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Stable carbon isotopic compositions of n-alkanes in the Hongyuan peat sequence from southwest China over the last 13 ka

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A peat bog deposit is an accumulation of immature organic matter composed mainly of dead plant material from various types of plants, including submerged, floating and emersed aquatic plants and terrestrial higher plants. In general, emersed aquatic and terrestrial higher plants contain long chain n-alkanes (C_{27}, $C_{29}$and C_{31}) in their epicuticular waxes, whereas submerged/floating aquatic plants contain a large proportion of mid-chain n-alkanes ($C_{23}$and C_{25}). Therefore, the $d^{13}C$ values of peat n-alkanes can provide clues to the paleoenvironmental information recorded in each type of plant, such as changes in continental hydrology, CO_2availability, vegetation and productivity in a bog. In southwest China, Holocene peat mires are widely distributed on the northeast edge of the Tibetan Plateau, which provide a good opportunity to examine the paleoenvironment significance of $d^{13}C$ variations in peat n-alkanes because of the existing paleoclimatic information. In this study, we measure $^{13}C/^{12}C$ ratios of the C_{23}, C_{25}, C_{27}, $C_{29}$and C_{31}n-alkanes in the Hongyuan peat sequence from southwest China to decipher paleoenvironmental information recorded in the $d^{13}C$ variations over the last 13 ka.

Our samples consist of 1 cm intervals taken every 10 cm in the 4.5 m core recovered at a location 2 km southeast of the city of Hongyuan in the Sichuan Province, southwest China. Aliphatic hydrocarbons were ultrasonically extracted with chloroform from ca. 2 g of freeze dried sample and isolated using silica gel column chromatography. The $^{13}C/^{12}C$ ratios of n-alkanes were determined using a HP 6890 gas chromatograph coupled to a Finnigan MAT Delta Plus isotope ratio mass spectrometer.

The $d^{13}C$ values of $C_{23}$to C_{31}odd carbon numbered n-alkanes range between -35.4 and -30.5 permil, which fall within the range of those observed for n-alkanes from modern C_3peat-forming vegetation. However, their vertical trends do not match with those in the $d^{13}C$ value of the C_3peat-forming plant cellulose. Such a discrepancy between the $d^{13}C$ profiles implies that the n-alkane $d^{13}C$ values are unlikely to reflect the emersed aquatic plant signals in the bog. Because submerged/ floating aquatic plants are major contributors of mid-chain ($C_{23}$and C_{25}) n-alkanes in the Hongyuan peat sequence, the decoupling between the $C_{23}$and C_{25}n-alkanes and the peat cellulose likely reflects that these mid-chain homologues primarily record the isotopic signals of submerged/ floating aquatic plants. The stratigraphic profile of $d^{13}C$ values of submerged/floating aquatic plant n-alkanes ($C_{23}$and C_{25}) reveals two prominent positive excursions (0.8 to 2.4 permil) during the early to middle Holocene. The excursions coincide with peat accumulation maxima and stronger Indian monsoon activity in southwest China, indicating that the $d^{13}C$ variations in submerged/ floating aquatic plants are closely related to changes in bog primary productivity controlled by the Asian monsoon activity. Although these relations should be confirmed by studies of more widespread regions, our results indicate that the $d^{13}C$ values of submerged aquatic plant n-alkanes can serve as a new proxy for climate-influenced bog primary productivity in southwest China.

Keywords: peat, stable carbon isotopes, n-alkane, Holocene, Asian monsoon