High Basal Melt at the WAIS-Divide ice-core site

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We use the depth-age relationship and borehole temperature profile from the WAIS-Divide ice core site to determine the basal melt rate and corresponding geothermal flux. The drilling of the WAIS-Divide ice core has been completed to 3400 m depth, about 60 m above the bed. The age of the deepest ice is 62 ka, younger than anticipated, with relatively thick annual layers of ~1 cm. The borehole temperature profile shows a large temperature gradient in the deep ice. We infer a basal melt rate of 1.5 (±0.5) cm yr^{-1} using a 1-D ice flow model constrained by these data sets. The melt rate implies a geothermal flux of ~230 mW m^{-2}, three times the measured value of 70 mW m^{-2} at Siple Dome.

We compile radio-echo sounding data sets to assess the spatial extent of high melt. Deep internal layers are the most useful for inferring spatial patterns of basal melt. Unfortunately, the IceBridge WAIS-core flight and two site-selection surveys did not image consistent reflectors deeper than Old Faithful (2420 m and 17.8 ka). A ground-based survey by CReSIS (Laird et al., 2010) was able to image consistent layers as deep as 3000 m, but the survey is not oriented along the ice-flow direction making interpretation more difficult. There is no obvious draw down of deep internal layers that would indicate an area of localized melt. While this suggests a uniform melt rate within the survey, it might also indicate that other factors (e.g. accumulation gradients, rough bed topography) obscure the influence of basal melt on the internal layer depths.