

A Marine Record of Holocene Climate Events in Tropical South America

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Compared to the rapid, large climate fluctuations that occurred during the last ice age, climate in the modern, post-glacial Holocene (the last 10,000 years) appears to have been relatively stable. Nevertheless, a growing number of studies from ocean drilling cores have revealed significant variations in regional Holocene climate, at least some of which likely affected human societal evolution.

Measurements of titanium (Ti) in sediments from the Cariaco Basin off northern Venezuela (ODP Site 1002) provide a detailed record of variations in terrigenous input to the basin from northern South America in response to changes in regional rainfall and riverine delivery. In the Cariaco Basin, low Ti values during the well-known Younger Dryas (11,500–12,800 years ago) Cold Event indicate arid regional conditions that are in agreement with lake-level and pollen data representing much of the tropical Atlantic. Following this interval, increased precipitation and riverine discharge marked the Holocene “thermal maximum” (10,500 to 5400 years ago), a period of relative warmth. Since ~5400 years ago, a gradual trend towards drier conditions over northern South America is evident, a pattern also recognized in other regional records. This trend was interrupted by high-amplitude Ti fluctuations and distinct precipitation minima, both between 3800 and 2800 years ago and during the historically documented “Little Ice Age”. These observed changes in local hydrological conditions appear to best be explained by a southward shift in the latitude of the Inter-Tropical Convergence Zone (ITCZ) during the Holocene. Such a shift was likely driven by changes in the seasonality of solar insolation associated with orbital changes, and/or by Pacific-based (El Niño–Southern Oscillation) climate variability with strong teleconnections to the Cariaco Basin region.

Many of the variations recorded in Cariaco Basin sediments coincide with societal events that have been suggested as being motivated by climatic change. For example, the Site 1002 sequence clearly records tropical climate events similar in timing to high latitude North Atlantic changes (e.g., Medieval Warm Period / Little Ice Age) often invoked as pivotal in the settlement history of the Vikings in Greenland and to societal developments in Europe. With a resolution of decades or less, the Cariaco sequence offers a prime example of the potential for cross-disciplinary research between archaeologists, historians, and paleoclimatologists into the impact of climate change on human history.

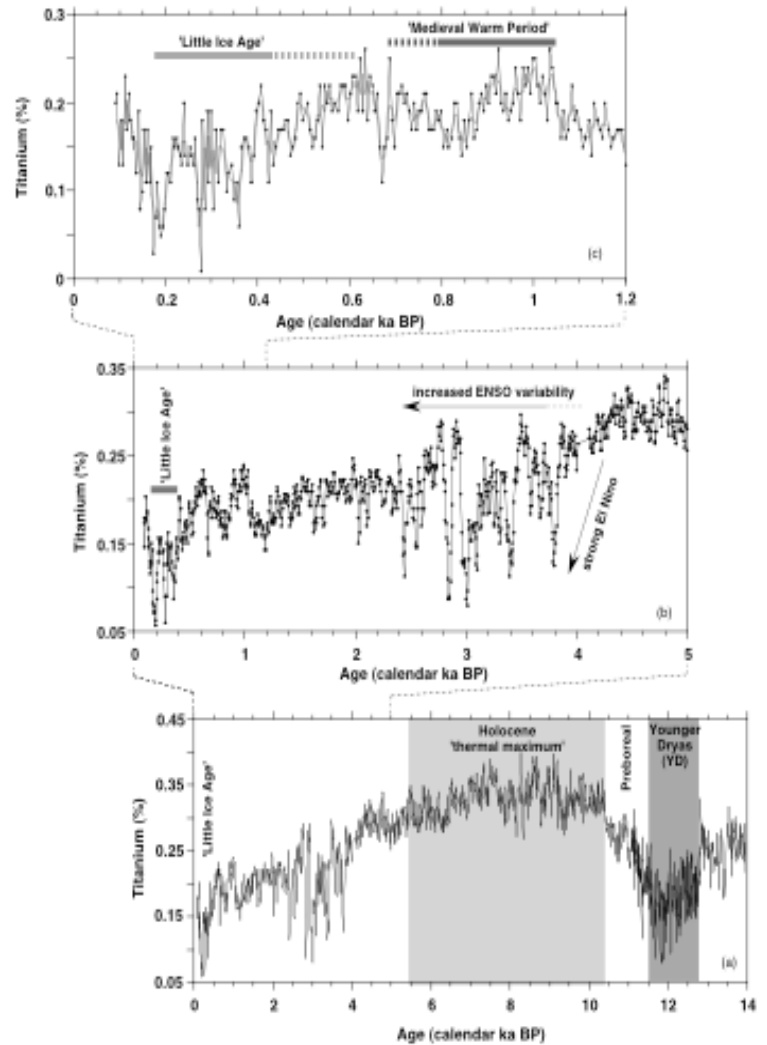


Figure Caption

Bulk titanium content of Cariaco Basin sediments from ODP Site 1002 versus age (in thousands of years before present), spanning (bottom) the last 14,000 years (3 point running mean); (middle) the last 5,000 years (3 point running mean); and (top) the last 1,200 years (raw data). Titanium variations in Cariaco Basin sediments reflect changes in terrigenous input and are interpreted as a proxy for regional changes in precipitation and river-runoff.

Reference

Haug, G.H., Hughen, K.A., Sigman, D.M., Peterson, L.C., and U. Röhl. Southward migration of the Intertropical Convergence Zone through the Holocene, *Science* 293, 1304–1308 (2001).