Enigmatic Sea Floor Mounds in Antarctica—analysis of bathymetry data from geophysical cruise NBP04-01

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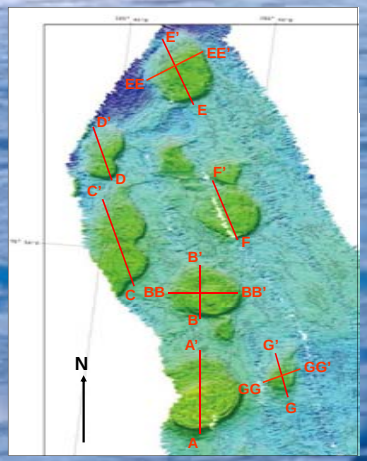
1 ABSTRACT

As part of the 2004 *Nathaniel B. Palmer*-0401 geophysical cruise, a structural geology enigma was identified on the Ross Sea floor off the Antarctica coast. Using multibeam bathymetry, a series of eight mysterious, "pepperoni-shaped" mounds were identified on the sea floor. My research entails the morphological study of these structures and the determination of their relationship to either nearby volcanism or subglacial features.

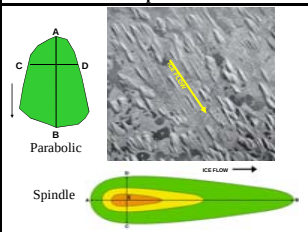
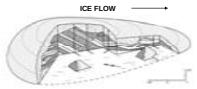
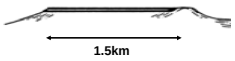
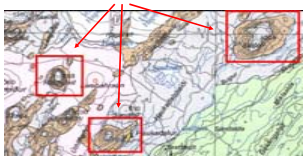
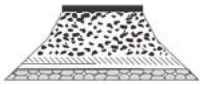
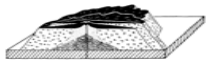
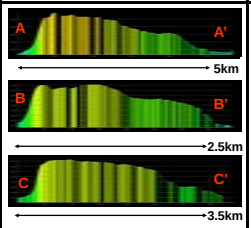
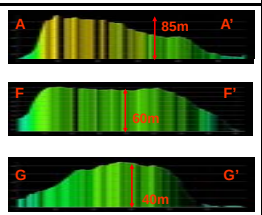
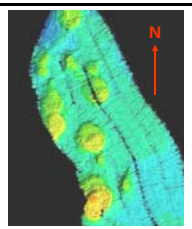
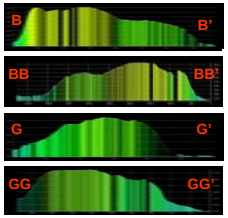
Through the use of the IVS-Fledermaus© software program, bathymetric data obtained from the cruise was projected in a 3-dimensional model. Morphological data from the seafloor hills is compared to the attributes of glacial drumlins and volcanic tuya. Future work will include adding seismic and magnetic profiles of the area to the 3D model to constrain their composition and the internal subsurface structure associated with the hills. Once the origin of these features has been determined, a search for their existence in similar environments worldwide can be conducted in order to determine their uniqueness.



2 WHAT COULD THEY BE?

This particular region of the Ross Sea was once covered by a grounded ice sheet at the last glacial maximum. The two hypotheses that were developed for the origin of the mounds are subglacial eruptions related to nearby volcanism, called tuyas, or subglacial depositional features, drumlins. Each of these two potential candidates are shown in further detail in the following section.

3

	Horizontal Scale	Height	Map View	Horizontal Profile	Internal Geometry	Internal Composition
DRUMLIN	▪100m – 1000m long axis ▪50m – 400m wide/shorter axis *Typically 2 – 3 times as long as wide	▪10m – 75m 		▪Long Axis Blunt End Tapering End ▪Short Axis	▪Complex, deformed internal layering ▪There is no typical internal form or geometry ▪All have a carapace of till 	▪Primarily sedimenta ▪Some drumlins have c of bedrock; which we existing knobs at the tim glaciation ▪Primarily unconsolida carapace of till surrou the core like an eggsh
TUYA	▪Characteristically ½km to upwards of 5km in length 	▪A few hundred meters or up to 1500m 	Tuyas in Iceland 	▪Flat-topped ▪Steep-sided 	▪All have a basal pillow lava deposit due to contact with water ▪The next layer is one of hyaloclastites and tuffs from explosive eruptions ▪The capping, flat-topped layer consists of brecciated lavas 	▪The entire structure consists of volcanics ▪Terrestrial tuya are sometimes capped by ec sediments which build u the flat top
ENIGMATIC MOUNDS					▪The internal geometry of these structures is unknown ▪Further studies of seismic imagery will assist in a better understanding of the internal structure	▪Dredging was not poss in this area due to sea ▪Additional investigati on magnetic and seism data of this particular re may help constrain th composition of these mounds; either volcani sedimentary
COMPARISONS	▪The size of these mounds is incredible, up to 5km ▪This is most similar to the length/diameter of a tuya	▪The largest mound rises up to 85m above the sea floor ▪The smallest is only 40m high ▪These mounds are intermediate between the two height ranges, yet closer to that of a drumlin	▪Some mounds are slightly elongate, but do not show the typical streamline drumlin shape ▪Near-circular mounds with a steep side more closely represent tuyas, but a gentle slope to the North suggests a drumlin	▪These do not show symmetrical steep sides, which is atypical of a tuya ▪Tapering to the north suggests a drumlin, but the blunt end is extremely steep	▪Seismic profiles should show a lack of internal reflections and show conduits or feeder dikes	▪The seismic data cou show the angular unconformity within a t ▪If these structures ar volcanic in origin, magn anomalies should be associated with these features

4 CONCLUSIONS

After comparing the several different characteristics of two subglacial processes, these enigmatic structures are surely a strange phenomenon. While their true identity is still unknown, a greater understanding has been achieved. The length, circular shape, steep side, and flat top all suggest a tuya; however, the contradiction is the tapering geometry and height which point to a drumlin. Further studies with seismic and magnetic data may help determine the internal composition and distinguish between the two.

ACKNOWLEDGEMENTS

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