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Decline of anthropogenic lead in South Atlantic Ocean surface waters from 1990 to 2011: new constraints from concentration and isotope data

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Anthropogenic emissions have severely perturbed the marine biogeochemical cycle of lead (Pb). While seawater Pb concentrations and isotope compositions have been thoroughly studied for the North Atlantic Ocean, this has not been the case for the South Atlantic. Here, we present new data on total dissolvable Pb concentrations and Pb isotope composition for surface seawater samples from GEOTRACES section GA02 in the western South Atlantic (March 2011). Based on hydrography, the western South Atlantic is divided into three different zones: *equatorial* (0-20°S), *subtropical* (20-40°S), and *subantarctic* (40-60°S). Possible atmospheric Pb sources for each zone are assessed based on backward aerosol particle trajectories and known Pb isotope compositions of natural and anthropogenic sources.

The equatorial zone is dominated by previously deposited Pb transported by surface currents. The subtropical zone largely reflects anthropogenic Pb emissions from South America, whilst the subantarctic zone presents a mixture of anthropogenic Pb from South America and natural Pb from Patagonian dust. Across all zones, the mean Pb concentration of 16.7 ± 3.8 pmol/kg (1 SD, n = 22) in 2011 is 34% lower than in the 1990s (25.2 ± 18.1 pmol/kg, 1 SD, n = 71) [1,2]. This decrease in Pb concentrations over time, which is mostly driven by changes in the subtropical zone, likely reflects the global effort to reduce anthropogenic Pb emissions. Support for this hypothesis comes from the isotopic fingerprint of the surface waters. The fraction of natural Pb, mainly from Patagonian mineral dust, increased from 24% to 36% between 1996 and 2011 [3]. Although the anthropogenic Pb signal remains predominant, the improved environmental conditions demonstrate that Pb pollution from anthropogenic activities has decreased in the South Atlantic Ocean, providing evidence for the effectiveness of policies that banned leaded gasoline.

References:

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