New aeromagnetic and aerogravity survey over the drainage basin of Pine Island Glacier

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The Pine Island Glacier (PIG) and the Thwaites glacier are major drainage systems of the Amundsen Sea Embayment. This is a key area of the WAIS where there is mounting evidence for possible melting, thinning and retreating (e.g. Shepherd et al., 2001; Thomas et al., 2004). However current knowledge of regional ice thickness and subglacial boundary conditions are insufficient to improve models of its evolution and sensitivity to climate change.

During the 2004-05 campaign a US-UK team accomplished the first comprehensive airborne geophysical survey over the Amundsen Sea Embayment. Overall 100,000 km of new airborne geophysical data, including airborne radar, aeromagnetic and airborne gravity were acquired. Here we focus on aeromagnetic and airborne gravity data collected by the British Antarctic Survey over PIG basin. A total of 32,000 line km were acquired during 32 survey flights. Three constant elevation blocks were flown at 8100, 6300 and 4600 ft to obtain high quality airborne gravity data over PIG, while also ensuring ice radar returns from bedrock.

High-sensitivity caesium magnetometers (Scintrex Cs-3), placed in fixed wing configuration, provided the total field aeromagnetic measurements. A three component fluxgate magnetometer was used for magnetic compensation. A Geometrics caesium magnetometer was installed at the base camp to monitor external magnetic field variations, while Leica and Ashtech receivers were installed on the aircraft and at the base camp to supply the GPS data. The gravity signal was measured using a LaCoste and Romberg air/sea gravimeter, recently modified and upgraded by ZLS.

Aeromagnetic processing included: magnetic compensation, base station and IGRF corrections, levelling and microlevelling (Ferraccioli et al., 1998). Aerogravity processing (Jones et al., 2002) involved calculating vertical and horizontal platform accelerations, latitude, Eotvos and Free-air corrections. This was followed by low-pass filtering, levelling and Bouguer corrections.

This new potential field dataset will provide a unique tool to analyse geological controls on the dynamics of the WAIS in the PIG drainage basin area. This region is thought to conceal the tectonic boundary between the Thurston Island and Marie Byrd crustal blocks (Dalziel and Elliot, 1982), a segment of the West Antarctic Rift system (Behrendt et al., 2004 and ref.), and the boundary between the rift and the adjacent Ellsworth-Whitmore Mountains block. To the north of the PIG, the Hudson Mountains contain several parasitic cones protruding above the WAIS, and possibly resting on eroded stratovolcanoes. Satellite data indicate that an eruption may have taken place during 1985, although this has not been confirmed (LeMasurier and Thomson 1990). Active, or recently active, volcanism has previously been proposed as a critical boundary condition for WAIS stability (Blankenship et al., 1993; Behrendt et al., 2004 and ref). Hence our aeromagnetic imaging will specifically target the subglacial extent of volcanism beneath the PIG basin. Additionally, subglacial sediments, in the form of narrow rift basin infill, or regional marine sediment drape have been previously proposed as geological templates for enhanced ice flow (Bell et al., 1998; Studinger et al., 2001). Analysis of new potential field data will therefore address the possible presence of subglacial sediments beneath the PIG basin.

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