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Carbon isotope ratios of particulate organic carbon in the lower euphotic zone

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Latitudinal variations in sea surface $\delta^{13}C$ values of particulate organic carbon ($\delta^{13}C_{POC}$) are now well recognized, but no large-scale efforts have been made to describe variations in $\delta^{13}C_{POC}$ over depth in the water column. We recently compiled published data demonstrating a widespread difference between $\delta^{13}C_{POC}$ values of the upper and lower euphotic zones in open ocean settings [1]. In 51 water column profiles, $\delta^{13}C_{POC}$ values in the lower euphotic zone on average were 1.4‰ lower than $\delta^{13}C_{POC}$ values in the upper euphotic zone. This downward decrease in $\delta^{13}C_{POC}$ values was often > 2‰ and up to 5‰, larger than the commonly recognized vertical $\delta^{13}C$ variation in dissolved inorganic carbon over the same depths. We compared the magnitude of upper water column variations in $\delta^{13}C_{POC}$ values to various oceanographic parameters, and we speculate that the largest variations may be characteristic of stratified euphotic zones with relatively high net primary productivity. Our data compilation demonstrates that there is a widespread pool of POC in the ocean with $\delta^{13}C$ values that are significantly different from those modeled as "source" photosynthetic values in the surface ocean; these $\delta^{13}C_{POC}$ values of the lower euphotic zone can propagate into the higher food web and also can potentially be exported in sinking particles. We therefore suggest that a more robust understanding of the drivers behind vertical variations of $\delta^{13}C_{POC}$ values in the modern ocean may influence the interpretation of sedimentary carbon isotope records. We present new compound-specific carbon isotope results that may help in distinguishing between potential photosynthetic and degradative mechanisms behind the observed patterns.

[1] Close & Henderson (2020), *Frontiers in Marine Science* 7: 540165