

Millennial-scale paleoceanographic changes off Shimokita Peninsula since the Last Glacial Maximum

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A strong oxygen-minimum zone (OMZ) currently exists at upper intermediate water depths on the northern Japanese margin, NW Pacific. The OMZ results largely from a combination of high surface-water productivity and poor ventilation of upper intermediate waters. We investigated late Quaternary history (last 34 ky) of ocean floor oxygenation and the OMZ using quantitative changes in benthic foraminiferal assemblages in three sediment cores taken from the continental slope off Shimokita Peninsula and Tokachi, northern Japan, at water depths between 975 and 1363 m. These cores are well located within the present day OMZ, a region of high surface-water productivity, and in close proximity to the source region of North Pacific Intermediate Water (NPIW). Late Quaternary benthic foraminiferal assemblages experienced major changes in response to changes in dissolved oxygen concentration in ocean floor sediments. Foraminiferal assemblages are interpreted to represent three main groups representing oxic, suboxic and dysoxic conditions. Assemblage changes in all three cores and hence in bottom water oxygenation coincided with late Quaternary climatic episodes, similar to that known for the southern California margin. These episodes in turn are correlated with orbital and millennial climate episodes in the Greenland ice core (GISP II) including the last Glacial episode, Bolling-Allerod, Younger Dryas, Pre-Boreal (earliest Holocene), early Holocene, and late Holocene. The lowest oxygen conditions, marked by dysoxic taxa and laminated sediments in one core, occurred during the Bolling-Allerod and the Pre-Boreal intervals. Suboxic taxa dominated mainly during the last glacial, the Younger Dryas and most of the Holocene. Dysoxic conditions during the Bolling-Allerod and Pre-Boreal intervals in this region were possibly caused by high surface water productivity at times of reduced intermediate ventilation in the northwestern Pacific. Remarkable similarities are evident in the late Quaternary sequence of benthic foraminiferal assemblage change between the two very distant continental margins of northern Japan and Southern California. The oscillations in OMZ strength, reflected by these faunal changes were widespread and apparently synchronous over wide areas of the north Pacific, reflecting broad changes in intermediate water ventilation and surface ocean productivity closely linked with late Quaternary climate change on millennial and orbital timescales.