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Seawater Pb concentrations and isotope compositions in the western tropical North Atlantic (GEOTRACES cruise GA02)

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Historic emissions from leaded gasoline polluted the marine environment during the last century. Lead concentrations in North Atlantic surface waters peaked at around 210 pmol/kg in the 1970s, before the phasing out of leaded gasoline commenced. Here, we present a new dataset of Pb concentrations and isotope compositions from four seawater depth profiles collected in the western tropical North Atlantic Ocean as part of GEOTRACES cruise GA02 (June–July 2010). The study area spans the western boundary of the Tropical Atlantic from 32°N to 1°N, encompassing atmospheric inputs originating and water masses ventilated from both hemispheres.

In the near–surface layer (upper 30 m), total dissolvable Pb concentrations of 18.6–21.9 pmol/kg were notably lower than during the last century and isotope fingerprints revealed spatial variability: lower $^{206}Pb/^{207}Pb$ ratios (1.166±0.001) in the southernmost station point to an influence from South African anthropogenic sources via the SE trade winds, while higher $^{206}Pb/^{207}Pb$ ratios (1.174±0.001) at the northernmost station reflect North American anthropogenic sources via the westerlies. Subsurface waters in the area were dominated by North Atlantic Central Water/Subtropical Mode Water (north of 15°N) with higher Pb concentrations (20.5–34.5 pmol/kg) and $^{206}Pb/^{207}Pb$ (1.173–1.180), compared to South Atlantic Central Water (south of 15°N) with lower Pb concentrations (16.6–19.6 pmol/kg) and $^{206}Pb/^{207}Pb$ ratios (1.156–1.165), indicative of different sources. Relatively low Pb concentrations (13.0±0.1 pmol/kg) were observed in the core of Antarctic Intermediate Water (AAIW) at the southernmost station. The $^{206}Pb/^{207}Pb$ isotope signature of this water mass was 1.166±0.001 and became progressively higher to the north as AAIW mixed with upper North Atlantic Deep Water (NADW). At greater depths, Pb concentrations at all stations decreased from 32.4–46.5 pmol/kg at ~2000 m depth to 7.2–15.9 pmol/kg in bottom waters. In the depth range of NADW, $^{206}Pb/^{207}Pb$ ratios were relatively uniform at 1.185±0.005 and this value extended to the layers corresponding to Antarctic Bottom Water.

Our new results will be discussed in the context of previously published data from the Atlantic Ocean to unravel the relative impacts of hydrography, vertical transport, and temporal variability of Pb pollution in governing seawater Pb concentrations and isotope compositions.