

Hydroxyapatite formation in *Cenococcum geophilum* sclerotia from steppe forest soils in Mongolia

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Cenococcum geophilum is one of the most worldwide encountered ectomycorrhizal fungi species, that often dominates in forests ^[1]. Under certain environmental stresses, such as desiccation, *C. geophilum* forms abundant spherical black sclerotia, which are formed by the hardening of mycelia to a black spherical compact mass ^[2]. Many ectomycorrhizal fungi able to produce organic acids may be related to their ability to solubilize minerals, converting them into oxalates that are precipitated among fungal mycelia ^[3]. The melanized sclerotia collected from Kastanozems of Mongolian steppe forest have been identified as *C. geophilum* based on similarities in the ITS1-5.8S-ITS2 region, and the mean residual time of the sclerotia in soil was estimated as approximately 40 years by AMS ¹⁴C/¹²C measurement ^[4]. *C. geophilum* sclerotia may have ability to survive broad pH environment. Higher concentration of Ca in sclerotia was confirmed by ICP-OES analysis in higher pH soils (5.9-7.5). Coexistence of Ca and P in cell compartments with a concentric distribution was observed for sclerotia samples by scanning electron microscope-energy dispersive X-ray spectrometry analysis. The Ca/P molar ratio and micromorphological features suggested biomineralization process of hydroxyapatite formation in slightly alkaline soils, which could be related to Ca and P sequestration in forest ecosystem in semi-arid area.

Keywords: *C. geophilum* sclerotia, hydroxyapatite, steppe-forest ecotone

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