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Arctic mercury increased at the Glacial-Holocene transition

Content

Mercury (Hg) is a pollutant of concern, especially for the Arctic ecosystems and populations. Present-day mercury biogeochemical cycle in the Arctic is extensively studied, however, the control of past climate changes on natural mercury variability remains uncertain. Arctic Hg is influenced by air-ocean exchanges and in turn, by the variability of the sea ice/open ocean fraction. Multi-year sea ice covering the Arctic waters during cold periods strongly limits Hg evasion from the ocean. During warmer periods, instead, multi-year sea ice melts and Hg is evaded from the ocean surface following biological and photochemical processes. Moreover, a larger fraction of first-year sea ice injects reactive bromine to the polar boundary layer, which contributes to scavenging of Hg to the snowpack. With the aim of understanding the relative contribution of the main climate-driven sources of mercury deposition in the Arctic, we report the first ice core record of Arctic Hg covering the Last Glacial Termination and Early Holocene (9000 – 15700 years before 2000 AD). The record has been measured in the EGRIP ice core (East Greenland Ice Core Project) and covers the Glacial-Holocene transition, the latest most abrupt climate change, representing a perfect context for investigating the main natural drivers of mercury variability in the Arctic without the influence of anthropogenic emissions. We find that mercury flux was three-fold higher during warm periods (Early Holocene) than during previous cold periods (the Younger Dryas). Using a multidisciplinary approach that combines ice cores and modelling, we find that climate-driven oceanic mercury evasion and, to a lesser extent, atmospheric bromine modulated mercury increase at the Glacial-Holocene transition. Both processes, oceanic evasion and atmospheric bromine levels, are controlled by the presence and age of sea ice. Our results suggest that the ongoing Arctic climate warming and projected future sea ice decline may lead to a more significant increase in oceanic mercury re-emissions than previously thought.

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