Lake evaporation recorded in δD values of sedimentary n-alkanes of Nam Co, Tibetan Plateau

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INTRODUCTION

Past and present changes in the hydrological cycle of Nam Co area (Fig. 1), Central Tibet, are assessed using compound-specific hydrogen isotope ratios of biomarkers (n-alkanes) from lake sediments. These results are compared to previously studied lake sediments from Lake Holzmaar, Central Europe. Studies on various European lake sediments already demonstrated that sedimentary n-alkanes record the water δD values and preserve information on evaportranspiration processes (Sachse et al. 2004, Fig. 2). Here we compare the δD values of n-alkanes from lake sediments of the arid Nam Co and the humid Holzmaar to establish that evapotranspiration of the lake systems is recorded and hence is suitable to reconstruct evapotranspiration in the geological past.

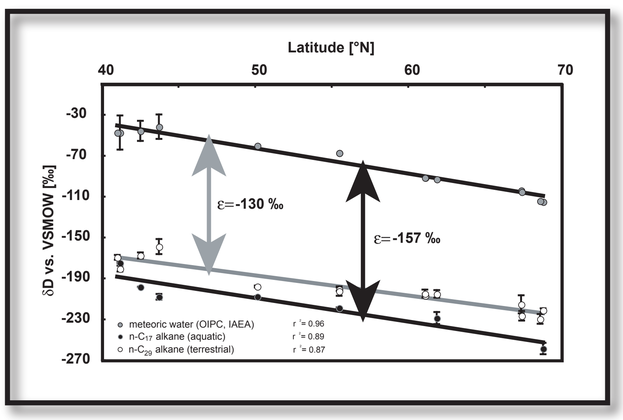

Fig. 2: Hydrogen isotpe ratios of meteoric water, terrestrial and aquatic sedimentary n-alkanes along a N-S European lake transect (Sachse et al. 2004)

Fig. 1: Overview of the study area, Lake Nam Co, Central Tibet. The esllipses mark the sediment sampling locations. (map source: Google Earth, http://earth.google.com)

Lake Nam Co, the second largest (1961 km^2) saline lake of the Tibetan Plateau is located in its central part (Fig. 2). The climate in this region is continental with low mean annual temperatures around -1° to + 3° and low precipitation amounts of 300-500 mm occurring mainly in the summer months during the monsoonal rains. Due to strong radiation annual evaporation (2465 mm) exceeds the annual precipitation.

RESULTS

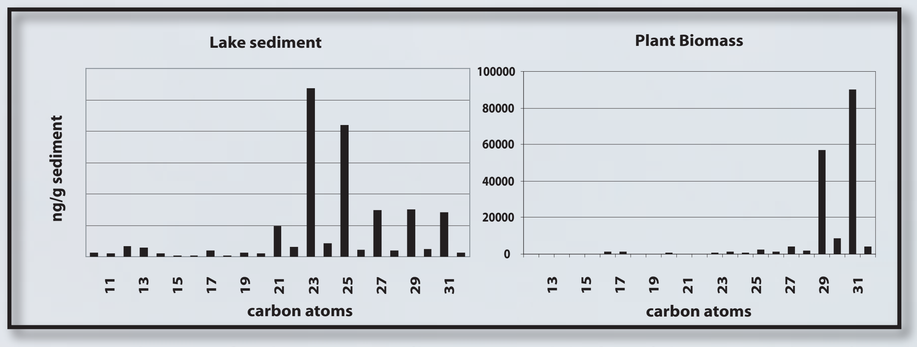

Fig. 3: Distribution of sedimentary n-alkanes (a) and (b) from lake surrounding plants

Long-chain n-$C_{27,}$ n-C_{29} and n-C_{31} alkanes from allochthonous material from leaf waxes of terrestrial plants were identified within the sediments (Fig. 3 a). The lake surrounding vegetation mainly contains n-C_{29} and n-C_{31} alkanes (Fig. 3b). Additionally, the amounts of n-C_{17} and n-C_{21} to n-C_{25} alkanes within the sediment originate from algae and submerged aquatic plants (Fig.3 a).

