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Atmospheric deposition, sediment desorption, and anthropogenic control on distribution of dissolved Lead in the Indian Ocean

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This study investigates the distribution of dissolved lead (dPb) in the Indian Ocean, including the Bay of Bengal, Arabian Sea, equatorial, and southern sector of the Indian Ocean. The dPb concentrations in the mixed layer depth range from 23 to 114 pM, with higher values observed in the northern Indian Ocean, where the concentration of dPb was as high as 162 pM in the eastern Arabian. A significant latitudinal gradient in the dPb abundance in the mixed layer was observed, decreasing from north to south. Atmospheric deposition is the primary source of dPb in the open ocean, with coal combustion and industrial activities in developing countries around the Indian Ocean being the major contributors. The Pb atmospheric flux based on Al flux ranged from 7 to 292 μmol m^{-2} y^{-1} over the Arabian Sea, 10 to 128 μmol m^{-2} y^{-1} over the Bay of Bengal, 3.5 to 18.9 μmol m^{-2} y^{-1} over the equatorial Indian Ocean, 4.5 to 30.5 μmol m^{-2} y^{-1} over the southern Indian Ocean, while the Pb flux from the continental shelf ranged from 82.6 to 151 μmol m^{-2} y^{-1} in the Bay of Bengal and 14.1 to 15.9 μmol m^{-2} y^{-1} in the Arabian Sea. The contribution of dPb from the continental shelf to the Bay of Bengal was significantly higher than the atmospheric flux, highlighting the importance of the shelf sediment flux in supplying dPb to the basin. In contrast, the Arabian Sea is more dominantly influenced by atmospheric contributions compared to the western shelf sediment flux. Apart from coal combustion, climatic events, such as the Indian Ocean Dipole (IOD), enhance Australian bushfires and dust storms, which play a substantial role in adding dPb over the southern Indian Ocean.