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Response of dD values of sedimentary n-alkanes to variations in source water isotope signals and climate proxies at Lake Nam Co, Tibetan Plateau

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The Tibetan Plateau is one of the most sensitive and interesting study sites representing a very complex and variable climatic system. Alternating monsoonal circulation over the Tibetan Plateau causes hydrological changes and affects the stable isotope content of precipitation. At present, the air masses of the southern part of the Plateau mainly originate from moist, warm air from the Indian summer monsoon providing the main part of precipitation from the Bay of Bengal along the Brahmaputra-Yalongzangbo river valley to this region (Tian et al., 2001).

In this study, we compared the compound-specific δD values of sedimentary$n$-alkanes from Nam Co (30˚30’ - 30˚56’N; 90˚16’ - 91˚03’E; 4.722 m a.s.l.) with isotope values from three different ice cores of the Tibetan Plateau and other climate proxies like temperature and radiation. This enabled us to estimate the importance of source water and of environmental factors at the ecosystem scale on variations of the isotopic composition of sedimentary n-alkanes. The ice core records from Dasuopu (28˚21´N; 85˚46´E; 5.600-8.000 m a.s.l.), Puruogangri (33˚44´-34˚44´N; 88˚20´-89˚50´E; 5.500-6.500 m a.s.l.) and East Rongbuk glacier (28.03 ˚N; 86.96 ˚E; 6.518 m a.s.l.) of the past 1.000 years show a continuous deuterium enrichment indicating a warming trend or decreased precipitation. The source signal of the precipitation water is in line with the results from the ice cores, i.e. between δD values of -105.9 ‰ and -134.4 ‰ which nicely agree with the measured isotope signal of -120 ‰. This suggests that the ice core isotopes record precipitation isotopes and therefore represent the source water isotopes.

Sedimentary n-alkane δD values also represent the same general tendency to enrichment in heavier isotopes. The δD values of n-alkanes nicely agree with known climatic events like Little Ice Age and Medieval Warm Period showing depleted and enriched δD values, respectively. However, the correlation to the δ^{18}O values derived from the ice record is very weak. The variability is about 20 – 30 ‰ larger in the sediments than in the ice cores. Applying the transfer function of Sachse et al. (2004) the measured isotope signal of precipitation would translate to δD values for terrestrial n-alkanes of about -250 ‰ but only -210 ‰ are found. Consequently additional environmental effects enrich the terrestrial signal. The δD values of the$n$-alkanes were best related to environmental drivers like temperature and solar radiation. Our results suggest that δD values of sedimentary$n$-alkanes mainly record driving factors like evapotranspiration and relative humidity that strongly influence δD values at the plant level. For this reason variations in the source signal are less significant than modifications by environmental conditions. Apparently, the isotope signal of precipitation is directly formed by the amount effect that is related to the monsoon activity, while the isotope signal of the lake system is primarily a function of temperature, humidity controlled evapotranspiration and vapour pressure deficit.

References:

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