Geophysical Research Abstracts
Vol. 15, EGU2013-13877, 2013
EGU General Assembly 2013

Consistency of plant specific n-alkane patterns in plaggen ecosystems

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Plaggen soils are an important soil type in north-western Europe that were formed by input of various vegetational sources during century-long plaggen (i.e. sod) application. This resulted in remarkably stable organic matter that appears to persists in spite of abandonment of large scale plaggen agriculture with the advent of artificial fertilizers in the early 20th century. Molecular characterization of the organic matter stored in plaggen soils, and in particular linkage to specific vegetation sources, could provide insight in yet poorly understood stabilization mechanisms and the fate of organic matter with ongoing land use change. Plant derived n-alkanes with chain-lenghts of 20-36 carbon atoms are usually well preserved in plaggen soils and could serve as important biomarkers for this purpose.

Source appointment in plaggen soils is based on the use of concentration patterns of preserved n-alkanes with modern vegetation sources functioning as proxies. A crucial prerequisite is that patterns as observed in relevant present-day vegetation are representative and consistent. While this is generally assumed, to our knowledge it was never explicitly tested for plaggen soils. Therefore, we evaluated published n-alkane patterns of plant species and parts representative of past and current input to plaggen soils. We analyzed distribution patterns showing relative abundances in chain-length range C17-36 for various shrub, tree and grass species. Here we present and discuss the published n-alkane patterns in detail. We attempt to link variation in observed patterns to potential (systematic) sources such as geographical, temporal and methodological variations.

Published distribution patterns derive from a variety of studies, characterized by differing laboratory techniques, environmental conditions etc. In spite of a surprisingly concise set of published n-alkane patterns, along with considerable scatter in the analyzed data, we did find meaningful clustering of n-alkanes allowing for clear distinction of input by shrubs, trees and grasses to plaggen soils. Indications of systematic variation were observed for ontogeny and according to spatial conditions among tree species, while effects by other variation sources were less pronounced. Our results emphasize the need for further extension and systematic clustering of available data on plant derived n-alkanes. Concurrently, they highlight that application of n-alkane biomarkers in paleo-environmental reconstructions of plaggen soils is challenging, but not prevented a-priori.