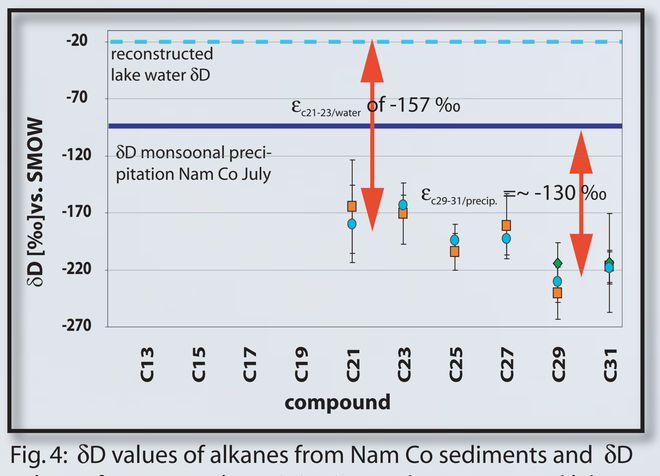

Fig. 4: δD values of alkanes from Nam Co sediments and δD values of monsoonal precipitation and reconstructed lake water

The dD values of terrestrial plants correspond to the dD values of precipitation in the growing season with an isotopic difference of 130‰. However, the reconstructed δD value of Nam Co water is -20‰ which is about 80‰ heavier than the monsoonal source water. This observed enrichment of heavier isotopes is the result of lake evaporation (Fig. 4).

CONCLUSIONS

The comparison of terrestrial and aquatic hydogen isotope ratios of **HUMID** Holzmaar lake system reveals a negative enrichment at about - 30‰ of terrestrial n-alkanes relative to the aqutic ones (Fig. 5).

In humid areas terrestrial plants are enriched in deuterium due to transpiration processes in the leaves, whereas lake water is not effected by evaporation.

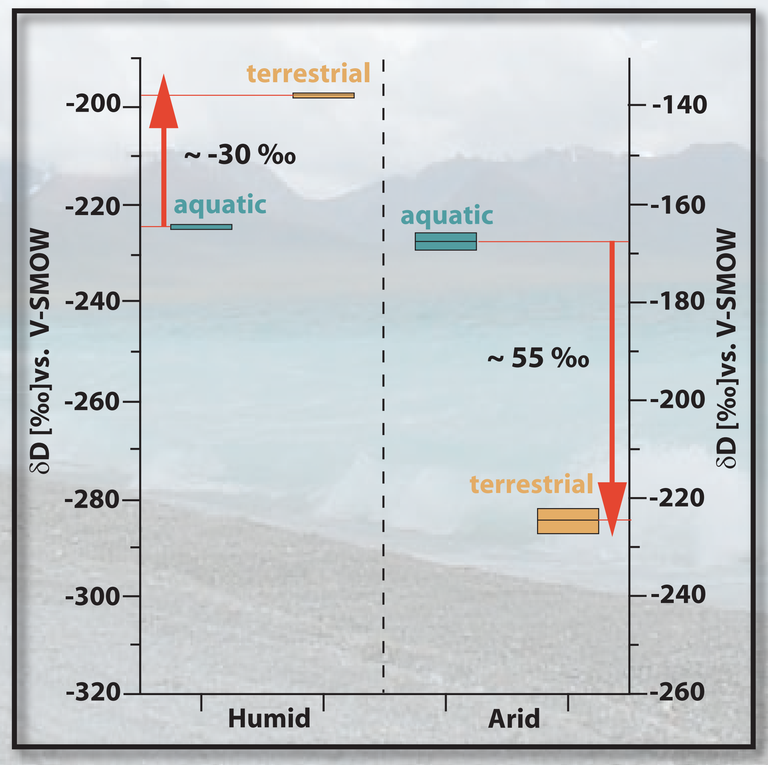

Fig. 5: Isotopic offset between aquatic and terrestrial n-alkanes δD values of Lake Holzmaar (humid) and Lake Nam Co (arid) sediments

The isotopic difference between aquatic and terrestrial n-alkanes at the **ARID** Nam Co is positive in the range of +55‰ (Fig. 5).

In an arid region the lake water is strongly enriched in deuterium due to evapotration at the lake surface. The enrichment of terrestrial plants leaf water reaches the same extent as in humid areas due to short vegetation times.

These first results suggest that the isotopic offset between terrestrial and aquatic plants might provide information on the intensity of lake evaporation. Hence, the direction of the isotopic offset could indicate whether climate conditions were humid or arid and therefore is suitable to track changes in the water cycle over the geological past.

References:

Sachse et al. (2004): Hydrogen isotope ratios of recent lacustrine sedimentary n-alkanes record modern climate variability. In: Geochimica et Cosmochimica Acta, Vol 68, No. 23, pp. 4877-4889.