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Bulk organic δ^{13}C and C/N as an indicator for the palaeomonsoonal variability during the mid Holocene - A case study from the Pearl River estuary, China

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This study aims to examine the applicability of organic carbon isotopes as a palaeo-monsoon proxy for summer monsoon freshwater discharge, using a case study in the Pearl River estuary, China. This research is based on the assumption that different sources of organic carbon possess different isotopic signatures and these differences are bigger than changes in the response to climate variability. Specifically, sources of organic matters within an estuary including terrestrial plants and soil, saltmarshes and mangroves, and in-situ productivity of algae. We assume that organic carbon materials of freshwater environment are chemically different from those of marine environment. Thus, δ^{13}C and C/N values of organic matters from estuarine sediments can help differentiate sources of organic carbon.

Samples collected range from terrestrial areas including plants and soil samples, to the estuarine area including seasonal estuarine particulate organic carbon (POC) and surface sediment. Results suggest variation of δ^{13}C and C/N ratios in the Pearl River delta and estuarine area is highly related to sources of the organic matter. For example, surface sediment samples from the marine environment exhibit more positive δ^{13}C values (–23.1‰ to –21.1‰), whilst samples from the freshwater environment possess more negative δ^{13}C values (–26.8‰ to –24.6‰). This relationship is supported by isotope ratios of suspended organic matter taken from different sites across the estuary. Thus, in the Pearl Estuary, more negative δ^{13}C values reflect greater level of contribution of freshwater organic carbon, i.e. stronger monsoonal freshwater discharge.

We then applied this technique to a sediment core obtained from the mouth of the estuary. The results show that freshwater discharge from the Pearl River catchment gradually declined from c. 6500 to 2300 cal. years BP, suggesting a gradual weakening of summer monsoon precipitation. The results are comparable to stalagmite records from caves and records from pollen analyses from southern China. We conclude that organic carbon isotopes are a good environmental proxy for palaeo-monsoon variability.