Synthesis of dissolved Pb and Pb isotope data of global ocean: sources, cycling, and mixing

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Inverse modelling using aerosol Pb isotope data suggests coal and Pb ores are the primary sources supplying Pb to the atmosphere (≥90%) and thus, to the oceans, while contribution from gasoline is minimal (<10%). The West Pacific and the North Indian Ocean surface waters are largely affected by unrestrained Pb emission from Asia as evident from their very high Pb concentration and small $^{206}Pb/^{207}Pb$ ratio. Conversely, in the North Atlantic, the observed low and declining Pb concentration with time stemms from phasing out of leaded gasoline in North America and Europe between1975-1985[1]. The measured largest $^{206}Pb/^{207}Pb$ ratio and low Pb concentration advocate Southern Ocean to be largely unaffected by anthropogenic activities.

Where data available[2], the open-ocean surface-waters across basins represent distinct Pb signal and the plots of $^{206}Pb/^{207}Pb$ vs 1/Pb deviate from a concurrent two end member mixing between coastal stations. Rather the obvious third end-member signal in central surface waters could be from the Pb signal of ocean currents influencing the ocean gyre and age of the respective central water mass.

The $^{206}Pb/^{207}Pb$ vs 1/Pb plots also confirm a diverse mixing behavior between shallow to intermediate (0-4000 m) and deep (>4000 m) waters of the North Atlantic. In the Indian Ocean; however, linear to hyperbolic trends suggest a gradual mixing between shallow and deep waters.

Mass balance model based on the fractional contribution of water masses and their $^{206}Pb/^{207}Pb$ ratio suggests the Pb isotopic signal in the West Atlantic (2000-4000 m) is the result of mixing of NADW and AABW. Using similar isotopic mass balance approach, we additionaly revise the $^{206}Pb/^{207}Pb$ ratio (1.195-1.205) of AABW, which is noticeably higher than the previously reported value of 1.183[3].

[1] Boyle et al. (2014) Oceanography **27**, 69–75. [2] Pinedo-Gonzalez et al. (2018) Geochimica et Cosmochimica Acta **235**, 41–54. [3] Paul et al. (2015) Analytica Chimica Acta **863**, 59-69.