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Effects of differential degradation of marine organic compounds on preserved radiocarbon ages and biomarker-based SST-Reconstructions

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Molecular-level radiocarbon studies of source-specific biomarkers have revealed that different components in marine surface sediments can exhibit a wide spectrum of apparent ages, ranging from "modern" to several thousand years. The presence of pre-aged marine biomarkers indicates the occurrence of advective processes that result in redistribution of organic matter. Once deposited, further changes in age distribution of biomarkers may occur by virtue of the differing reactivities and modes of delivery of organic matter inputs.

We have analysed two types of co-occurring lipid biomarkers from marine sources, long-chain alkenones derived from phytoplankton and crenarchaeotal tetraether lipids (crenarchaeol). Both of these compound-classes are used as proxies for paleo-envirnomental reconstructions, i.e. for the reconstruction of past sea-surface temperatures. Compound-specific radiocarbon ages of these lipids were compared with radiocarbon ages of co-occurring planktic foraminifera. Some additional radiocarbon ages of fatty acids extracted from the same samples were also determined.

Our data show systematic differences in preserved radiocarbon ages of co-occurring alkenones and crenarchaeol. Crenarchaeol is typically younger than the alkenones. While differences in habitat of the source organisms may influence the radiocarbon age at the time of compound formation, the observed age-differences are substantially larger and in the opposite direction than what could be explained by initially different radiocarbon ages. The results provide evidence that next to advection of pre-aged

material, the preservation potential related to the differing reactivities of the compounds is an important factor in determining the preserved radiocarbon age of organic compounds in marine sediment. Our findings reveal the importance to consider sedimentology and organic-matter preservation for the paleo-environmental interpretation of biomarker-based sea-surface temperature reconstructions.