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A 62 ka record from the WAIS Divide ice core with annual resolution to 30 ka (so far)

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Drilling of the West Antarctic Ice Sheet (WAIS) Divide ice core has been completed to a depth of 3400 m, about 60 meters above the bed. We present an annually resolved time scale for the most recent 30ka (to 2800 m) based on electrical conductivity measurements, called "timescale WDC06A-5". Below 2800 m the ice is dated by matching isotopes, methane, and/or dust records to other ice cores. Optical borehole logging provides stratigraphic ties to other cores for the bottom-most 75 m that was drilled in December 2011, and indicates the bottom-most ice has an age of 62 ka. The relatively young ice at depth is likely the result of basal melting. The inferred annual layer thickness of the deep ice is >1 cm, suggesting that annual layer counting throughout the entire core may be possible with continuous flow analysis of the ice core chemistry; however, the annual signal in the electrical measurements fades at about 30 ka.

We compare the WDC06A-5 timescale through the glacial-interglacial transition with the Greenland GICC05 and GISP2 timescales via rapid variations in methane. We calculate a preliminary delta-age with: 1) accumulation rate inferred from the annual layer thicknesses and thinning functions computed with a 1-D ice flow model, and 2) surface temperature inferred from the low resolution d18O record and a preliminary borehole temperature profile. The WDC06A-5 timescale agrees with the GICC05 and GISP2 timescales to within decades at the 8.2k event and the ACR termination (Younger Dryas/Preboreal transition, 11.7 ka). This is within the delta-age and correlation uncertainties. At the rapid methane drop at ∼12.8 ka, the WDC06A-5 timescale is ∼150 years older than GICC05 and ∼90 older than GISP2; while at ∼14.8 ka, the timescales once again agree within the delta-age and correlation uncertainties. The cause of the age discrepancy at 12.8 ka is unclear.

We also compare the WDC06A-5 timescale at Dansgaard-Oeschger events 3 and 4 (∼27.5 and 29 ka) to the radiometrically-dated speolethem records from Hulu Cave, China (Larry Edwards and Hai Cheng, personal communication). To make such a comparison, we assume that the rapid variations in methane from the WAIS Divide core are synchronous with the rapid variations in d18O in the speleothem record. We find that the WDC06A-5 timescale is multiple hundreds of years older than the Hulu Cave record. As the GICC05 timescale is younger than the Hulu timescale, this puts the WDC06A-5 timescale even older than the GICC05. The uncertainties in the comparison are large both because of the uncertainty in the synchroneity of the ice core methane and speleothem isotope variations and because of the larger delta-age for the ice core in the glacial period. The timescale for the WAIS Divide core will be revised when the CFA results become available.