

D/H composition of leaf waxes from C₃ plants along a transect from the UK to central Siberia, Russia

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The δD values of individual organic compounds from leaf waxes are being increasingly used in environmental sciences. Extracting palaeoecological and palaeoclimatological information from the organic D/H signal requires a clear understanding of hydrogen isotope fractionation between the source water and biosynthates. The purpose of this work is to investigate differences in hydrogen apparent fractionation factor (ϵ) among several common deciduous and conifer plant species in northern Eurasia.

We determined the D/H composition of *n*-alkanes derived from leaf waxes extracted from several extant plants representing conifer (*Pinus*) and deciduous angiosperm (*Betula* and *Salix*) genera along a longitudinal transect from the UK to central Siberia in 11 locations. We also measured the δD values of tap waters collected at the same locations. The *n*-alkane and leaf water data were then used to calculate ϵ values. Our initial results show the following.

The δD values of *n*-C₂₇ alkane from individual genera correlate with the δD values of tap water along the transect. The R² values for *Betula* (9 locations), *Salix* (5 locations) and *Pinus* (6 locations) are 0.95, 0.97, and 0.82, respectively. However, the ϵ values calculated between *n*-C₂₇ alkane and tap water differ significantly among the genera: *Betula* -84‰, *Salix* -142‰, and *Pinus* -119‰. We suggest that there are at least two possible explanation that could account for such large difference in the ϵ values. Because of the differences in tree morphology and habitat, the plants could be using isotopically different soil water, so that *Betula* consumed soil water that underwent a larger D-enrichment than *Pinus* and *Salix*. Additionally, or alternatively, plants could vary in terms of their leaf morphology and biochemistry of photosynthesis so that the differences in biosynthate D/H composition – and thus in the ϵ values – arise during the processes that take place at the leaf level.

Further research involving analysis of the δD values of soil and leaf water as well as plant physiological variables at individual locations will help clarify which factors and to what extent control D/H fractionation between the individual compounds in leaf waxes and the source water.

Desorption of quinoline from clay: An investigation of the LoSal™ mechanism

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Oil recovery from reservoirs is often less than 30%; increasing this would be an efficient way of increasing the available global oil resources. In traditional water flooding, recycled reservoir brine or sea water is injected to flush out interstitial oil. When this high salinity water is substituted with low salinity water (LoSal™), oil recovery from sandstone reservoirs has been shown to increase by 5 to 15% [1]. We have investigated the interaction between aromatic base compounds, as models for crude oil, and clay to gain understanding about the mechanism behind the LoSal™ effect.

Quinoline, a model for aromatic bases in oil, was adsorbed from aqueous solution onto kaolinite and Ca-montmorillonite. The clay samples were subsequently rinsed with high (36000 ppm) or low salinity water (1400 ppm). We found that high salinity water was more than 50% more effective in removing quinoline from both kaolinite and Ca-montmorillonite. Quinoline is adsorbed as a cation and therefore increased desorption can be explained by cation exchange. These results contrast with the LoSal™ effect, suggesting that the LoSal™ effect is not associated with the adsorption of aromatic bases on clays. We are currently investigating the interaction of other functional groups and minerals in an attempt to mimic the LoSal™ effect. This is the first step toward improving understanding of oil-water-mineral interactions in reservoirs at the molecular level.

[1] Lager, Webb & Collins (2008) *SPE/DOE Symposium on Improved Oil Recovery* 113976-MS