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1 The added value of soil organic matter pyrolysates to the interpretation of radiocarbon dating of humic soil horizons.

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Late glacial aeolian coversand dominates the surface geology of the eastern part of the province Noord-Brabant (Netherlands). During prehistoric and early historic time, forest grazing and shifting cultivation gradually transformed natural forest into heath land. Subsequently the use of the heath for the production of organic manure during the period of plaggen agriculture (from early Middle Ages to the invention of chemical fertilizers around 1900 AD) initiated sand drifting and locally modified the coversand landscape into a driftsand landscape with characteristic new landforms and soils. Interesting elements in these cultural landscapes are polycyclic driftsand deposits, geo-ecological records of alternating instable and stable phases in landscape development.

Interpretation of geo-ecological information, derived from these records, requires application of dating techniques. Traditionally radiocarbon dating was applied to humic horizons of buried soils. A chronological framework, based on radiocarbon ages, was designed to date events as driftsand deposition, tumulus deposition and the rise of fimic horizons in cultural landscapes. More recently the technique of Optical Stimulating Luminescence (OSL) dating was introduced. OSL dating was applied to well bleached quartz grains, extracted from samples of previous radiocarbon dated profiles.

The OSL ages are not in line with the results of radiocarbon dating. In general, OSL ages of minerals from the AE horizon of buried micropodzols and fimic horizons are younger than the radiocarbon ages of the extractions of soil organic matter from the same horizon. The OSL ages of minerals from driftsand deposits on buried podzols can be older than radiocarbon ages of soil organic matter, extracted from buried Ah and Bh horizons.

A first evaluation of the reliability of radiocarbon dates of soil organic matter extractions can be based on soil micromorphology. Analyses of thin sections of buried micrpodzols point to a mixture of contrasting compounds in the fabric of the humus form. A part of the organic matter is post-sedimentary, originated from the accumulation and decomposition of litter from the local vegetation during the phase of soil development. But the concentrations of sin-sedimentary charcoal particles and humic aggregates, originating from eroded older humic horizons in the surroundings, are reasonably. The result of the mixture of sin-sedimentary and post-sedimentary soil organic matter explains the older radiocarbon ages. Analyses of thin sections of humic horizons of buried podzols show correct distributions of soil organic matter. Intertextic distributed organic aggregates in the Ah, humic cutans in the Bh horizon. There is no evidence of a mixture of compounds, explaining the relative young radiocarbon ages.

Pyrolysis of extracted soil organic matter provide useful additional information to understand the contrast between OSL and radiocarbon ages in polycyclic sequences with buried podzols. The chromatograms of Ah and Bh horizons of buried podzols show that the chemical composition of the organic extraction is dominated by root-derived compounds rather than aboveground litter-derived compound. These observations point to an unexpected process in buried podzols. The micromorphology of organic matter in buried Ah and Bh horizons is undisturbed, but aboveground derived compounds are in the organic fabric replaced by root derived compounds.

The information from pyrolysates of organic matter explains the underestimating of age by radiocarbon dating. Compared with OSL ages, radiocarbon dates are less reliable for the design the chronological framework for the development of sandy cultural landscapes.