Tectonics and plankton evolution during the Mid-Cretaceous

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One of the great enigmas of the mid-Cretaceous world (127-83 Ma) was the burial of vast amounts of organic carbon in the ocean. Higher global sea level and expansive epicontinental seas, coupled with warm climates and oxygen-poor water masses contributed to the enhanced burial and preservation of organic matter. Organic-rich sediments deposited at this time are informally known as black shales. However, conditions were not persistently warm or oxygen-poor. For example, numerous distinct episodes of widespread black shale deposition, known as Oceanic Anoxic Events (OAEs), occurred during Aptian to Turonian time (121-89 Ma) [Arthur *et al.,* 1990; *Bralower et al.,* 1993]. Patterns in the evolution of calcareous plankton suggest that the oceanic biosphere responded to major perturbations in the marine environment, coincident with global episodes of organic carbon burial. Fluctuations in global sea level and in the nature of oceanic circulation may have directly affected plankton evolution. However, changes in plankton trophic structure and stability support the possibility of changing oceanic fertility patterns during times of black shale deposition. Strontium isotope evidence points squarely to forcing mechanisms tied to tectonic activity, particularly during Aptian and early Albian time [*Bralower et al.,* in press]. Heightened rates of seafloor spreading and arc volcanism, coupled with the emplacement of several large igneous provinces (LIPs) directly influenced sea level and global climate [*Larson,* 1991]. In addition, it is possible that increased hydrothermal activity also influenced biogeochemical cycles, oceanic productivity, and plankton ecosystem structure. Recovery of additional deep-sea sedimentary records with well preserved microfossils is required to further test this hypothesis.

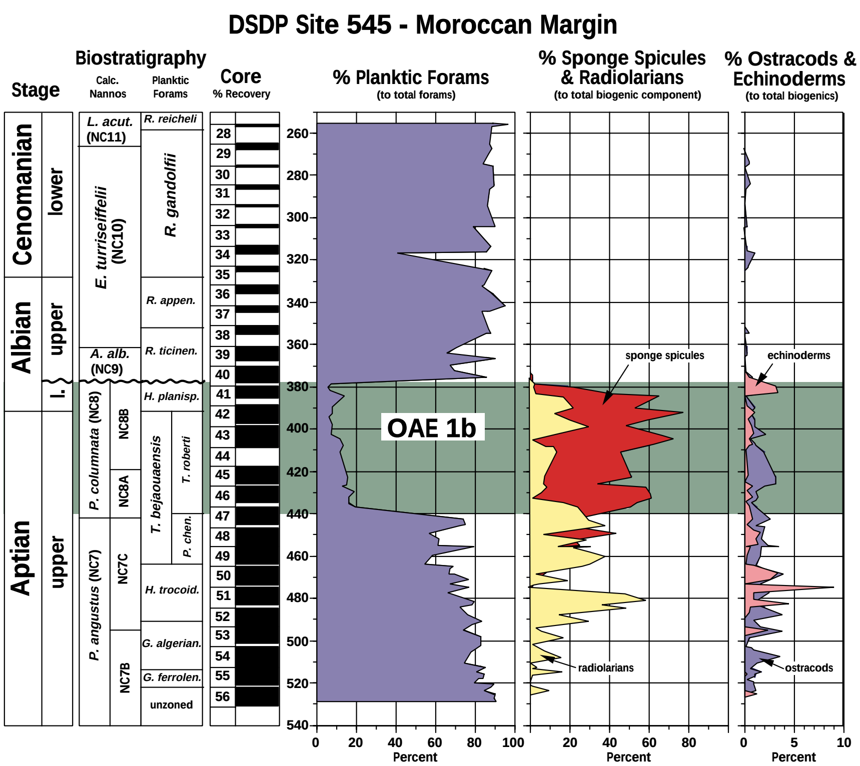
References:

Arthur, M.A., H.-J. Brumsack, H.C. Jenkyns, and S.O. Schlanger, Stratigraphy, geochemistry, and paleoceanography of organic carbon-rich Cretaceous sequences, In: Ginsburg, R.N., and B. Beaudoin (eds.), *Cretaceous Resources, Events and Rhythms, Kluwer Academic Publ.,* 75-119, 1990.

Bralower, T.J., P.D. Fullagar, C.K. Paull, G.S. Dwyer, and R.M. Leckie, Mid-Cretaceous strontium-isotope stratigraphy of deep-sea sections, *GSA Bulletin,* in press.

Bralower, T.J., W.V. Sliter, M.A. Arthur, R.M. Leckie, D.A. Allard, and S.O. Schlanger, Dysoxic/anoxic episodes in the Aptian-Albian (Early Cretaceous), In: Pringle, M.S., W.W. Sager, W.V. Sliter, and S. Stein (eds.), The Mesozoic Pacific: Geology, Tectonics, and Volcanism, *AGU Geophys. Monogr., 77,* 5-37, 1993.

Larson, R.L. Geological consequences of superplumes, *Geology, 19,* 963-966, 1991.



Latest Aptian-Earliest Albian

- **Kerguelen Plateau volcanism (LIP)**
- **Oceanic Anoxic Event 1b**
- **minimum Sr-isotope values**
- **collapse of planktic foram diversity**
- **high biological productivity in eastern North Atlantic (Tethys)**

Shaded band highlights major changes in planktic and benthic assemblages at Site 545 during latest Aptian-early Albian time. This interval corresponds with Oceanic Anoxic Event 1b, Kerguelen Plateau volcanism (LIP), minimum Sr-isotope values, a global collapse of planktic foram diversity, and high biological productivity in the eastern North Atlantic (southern margin of Tethys).