CONTINENTAL MARGINS AS ORGANIC MATTER "AGING FACTORIES"

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The marine carbon cycle is an intrinsic dynamic driver for global climate, and on millennial and longer timescales it is strongly dependent on organic carbon (OC) burial in marine sediments. There is a growing body of evidence that organic matter (OM) accumulating on continental margins consists of heterogeneous organic components with various radiocarbon (^{14}C) contents in the sediments (Eglinton et al., 1997; Griffith et al., 2010; Blair and Aller, 2012). The ^{14}C content in the sedimentary OM can provide a means to evaluate the source and fate of OC in the marine setting. Prior studies have investigated factors controlling bulk OM ^{14}C contents in the continental margin sediments in terms of carbon sources and residence times within different reservoirs. Recently, however, sedimentological properties (i.e., grain size) have been found to exert strong influence on the balance of degradation and preservation of OC, and further influence sedimentary OM ^{14}C contents (Bao et al., 2016).

Here, we present results from detailed ^{14}C-based investigation of bulk OM, thermally-resolved organic fractions, and specific compounds applied to different grain size fractions of sediments from the western and eastern Pacific continental margins. Surface sediments (0-2 cm) were collected along two terrestrial OM dispersal pathways from delta to inner shelf of the Bohai/Yellow Sea, and from outer shelf to upper slope settings on the Washington Margin. Calculated lateral transport times along sediment dispersal pathways from two margins vary among the grain size fractions, regardless of carbon source. For instance, the lateral transport time of finer fraction sediments (< 20 μm) may be ~200 yr traversing ~500 km, but approaching ~1000 yr for coarser-grained sediments (63-250 μm) travelling only ~35 km in western and eastern Pacific margin transects, respectively. In addition, we find systematic increases in both the heterogeneity and magnitudes of OM ^{14}C ages among grain size fractions (Fig. 1). This implies that ^{14}C age variations in continental margin sediments must at least partly be driven by varying hydrodynamic properties of different sedimentary grain sizes in the ocean. The latter thus appears to be a key modulator of OM dynamics during lateral transport on continental margins, with serving as an "aging factory". In this context, sediments of different grain size act as "factory conveyors" moving OM along a transect at different speeds. Dictated by local hydrodynamic conditions, this lateral pumping of variably aged OC causes marked heterogeneity of ^{14}C ages and appears to be a global phenomenon on continental margins. These marked, grain size-specific variations in lateral transport time serve as an impetus for future studies to advance our understanding of dynamics of carbon cycle in the ocean.

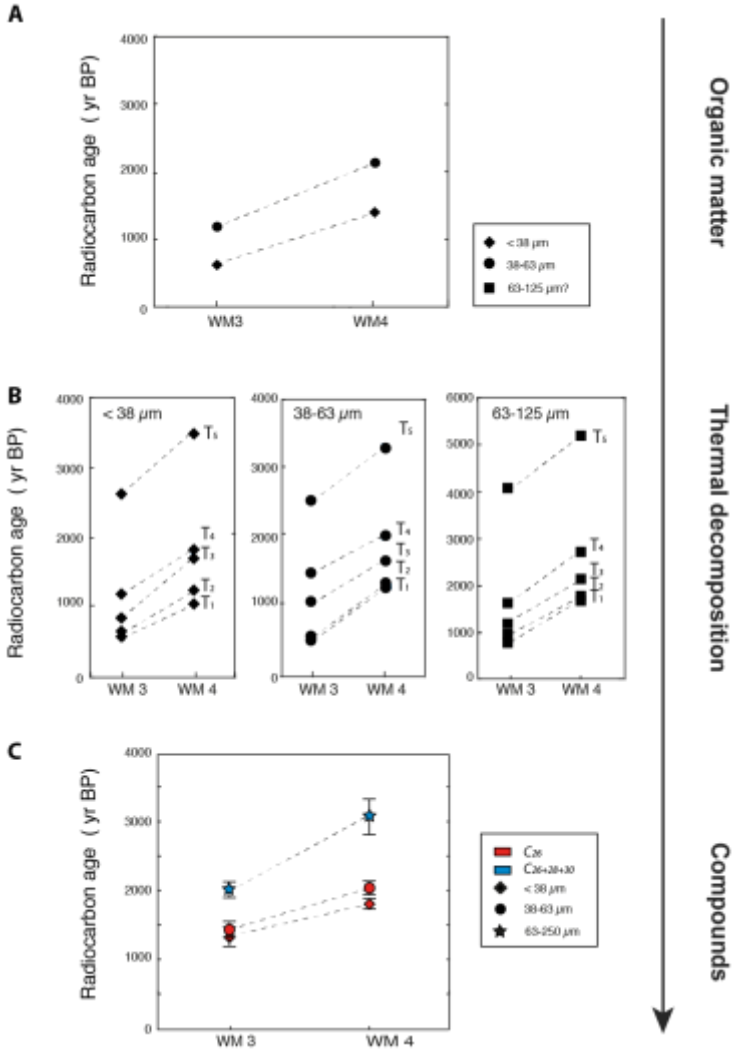

Figure 1 *^{14}C age offsets of (**A**) whole OM, (**B**) thermal decompositions, and (C) compounds Fatty acids (FA) of different grain size fractions from outer shelf (WM 3) to upper slope (WM 4) transect (~35 km distance) on the Washington Margin. (**A**) ^{14}C results of the 63-125 µm fraction are not shown.*

References

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