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WEATHERING OF GLAUCONITE IN A LUVISOL PROFILE FROM GORA PULAWSKA, POLAND

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Glauc onite is an iron-rich, dioctahedral, interlayer cation deficient mica commonly occurring in soils developed from sediments and sedimentary rocks. Generally in the course of soil weathering glauconite releases potassium and iron and transforms into other phyllosilicates. However, the exact mechanism of glauconite weathering appears to be poorly understood and only a few papers dealing with the issue are available. The aim of the research reported herein was to study the weathering of glauconite taking place in a Luvisol profile developed on quartz-glauc onite sand in Góra Puławska near Puławy (eastern Poland).

Basic soil properties were determined for the collected samples. Bulk soil material (i.e. <2 mm fraction), separated clay fractions (<2 μm and <0.2 μm), and glauconite pellets were analysed by X-ray diffractometry. The pellets and the fine clays were also analysed using Fourier transform infrared spectrometry and Mössbauer spectroscopy. Thin sections prepared from undisturbed soil materials were examined using optical microscope. Chemical composition of the fine clay and the pellets was analysed by energy dispersive spectrometry under scanning electron microscope.

The bulk soil material contains quartz, glauconite, glauconite-smectite mixed-layered minerals rich in smectite layers, and traces of feldspars. When compared with the parent material (the C horizon), the Bt1 and Bt2 horizons are enriched in clay minerals while the Ap, AEg, and E horizons are depleted in clays. The observed mineral distribution is most likely controlled by the weathering of clay minerals in the uppermost part of the profile and translocation of clay fractions down the profile (lessivage). However contamination with glaciofluvial and/or aeolian material has to be taken into consideration. According to the microscopic observations of the thin sections clay is present in the B/C and C horizons in the form of clay coatings and clay infilings. This indicates that initially the parent sand did not contain clay fraction. The fraction was formed most likely somewhere in the upper part of the soil profile and was deposited in the lower horizons by percolating atmospheric waters. Green pellets separated from all the soil horizons are composed of glauconite showing more or less uniform chemical composition, while clay fractions from all the horizons contain glauconite and glauconite-smectite. Fine clay fractions separated from Ap and AEg horizons are enriched in glauconite-smectite in relation to the fractions separated from the lower horizons. The presence of glauconite and glauconite-smectite minerals in the clay fractions studied indicates that glauconite weathering in the soil studied involves formation of glauconite clay by the pellets disintegration and glauconite smectitization. Ferrous iron constitutes only 6-7% of the total iron in the primary glauconite. This indicates that ferrous iron oxidation is not the main mechanism leading to the glauconite smectitization.
Because the smectite appears to be depleted in magnesium and total iron and enriched in aluminum and silicon when compared with primary glauconite, leaching of magnesium and iron together with possible reorganization of the structure appear to be the likely mechanisms for the glauconite smectitization.