MIXED-LAYER PHYLLOSILICATES CHANGE IN TOP OF FOREST-STEPPE SOILS: PREFERENTIAL DECOMPOSITION OF AN EXPANSIBLE PHASE, ILLITIZATION OR EFFECT OF ORGANIC MATTER TIGHTLY BOUND TO INTERLAYERS?

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Humus substances and metastable secondary aluminosilicates are considered as a spatially structured open nonequilibrium reacting self-organizing system of clay-metal-organic soil complex; a special role of illite-smectite (illite-vermiculite) minerals is emphasized (Shinkarev et al., 2003). Modern concepts about transformation of clay minerals in the early diagenetic zone, late diagenetic zone, anchizone and epizone conditions are consistent enough. However mechanisms of transformation of mixed-layer phyllosilicates in a soil zone of the A horizon become recently more and more debatable. For example, some researchers consider that the increase proportion of illite component in upper part of a soil profile is caused by preferential decomposition of an expansible phase. According to other researchers, though there is some evidence that illite may form pedogenically, but only in special circumstances. Contrary to these points of view, as dominating forms of the transformation process in top of alteration soil profiles are considered both illite-to-smectite (simple "degradation" process) and smectite-to-illite (not fully understood "agradation" process). It is possible to admit (after Velde, Meunier, 2008), that the major difference, seen by laboratory identification methods in upper part of a soil profile is the interlayer site occupancy and that potassium fixation in closed (non-expandable) layers can be a reversible process in short periods of time. However in explanations mentioned above it is not taken into account that decrease in intensity of smectite basal diffractions can be caused by soil organic components tightly bound to interlayers.

Possibility of this effect was investigated in experiments with artificial clay-humus complexes (Гиниятуллин и др., 2006) and in profiles of forest-steppe soils in natural environments (Кринари и др., 2008). In samples with the size of particles <2.5 μm are investigated quantitative both quality characteristics of tightly bound organic matter and their interrelation with a mineralogy and real structure of clays. By complex of methods (the X-ray diffraction analysis, the thermogravimetry analysis combined with IR-Fourier spectrometry, the chromato-mass-spectrometry, the elemental organic analysis, the inductively coupled plasma–atomic emission spectroscopy and the laser diffraction method for particle-size distribution analysis) it is shown, that fixation of organic substance in forms resistant to H_2O_2 treatment is related to change of real structure of clay aggregates. At interaction of clay minerals with products of transformation of plant residues the organic-mineral complexes as composites are formed. Penetrating into slits between thin particles of layer silicates and probably, also between smectite layers, organic molecules output from diffraction a considerable part of crystalline substance, breaking a constancy and (or) plane-parallel arrangement of its interlayer distances.

Thus original organic-silicate compositions which can be carried to minerals with the hybrid structure disorder on an axis c* are formed. Remaining basically crystal phases, they can not bring the contribution to X-ray diffraction of the oriented preparations. It is found, that the quantitative estimations of a smectite phase performed by X-ray diffraction (Krinary et al., 2006) disagree with quantitative estimations performed by the adsorptive-luminescent analysis (Эйриш и др., 1975) not only in experimental, but also in soil samples. Formation organic-smectite complexes with hybrid structure, disorder on an c* axis, is the usual and universal mechanism of clay transformation at soil formation in the conditions of forest-steppe.

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Krinari G.A, Shinkarev A.A., Giniyatullin K.G. (2006) Mineralogy of the clay fraction of water-stable aggregates from dark gray forest soil // Euras. Soil Sci. V. 39, N 1. – P. 71-83.

Shinkarev A.A., Giniyatullin K.G., Krinari G.A, Gnevashev S.G. (2003) Systems approach to the study of clay–humus interactions in soils // Euras. Soil Sci. V.36, N 4. P. 430-438.

Velde B., Meunier A. (2008) The origin of clay minerals in soils and weathered rocks. Berlin Heidelberg: Springer-Verlag. 406 pp.