Geophysical Research Abstracts
Vol. 16, EGU2014-8183, 2014
EGU General Assembly 2014

Aeromagnetic and gravity imaging of subglacial geology beneath major ice streams flowing in the Weddell Sea Embayment

Fausto Ferraccioli (1), Owen King (1), Tom Jordan (1), Neil Ross (2), Rob Bingham (3), David Rippin (4), Anne LeBrocq (5), Martin Siegert (6), Andy Smith (1), and Richard Hindmarsh (1)

(1) British Antarctic Survey, Geological Sciences, Cambridge, United Kingdom (ffe@bas.ac.uk), (2) Newcastle University, School of Geography, Politics and Sociology, Newcastle, United Kingdom, (3) University of Edinburgh, School of Geosciences, Edinburgh, United Kingdom, (4) University of York, Environment Department, York, United Kingdom, (5) University of Exeter, Geography, College of Life and Environmental Sciences, Exeter, United Kingdom, (6) University of Bristol, School of Geographical Sciences, Bristol, United Kingdom

Extensive airborne geophysical research has helped unveil subglacial geology beneath the West Antarctic Ice Sheet (WAIS) in particular over the Ross Sea Embayment. Three key geological controls on the onset and maintenance of fast glacial flow for the WAIS have emerged including the presence of widespread subglacial sediments deposited within deep rift basins, thinner drapes of marine sediments within the low lying topography of the West Antarctic Rift System (WARS) and high geothermal heat flux associated with Cenozoic rift-related magmatism.

Here, we compile a suite of new and vintage aerogeophysical observations over the catchments of several major ice streams flowing into the Weddell Sea Embayment to examine their large-scale geological setting and assess the role of regional geological controls on subglacial topography and WAIS flow regimes. Specifically, we examine the subglacial geology beneath the catchments of the Institute and Moeller ice streams, the Rutford ice stream and the Evans ice stream using a combination of airborne radar, aeromagnetic and airborne gravity imaging. We show that the Moeller ice stream is underlain by the largest strike-slip fault system recognised so far along the tectonic boundary between East and West Antarctica. This fault system controls the location of a set of en-echelon subglacial basins that steer enhanced flow inland. We find no evidence, however, for deep sedimentary basins along this fault system, suggesting that subglacial sediments are not necessarily a geological template for the onset of fast flow. However, the newly identified Robin Subglacial Basin that underlies the fast flowing coastal region of the Institute ice stream contains 1-3 km of sedimentary infill and remarkably smooth bedrock topography. Enhanced flow in the tributaries of the Institute ice stream that cut through the Ellsworth Mountains are controlled by major basement faults likely active in Cambrian and Permian times and perhaps reactivated during Cretaceous and Cenozoic mountain uplift.

Prominent magnetic anomalies overly outcrops of Jurassic granitic intrusions and enable us to trace their subglacial extent beneath the catchments of Institute, Moeller and Rutford ice streams. These large granitoid bodies form the topographic highs and ridges that also exert significant controls on ice flow. Magnetic anomalies also delineate the extent of a major Precambrian basement block that underlies a significant part of the Evans ice stream catchment. We propose that the edges of this Precambrian block may have been reactivated forming narrow rifts that appear to be a significant control on fast flow and may speculatively be connected to the Weddell Sea rifts and/or to the WARS.