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Laminated Diatom-Ooze – Sensitive Holocene Archives for Lead and Mercury Loads in Marine Antarctica

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Mercury (Hg) and lead (Pb) are pollutants of concern due to their toxicity. Human activities have influenced the global biogeochemical cycle of these elements compare to their natural background. Despite the existence of well-studied records of Hg and Pb in the northern hemisphere, the extent of these elements accumulation extending back for millennia and the onset of anthropogenic pollution in the southern hemisphere, particularly marine Antarctica are not well understood. In general, not all the marine sediment archives have a potential to provide high temporal resolution records of natural and modern contaminant trends due to generally slow accumulation rates and well-oxygenated bottom waters which prevents accumulation of reduced metal phases. To reconstruct the global background values of these heavy metals in marine Antarctica and distinguish between natural variations and anthropogenic inputs, we used well-preserved and laminated biogenic siliceous sediments (diatom-ooze). Diatom-ooze cores taken at three basins around Antarctica (IODP318-U1357, ODP119-740, and ODP178-1098) eliminate the mentioned limitation due to high sedimentation rate reaching up to 2 cm/yr. This study provides the first resolved high-resolution records of Pb and Hg concentration in combination with the climatic variability of the Holocene.
We observed a pronounced peak in Hg records with the beginning of the industrial period with no evidence of preindustrial Hg emissions. In contrast to Hg, no indication of industrial marine Pb pollution has been found compared to background values. Existed studies relate low concentrations of Pb in Antarctica surface water to the biological scavenging of the Pb during periods of intense primary production. The studied diatom-ooze cores -found in high primary biological productivity regions- demonstrate that the reason is possibly the fact that remote areas such as Antarctica are still little affected by anthropogenic Pb emissions to the atmosphere.
In conclusion our results emphasis the importance of Hg as a gaseous element and its atmospheric deposition over remote areas which are not affected by direct anthropogenic sources. Besides, we performed a principal component analysis (PCA) on geochemical data obtained by ICP-MS and XRF from diatom-ooze cores. The results of PCA further revealed diatom-ooze as the dominant geochemical component with minor influence from other sediment compounds which makes the studied core as appropriate archives to study atmospherically deposited elements as the main driver.