Productivity paradox in the western equatorial Pacific, late Quaternary

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It is well known that the productivity of the equatorial Pacific was higher during the last glacial period than in the Holocene, both in the east [*Lyle et al.,* 1988] and in the west [*Herguera and Berger,* 1991]. The abundance of benthic foraminifers (figure 1a, upper panel) exhibits a strong correlation with the oxygen isotope record, such that cold periods have high abundances, and vice versa. This relationship holds over the entire Milankovitch chron (the last 625 years). The modal stack (figure 1b), an internal average for the 100-kyr-period, shows that the alignment is almost precisely in phase, with some indication for a slight lead in the productivity signal. Diatom abundance has long been considered an excellent proxy for productivity, since diatom supply to the sea floor is high in upwelling regions, and low below central gyres. Thus, based on the benthic abundance patterns (which presumably reflect food supply to the sea floor) we should expect that diatom abundance variations run parallel to benthic abundance. The exact reverse is found in the western equatorial Pacific (figure 1a, lower panel). While more irregular than the benthic record, the diatom record shows high abundance during interglacials and low abundance during glacial periods. Again, the modal stack (figure 1c) demonstrates almost perfect agreement in phase, between diatoms and the oxygen isotope record, and again there is a slight lead in the productivity record. Only, the two proxies are exactly 180 degrees out of step. This is the productivity (proxy) paradox. We have no ready explanation for the paradox. We take the benthic foraminifers as reliable reporters of productivity, and assign to the diatoms the role of monitoring silica preservation, rather than supply, in this region and for this time. The question then becomes why preservation was reduced during glacial periods. We suggest that 1) the Atlantic captured a much greater portion of biogenic opal during glacial time than during interglacials, especially in the North Atlantic, 2) the turning down of the North Atlantic Deep Water during glacials decreased basin-basin fractionation, which currently (in an interglacial) greatly favors the accumulation of silica in the Pacific, and 3) intermediate waters in the western Pacific had much lower silicate content during glacial time than today, because of a lessened supply of pre-formed silicate from the high-latitude frontal regions. A similar paradox may occur elsewhere, notably in the eastern South Atlantic [*Hay and Brock,* 1992; *Berger and Wefer,* 1996].

References:

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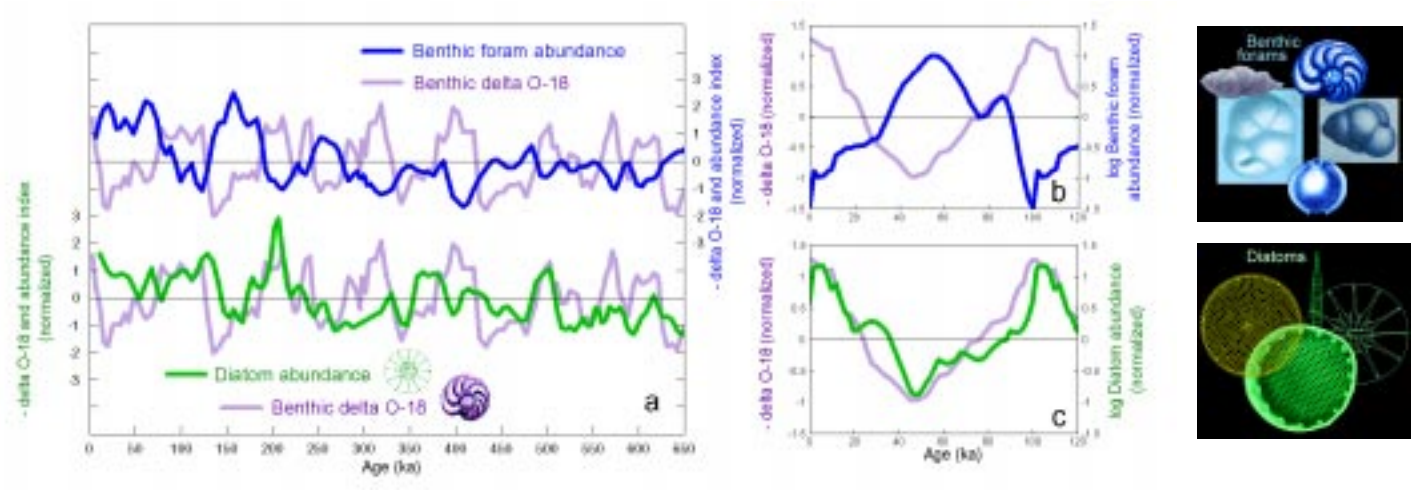

Record of productivity variation in the western equatorial Pacific, as seen in the abundance of benthic foraminifers and diatoms in ODP Site 806B, compared with oxygen isotope stratigraphy. a) Upper panel: Benthic foraminifers, data from Bickert et al. [1993] and Yasuda et al. [1993]. Lower panel: Diatoms, data from Lange and Berger [1993]. b) and c) Modular plots of the records in a), obtained by internal stacking of standardized 100-kyr sections.