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Productivity and Preservation of Organic Carbon in the South China Sea: Insights from Redox-Sensitive Elements

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Sedimentary records of organic carbon and redox sensitive element ratios covering approximately the last four glacial-interglacial cycles from two cores from the northern and southeastern South China Sea were used to reconstruct variations in factors controlling organic matter productivity and preservation. Core MD972142 (12°41.33'N, 119°27.90'E) was retrieved at a water depth of 1557 m at the continental slope off Palawan Island during the 1997 IMAGES-III-IPHIS Cruise, and the 1215 cm long piston core GIK17925-3 (119°2.8'E, 19°51.2'N, 2980 m water depth) was taken from the north-eastern South China Sea during the SONNE 95 cruise in 1994. Sedimentary organic carbon (TOC) content show a strong glacial-interglacial cyclicity with enhanced values during glacial periods, but also higher frequency oscillations. The amplitude of the variations generally is considerably larger at the southeastern compared to the northeastern site. Stable carbon isotopes of the organic carbon suggest that increased marine productivity rather than changes the input in terrestrial carbon is responsible for the fluctuations in TOC. Proposed explanations for these increased glacial levels of TOC include enhanced primary productivity due to enhanced upwelling or mixing of surface waters by intensified monsoonal winds, or nutrient trapping caused by decreased exchange with the open ocean during sea-level low-stands. The manganese/aluminum and phosphorus/aluminum ratios, however, suggest major variations in bottom water oxygenation related to sea level changes with clearly decreased bottom water oxygenation during glacial maxima and well-oxygenated conditions during peak interglacial conditions. Again, the southeastern site display considerably larger amplitude in its variability when compared to the northeastern site. Manganese and phosphorus are both redox-sensitive elements and the increased values during peak interglacial conditions could be a result of higher oxygen levels in the deep waters due to a more vigorous exchange between the South China Sea and neighboring seas during sea level high-stands. In contrast, during sea-level low-stands, when the exchange with the open ocean was restricted, low-oxic conditions developed especially in the southern part of the basin which was situated the furthest from the only remaining connection at the Luzon Strait. We therefore propose that the TOC record is a palimpsest record of short-term productivity signals primarily controlled by insolation variations and longer-term preservation signals governed by variations in deep-water circulation, ultimately controlled ice-volume/sea-level variations.