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Atmospheric CO2 and abrupt climate change on submillennial timescales

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How atmospheric CO2 varies and is controlled on various time scales and under various boundary conditions is important for understanding how the carbon cycle and climate change are linked. Ancient air preserved in ice cores provides important information on past variations in atmospheric CO2. In particular, concentration records for intervals of abrupt climate change may improve understanding of mechanisms that govern atmospheric CO2.
We present new multi-decadal CO2 records that cover Greenland stadial 9 (between Dansgaard-Oeschger (DO) events 8 and 9) and the abrupt cooling event at 8.2 ka. The CO2 records come from Antarctic ice cores but are well synchronized with Greenland ice core records using new high-resolution CH4 records,precisely defining the timing of CO2 change with respect to abrupt climate events in Greenland.
Previous work showed that during stadial 9 (40∼38 ka), CO2 rose by about 15∼20 ppm over around 2,000 years, and at the same time temperatures in Antarctica increased. Dust proxies indicate a decrease in dust flux over the same period. With more detailed data and better age controls we now find that approximately half of the CO2 increase during stadial 9 occurred abruptly, over the course of decades to a century at ∼39.6 ka. The step increase of CO2 is synchronous with a similar step increase of Antarctic isotopic temperature and a small abrupt change in CH4, and lags after the onset of decrease in dust flux by ∼400 years.
New atmospheric CO2 records at the well-known ∼8.2 ka cooling event were obtained from Siple Dome ice core, Antarctica. Our preliminary CO2 data span 900 years and include 19 data points within the 8.2 ka cooling event, which persisted for ∼160 years (Thomas et al., Quarternary Sci. Rev., 2007). We find that CO2 increased by 2∼4 ppm during that cooling event. Further analyses will improve the resolution and better constrain the CO2 variability during other times in the early Holocene to determine if the variations observed during at 8.2 ka event are significant.