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Sediment sources and transport pathways to the western South Atlantic since Termination I

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Lic. Rodrigo Martín, from Argentina, visited the University of São Paulo, Brazil, as a PAGES-IAI International Mobility Research Fellow (23 July – 27 Aug 2023) to perform X-ray fluorescence (XRF) and stable isotope analyses on sediment cores retrieved from the western South Atlantic Ocean. These analyses will help to understand the sediment sources and transport pathways active in the region since Termination I.

The western South Atlantic circulation is dominated by the Brazil-Malvinas Confluence (~38°S) that emerges from the encounter of the southward-flowing Brazil Current and the equatorward-flowing Malvinas Current. The upper slope off Uruguay, however, is strongly influenced by the Brazilian Coastal Current that transports the Plata Plume Water (PPW), derived from the Plata River discharge (Fig. 1a). The northward penetration of the PPW is mainly controlled by the seasonal alongshore wind stress, including the southern westerly winds (SWW), and reaches its northernmost position during the austral winter when the SWW displace to the north (Piola et al. 2008). South of 38°S, the Patagonian margin is controlled by the Malvinas Current, and the low precipitation and strong SWW over the Patagonian Steppe make it a major dust source to the adjacent ocean (Prospero et al. 2002).

The past evolution of the sources and transport pathways of terrigenous sediments deposited at the western South Atlantic since Termination I is poorly understood. To shed light on this issue and provide important insights into the climate and oceanographic variability in this region, we analyzed three radiocarbon-dated marine sediment cores from the Uruguayan and Patagonian margins (Fig. 1a). We used major elemental composition to trace changes in the terrigenous input: Fe/Ca ratio employed as an indicator of terrigenous material of fluvial origin (Arz et al. 1998), and Ti/Al ratio used as an indicator of grain size variation and/or provenance (Govin et al. 2012). Additionally, we analyzed the benthic-foraminifera stable carbon isotopes ($\delta^{13}C$) to gain insight into intermediate water circulation.

Terrigenous input evolution from the western South Atlantic

Our geochemical data indicate that the terrigenous input to the western South Atlantic was higher during Termination I than during the Holocene (Fig. 1b). The lower sea level, together with a northward displacement of the SWW, increased terrigenous material input at the Uruguayan (GeoB22735-2) and Patagonian (AU_Geo02_GC20/21) margins. Nevertheless, the sedimentary pathways at these two regions were different.

At the Patagonian margin, low Ti/Al ratios suggest low eolian input; and high Fe/Ca ratios reflect not only lower sea level, but also enhanced input of fluvial-derived material due to melting of the Patagonian Ice Sheet (Gaiero et al. 2003). At the Uruguayan margin, conversely, high Fe/Ca ratios reflect a major influence of the PPW due to a northern position of the SWW (Piola et al. 2008), whereas the low Ti/Al ratios indicate limited input from the Bermejo River (a major Andean tributary) to the Plata River (Depetris et al. 2003).

During the Holocene, the decrease in Fe/Ca ratios indicates a reduction in the terrigenous input of fluvial origin at both sectors due to sea-level rise and the southward displacement of the SWW. Higher Ti/Al ratios at the Patagonian margin suggest a stronger Patagonian dust plume, whereas at the Uruguayan margin it indicates a major relative contribution of sediments derived from the Bermejo River that carry a signature rich in Ti (Depetris et al. 2003). Preliminary analyses of the Holocene $\delta^{13}C$ indicate that the higher values recorded at the Uruguayan margin since the mid-Holocene indicate a smaller influence of southern-source waters at intermediate depths (García Chapori et al. 2022). Further ongoing analyses will help to evaluate these hypotheses in this key region of the worlds oceans.

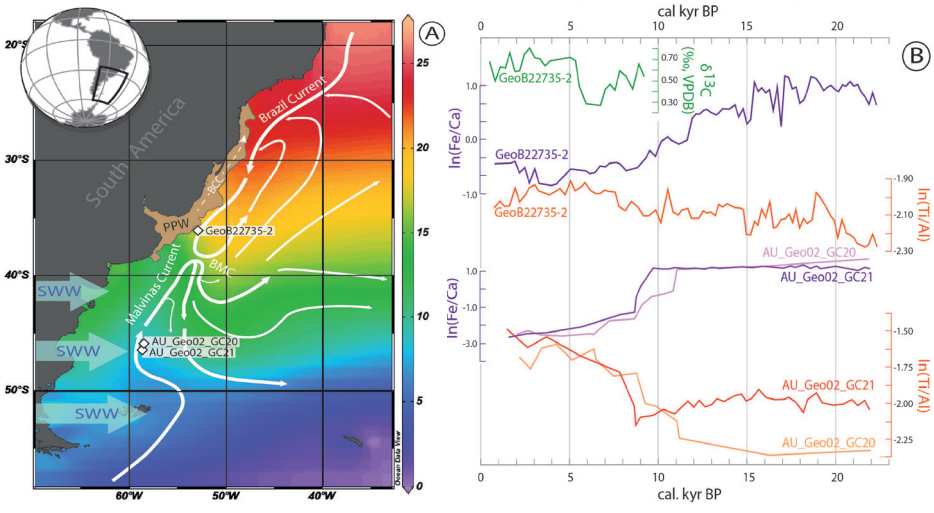

Figure 1: (A) Map showing annual sea-surface temperature of the western South Atlantic. White diamonds represent the analyzed cores. White arrows represent the main oceanic currents (BC: Brazil Current; BCC: Brazilian Coastal Current; PPW: Plata Plume Water). Gray arrows represent the southern westerly winds (SWW). BMC: Brazil-Malvinas Confluence. **(B)** Records of benthic-foraminifera stable carbon isotopes (Cibicidoides-$\delta^{13}C$), ln(Fe/Ca) and ln(Ti/Al) ratios of cores GeoB22735-2 (Uruguayan margin), AU_Geo02_GC20 and AU_Geo02_GC21 (Patagonian margin).

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