

Correlation and Interpretation of Environmental Oscillations along the Late Quaternary California Margin

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Paleoichnofabrics are frequently used for stratigraphic correlation based on the assumption that regionally or globally synchronous environmental changes are reflected in the behavioral traces of benthic organisms. Unfortunately, chronologic precision is generally too low to prove that the correlation is accurate. Along the California Margin, we take advantage of the great climatic variability of the Late Quaternary to unequivocally demonstrate that within Santa Barbara Basin 1) millennial-scale climatic oscillations (Dansgaard-Oeschger events) are recorded by synchronous alternations in ichnofabric, benthic fauna, and oceanography, and 2) preserved ichnofabrics faithfully reflect environmental and ecologic changes without stratigraphic overprinting.

Correlation between environmentally distinct locations along the margin required development and use of two different quantitative indices. In the silled Santa Barbara Basin (122 cm/kyr sedimentation rate), semiquantitative visual assessment of the preservation or disruption of varves at 1-cm increments provided a highly sensitive indicator of near-anoxic to oxic conditions with <10yr temporal spacing. 100 km to the west, on the open Santa Lucia Slope (20 cm/kyr sedimentation rate), where sediments were continuously bioturbated beneath well-ventilated waters, quantitative measurement of burrowing was made from bedding-parallel CAT-scans taken every 5 cm (~250yr). We found that burrow ellipticity (reflecting obliquity) is a better proxy for paleo-oxygenation than burrow size or abundance. We propose that mean burrow orientations shifted to accommodate expanding or contracting depth zones of habitable porewater oxygenation. Subsequent overprinting limits the temporal resolution at this location and prevents confident correlation of millennial-scale events, yet permits recognition and correlation of Milankovitch-band variation on the 10-20kyr scale.