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Clay mineralogy of Vertisols with aeolian and glacial admixture in SW Poland

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Introduction

Vertisol formation is strictly related to lithology and clay-rich Neogene and Quaternary deposits. They are widely distributed from Europe through North America, Australia, northern and central Africa till Asia and are easily detectable due to shrink-swell phenomena. Although they usually have a clay texture and are dominant in the clay swelling phases their mineralogy might be modified due to the contribution of substrates of different origins (e. g. loess, glacial tills or sands) and thus affect the expression of morphological features important for their recognition.

Thus, we aimed to evaluate the clay mineralogy of such clay-rich soils (Podlech 2022).

Study area

We selected two soil profiles developed from Neogene clays and clay loams located on arable land near Dobrogoszcz village at the foot of the Niemczańsko-Strzelińskie Hills (Lower Silesia, SW Poland) revealing morphological features for Vertisols (Pelosols) (IUSS Working Group WRB 2022) (Fig. 1) and significant additions of glacial tills and Vistulian loess.

Methods

The mineralogical composition of the selected samples was determined by X-ray diffraction analysis (XRD) using a Bruker D8 Advance θ–θ diffractometer with Fe-filtered CoKα radiation (40 kV, 30 mA). The diffractometer was equipped with a 0.5° divergence slit and a 1D LynxEye detector. Scans

