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Widespread pollution of the South American atmosphere predates the industrial revolution by 240 years

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In the Southern Hemisphere, evidence for preindustrial atmospheric pollution is restricted to a few geological archives of low temporal resolution that record trace element deposition originating from past mining and metallurgical operations in South America. Therefore the timing and the spatial impact of these activities on the past atmosphere remain poorly constrained. Here we present an annually resolved ice-core record (793-1989 AD) from the high altitude drilling site of Quelccaya (Peru) that archives preindustrial and industrial variations in trace elements. During the pre-colonial period (i.e. pre-1532 AD), the deposition of trace elements was mainly dominated by the fallout of aeolian dust and of ash from occasional volcanic eruptions indicating that metallurgic production during the Inca Empire (1438-1532 AD) had a negligible impact on the South American atmosphere. In contrast, a widespread anthropogenic signal is evident after 1540 AD, which corresponds with the beginning of colonial mining and metallurgy in Peru and Bolivia, 240 years prior to the Industrial Revolution. This shift was due to a major technological transition for silver extraction in South America (1572 AD), from lead-based smelting to mercury amalgamation, which precipitated a massive increase in mining activities. However, deposition of toxic trace metals during the Colonial era was still several factors lower than 20th century pollution that was unprecedented over the entirety of human history.