



Atmospheric CO₂ Over the Last 1000 Years: WAIS Divide Ice Core Record

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How atmospheric CO₂ varied over the last thousands years is of great interest because we may see not only natural, but also anthropogenic variations (Ruddiman, *Climatic Change*, 2003). The Law Dome ice cores reveal decadal to centennial variations in CO₂ over the last 2000 years (MacFarling Meure et al., *Geophys. Res. Lett.*, 2006). However, these variations have not yet been well confirmed in other ice core records. Here we use a newly drilled WAIS Divide ice core, which is ideal for this purpose because WAIS Divide has relatively high snow accumulation rate and small gas age distribution that allow us to observe decadal CO₂ variations with minimal damping.

We have started an extensive study of CO₂ in WAIS Divide core. So far we have obtained data for 960-1940 A.D. from the WDC05-A core drilled in 2005-2006. 344 ice samples from 103 depths were analyzed and the standard error of the mean is \sim 0.8 ppm on average. Ancient air in 8~12 g of bubbly ice is liberated by crushing with steel pins at -35 °C and trapped in stainless steel tubes at -262 °C. CO₂ mixing ratio in the extracted air is precisely determined using a gas chromatographic method. Details of the high-precision methods are described in Ahn et al. (*J. of Glaciology*, in press).

Our new results show preindustrial atmospheric CO₂ variability of \sim 10 ppm. The most striking feature of the record is a rapid atmospheric CO₂ decrease of 7~8 ppm within \sim 20 years at \sim 1600 A.D. Considering the larger smoothing of gas records in the WAIS Divide relative to Law Dome, our results confirm the atmospheric CO₂ decrease of \sim 10 ppm in Law Dome records observed at this time. However, this event is not significant in the Dronning Maud Land ice core (Siegenthaler et al., *Tellus*, 2005), probably due to more extensive smoothing of gas records in the core. Similar rapid changes of CO₂ at other times in the WAIS Divide record need to be confirmed with higher resolution studies.

We also found that our WAIS Divide CO₂ data are slightly higher than those of Law Dome by 3~5 ppm over most of the record. It is not clear whether the offset is due to real variability in ice cores or an analytical offset. We are participating in international laboratory intercalibration to determine the origin of the offset. Several WDC05-A and Law Dome ice samples are shared and will be analyzed for data comparison with CSIRO (Australian Commonwealth Scientific and Research Organization).