

Sub-glacial volcanism in western Ross Sea?

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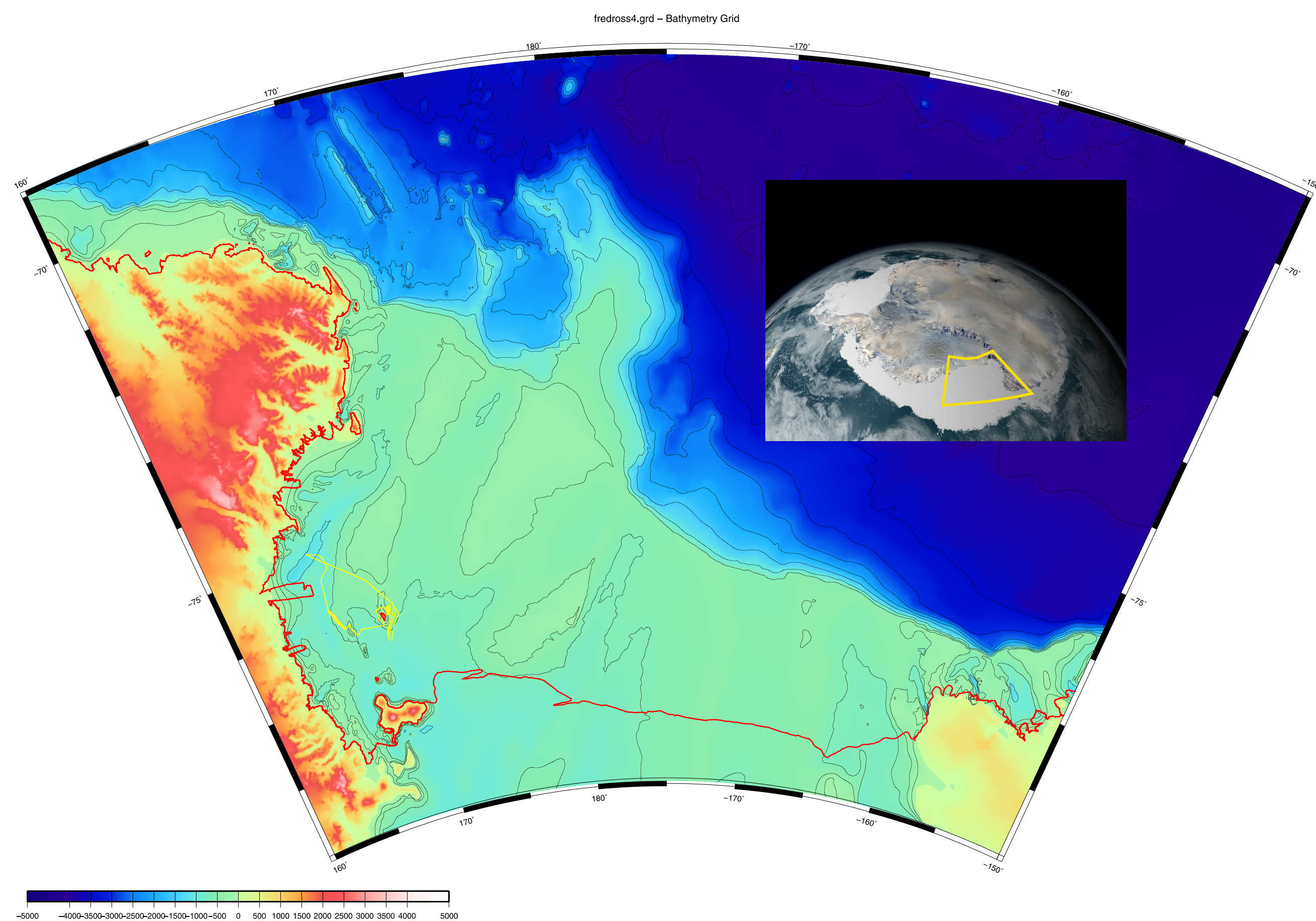


