Application of the ramped pyrolysis ^{14}C dating to postglacial sediments from the Alaskan margin, Arctic Ocean

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Radiocarbon dating of biogenic carbonates, such as foraminiferal tests, is commonly used for dating marine sediments up to 50 ka old. However, in carbonate-poor environments, such as typical for polar seas, direct dating of carbonaceous material is difficult, while bulk organic matter (OM) may contain a mixture of carbon with different ages. Rosenheim et al. (2008) developed the ramped pyrolysis ^{14}C dating of the bulk OM based on incremental generation of CO_2 from a range of carbon fractions, from highly reactive to more thermochemically stable. Application of this approach to Southern Ocean sediments showed that ages of highly-reactive, lower temperature fractions were considerably younger than other fractions and the bulk ^{14}C age. In this study, we explore ramped pyrolysis ^{14}C dating in Arctic Ocean sediments from the Alaskan margin to determine if the same relationships hold true.
Samples were taken from two sediment cores collected on the 2005 HOTRAX expedition and comprising Holocene marine and older glaciomarine strata (Darby et al., 2009a). Several ^{14}C ages have been generated on the Holocene biogenic carbonates (Darby et al., 2009b). New samples from both the Holocene and older sediments were pyrolyzed from room temperature to 900 ˚C, and the released, purified CO_2 fractions were sealed in borosilicate glass ampoules at the University of South Florida. Measurement of $\Delta^{14}C$ was conducted at the University of Tokyo.
Pyrolysis followed by oxidation generated three peaks of CO_2 at ~300 ˚C, ~400 ˚C and ~540 ˚C, which were deconvolved into three Gaussian peaks (G1 to G3). These peaks were interpreted to reflect the consecutive degradation of oxygen-containing OM functional groups, cleavage of carbon-carbon bonds, and cleavage of aromatic ring carbon, respectively. In this scenario G1 contains most of the autochthonous carbon from the sediment. We found that the slopes of the G1-G3 ^{14}C ages plotted against temperature of the Gaussian centroid are proportional to the offset between ^{14}C ages of G1 and earlier analyzed biogenic carbonates from the same core levels. Assuming that this relationship is a constant function of the overall measured age spectra, we propose to use it for estimating sediment ages from the ramped pyrolysis ^{14}C data. The estimated G1 age offsets range from 800 to 3,000 years in the Holocene and from 4,000 to possibly as high as 5,000 years in the older glaciomarine sediments.

