Sources of Magnetic and Gravity Anomalies on the Scotian Shelf South of Cape Breton Island, Nova Scotia, and Onshore-Offshore Geological Correlations Using Geophysical Modeling

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The Scatarie Ridge Magnetic Anomalies (SRMA) form a prominent northeasterly-trending belt, 100 km long by 25 km wide, on the Scotian Shelf south of Cape Breton Island. The area is inferred to be part of the Mira Terrane, a component of the Avalonia realm of the northern Appalachian Orogen. The magnetic anomalies range from 300 nT to 600 nT with the centres reaching highs of 1000 nT. In conjunction with the magnetic anomalies are positive gravity anomalies that range from 10-30 mGal. This study is using forward-modeling software to model magnetic and gravity data to investigate possible sources of the SRMA. The interpretations are constrained by physical property data measured in samples collected from onshore areas, and by multichannel seismic lines collected by PetroCanada and the Geological Survey of Canada Frontier Geoscience Project (Lithoprobe East). Previous seismic interpretations helped locate known reflectors and made it possible to correlate these reflectors across the seismic lines. In areas where seismic lines do not extend, magnetic and gravity profiles were extrapolated into these areas to provide additional constraints. The second vertical derivative magnetic anomaly map shows continuous linear trends as well as circular anomalies of various sizes that are similar to those on the onshore Mira Terrane. The linear trends mark the northern boundary of the Orpheus Graben and demonstrate values for magnetic susceptibility and density that are similar to the data measured in rock samples from the Fourchu Group onshore. The circular bodies yielded model magnetic susceptibility and density values resembling granitic and gabbro bodies. Offshore Mira units are 12-14 km deep at the centre of the Orpheus Graben, but lie at depths of 600 m to the north where they are overlain by Carboniferous cover. Offshore Meguma units are interpreted to overlie the offshore Mira units in the graben and on average have 1-2 km of Mesozoic-Cenozoic cover. In Orpheus Graben the Mira and Meguma units are buried beneath 10 km of Mesozoic-Cenozoic sedimentary rocks. The offshore Mira Terrane has been modeled as several units with different magnetic susceptibility and density values to represent changes in lithology similar to the changes in Neoproterozoic volcanic, sedimentary and plutonic rocks that form much of the onshore terrane. The Mira basement is divided into units based on differences in magnetic susceptibility and density, 0.03×10^{-3} to 0.08×10^{-3} SI and 2700-2800 kg/m^3, respectively. The Meguma basement in the models has similar density, but lower magnetic susceptibility (0.01×10^{-3} SI).

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