type of absorption complex, which, together with peculiarities of fall off decomposition, accounts for the high degree of base saturation.

These properties result directly from the arid features in the climate of Lenkoran region and connect its soils with the soils of semiarid subtropics — the cinnamonic soils. The latter are known to have a humic organic matter, mainly montmorillonitic nature of secondary minerals and a complete base saturation.

On the other hand, the Lenkoran geltozems have more clearly pronounced features of pseudogley, lessivage and Fe_2O_3 migrations (according to micromorphology), than the krasnozems and geltozems of Western Georgia. It may be explained by an extreme seasonal (in autumn) extramoistening.

All the results of investigations of geltozems of Western Georgia and Lenkoran displayed rather complicated interrelations between the three main soil groups in the subtropics. First of all, geltozems of Western Georgia are similar to krasnozems for their properties and elementary processes. Both soils are very young, they have similar characteristics of acidity, base saturation, organic matter composition, R_2O_3 leaching, lessivage and pseudogley phenomena. The differences, concerning the degree of ferralitization, iron oxides hydratation, intensity of leaching, are due only to parent rock properties, inherited by soils.

The only difference between the krasnozems and geltozems is the higher base saturation in the humus horizons of the latter. These indications seem to be the only reflecting some bioclimatic differences.

Our data brought us to the conclusion, that the geltozems of Western Georgia are rather a variety of krasnozems, connected with certain parent rocks, i.e. the type of geltozems is a genetic, but not a bioclimatic one. This concept was suggested by Sabashvili [10], we tried to demonstrate it on larger materials.

So, due to peculiar bioclimatic conditions the Lenkoran geltozems display a combination of features, typical both for soils of humid and semiarid subtropics.

The Lenkoran geltozems, without any doubt, can not be distinguished only as a subtype of geltozems, they have enough indices to be regarded on the type level. We think the name "cinnamonic geltozems", given by Akimtzev [1] the most suitable for these soils. It reflects all their peculiarities and "contradictions". It indicates their double nature resulting from the climatic conditions. The winter and autumn are favourable for the creation of properties typical for the soils of humid subtropics, while the summer and spring facilitate the development "cinnamonic" properties.

At least, land use of the territories with geltozems proves our point of view. For successful growing of many crops, including tea and citruses, irrigation is necessary.

SUMMARY

Results of geographical, chemical, and especially of micromorphological investigations of the yellow earth (geltozems), observed in Western Georgia and South-Eastern Azerbaijan-Lenkoran district, were taken for their genetic characteristics as well as for precising their place in the group of humid subtropical soils of the U.S.S.R.

The main micromorphological feature suggest the necessary distinction of the semi-humid Lenkoran geltozems as an independent soil type, combining features both of typical geltozems and typical cinnamonic soils. The old name "cinnamonic geltozems" given by Akimtzev seems to be quite suitable for the Lenkoran yellow earths.

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