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Phosphorus burial in marine sediments during the Cenomanian-Turonian Oceanic Anoxic Event (OAE-2)

P. Kraal (1), C. P. Slomp (1), A. Forster (2), H.-J. Brumsack (3)

(1) Faculty of Geosciences, Utrecht University, The Netherlands, (2) Royal Netherlands Institute for Sea Research (NIOZ), Texel, The Netherlands, (3) Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Germany (p.kraal@geo.uu.nl / +31 30 253 3264)

Enhanced recycling of phosphorus (P) has been suggested to have played an important role in the formation of black shales during Cretaceous oceanic anoxic events (OAEs). This is based on the elevated ratios of organic carbon (C) to total P that are observed in these anoxic sediments. As yet, detailed information on the forms of P in Cretaceous black shales and surrounding sediment layers is scarce, however. This precludes an accurate assessment of the most important mechanisms driving the enhanced regeneration of P from black shales and the possible role of changes in marine P cycling in the initiation and termination of OAEs.

In this study, we determine the sediment P speciation at two sites in the Atlantic Ocean before, during and after the Cenomanian-Turonian oceanic anoxic event (OAE-2; ∼94 Myrs BP). We focus on a shelf site with year-round upwelling (Tarfaya Basin; ∼400 m paleo water depth) and a deep sea location (Angola Basin near Walvis Ridge; ∼3500 m paleo water depth). Elevated organic C/reactive P ratios during OAE-2 confirm the occurrence of enhanced regeneration of P relative to C. Biogenic Ca-P (fish debris) is an important P sink at the Tarfaya Basin shelf site and accounts for, on average, 62% of total P burial. Authigenic P concentrations are highest before and after the OAE, suggesting that a change in authigenic P formation also contributes to enhanced P recycling. At the deep-water site, biogenic Ca-P is not quantitatively important. Here, authigenic P and iron-bound P are the major P species. At the onset of OAE-2, total and detrital P concentrations are elevated. This suggests that increased input of P - possibly linked to enhanced continental weathering - may have helped to trigger OAE-2.