Stable Equatorial Pacific Productivity over the last 1Ma

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The large glacial to interglacial fluctuations in the atmospheric CO_2 concentration during the Pleistocene have been attributed to changes in the oceanic carbon system, i.e. ocean productivity. The Equatorial Pacific represents an important component of global oceanic productivity and, thus, is speculated to have a major influence on global climate.

Conventional wisdom has held that Equatorial productivity was substantially greater during glacials than during interglacials. Support for this hypothesis comes for example from Paytan et al. (1996) reporting that the burial rate of barite varied by a factor of 5-6 between interglacials and glacials throughout the Pleistocene climate cycles.

To test this hypothesis we present ^{230}Th and ^{3}He data for two cores from the central equatorial Pacific at 140W (PC 72, PC114). Both tracers represent constant flux proxies (CFP), i.e. tracers of constant supply through time, which allow us to reconstruct accumulation rates that are not biased by sediment redistribution or errors in the stratigraphy. Consequently, we use these tracers to re-evaluate the sedimentation record of paleoproductivity proxies. Normalizing the excess Ba record of the past 1Ma to CFPs eliminates the large variability in the conventional ^{18}O-derived accumulation rates. We show that the fluctuations reported by Paytan et al. (1996) are an effect of the use of stratigraphy-derived sedimentation rates. This holds also true for the period of the Mid-Pleistocene Climate Transition (MPT, 800-560ka) for which Murray et al. (2000) inferred a major productivity increase from Ti-normalized Ba, Al and P data. Using normalization to ^{3}He we show that the apparent maxima in the profiles during the MPT are due to a decrease in Ti, i.e. dust, and that there was no significant productivity increase during the MPT.

Re-evaluation of the Ba records with CFPs implies that the export productivity in the Equatorial Pacific was constant during the past 1Ma. The variability in the carbonate pattern in the Pacific Ocean can be exclusively attributed to variable $CaCO_3$ dissolution driven by changes in the paleochemistry of the deep ocean. Our study proves the unequivocal need to apply constant flux proxies (instead of stratigraphy-based sedimentation rates) to reconstruct sedimentary fluxes in the past.

References

Murray R.W., Knowlton C., Leinen M., Mix A.C. and Polsky C.H. (2000), *Paleoceanography* 15(6), 570-592.

Paytan A., Kastner M and Chavez F.P. (1996), Science 274, 1355-1357.

The Origin of Solar System Organic Matter: Evidence from IDPs

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Some extraterrestrial material contains organic matter, but the origin of the organic compounds has not been established. A variety of mechanisms have been proposed, with a Miller-Urey type process, producing organic matter in an aqueous process, and a Fisher-Tropsch type process operating in the Solar Nebula as two extreme cases. If the organic matter were produced by a Miller-Urey type process we would expect to see organic matter predominately in extraterrestrial samples that exhibit other evidence of aqueous processing (e.g., abundant clay minerals) while a Fisher-Tropsch type process should result in comparable amounts of organic matter in either hydrated or anhydrous samples.

The hydrated carbonaceous meteorites have %-level concentrations of organic matter, but anhydrous carbonaceous chondrites have much lower concentrations, with most of the carbon in elemental form. This observation favors a Miller-Urey type mechanism. But all anhydrous carbonaceous chondrites are depleted in volatile elements. These depletions are believed to result from either incomplete condensation or subsequent vaporization of elements more volatile than Mn. Such a process requires temperatures in excess of 1200° C, and is incompatible with the survival of organic matter.

We determined the abundance and types of carbon in anhydrous and hydrated interplanetary dust particles (IDPs) collected from the Earth’s stratosphere. Many anhydrous IDPs have contents of the moderately volatile elements ≥CI, unequilibrated minerals, and D anomalies within a few µm of D-normal material. These features indicate many anhydrous IDPs have never been significantly heated, making them better candidates to test the origin of Solar System organics.

Scanning Transmission X-ray Microscope (STXM) carbon maps show carbon contents ranging from a few vol-% to over 90 vol-%, with comparable amounts of carbon in anhydrous and hydrated IDPs. Carbon X-ray Absorption Near Edge Structure (XANES) spectra of both anhydrous and hydrated IDPs show similar pre-edge spectra: with a strong C-ring absorption at ~285 eV and a carbonyl (C=O) absorption at ~288.5 eV. We confirmed the presence of percent-level carbonyl by oxygen XANES.

FTIR spectroscopy detected C-H stretching absorptions from aliphatic hydrocarbon at about the same strength in both hydrated and anhydrous IDPs. We compared the relative strength of C-H stretching and silicate absorptions in IDPs to mixtures of aliphatic hydrocarbon and glass, and conclude aliphatic hydrocarbon is present at the %-level in most IDPs.

Since we found organic matter of similar types and abundances in both anhydrous and hydrated IDPs, it appears that the bulk of Solar System organic matter was produced early in Solar Nebular history, possibly by a Fisher-Tropsch type process or by irradiation of carbon-rich ices.