

Origin of pedogenic needle-fiber calcite revealed by micromorphology and stable isotope composition — a case study of a Quaternary paleosol from Hungary

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Abstract

Pedogenic needle-fiber calcite was studied regarding its morphology, texture and stable isotope composition from the paleosol of the Quaternary Várhegy travertine (Budapest, Hungary). The needle-fiber calcite is composed of 40–200 μm long monocrystals. Smooth rods as well as serrated-edged crystals with calcite overgrowths were identified by SEM. Needles have several textural varieties: randomly distributed crystals in vugs and pores with calcite hypocoatings, bundles of subparallel crystals forming coatings around grains and alveolar structure with bridging needles in vugs.

The morphological study of needle-fiber calcite suggests that needles are calcified fungal sheaths and produced by fungal biomineralization, a common process in recent and fossil soils and calcretes. The stable isotope composition of needle-fiber calcite (average: $\delta^{18}\text{O} = -7.1\text{‰}$ and $\delta^{13}\text{C} = -7.3\text{‰}$ vs. V-PDB) indicates significant incorporation of organically derived CO_2 and probably biological influence on needle genesis. Dissolved host rock travertine and/or atmospheric CO_2 could also contribute some carbon to the acicular calcite.

Keywords: Needle-fiber calcite; Pedogenic carbonate; Paleosol; Biomineralization; Micromorphology; Alveolar texture; Stable isotope; Fungi; Travertine; Quaternary

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