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Clay minerals and micromorphological features of soils developed from carbonate-rich slope sediments in the Western Carpathians, South Poland

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Carbonate-rich slope deposits provide heterogenous substrate for soil development, where different distribution of calcium carbonate may force pathways of clay minerals formation and their transformation. We investigate four Luvisols (K1-K4) developed on such stratified materials, originated from the menilite shales in the Western Carpathians of southern Poland. Tracking the calcium carbonate forms and fixing it with the degree of clay illuviation we applied field and micromorphological approach. Based on field observations studied soils represents three types of calcium carbonate arrangement: i) carbonates were present in the whole solum (K2); ii) only lowermost horizons (BC and/or C horizons) were rich in the carbonates (K1 and K3) iii) carbonates were not present (K4).

Our results proved that calcium carbonate did not influence the transformation of the secondary phases. We did not note significant mineralogical differences in clays between calcium carbonate-rich soils (K1, K2, K3) and non-carbonate soil (K4). In both analyzed clay fractions (<2 μm and <0.2 μm) from soil samples and menilite shales mica (illite), kaolinite, chlorite and quartz occurred. Also, hydroxy interlayer vermiculite (HIV) and the mixed layered clay minerals such as mica HIS/mica HIV and chlorite-smectite have been identified. Furthermore, in soil samples, besides the occurrence of above mention phases, the minerals such as mixed layer mica-HIV and mixed layered mica-smectite have been noted.

Despite the fact that in this study the qualitative composition of clay mineral fraction did not indicate significant differences in clay mineralogy, causes of such conditions should be specified and highlighted. Layering in such soils did not modified direction of clays transformation, rather soil mixing during formation of slope sediments play a role in the homogenization of secondary phases. Furthermore, strong weathering of menilite shale fragments provide uniform initial substrate for any transformations. Micromorphological analysis confirms various forms of clay translocation e.g. quasi- and hypocoatings, pendent coatings, capping coatings and crescent coating, in argic horizon but also in under and overlaying horizons. We deduce therefore rather short-range clay translocation among horizons, that did not affect the clay mineralogy in typical way as for the standard Luvisols.