Geophysical Research Abstracts
Vol. 19, EGU2017-12770, 2017
EGU General Assembly 2017

Bipolar synchronization of Dansgaard-Oeschger events 19 and 20 (71-77 ka BP)

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Greenland and Antarctic ice cores have revealed the existence of a series of major, abrupt climate change events occurring throughout the last glacial period. Despite the clear evidence of these changes in ice cores and other paleoclimate records, the underlying mechanisms of the events are a matter of ongoing debate. Here we investigate the bipolar timing of events across the period 71-77 thousand years before present, where some of the most significant abrupt climate change of the last glacial period occurs. The interval covers the Greenland Interstadials 19.2 and 20 (GI-19.2 and GI-20).

We apply annual layer counting and volcanic synchronization of the Greenland NGRIP and the Antarctic EDML and EDC ice cores to obtain a precise bipolar sequence of events. The synchronization allows us to investigate the bipolar phasing of climate (water isotopes and accumulation), atmospheric circulation (dust), and volcanism (acidity proxies) at decadal resolution.

At the onset of GI-19.2, abrupt change occurs synchronously at the two poles within few decades. At the EDC site, an abrupt increase in water isotopes (d18O) and a corresponding 20% increase in snow accumulation occurs right at the onset of GI-19.2 in Greenland, and an isotopic maximum occurs approx. 200 yr after the onset. The onset occurs right after a couple of bipolar volcanic eruptions that we hypothesize to trigger the event. Major changes in dust levels associated with the volcanic eruptions suggest a related change in atmospheric circulation. At the EDML site, however, no significant change is observed in relation to the GI-19.2 onset, so different sectors of East Antarctica display different patterns.

At the onset of GI-20, the EDC isotopes and accumulation show significant increases some 50 years prior to the Greenland isotopic onset. This occurs synchronously with significant dust level changes at both NGRIP and EDML. There are no major global volcanic eruptions related to the onset, but Greenland expresses a 50 year period of volcanic activity prior to the Greenland onset. No distinct isotopic maximum occurs at EDC or EDML after the onset of GI-20.