A new biomarker aproach to reconstruct past vegetation patterns

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We developed a new biomarker approach to reconstruct past vegetation dynamics and applied it to reconstruct shifts in upper forest line positions in the Ecuadorian Andes in the last 6000 years BP [1, 2].

The approach is based on plant-specific concentration patterns of *n*-alkanes and *n*-alcohols with chain-lengths of 20-36 carbon atoms originating from the epicuticular wax layers on leaves and roots of terrestrial higher plants and preserved in sediments or soils. Unique concentration ratios of several lipids of different chain-lengths are species-specific, and not the individual lipids themselves. As a result until now progress was hampered by the lack of a suitable method to unravel the mixture of lipids of various chain-lengths in peat sediments or soils into the species-specific concentration ratios.

We first constructed a biomarker database for dominant present-day vegetation in the Ecuadorian study area, and established that in most cases biomarker based separation was possible at the species level [1]. To enable interpretation of the mixed biomarker signal, we subsequently developed the VERHIB model: a constrained linear regression model that describes how vegetation development over time at a certain location results in accumulation of biomarkers in a suitable archive [2]. Paleo-vegetation is reconstructed from the accumulated biomarker signal by inverting the forward model.

After successful testing with artificial data and various levels of added noise, VERHIB was applied to reconstruct vegetation from a peat sediment core from the Ecuadorian setting. Combined with pollen data from the same core, the new method gave a vegetation reconstruction with high spatial resolution and level of separation, far beyond that obtainable by pollen analysis alone [2]. This allowed us to reconstruct the natural upper forest line position in the northern Ecuadorian Andes and thereby guide sustainable reforestation efforts in this area.

[1] Jansen *et al*. (2006) *Org. Geochem*. **37**, 1514–1536.
[2] Jansen *et al*. (2010) *Palaeogeog. Palaeocl*. **385**, 119–130.

Impact of mobile-immobile water domains on the retention of Technetium (^{99}Tc) in unsaturated soils

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The transport of technetium (^{99}Tc), is of interest due to the potential for human exposure and impact on ecosystems. Technetium has been released to the environment through nuclear weapons testing, nuclear power production, and nuclear fuel reprocessing; as a result, ^{99}Tc is a predominant risk driver at DOE sites across the US. The current body of work conducted on ^{99}Tc has provided a wealth of information regarding the redox relationship and stability of the mineral phases, however little work has been conducted on the physical transport of the pertechnetate oxyanion in the subsurface. Current conceptual models do not explain the persistence and presence of the anion in deep vadose zone environments such as the Hanford site. In an oxic reducing environment with low organic content the residence time of technetium is the soil would be expected to be near zero, due to its low sorption. Surprisingly, nearly 50 years following the release of contamination into the site, much of the element has persisted in the subsurface, in its most mobile form. Using an Unsaturated Flow Apparatus (UFA) we have conducted a series of experiments to examine the impact of mobile-immobile domains on the transport of ^{99}Tc. By varying sand/silt ratios and saturations we examined how changes in pore morphology and moisture content impact the transport of ^{99}Tc within our experimental system. Results demonstrating the impact of sediment texture pore morphology, and soil moisture content on physical impediments to ^{99}Tc transport will be presented.