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Validation of OSL and 14C dating of initial soils in Late-Holocene polycyclic drift-sand deposits (Weerterbergen, S.E. Netherlands)

Dr. J.M. van mourik (1), Drs. M.L.M Schilder (2), and Dr. J. Wallinga (3)

(1) University of Amsterdam, IBED-P&L, Amsterdam, The Netherlands (j.m.vanmourik@uva.nl), (2) University of Amsterdam, IBED-P&L, Amsterdam, The Netherlands , (3) Technical University Delft, NCL, Netherlands.

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, wood cutting 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) resulted in the comeback of sand drifting and locally the coversand landscape transformed into a driftsand landscape with characteristic new landforms and soils. Polycyclic driftsand deposits are paleoecological records of alternating instable (sand drifting) and stable (soil formation) phases in landscape development.

Interpretation of paleoecological information, derived from these records, requires accurate knowledge of the geochronology. Traditionally radiocarbon dating was applied on SOM (soil organic matter), extracted from humic AE horizons of buried initial soils (micropodzols), developed in driftsand beds.

In polycyclic driftsand sequences, micropozols indicate a stable period in landscape development. One of the research questions in driftsand landscapes was related to the distribution and age of micropodzols: Are they the result of just local or more regional events in landscape evolution? The calibrated 14C ages of seven selected of extracted humic acids of micropozols range from 340 – 1950 AD. Based on these results, the alternation of instable and stable periods in landscape development seems to be controlled by local events.

But to understand the development of polycyclic sequences, we need more information than just the 14C ages of micropodzols. Every cycle of a polycyclic sequence reflects a period of landscape instability (deposition) and landscape stability (soil development). A 14C based chronological framework does not allow the indicate the available time for deposition and for soil formation.

Micromorphological analysis of thin sections of micropodzols provide more information about the composition of SOM of the humic horizons. SOM consists of post sedimentary compounds, related to soil formation. We can identify soil fungi, fragmented litter and fecal pellets as the results of litter decomposition. But SOM contains also sin sedimentary compounds, related to sand drifting. We can identify transported and rounded organic aggregates, mineral grains with organic cutans and charcoal fragments, originating from eroded (older) soil horizons. Consequently, the 14C dates of extracted SOM are not reliable.

Recently the optical stimulated luminescence (OSL) dating technique was introduced in earth science. OSL dating works excellent for aeolian sandy deposits with a high percentage of quartz grains. The OSL age is defined as the time after the last bleaching by solar radiation of mineral grains. In contrast to 14C dating, application of OSL dating provides accurate information over the age of top and bottom of deposited sand beds and consequently over the time, available for soil development. Based on OSL dates, the micropodzols developed between 1700 and 1900 AD. Application of OSL dating improves the knowledge of geochronology of polycyclic driftsand sequences in cultural sandy landscapes.