RAPID CLIMATIC AND OCEANOGRAPHIC CHANGE IN SANTA BARBARA BASIN

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Understanding the nature and mechanisms of rapid climate change and related biospheric responses is critically important to current discussions of global climatic stability and perturbation. Two cores taken during ODP Leg 146 at Site 893 in 1992 represent the highest resolution sedimentary record of oceanic environmental and biotic changes over the last 160,000 years yet recovered from anywhere in the ocean, and provide unique opportunities to study rapid climate change.

The Santa Barbara Basin record shows strong evidence for major instability of the marine environment and ecosystem off coastal California during the late Quaternary [*Kennett & Ingram,* 1995; *Behl & Kennett,* 1996]. This instability occurs over a range of time-scales, but is most dramatically shown in association with a sequence of 18 Dansgaard-Oeschger (D/O) climatic oscillations that occurred during the last 80,000 years [*Behl & Kennett,* 1996]. These extremely rapid and major climatic warming episodes (interstadials) were first recognized in the Greenland Ice Sheet where they have been tied to synchronous CO_2 and methane fluctuations. The Santa Barbara Basin record demonstrates that sea-surface temperatures increased and decreased very rapidly over intervals as short as 50 to 70 years, at both the initiation and termination of the interstadials, as was the case in Greenland. This similarity suggests a remarkably tight coupling between the atmosphere, the Northern Hemisphere cryosphere and hydrosphere. In Santa Barbara, oxygen isotope data indicate that sea-surface temperatures increased up to 7°C in less than 70 years before stabilizing at ~4°C warmer than before the D/O event. An extraordinary feature of this isotopic record are ~0.5‰ $\delta^{18}O$ overshoots occurring near the beginning of the interstadials, producing a sawtooth pattern familiar in other scales of Quaternary climate change. This feature suggests the involvement of brief, strong greenhouse gas feedback mechanisms, associated with the initiation and termination of the interstadials.

The rapid climate changes are linked with equally rapid changes in the oxygenation and ecology of the basin. Upheaval of the benthic (seafloor) ecosystem is reflected by oscillations between laminated and faunally mixed sediments and by changes in benthic foraminiferal species. Benthic assemblages associated with laminated sediments during warm intervals are dominated by taxa that tolerate low oxygen conditions, such as *Bolivina tumida* and *Buliminella tenuata*. Assemblages associated with bioturbated sediments typical of cooler episodes are dominated by taxa typical of oxygenated waters. These fluctuations within Santa Barbara Basin were controlled by oscillations in the oxygenation of intermediate waters along the California margin.

References:
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Behl, R. J. and J. P. Kennett, Brief Interstadial Events in the Santa Barbara Basin, NE Pacific, During the Past 60 kyr, *Nature, 379,* 243-246, 1996.