Distribution of Sediments Beneath the Ross Ice Shelf, Antarctica, from Airborne Magnetic Data

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Knowledge of the tectonic development of the Ross Embayment in Antarctica can help constrain both the development of the West Antarctic Rift and the paleo-erosive extent of the Antarctic Ice Sheet. Thorough understanding of this tectonic development has been hampered by a lack of data constraining the region under the Ross Ice Shelf. In 2015, the first phase of the ROSETTA-Ice mission obtained an extensive suite of aerogeophysical data over the Ross Ice Shelf including radar, lidar, gravity, and magnetics. We applied a Werner deconvolution to the ROSETTA-Ice magnetic data to identify the basement topography below the Ross Ice Shelf. Interpretation of the depth solution was guided by comparison of Werner depth solutions from Operation IceBridge magnetic data in the Ross Sea with the acoustic basement from the ANTOSTRAT project. We established a threshold of susceptibility that provides a good fit between depth estimates of acoustic and magnetic basement. Operation IceBridge and ROSETTA-Ice data were compared along a coincident survey line and found to match well. We identify a pattern of alternating sediment troughs and highs that can be traced from the Ross Sea underneath the shelf. Notably, we find the Eastern Basin to extend southward from the shelf front for 250 km before curving southeastward, attaining a maximum depth of about 6 km. The Central Trough and Coulman High both extend south-southeastward from the shelf front for 150 km before being truncated by a deep (5-7 km) sedimentary basin that strikes northeastward from the outlet of the Byrd Glacier. We also identify a cross-cutting feature characterized by thick sediments, shallow bathymetry and high free-air gravity, potentially a remnant grounding line of the West Antarctic Ice Sheet. We generally observe thicker sediment at bathymetric highs and thinner sediment at bathymetric troughs, suggesting that the landscape under the Ross Ice Shelf has been significantly influenced by erosion. Despite the thick sediments predicted from the magnetic data, gravity models suggest relatively high densities under these bathymetric highs. Complex relationships between rifting, sedimentation and the resulting gravity anomalies have been reported from the western Ross Sea. Further work will incorporate the ROSETTA-Ice surveys from the 2016 season to investigate these relationships.