CLAY MINERALOGY OF QUATERNARY LOESS–PALEOSOL SECTIONS AT BEREMEND AND PAKS, HUNGARY: A COMPARATIVE STUDY

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In this study, mineralogical composition of loess and paleosol samples collected from Beremend (SE Transdanubia, Villány Hills; 25 samples) and Paks (mid-Hungary, next to the right bank of the Danube River; 64 samples) sections were analyzed. Both sections represent partly the Old Loess Series (OLS; MIS 11–17? and 11–22, respectively) and partly the Young Loess Series (YLS; MIS 5–7? and 2–10, respectively) exposing four and ten paleosol layers, respectively. In the Beremend section, unconformities among sediments appear to be common.

The bulk mineral composition of sediments estimated from XRD data indicates that quartz, smectite (sme), and carbonate minerals (calcite and dolomite) are the dominant minerals in both studied sections. Illitic material (ill) with chlorite (chl) is present in all samples but usually in small proportion. Albite, K-feldspar, and kaolinite are the typical minor components with amorphous material. The bulk carbonate content of the YLS sediments is tendentiously higher than those of the OLS samples. Furthermore, the YLS loess samples of the Paks section are especially rich in dolomite (up to 25%). On the other hand, in the Beremend samples, goethite is also a frequent constituent but it is almost totally absent in the Paks section where sediments usually contain only a detectable amount of amphibole. The paleosol samples can be characterized by a smectite-dominance (Beremend: 30–60%; Paks: 10–40%) compared to loess samples (Beremend: 10–40%; Paks: 0–30%) which contain higher amounts of illite. Interestingly, in the loess samples from the Paks YLS, smectite can not be detected. Both sections show no systematic variation in kaolinite content.

ATR-FTIR observations on bulk rock specimens (11 samples from Beremend and 17 samples from Paks) support the qualitative mineralogical compositions determined by XRD measurements. Additionally, infrared spectra of samples show characteristic changes in the integrated areas, band positions and intensity for both locations. The integrated area of water and hydroxyl stretchings, i.e. the absorption band between 2800 and 3750 cm^{-1}, is usually larger for paleosol samples than loess samples. This is also true for the bending band of water which can confirm the higher swelling clay mineral content of the paleosol samples. These parameters are well correlated indicating that they are closely related. The detected water could only be derived from swelling clays due to the sample preparation which dried off adsorbed water. Characteristics of the IR bands at ~3620 and ~3400–3430 cm^{-1} in clays appear to indicate the dominance of aluminum in the octahedral layer and the presence of Na and Ca in the interlayer space. These observations are based on similarities to known standards, therefore, should be handled with precaution at this stage.

Paleoproxy indicators, based on semi-quantitative XRD data, such as sme/ill and sme/(ill+chl) ratios also show systematic variations with lithology. These ratios in paleosols show higher values than in loess samples. Furthermore, in the lower part of the Paks section (OLS), the sme/ill and sme/(ill+chl) ratios in paleosols are significantly higher than in YLS fossil soils. Changes in bulk kao/ill ratio show significant differences between the Beremend paleosol (bulk kao/ill > 1) and loess (bulk kao/ill < 1) samples. The same pattern related to lithology is apparent in the bulk kao/ill ratio for the Paks samples; however, all values remain below 1.

The relatively high sme/ill and sme/(ill+chl) ratios observed in paleosols, could suggest a strengthened chemical weathering and weak physical erosion. By contrast, lower ratios in loesses could indicate intensified physical erosion and weakened chemical weathering. Decreasing values of mineralogical proxy indicators from the OLS to the YLS, especially in the Beremend section, highlight the superimposed effects of climate and tectonism on the Danube loess. Additionally, the observed variations between the two sections can be regarded as a result of differences either in the provenance or in the paleoenvironmental history.

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