

## **The added value of biomarker analysis to the genesis of Plaggic Anthrosols; the identification of stable fillings used for the production of plaggic manure.**

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Plaggic Anthrosols are the result of historical forms of land management in cultural landscapes on chemically poor sandy substrates. Application of plaggic manure was responsible for the development of the plaggic horizons of these agricultural soils. Pollen diagrams reflect aspects of the environmental development but the interpretation of the pollen spectra is complicated due to the mix of the aeolian pollen influx of crop species and species in the surroundings, and of pollen occurring in the used stable fillings. Pollen diagrams and radiocarbon dates of plaggic Anthrosols suggested a development period of more than a millennium. *Calluna* is present in almost all the pollen spectra, indicating the presence of heath in the landscape during the whole period of soil development. Optically stimulated luminescence dating of the plaggic horizon made clear that the deposition of plaggic covers started in the 16th century and accelerated in the 18th century. The stable fillings, used for the production of plaggic manure and responsible for the rise of the soil surface, cannot be identified with pollen diagrams alone. Biomarker analyses provide more evidence about the sources of stable fillings. The oldest biomarker spectra of the plaggic horizons of three typical plaggic Anthrosols examined in this study, were dominated by biomarkers of forests species as *Quercus* and *Betula* while the spectra of middle part of the plaggic horizons were dominated by biomarkers of stem tissue of crop species as *Secale* and *Avena*. Only the youngest spectra of the plaggic horizons were dominated by biomarkers of *Calluna*. This indicates that the use of heath sods as stable filling was most likely introduced late in the development of the Anthrosols. Before the 18th century the mineral component in plaggic manure cannot be explained by the use of (dry) heath sods. We conclude that other sources of materials, containing mineral grains must have been responsible for the raise of the plaggic horizon.