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Carbon cycling in polycyclic driftsand sequences

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Polycyclic driftsand sequences are a common soil type in The Netherlands related to historic plaggen agriculture, where heath sods were seasonally removed from sandy soils to fertilize adjacent fields upon mixing with animal manure. When sods were removed too rigorously, this led to instable periods with sand drifting. These were alternated by stable periods with soil formation (initial podzols). Polycyclic sequences such as these are valuable geoecological records that contain important soil archives used for landscape evolution studies. Proxies commonly used for this purpose are fossil pollen analysis and 14C dating. We recently combined the mentioned proxies with OSL dating and biomarker analysis in a landscape evolution study in a typical polycyclic driftsand deposit in The Netherlands. For biomarker analysis we used the VERHIB model that we recently developed to unravel preserved biomarker patterns (n-alkanes and n-alcohols) in soils or sediments into their plant species-specific origin [1]. We discovered that the combination of proxies not only yielded information about landscape evolution, but also about carbon cycling in the soils in question. OSL dating yielded the age of the initial deposition of the driftsand. Therefore, the observed difference with the 14C derived age of various organic matter fractions at the same depth in a profile provided initial clues about soil organic carbon input and turnover [2]. We found that such information could be expanded through application of the VERHIB model. The leaves and roots of plant species have distinctly different biomarker patterns that are both considered by the model; it uses the root to leaf input ratio as well as rooting depth as explicit parameters [2]. We found that when VERHIB modeling results were related to the fossil pollen based vegetation reconstruction from the same driftsand sequence, information could be obtained about the relative input of root material vs. leaf material. Therefore, a multi-proxy approach where biomarker analysis in combination with VERHIB modeling, fossil pollen analysis and 14C and OSL dating are combined, offer great opportunities to gain information about carbon cycling in driftsand deposits showing an important role for root input. And potentially also for the adjacent plaggen soils, which is very significant given the great stabilization of organic carbon in the latter, the mechanisms of which are still unclear.

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[2] J. Van Mourik, K.G.J. Nierop, D.A.G. Vandenberghe, 2010. Catena, 80: 170-181.