Millennial-scale changes in temperature during Termination 1: a case study from the western South Atlantic and the adjacent continent

C. M. Chiessi[1*], S. Mulitza[2], G. Mollenhauer[2,3], J. B. Silva[4], J. Groeneveld[2] and M. Prange[2]
[1] School of Arts, Sciences and Humanities, University of São Paulo, São Paulo, Brazil, chiessi@usp.br
[2] MARUM - Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany
[3] Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
[4] Institute of Geosciences, University of São Paulo, São Paulo, Brazil

During Termination 1, millennial-scale weakening events of the Atlantic meridional overturning circulation (AMOC) supposedly produced major changes in sea surface temperatures (SSTs) of the western South Atlantic, and in mean air temperatures (MATs) over southeastern South America. It has been suggested, for instance, that the Brazil Current (BC) would strengthen (weaken) and the North Brazil Current (NBC) would weaken (strengthen) during slowdown (speed-up) events of the AMOC. This antiphase pattern was claimed to be a necessary response to the decreased North Atlantic heat piracy during periods of weak AMOC. However, the thermal evolution of the western South Atlantic and the adjacent continent is so far largely unknown. Here we address this issue, presenting high-temporal-resolution SST and MAT records from the BC and southeastern South America, respectively. While our SST record is based on Mg/Ca analyses performed on shallow-dwelling planktonic foraminifera, our MAT record is based on continentally derived lipid analyses. Our SST record from the BC in the western South Atlantic shows a marked positive anomaly during HS1. This is the first record that corroborates model suggestions that the surface layer of the BC acted as an important conduit and storage volume for part of the heat not transported to the North Atlantic under a sluggish AMOC. Thus, the BC was of paramount importance in propagating southwards the thermal bipolar seesaw signal of HS1. We note an in-phase behavior with an existing SST record from the NBC, contradicting previous assumptions of a BC–NBC anti-phase. Additionally, a similar SST evolution is shown by a southernmost eastern South Atlantic record, suggesting a South Atlantic-wide pattern in SST evolution during most of Termination 1. Over southeastern South America, our MAT record shows a two-step increase during Termination 1, synchronous with atmospheric CO_2 rise (i.e., during the second half of HS1 and during the Younger Dryas), and lagging abrupt SST changes by several thousand years. This delay corroborates the notion that the long duration of HS1 was fundamental in driving the Earth out of the last glacial.