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Temporal variations of sinking particulate organic radiocarbon in the deep Sargasso Sea

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The imprint of bomb radiocarbon on sinking particulate organic carbon ($PO^{14}C$) intercepted by sediment traps, together with flux and elemental data, provides information about the origin and dynamics of oceanic particles (Hwang et al., 2010). Of particular interest is the question of the degree to which sinking POC in the deep ocean stems from overlying primary production, i.e., vertical supply via the biological pump, versus other processes such as advection and subsequent aggregation of resuspended sedimentary carbon originating from continental margins and other distal sources (Conte et al., 2019). In this context, natural abundance variations in ^{14}C serves as a useful tracer given contrasting signatures recently fixed and pre-aged carbon sources. To quantify the seasonal to inter-annual variability in sinking $PO^{14}C$, we have analyzed sediment trap samples from the Oceanic Flux Program (OFP) in the Sargasso Sea, a deep ocean time-series which has examined the particle flux and its composition at 500, 1500 and 3200 m water depths since 1978.

Radiocarbon measurements of POC of all OFP samples spanning September 2012 to December 2015 reveal seasonal and subseasonal variations in sinking $PO^{14}C$ with an amplitude in $\Delta^{14}C$ values of ca. 100 ‰. This variability in $\Delta^{14}C$ values is inversely linearly correlated with the proportion of lithogenic material to POC (LM:POC; r^2=4.2, p <0.01). This relationship suggests that POC with high $\Delta^{14}C$ values and a low LM:POC ratio reflect the supply of particles that sink vertically via the biological pump. Conversely, lower $\Delta^{14}C$ values and high LM:POC ratios indicate laterally transported materials originating from resuspended sediments containing pre-aged organic carbon. Significant deviations from the linear regression (p <0.01) correlate with $\delta^{13}C$ values, indicating an increased state of POC remineralization that is independent of $\Delta^{14}C$ variations attributable to particle provenance.

Over the 3.3 year period of observation, $PO\Delta^{14}C$ decreased by ca. 26 %, exceeding the expected annual decline (~6 ‰) based on reconstructed surface $DI^{14}C$. This decline potentially could be linked to different source(s) of laterally supplied aged organic carbon associated with lithogenic material and/or a shift in the $PO\Delta^{14}C$ of the overlying flux (e.g. from reduction in particle sinking

speeds, enhanced decomposition, increased incorporation of aged suspended particles and/or dissolved organic carbon into the sinking flux). On-going work extending the OFP time-series will examine these multiyear trends and assess potential variability in the balance between vertically exported and laterally supplied POC to the deep ocean flux in the deep Sargasso Sea, enabling a better understanding of the underlying processes which control POC dynamics.