Data repository item: Description of airborne magnetic data processing.

A caesium magnetometer in a 'fixed-wing' configuration sampled the magnetic field at 10 Hz. A near constant aircraft speed of ~60 m s^{-1}, was maintained to provide magnetic data every ~ 6 m. All raw data were low-pass filtered with a 5 data point smoothing window to remove artefacts of aircraft motion.. Regional diurnal variations were subtracted using data from a magnetic base station installed at the base camp. The core geomagnetic field was removed from the survey data using the year 2000 IGRF coefficients, to obtain the crustal anomaly field. Statistical levelling and microlevelling procedures reduced residual crossover errors. The data were then corrected for distance to source (draped) to provide the total magnetic intensity (TMI) anomalies at 2 km above bedrock.

To enhance shallow magnetic sources the anomaly data were then high-pass filtered with a filter cut-off wavelength of 9km to produce amplitudes of residual anomalies (AoR). By analysing the gradient of the radially averaged power spectrum of the TMI anomaly data [I], we found that a wavelength of 9 km corresponds to a depth of 2-4 km below the observation altitude. For our draped dataset this corresponds to a layer up to 2 km thick. 2D Werner deconvolution [II] was used to quantify the depths of the magnetic sources responsible for the AoR shown in Figure 4 of the paper. In the low AoR area overlying T1, the Werner depth solutions are no shallower than 3 km below bedrock (Figure DR1). Solutions below a depth of about 4 km are due to "leakage" in the high-pass filter and do not represent "real" solutions. Most of the coherent clusters of sources lie above this depth except at ~1200 km and 1325 km. The latter cluster is most likely affected by edge effects as it lies near the limit of the data coverage. Forward modelling of one of the flight lines crossing the low AoR region was also performed (Figure DR2). The simple forward model was constructed by introducing a magnetic body within non-magnetic background. A dipping magnetic basement explains the slope in the regional anomaly. Using values of apparent susceptibility in the range of 10 $\times 10^{-3}$ SI units and assuming a thickness of approximately 8 km for the magnetic basement, depth to basement is approximately 3 km below bedrock in the centre of STN. This model is consistent with the independent Werner Deconvolution depth estimates (also shown in Figure DR2). Our model indicates the presence of a half-graben structure beneath STN with a 3 km thick sedimentary infill.

[I] A. Spector and F.S. Grant, Statistical Models for Interpreting Aeromagnetic Data, Geophysics 35(2), 293-&, 1970.

[II] C.C. Ku and J.A. Sharp, Werner Deconvolution for Automated Magnetic Interpretation and Its Refinement Using Marquardt Inverse Modeling, Geophysics 48(6), 754-774, 1983.

