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A 300-year high resolution Greenland ice record of large-scale atmospheric pollution by arsenic in the Northern Hemisphere

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We report the first high-resolution record of arsenic (As) observed in Greenland snow and ice for the periods 1711 to 1970 and 2003 to 2009 AD. The results show well-defined large-scale atmospheric pollution by this toxic element in the Northern Hemisphere, beginning as early as the 18th century. The most striking feature is an abrupt, unprecedented enrichment factor (EF) peak in the late 1890s, with a ~30-fold increase in the mean value above the Holocene natural level. Highly enriched As was evident until the late 1910s; a sharp decline was observed after the First World War, reaching a minimum in the early 1930s during the Great Depression. A subsequent increase lasted until the mid-1950s, before decreasing again. Comparisons between the observed variations and Cu smelting data indicate that Cu smelting in Europe and North America was the likely source of early anthropogenic As in Greenland. Despite a significant reduction of ~80% in concentration and ~60% in EF from the 1950s to the 2000s, more than 80% of present-day As in Greenland is of anthropogenic origin, probably due to increasing As emissions from coal combustion in China. This highlights the demand for the implementation of national and international environmental regulations to further reduce As emissions.