

SURFACE AND DEEP WATER CIRCULATION IN LATE CRETACEOUS NORTH ATLANTIC GREENHOUSE OCEAN

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ABSTRACT

This research provides the first of its kind empirical data regarding the evolution of Maastrichtian surface to deep ocean circulation in the North Atlantic. Differences in foraminiferal abundances and oxygen and carbon isotopic ratios of bulk carbonate and foraminifera between two Ocean Drilling Program Sites in the subtropical North Atlantic indicate a sharp water mass boundary was a relatively stable and persistent feature of the Maastrichtian North Atlantic despite significant regional warming across the interval. Neodymium isotopes of fish debris, on the other hand, indicate significant changes in intermediate and deep water circulation through the Late Cretaceous and especially during the Maastrichtian. During the Cenomanian-Campanian interval at least three different deep water masses were active in the North Atlantic including one formed by downwelling of warm saline waters in the Demerara Rise region. During the Campanian-Maastrichtian, low-latitude-sourced waters seem to have reached abyssal depths, but from the mid-Maastrichtian on, this water mass seems to have declined in importance. From the mid-Danian on, we found evidence for only one water mass (plausibly sourced in the northern North Atlantic, as it is today) at bathyal and abyssal depths in the North Atlantic. Our data demonstrate that surface and, especially, intermediate and deep water circulation patterns are an important (and measurable) variable that helps determine greenhouse temperature distributions on regional and global scales.