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Resolving the Opal Paradox in the Glacial Eastern Equatorial Pacific: Implications for the Biological Pump of Carbon

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The modern Eastern Equatorial Pacific (EEP) is a major oceanic source of carbon to the atmosphere and could have potentially played a key role in lowering CO₂ levels during glacial times. However, available records of nutrient supply, carbon export and opal accumulation from the EEP show contradictory trends over the last glacial cycles and hence the efficiency of the biological pump in the area and its role in glacial CO₂ drawdown remain unclear. Here we report new silicon isotope records and propose a new model which reconciles existing records of glacial-interglacial variability in upwelling intensity, nutrient availability, carbon productivity and opal accumulation from the EEP. Specifically, we suggest that the paradoxically low opal accumulation rates in the glacial EEP is a result of the alleviation of iron limitation during the dustier glacial periods and the consequent decrease in Si:C uptake ratio by diatoms, and does not reflect a decline in rain rate ratio and biological CO₂ pump as suggested previously. Therefore, we argue that the EEP could have been an important contributor for the reduced atmospheric P_{CO2} during glacial periods.