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The sources of amino acids in marine sediments estimated from nitrogen isotopic composition of amino acids and chlorin

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Amino acids are the building blocks of proteins and peptides and key compounds in microbial metabolisms. Amino acids represent one of major fractions of sedimentary organic matter and are important in undergoing organic matter mineralization in marine sediments. However, our understanding is still limited about the biogeochemical dynamics of amino acids in marine sediments, in part because currently available methods are not sufficient to constrain sources and transformation processes of amino acids in sediments.

Here, as a new method to estimate sources of amino acids in marine sediments, this study reports down-core profiles of compound-specific nitrogen isotopic composition (d15N) of total hydrolysable amino acids (THAA) in marine sediments of the Japan Sea (a surface sediment and a 7-m-long piston core; ca. 46,500 years). The d15N profiles of THAA were compared with a down-core d15N profile of chlorin pigment (pyrophaeophytin a), which reflects the d15N values of organic matter produced by photosynthetic organisms in the past ocean.

Significant correlations were observed between d15N of amino acids and chlorin pigment in the piston core samples (r2 = 0.87 for phenylalanine, 0.78 for glutamic acid, 0.77 for alanine, and 0.62 for glycine; n = 13). This result suggests that the major source of THAA is organic matter produced by the organisms in the past ocean (i.e., necromass) and that contribution of in situ sedimentary microbial production to THAA is less than 15% below 1 m depth in the core. The offset values of d15N between amino acids and chlorin pigment in the sediments of 1-7 mbsf (e.g., d15N-phenylalanine - d15N-chlorin = +7.3 permil in average) suggest that the source organisms of THAA contain not only photosynthetic algae and animals but also heterotrophic or chemoautotrophic microbes in the past ocean (water column and surface sediments).

Keywords: Organic matter, Nitrogen isotope, Amino acids, Photosynthetic pigments, Marine sediments, Paleoceanography