Inferred accumulation and thickness histories near the Ross/Amundsen divide, West Antarctica

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The United States ice coring community has identified the ice divide between the Ross and Amundsen Seas as the next site for a deep U.S. coring effort (Inland WAIS). As part of this program, we have used ground based radar-detected internal layers (assumed to be isochrones) to derive depth-age relationships for a prospective ice core site in the Inland WAIS area approximately 25 km from the current divide on the Ross Sea side.

The depth-age relationship is based on radar layers tracked from the dated ice core at Byrd to the prospective site. The depth of the oldest distinct radar layer (observed at 1.5 MHz) corresponds closely to an acidity event in the Byrd core, which has been attributed to "excessive volcanism" 17.5 ka BP. Due to the lack of any layers between 8.4 ka and 17.3 ka BP, we are unable to resolve any details of accumulation rate in that time period. Consequently, we restrict our analysis to the most recent 8.4 ka. The traced-radar-derived time scale for Inland WAIS is compared with results from a one-dimensional flow model to infer possible combinations of past thinning, accumulation, and ice sheet geometry at the site in the Holocene. Our model is based on the formulation of Dansgaard and Johnsen (1969) and includes the effects of strain-thinning, variations in accumulation rate and ice thickness in the past and basal melting.

Our results suggest that the thick ice in the region (3,300m) makes the depth-age relationship relatively insensitive to small changes in ice thickness. Variations in layer thickness on short time scales (relative to the characteristic response time of ice thickness divided by accumulation rate) arise primarily from variations in accumulation rate. Model results suggest that the Holocene accumulation rate between 8.4ka and the present averaged ~125% of the modern value, and that accumulation rate reached a maximum value between 6 and 4 ka BP.