Figure 1. Ross Sea region (yellow box on inset). 2011 ARAON survey track (yellow line). Coast and ice shelf edge (red line)

Introduction

Preliminary marine geophysical results are presented from the Korean Expedition on R/V IB ARAON to Terra Nova Bay in western Ross Sea in February 2011 (Figure 1). The marine geophysical survey (3 days) recorded underway multibeam bathymetry data, gravity data and 3 component geomagnetic data. One dredge station was carried out. These data have been integrated with other existing geophysical data (US NBPalmer and SPLee cruises, Italian OGS Explora cruises)

The **multibeam** data, recorded using an EM122 swath echosounder, extended the area of the field of unusual flat topped seafloor mounds located west of Franklin Island by about 6 km further south east. An additional nine mounds have been delineated. The total field covers an area about 20 km square and lies at a depth of about 500 m (Figures 2A and 3A). Similar features also occur 25 km south (four mounds) and 5 km east (one mound) of Franklin Island (Figure 2B and 3B) at depths of 650 m and 500 m respectively. Data also covered a pock mark field (Figure 3D) and a major volcanic bank.

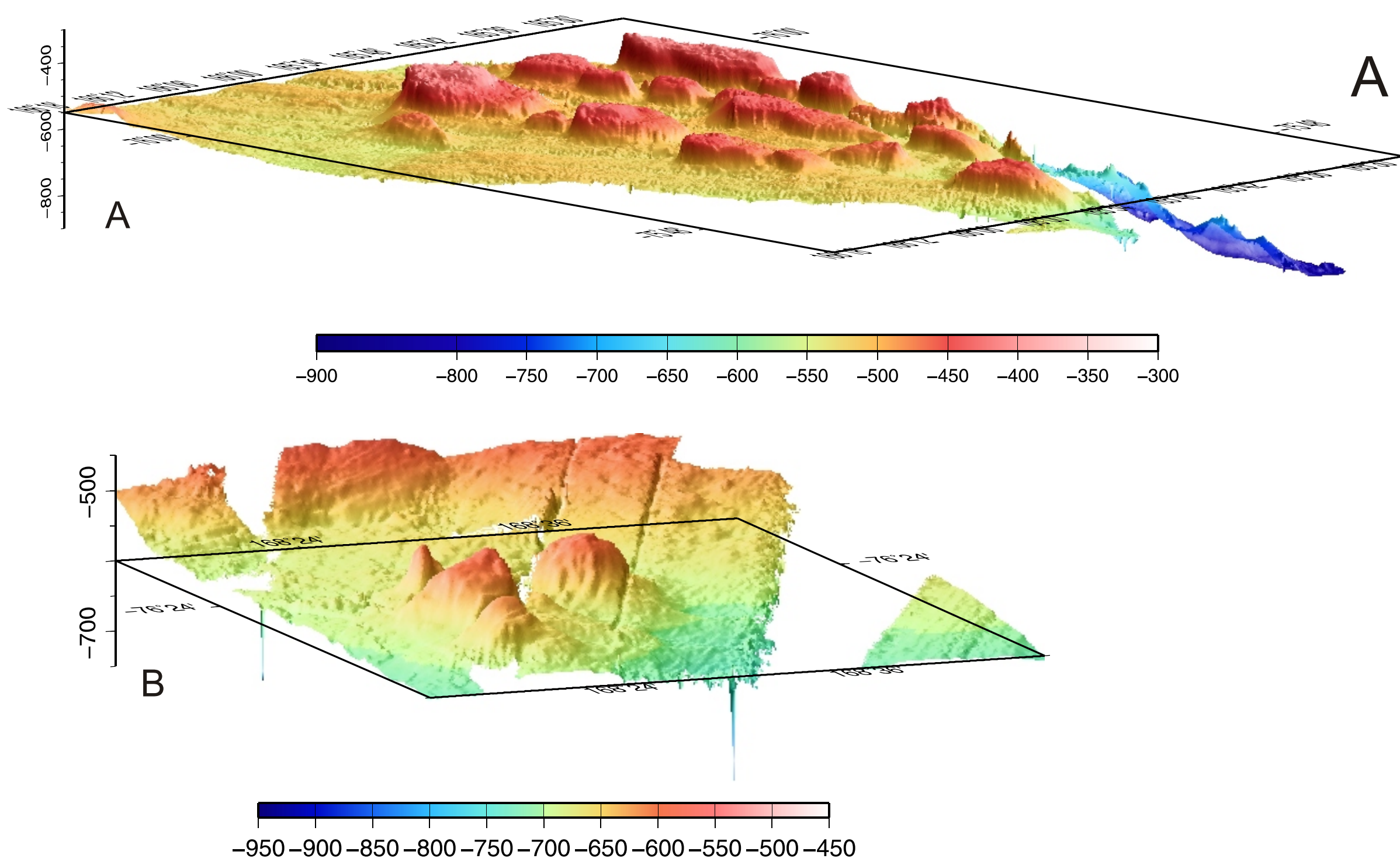


Figure 2 A. 3D view of western mounds from the northeast
B. 3D view of southern mounds from the south

Morphological characteristics

West group. Largest mound is about 4 km across and 100 m high. Steepest slope to the south-east, shallowest slope to the northwest, consistent with erosion by a northwest icesheet movement. Northerly trend and tend to be circular in the east and linear in the west, probably fault controlled (seismic data).

South group. Largest mound is about 4 km across and 100 m high. Steepest slope to the south-east, shallowest slope to the northwest, consistent with erosion by a northwest icesheet movement. No alignment apparent.

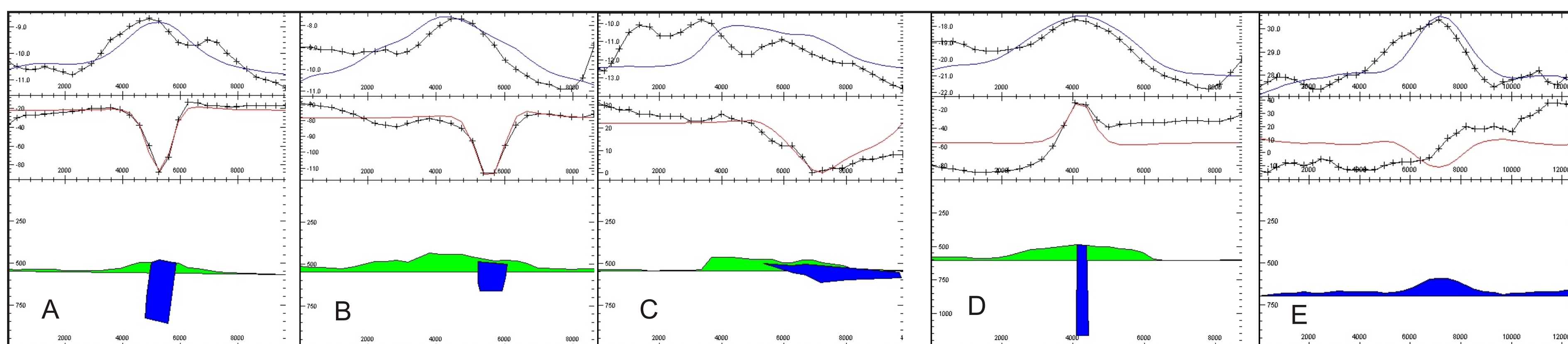
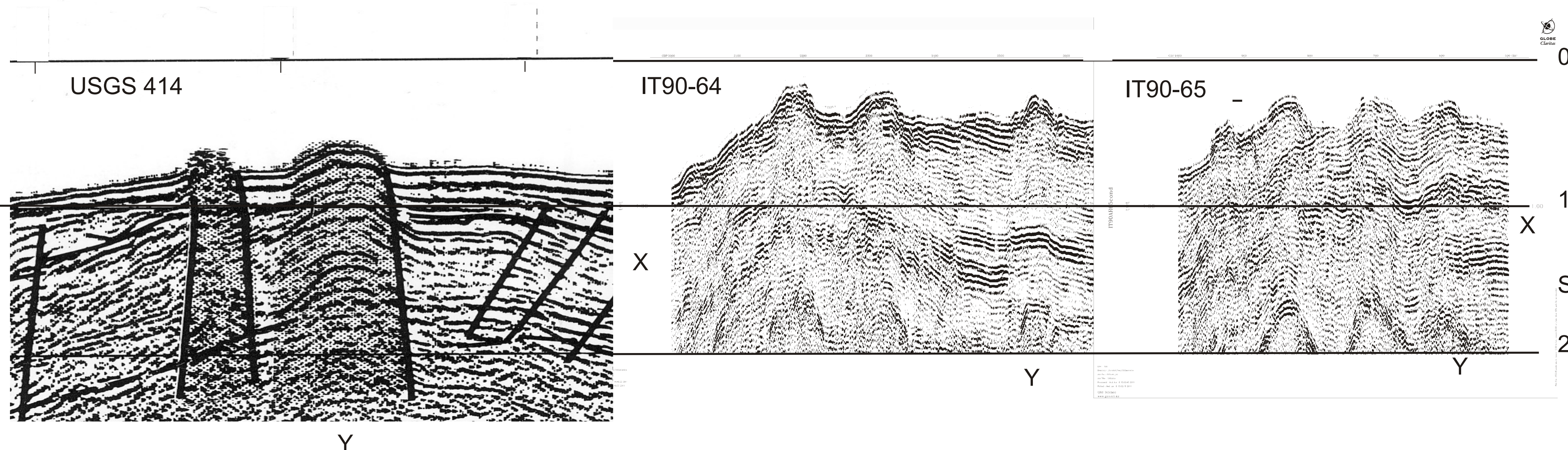


