Diatoms as Valuable Tools for Biochronology and Paleoclimatology of the Monterey Formation and Related Biosiliceous Sediments

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Abstract

Planktonic marine diatoms are extremely valuable for dating and correlation of the Monterey Formation and diatom-bearing units throughout California and its offshore regions. Deep Sea Drilling Project studies by Schrader (1973; Leg 18) and Koizumi (1973; Leg 19) provided a basis for evaluating the stratigraphic utility of diatom genera such as Denticulopsis and Thalassiosira throughout the North Pacific region. Correlative diatom datums (appearances and extinctions) occur throughout the North Pacific margin in Mexico, Oregon, the Aleutian Archipelago, eastern Russia, and Japan, as well as in oceanic sediment cores, where diatom events are directly tied to paleomagnetic stratigraphy. Diatom biochronology approaches ± 0.1 m.y. resolution. Limitations occur when biosiliceous sediments are altered to porcelanite or chert, when the original opal-A of the constituent diatom frustules is altered to opal-CT (cristobalite) or quartz, a process that typically destroys the diatom frustules. In some cases however, diatom frustules may yet be preserved in calcium carbonate concretions or dolomite beds that were formed early during diagenesis. During the 18 to 5 Ma deposition of the Monterey Formation and overlying terrigenous-rich diatom bearing units, diatoms record increasing climatic cooling, which typically results in decreased calcium carbonate preservation. Diatoms indicative of coastal upwelling and high primary productivity dominate the younger sequences. Global cooling steps at ~14.8, 13.0, 10.0, and 7.5 Ma coincide with increasing cool water diatoms along the California margin. These cooling steps correspond with falling sea level, which is recognizable in Monterey sections by compressed intervals/hiatuses and/or by a transition to more clastic sediments such as the Santa Margarita Sandstone.