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Temporal variations of Barremian-Aptian Pacific Ocean temperatures at low latitudes: Stable isotope data from DSDP Site 463

Atsushi Ando[1], Kunio Kaiho[2], hodaka kawahata[3]

[1] IGPS, Tohoku Univ., [2] Geol. and Paleontol., Tohoku Univ., [3] AIST

An extremely warm climate has been reconstructed for the mid-Cretaceous period (ca. 120-80 Ma). Accelerated oceanic crust production and associated increase in volcanic CO2 outgassing has been accepted as the primary cause of the greenhouse condition. During this period, massive deposition of organic carbon-rich sediments occurred on large ocean basins, and various kinds of marine and terrestrial biota underwent crisis, evolutionary appearance, and rapid diversification. Much interest has been centered on the correaltion of these paleoenvironmental and biotic episodes with the igneous events in view of documenting an essential part of the biogeochemical cycle on the greenhouse Earth.

Climatic conditions during the mid-Cretaceous have been illustrated quantitatively by oxygen isotope records of calcareous microfossils and pelagic limestones. However,d18O data for the Barremian and Aptian Stages, i.e., earlier part of the mid-Cretaceous, are surprisingly limited. Marine temperature estimates based on d18O analyses for these periods have been hampered by multiple factors, such as the predominance of meteoric diagenetic effect and/or widespread hiatus for the Mediterranean Tethys regions, and poor core recovery and burial diagenetic lithification of deep-sea carbonates. Moreover, semi-closed and hypersaline paleoceanographic condition has hypothesized for low latitudinal paleo-North Atlantic Ocean. Hence, there still is no definitive d18O profile available for the Barremian-Aptian. Therefore, a more systematic and quantitative data set of d18O measurements, in particular from a continuous and expanded Barremian-Aptian sequence in an open-ocean setting, is desirable for the precise delimitation of the mid-Cretaceous evolution of the Earth's surface temperature.

In order to constrain the uncertainty, whole-rock oxygen isotope analyses were performed on upper Barremian-middle Albian pelagic carbonates from the Mid-Pacific Mountains, Deep Sea Drilling Project Site 463 (cored interval: 471.12-699.50 mbsf; paleolatitude: ~10-15 degrees). Planktonic foraminiferal datums, carbon isotope stratigraphy, and burial diagenetic processes were also examined.

The d18O values ranged from -4.8 to -0.8 per mil with an average of -2.1 per mil. Overall, the d18O profile exhibited long-term variations consisting of: (1) a late Barremian-early Aptian plateau interval at ~-2--3 per mil; (2) a late Aptian positive shift by ~2.4 per mil (from ~-3.2 to ~-0.8 per mil); and (3) a latest Aptian to Albian negative shift by ~1.5-2 per mil (from ~-0.8 to ~-2.2 per mil). Thus, it is suggested that the late Aptian was the duration of significant cooling as compared to the preceding and following periods.

The analyzed interval has subjected to burial diagenetic lithfication from ooze to chalk to limestone. In order to examine the relative fluctuation patterns of past marine temperatures based on whole-rock d18O analyses, it is necessary to quantify the effect of cementation calcite, acquired mainly at the chalk-limestone transition, on primary d18O variations. In this presentation, discussion is given for the evaluation of burial diagenetic effects on primary d18O signals using Sr/Ca ratios. Further discussion is given for the cause of conflicting results of this study, showing the episode of significant cooling during the mid-Cretaceous, with those derived from ocean crust production data predicting an Aptian-Albian extreme warmth.