Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35956

# Transfer of anthropogenic lead (Pb) to Antarctic waters and the Pb-inventory of the Southern Ocean water column

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Human activities in the last 150 years have led to increased lead (Pb) concentrations in the southern hemisphere oceans, making this element a prime example of anthropogenic metal pollution. While the impact of anthropogenic Pb on the Antarctic ecosystem does not yet seem as dramatic as on other regions, Pb pollution in the Southern Ocean (SO) has not significantly decreased until recent years, despite continued international efforts to reduce Pb emissions in the Southern Hemisphere, highlighting the significant human impact on the atmospheric cycle of Pb even in the most remote places on Earth.

Anthropogenic Pb inputs and distribution processes in the SO are not yet well constrained with the Indian sector being the least explored and understood sector of the SO. It borders the marine-based East Antarctic Ice Sheet (EAIS), which is regionally increasingly exposed to corrosive warm modified Circumpolar Deep Waters, driving basal melting. In addition to potentially dramatic impacts on future sea-level rise, increased melting of the EAIS and the concomitant change in circulation on the East Antarctic shelf has consequences for trace element cycling. These environmental changes also result in more efficient entrainment of atmospherically deposited anthropogenic Pb into intermediate water depths of the Antarctic Circumpolar Current within the SO.

Owing to its distinct isotopic composition, Pb-isotope ratios serve as effective tracers for distinguishing and identifying natural and anthropogenic sources as well as tracking their distribution in marine environments. Here we present Pb-isotope data from 46 water column sampling stations in the Indian sector of the SO, obtained during the R.V. Polarstern expedition PS140/EASI-2 in the austral summer season 2023/24. These data enable us to constrain how and in what quantity anthropogenic Pb enters Antarctic waters, where it mixes with naturally sourced dissolved Pb. The combination of our results with classic physical-oceanographic water parameters such as density, temperature and salinity, that were also measured during the cruise, allows us to make clear statements as to where the dissolved lead in each examined body of water is derived from.