

Late Quaternary intermediate water oxygenation history in Santa Barbara Basin from benthic foraminiferal assemblages

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The Southern California margin adjacent to Santa Barbara Basin (SBB) experienced dramatic changes in bottom water oxygenation and related strength of the oxygen minimum zone (OMZ) on millennial through orbital scales during the late Quaternary. These are clearly recorded by quantitative changes in benthic foraminiferal assemblages and/or strength of sediment laminations in SBB. The basin was well oxygenated during cool episodes and poorly oxygenated during warm episodes, in response to changes in intermediate water ventilation and surface ocean productivity. Previous work has shown that benthic foraminiferal assemblages exhibit high sensitivity to changing oxygenation state and groups of taxa can be ranked accordingly. The history of basin oxygenation change during the late Quaternary (last 25 to 33 ka) is now extended over greater depth range through studies of two new IMAGES cores in SBB (569 m at deep basin and 440 m at sill depth). During cool episodes (LGM; Younger Dryas) the assemblages indicate that the water column was well mixed and oxygenated. No evidence exists of significant water mass stratification or presence of the OMZ. Faunal changes are remarkably similar and correlated between the two water depths. In contrast, the assemblages during warm episodes (Bolling/Allerod; and Holocene) indicate strong vertical water mass stratification in oxygenation. The deep basin is much more poorly oxygenated than that at sill depth. Yet, changes in assemblages at sill depth, although often taxonomically different, clearly record oscillations in strength of the OMZ. One benthic foraminiferal species (*Bolivina tumida*) appears, from earlier works, to be indicative of high concentration of dissolved methane and/or maximum deficiency of oxygen concentration in the basin floor. If so, changing pattern in this species would suggest broad methane expulsions during the early Holocene and during the three episodes in the B/A. The early Holocene was poorly oxygenated compared with the late Holocene.