Radiocarbon constraints on the origin and fidelity of sediment-based paleoclimate records

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Marine sediments represent crucial archives of information on past ocean and climate conditions, incorporating environmental signals from surface and deep waters, as well as those delivered from adjacent continents. For sedimentary sequences that have accumulated since the last glacial period, chronologies are typically established based on ^{14}C measurements of planktonic foraminifera, and corresponding age models are applied to all proxy signals retrieved from the same sedimentary record. However, hydrodynamic processes that promote lateral dispersal of particulate matter both in the water column and in the benthic boundary layer have the potential to result in spatial and temporal decoupling of signals associated with different sedimentary constituents. The frequency and magnitude of such decoupling in ocean sediments remains poorly known.

We present findings from the detailed study of a sediment core from the southwest Portugese margin that spans the deglacial to the present. We find marked variations in the ^{14}C content of organic matter associated with different grain size fractions, with the coarser "sortable silt" fraction frequently exhibiting the most ^{14}C-depleted values. Moreover, the overall spread in isotopic values among grain size fractions varied throughout the core, suggesting links with changes in paleoceanographic conditions. Molecular proxy compounds (alkenones and plant waxes) were concentrated in the finest (clay) fraction, but in some cases were also abundant in coarser fractions. Past changes in ocean current strength and trajectory, and thus hydrodynamic regime, may have influenced proportion, provenance and age of proxy signals. By the same token, such ^{14}C and other geochemical measurements may provide new insights into past hydrological and sedimentological changes. We are presently examining the ^{14}C characteristics of a broader range of sedimentary constituents in order to determine the influence on corresponding records as well as to improve our understanding of past sediment and ocean dynamics.