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Eastern Equatorial Pacific paleoceanography during the last 8 Myr: Untangling proxy signals from bulk sediment stable carbon and oxygen isotopes.

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The stable carbon and oxygen isotope signatures (δ^{13}C and δ^{18}O) of bulk sediment calcium carbonate ($CaCO_3$) are routinely analyzed in paleoceanographic studies. However little is known about the relative contribution of different biogenic $CaCO_3$ components to these mixed 'bulk' isotopic signals and how this might correlate spatial or temporal differences in paleoceanography and carbonate preservation, especially in deep water settings close to the lysocline where paleoceanographic data is at a premium. Here we attempt to improve the understanding of bulk sediment δ^{13}C and δ^{18}O as a paleoceanographic tool by untangling the isotopic contribution of different biogenic components, principally foraminifera and calcareous nannofossils, in a series of deep sea sediment cores from the deep equatorial Pacific spanning the last 8 Myr. This region is characterized by extremely dynamic oceanography but the history is difficult to resolve due to the paucity of available proxy records. Here existing bulk sediment δ^{13}C and δ^{18}O from ODP Leg 138 are combined with 791 new bulk sediment δ^{13}C and δ^{18}O data from IODP Site U1338 and DSDP Site 573, situated within the belt of strong equatorial upwelling and high primary productivity in the eastern equatorial Pacific (EEP). For a subset of 100 of the new samples, the δ^{13}C and δ^{18}O was measured on isolated <63 μm and <38 μm sediment fractions. Mimicking natural preservational processes, these fractions are progressively enriched in calcareous nannofossils at the expense of foraminifera. The proportions of sand-sized material (>63 μm) and $CaCO_3$ ware also determined. The bulk sediment δ^{13}C and δ^{18}O records at Sites U1338 and 573 exhibit similar long-term trends and short-term deviations. The absolute values are consistent with published records from ODP Site 850 situated near the equator in the EEP, supporting the idea of strong similarities in bulk δ^{13}C across the whole EEP region but significant δ^{18}O variability, especially between on-equator and off-equator stations. Trends in δ^{13}C and δ^{18}O of the <63 μm and <38 μm fractions closely parallel the bulk isotopic signal. However, when the sand fraction exceeds 5 %, both of these finer isolates show slightly lighter δ^{13}C (0.2 - 0.4 ‰) than the bulk signal. These differences likely result from the progressive exclusion of adult foraminifera and fragmentary material (depleted in ^{12}C) and concentration of juvenile foraminifera (enriched in ^{12}C) and calcareous nannofossils in <63 μm and <38 μm 'fine' fractions. These foram/nannofossil 'preservation' signals do not help explain why bulk δ^{13}C is so similar across the EEP region or why there are major on-equator compared to off-equator differences in δ^{18}O in the existing bulk sediment isotopic data sets. Instead the δ^{13}C bulk signal must reflect changes in surface water δ^{13}C that have affected the entire EEP in a similar way over the last 8 Myr. In contrast, the more positive bulk δ^{18}O, higher sedimentation rates, higher $CaCO_3$ content and low abundance of sand-sized material at on-equator sites between 8.0 and 4.5 Myr might reflect intensified wind-driven upwelling and enhanced primary productivity along the equator during the late Miocene and early Pliocene compared to today.