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Exploring the control of earthworm cast macro- and micro-scale features on soil organic carbon mineralisation across species and ecological categories

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The role of earthworms on biogeochemical carbon cycling is a major knowledge gap resulting from the difficulty of isolating and exploring the effects provided by the diversity of organisms. In this study, we investigated the effect of six earthworm species belonging to three ecological categories on soil organic carbon (SOC) mineralisation. To this end, we produced casts with the six species using subsoil material with low SOC content and miscanthus litter. Cast were subjected to laboratory ageing for 140 days. During this process, we monitored physicochemical parameters, CO_2 emissions and determined the micro-scale organisation of the casts' particulate organic matter and pores using X-ray tomography.

Our results showed contrasting properties of fresh casts from the 3 main ecological categories, in accordance with the earthworm species' morphological or behavioral strategies, indicating that those were maintained in artificial environments. However, species-specific changes in cast properties throughout ageing increased intragroup variability among ecological categories. As a result we observed earthworm species-specific evolution of CO_2 mineralisation rates during casts ageing. We found that at least half of the variability in CO_2 emissions was explained by cast microstructural changes, related to the spatial arrangement between particulate organic matter, porosity, and mineral particles. We conclude that earthworm species-specific traits may play a role in organic carbon protection through their impact on microstructural cast properties.