Subglacial conditions and ice flow across the Weddell Sea sector of West Antarctica: synthesis from recent aerogeophysical surveys

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Institute and Möller Ice Streams (IMIS) together drain ~20% of the ice from West Antarctica, forming major contributors to the Weddell Sea Sector (WSS) of Antarctica. Before 2010, relative to the other major West Antarctic drainage basins feeding the Ross and Amundsen Seas, the WSS was rated as West Antarctica's "pole of ignorance" concerning past and present glaciological conditions and sensitivity to change. Underpinned by the hypothesis that IMIS may be underlain by deformable marine sediments analogous to the Siple Coast ice streams, and may therefore be prone to similar ice-dynamical instabilities, a comprehensive aerogeophysical survey of IMIS was undertaken in the austral summer 2010/11 under the auspices of NERC's Antarctic Funding Initiative. Herein we present a synthesis of findings from the new data.

We now know that the lower portion of IMIS is underlain by a deep basin filled with marine sediments and sloping inland, rendering much of the region vulnerable to the marine ice-sheet instability. Inland of the marine basin, the subglacial terrain is composed of mixed roughness. This reflects, in part, a significant tectonic signature of faults, structural lineaments and Jurassic intrusions likely emplaced during opening of the Weddell Sea Rift. Superimposed is a geomorphological signature testifying to the basin's experience of waxing and waning ice cover over glacial cycles. An extensive plateau inland of the deep basin was likely created under ice-free conditions during the mid-Miocene (17-15 Ma), while large channels cut into the bedrock testify to the presence of thinner, temperate ice cover which allowed supraglacial-subglacial connections during the Pliocene (5.3 – 2.6 Ma). Today the regional ice cover is thinning steadily from the Last Glacial Maximum (20 ka). Patterns of englacial layering suggest that in the less topographically constrained western and southern parts of IMIS the spatial configuration of ice has changed considerably, likely in response to thinning and increased grounding of the Bungenstock Ice Rise and a proportional increased to drainage of IMIS via Institute Ice Stream. Multiple lines of evidence show that IMIS is today underlain by a highly dynamic subglacial hydrological system which may facilitate further changes to the ice flow. Modelling suggests that of all the WSS ice streams, IMIS may be particularly susceptible to considerable change after only a projected moderate increase in ice-shelf melt at its grounding zone.

Sung to the tune of: Changes in WAIS from observations (*The Times They are a-Changin')*