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The dust enigma – Phases of enhanced calcium concentrations in Skytrain Ice Core (Antarctica) during the last 100 ka

Content

The concentration of mineral dust recorded in ice cores is a valuable indicator of past climate atmospheric aerosol load and atmospheric circulation patterns. As part of the WACSWAIN (WArm Climate Stability of the West Antarctic ice sheet in the last Interglacial) project, a new ice core was recently drilled to bedrock at Skytrain Ice Rise in West Antarctica. Continuous flow analysis (CFA) was performed over the whole length of the core. Measurements included the concentration of total dust using an Abakus particle counter, magnesium, calcium, sodium and aluminium using ICP-MS and sulfate via fast ion chromatography (FIC). A chronology was established by application of the Palaeochrono model in combination with absolute age markers supported by annual layer counting for the last 2000 years. We found that the stratigraphy of the core is preserved until about 126 ka BP with a small discontinuity around 105 ka BP. We observe enhancement of all dust markers (dust, nssCa, nssMg, Al) in parallel with those seen in other Antarctic ice cores at times such as the last glacial maximum. However, by comparison with other data, mainly from EPICA Dome C (EDC), we identified two additional phases of enhanced dust and calcium concentrations during the last glacial period. The first and most pronounced phase occurs from about 40 – 60 ka BP and the second from 80 – 100 ka BP. Calcium concentrations during these intervals are almost double the values measured in the EDC core. The enhanced calcium concentrations are associated with elevated large particle counts (> 4.5 µm) but not with high aluminium levels. These findings suggest a local source, namely the Ellsworth mountains, rather than dust transported from larger-scale circulation (i.e. changes in atmospheric transport) as the most likely reason for the excess of calcium and dust in the Skytrain Ice Core. This source could potentially correlate with the advance and retreat of local ice cover during colder and warmer phases within the last glacial, resulting in exposure of fresh glacially-abraded bedrock. We explore this hypothesis by making use of insights from the local geology and other methods for geochemical source apportionment.

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