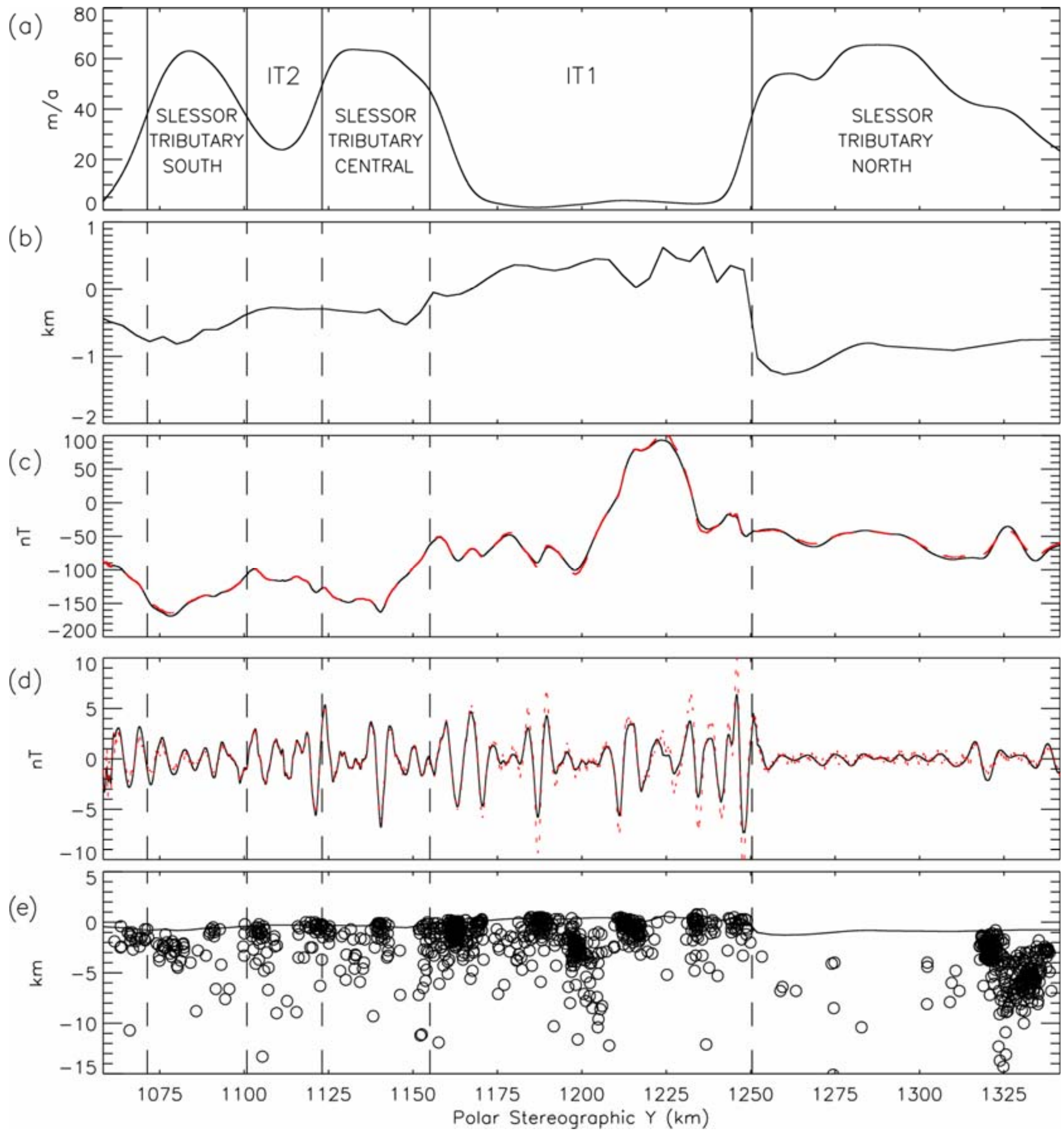

Figure DR1. Example profile crossing the low AoR magnetic region. The location of the flight line is shown in Figure 4. (a) Combined InSAR and balance velocities. The locations of shear margins (identified from SAR imagery) are shown (solid vertical lines) separating tributaries from inter-tributary regions, marked IT1 and IT2. These margins are shown as dashed lines in the remaining five panels. (b) Bedrock elevation from RES data. (c) Draped (solid) and original (red dotted) TMI profiles. (d) Residual high-pass filtered profile calculated from draped (solid) and original (red dotted) data. Note that high AoR values are interpreted as arising from Jurassic sills and dykes, while the low AoR region between 1255 and 1310 km is related to subglacial sediments overlying these rocks. (e) 2D Werner Deconvolution depth estimates. Magnetic sources are plotted as circles along with the bedrock elevation data (solid line). The 3 km thick sedimentary basin beneath Slessor Tributary North (1255-1310 km) is clearly defined by the lack of shallow magnetic sources in this region. Solutions below about 4 km are unlikely to be "real" and can be ignored here.

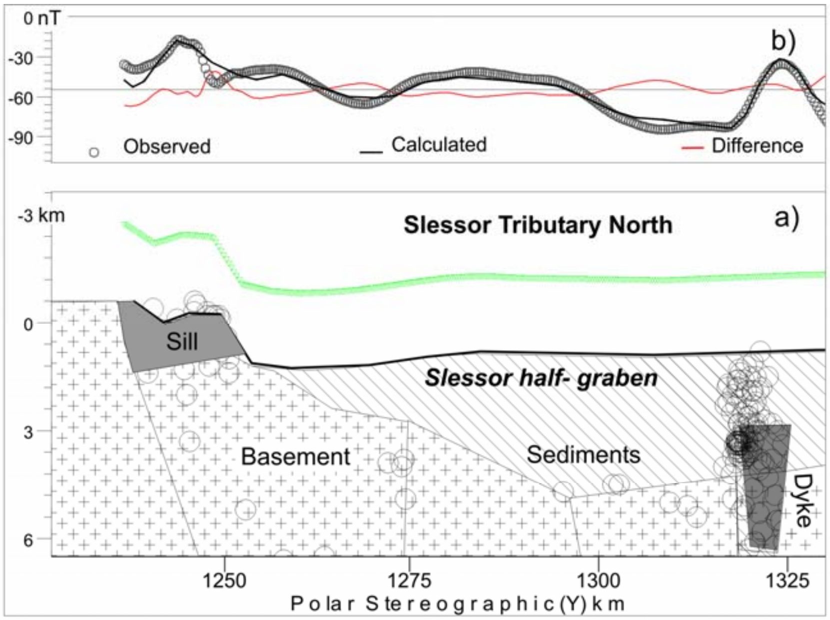

Figure DR2. a) Forward model along the section of the flight line shown in Figure S1, covering the area of low AoR from 1255-1310 km in Fig S1 and along the flight line in Figure 4. Flying altitude is shown by the green triangles. Apparent susceptibilities are between 5-12 10^{-3} SI units for the basement rock (crosses) and 15-20 10^{-3} SI units for the Jurassic sill and dyke complexes (grey). The diagonal hatched area shows the non-magnetic sedimentary infill of the Slessor half-graben structure interpreted as underlying STN. Werner solutions (circles) are at depths greater than 3 km below bedrock beneath this inferred sedimentary basin. A greater vertical exaggeration compared to figure S1 is used to enhance visualisation of shallow magnetic sources. Werner solutions are masked north of 1325 km, where magnetic modelling was not attempted because of possible edge effects. b) modelled and observed susceptibilities along the profiles and the difference, which has a mean of zero, indicated by the solid horizontal line at -55 nT (i.e. offset by this amount on the y axis scale).