Degradative history of organic matter in sediments underlying oxic and suboxic waters off the Pacific Coast of Mexico

R. G. Keil
E. Tsamakis
A. H. Devol

School of Oceanography, Box 357940, University of Washington, Seattle, WA 98195-7940, USA

An oxygen-deficient water mass currently impinges along the coast of the eastern tropical north Pacific continental margin. Sediments deposited within this environment (oxygen not measurable in the bottom waters by Winkler titration) typically have organic matter contents that are elevated over similar sediments deposited under more oxic conditions. We evaluated the organic matter content and the amino acid content and composition of sediments from a transect off the Mexican coast near Mazatlan, as well as a gravity core taken in the center of the current oxygen-deficient zone. Organic matter contents in these cores range from 1–11% OC and amino acid contents range from 8–24 mgAA/100 mgOC. Amino acid contents (either carbon- or mass-normalized) are inversely related to oxygen content of the bottom water and more strongly to the oxygen exposure time of the sediments (calculated as the quantity of time sedimentary organic matter is exposed to oxygen prior to burial: Hartnett *et al.*, 1998). The positive correlations between carbon-normalized amino acid contents and overlying water oxygen content or oxygen exposure time suggests that amino acids undergo diagenesis at an accelerated rate relative to the bulk organic matter in the sediments.

Amino acid compositions also correlate with environmental parameters. Within the oxygen-deficient zone, amino acid contents are very similar to that of fresh plankton samples or fecal materials. This suggests that the amino acids present in these sediments have undergone relatively little diagenetic alteration. Conversely, the non-protein amino acids β-alanine, γ-aminobutyric acid and ornithine, which are not commonly found in planktonic sources, are present in elevated quantities in sediments having higher ambient oxygen concentrations or longer oxygen exposure times. Elevated quantities of non-protein amino acids in marine sediments result from diagenetic reactions, and thus indicate an increased relative level of diagenesis. Mole percentages of non-protein amino acids are low (< 2.5%) in sediments taken from within the oxygen-depleted zone, and higher (3–6 mole %) in sediments taken from areas with longer oxygen exposure times. These latter levels (3–6%) are typical of continental margin sediments that are not oxygen-deficient. The correlations of mole percent non-protein amino acids with ambient oxygen levels in overlying water masses or oxygen exposure times suggests that the amino acids present in sediments from under the oxygen-deficient waters have undergone less diagenesis than those deposited under more oxic conditions.

Similar trends are inferred in the gravity core sample taken from within the present-day oxygen-deficient zone (see also Ganeshram *et al.*, 1996). In sediments deposited during the Holocene, at which time oxygen-deficient waters are thought to have been continuously present, amino acid contents and compositions are consistently elevated and plankton-like in composition. Before the Holocene–Pleistocene transition, approximately 11,000 years ago, the amino acid contents and compositions were consistent with those observed under the present day oxic conditions (lower yields, altered compositions). These data, along with other (^{15}N isotopic compositions, organic carbon to mineral surface area ratios) suggest that the oxygen minimum zone was not present (or was not as intense) during the last glacial period.

References

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