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Macro-, micro- and nanoscale analysis of secondary carbonates

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The primary carbonate content of the loess derives from the CaCO3 and CaMg(CO3)2 minerals sedimented contemporaneously with the dust, the secondary carbonates originate from the vertical, horizontal or in situ resettlement of the carbonates. In these processes biomineralization and the flow of bicarbonate solutions play a great role.
The simultaneous macro-, micro- and nanoscale studies of the distribution and amount of the various types of secondary carbonates help to indicate different paleoenvironment and postdepositional alterations. Besides the interpretation of environmental signals morphological analysis was made on secondary carbonates from the loess-paleosoil sequence of Süttő, which is the most complete and most detailed studied profile in Hungary.
The carbonate concretions (e.g. loess dolls) are classified into the macroscale category. The outer shape of the loess dolls were described and the inner structure was determined by experiments with 10% HCl and cutting into parts.
Among others the hypocoatings, calcified root cells and needle-fiber calcite belong to the microscale category.The microscale features were investigated in thin sections and analysed after wet sieving of bulk samples under an optical microscope and some chosen samples under micro- and for more detailed picture nanoscale resolution scanning electron microscope as well.
The study of oriented thin sections from the paleosoil and loess horizons shows the vertical and horizontal distribution of the soil features, among them the distribution and amount of the different types of secondary carbonates, and their related distribution to the others. It also provided information on those secondary carbonates which are not separable from the material such as the earthworm biospheroids, which are important indicators of the former carbonate rich environment in leached sediment and their disturbance is indicative of the reworking of the material. The occurrences of the secondary carbonates have often uneven distribution in the matrix, varied concentrations are recognizable e.g. in relation to biogalleries or bioturbated structures.
The nanoscale analysis gave more circumstantial data for the origin and evolution of microscale secondary carbononates. Thanks to our SEM/FIB instrument (FEI Quanta 3D) it is possible to see the change of the element content in cross-section of these carbonates. Focused Ion Beam (FIB) allowed to obtain information below the surface and Energy-dispersive X-ray spectroscopy (EDS) used for the elemental analysis (chemical characterization) of the samples to the whole section.
The results gained by the different scale of investigation from the loess-paleosoil sequence of Süttő supports the results of other methods such as malacology, sedimentology and aminoacid stratigraphy (AAR).