Figure 3 A. Bathymetry of western mounds, contour 25 m intervals. Tracks: blue - ARAON, red - NBP0401. Seismic profiles (Figure 5) green and annotated. Gravity and magnetic model profiles (Figure 4) white and annotated.
B. Bathymetry of southern mounds, contour 25 m intervals. Tracks: blue - ARAON. Gravity and magnetic model profiles (Figure 4) white and annotated.
C. East mound. D. Pockmarks and ice furrows northwest of Franklin Island

Gravity and magnetic data. Gravity anomalies are small (2 - 4 mgal) (Figure 4A - E) and generally non-discriminant. Gravity data over the mounds, although often affected by ship movements or bad sea conditions, indicate that the mounds are largely low density.

Magnetic data show both very small anomalies indicating non-magnetic bodies forming the mounds, and distinct but small amplitude (~ 50 nT), short wavelength, normal or reversed magnetic anomalies, suggesting a magnetic core to the mounds Figure 4a-d). Simple 2.5 D models give magnetisations consistent with volcanic cores. Normal and reversed magnetization suggests rocks may have been emplaced around the last geomagnetic reversal (0.78 Ma). [Green body density 2.2. Blue body magnetic susceptibility 0.001 cgs]



Seismic data (Figure 5). No high resolution data are available. The mounds often overlie a largely non-disrupted sedimentary section (Figure 5 - X), although little structure can be seen within a mound. Faulting is common with large offsets in places. Velocity pull-up of underlying reflections (Figure 5 - Y) indicate low seismic velocity rocks (< 4 km/s) forming the mounds, consistent with the limited gravity modelling.

Discussion

The morphology, low density and often lack of magnetic anomaly of the mounds and their proximity to inferred subsurface gas hydrates and associated mud volcanoes (Geletti and Busetti 2011) and pockmarks (Lawver et al. 2007) suggest they may be carbonate banks, as delineated in the Porcupine Trough (O'Reilly 2003). However, they also occur close to a major volcanic bank and along the volcanic Franklin Island ridge. We suggest the distinct short wavelength magnetic anomaly, indicating both normally and reversed magnetisation, would favour the interpretation that they are of volcanic origin, erupted under a grounded ice sheet as hyaloclastite edifices as hyaloclastites can reach very low densities (~2.02 g/cm³) and magnetizations (Caratori Tontini, 2010)

References

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