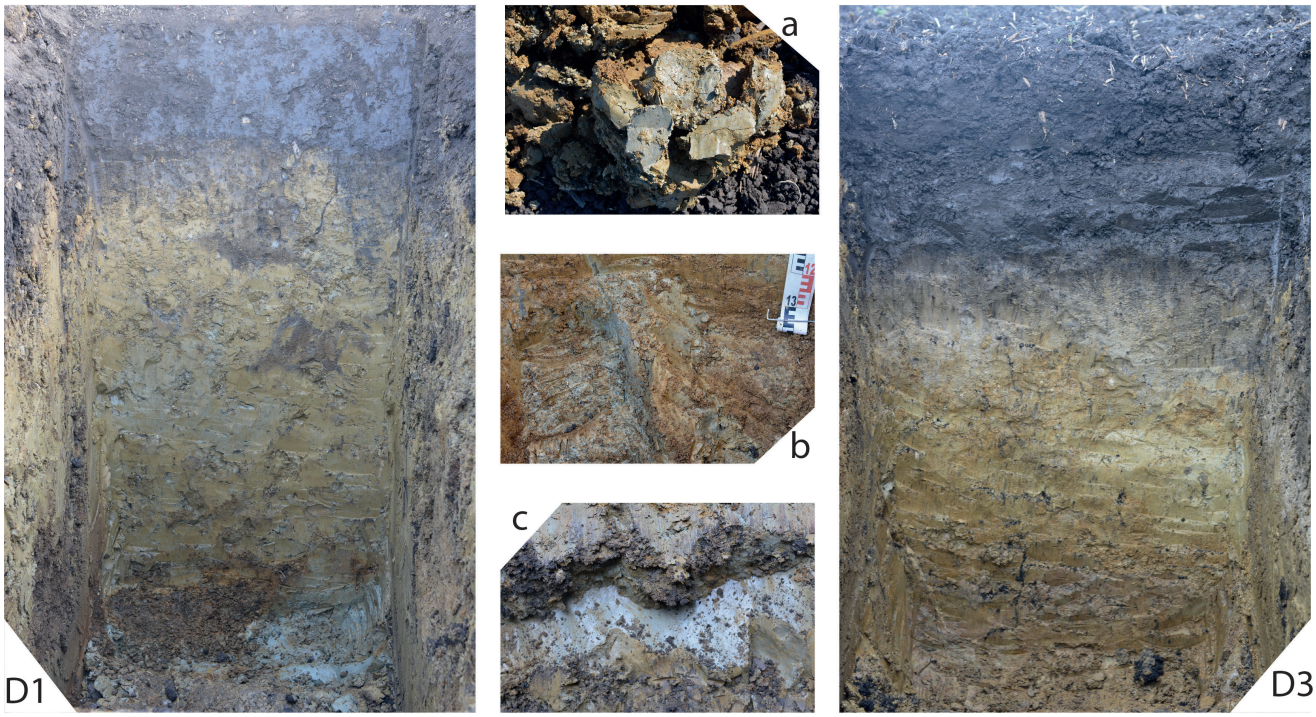

Fig. 1: Soil profiles D1 and D3 with typical Vertisols features: a, c – smooth and shiny surfaces, slickensides; b – close narrow cracks

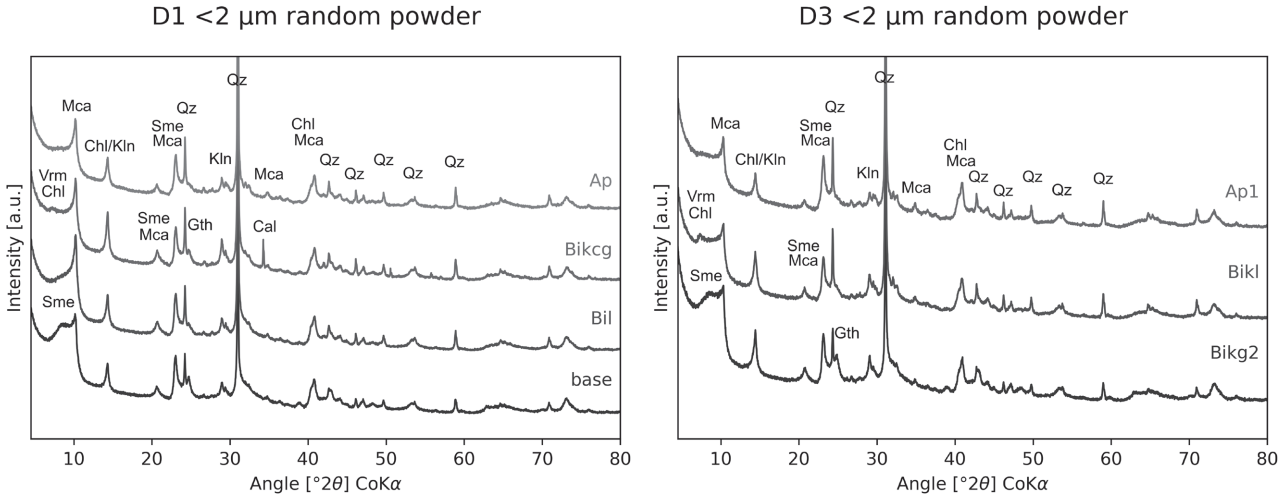

Fig. 2: XRD pattern of random powder preparations for soil profiles D1 and D3. Gth – goethite; Qz – quartz; Chl – chlorite; Kln – kaolinite; Mca – mica; Sme – smectite; Vrm – vermiculite (IMA-CNMNC approved mineral symbols after WARR 2021).

were collected between 4° and 80° 2θ for side-loaded randomly oriented powders (scanning rate 1° 2θ/min) and between 4° and 40° 2θ for oriented aggregates to determine the clay mineral composition (Moore & Reynolds 1997). The qualitative mineralogical analysis was performed according to Brindley & Brown (1980) and Whittig & Allardice (1986) using the Diffracplus eva 2 Version 14.0 (Bruker-AXS) software.

Results and discussion

In the subsoil (heavy clay texture) of both profiles, clay minerals, especially smectites, were detected as dominant phases (Fig. 2). While the proportion of accessory minerals increases, clay minerals occur as mixed layered phases (mica-smectite, vermiculite-chlorite), while mica, kaolinite and chlorite-mica phases predominate in the topsoil. As a result, shrinkage phenomena are less pronounced here.

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