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Opal burial in the Eastern Equatorial Pacific controlled by Si leakage and eolian dust inputs.

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The Silicic Acid Leakage Hypothesis (SALH) attempts to explain part of the large and regular atmospheric CO2 changes over the last glacial-interglacial cycles by a floral shift in the equatorial ecosystem from coccolithophorids to diatoms. The SALH predicts that increased eolian iron input or extended sea ice cover during glacial stages created a pool of excess Si in the Southern Ocean that escaped to the low-latitudes. Numerous downcore opal records from the Equatorial Pacific have recently been investigated in an effort to test the SALH.
In contrast to SALH predictions, sedimentary records from the Eastern Equatorial Pacific (EEP) do not show enhanced opal burial during the Last Glacial Maximum (LGM), but during the deglaciation and during Marine Isotopic Stage 3 (MIS3) [e.g. Bradtmiller et al., Paleoceanography, 2006; Kienast et al., GRL, 2006]. The peak in opal productivity during the deglaciation has been attributed to increased supply of nutrient-rich waters driven by stronger upwelling of deep water in the Southern Ocean [Anderson et al., Science, 2009]. The larger peak in opal burial during MIS3 was interpreted as evidence of Si leakage when Southern Ocean diatom productivity is limited by both low dust flux and extended sea ice [Kienast et al., GRL, 2006]. On the other hand, the paradoxical LGM decline in opal accumulation in the EEP was explained by enhanced dust input lowering the diatom Si:C uptake ratio [Pichevin et al., Nature, 2009].
Here we use a combination of molecular fingerprints of algal productivity and radioisotope tracers of sedimentation to revisit opal burial in the EEP, in particular during the MIS3 “opal peak”. An increase in algal productivity is not supported by the sedimentary concentration of brassicasterol, a biomarker for diatoms, nor by the ratio of (231Pa/230Th)xs,0, a proxy for opal export production. We therefore conclude that the large peak in opal burial during MIS3 more likely reflects enhanced preservation of diatoms. Building on mechanisms invoked in previous studies, we suggest that opal burial in the EEP is controlled by both the physiological response of diatoms to low-latitudes dust inputs and the high latitude processes leading to Si leakage.