



Constraining the Antarctic contribution to global sea-level change: ANDRILL and beyond

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Observations, models and paleoclimate reconstructions suggest that Antarctica's marine-based ice sheets behave in an unstable manner with episodes of rapid retreat in response to warming climate. Understanding the processes involved in this "marine ice sheet instability" is key for improving estimates of Antarctic ice sheet contribution to future sea-level rise. Another motivating factor is that far-field sea-level reconstructions and ice sheet models imply global mean sea level (GMSL) was up to 20m and 10m higher, respectively, compared with present day, during the interglacials of the warm Pliocene (~4-3Ma) and Late Pleistocene (at ~400ka and 125ka). This was when atmospheric CO₂ was between 280 and 400ppm and global average surface temperatures were 1 to 3°C warmer, suggesting polar ice sheets are highly sensitive to relatively modest increases in climate forcing. Such magnitudes of GMSL rise not only require near complete melt of the Greenland Ice Sheet and the West Antarctic Ice Sheet, but a substantial retreat of marine-based sectors of East Antarctic Ice Sheet.

Recent geological drilling initiatives on the continental margin of Antarctica from both ship- (e.g. IODP; International Ocean Discovery Program) and ice-based (e.g. ANDRILL/Antarctic Geological Drilling) platforms have provided evidence supporting retreat of marine-based ice. However, without direct access through the ice sheet to archives preserved within sub-glacial sedimentary basins, the volume and extent of ice sheet retreat during past interglacials cannot be directly constrained. Sediment cores have been successfully recovered from beneath ice shelves by the ANDRILL Program and ice streams by the WISSARD (Whillans Ice Stream Sub-glacial Access Research Drilling) Project. Together with the potential of the new RAID (Rapid Access Ice Drill) initiative, these demonstrate the technological feasibility of accessing the subglacial bed and deeper sedimentary archives. In this talk I will outline the scientific challenges, some potential sub-glacial sedimentary targets, and a strategy for future drilling of sub-glacial sedimentary basins.