

Mapping the Lake Owen Layered Mafic Complex With Earth MRI Aeromagnetic Data, Medicine Bow Mountains, Southern Wyoming

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As part of the USGS Earth Mapping Resources Initiative (Earth MRI) to improve understanding of geology relevant to domestic critical mineral resources, this study presents new geophysical data and interpretations for the ca. 1775 Ma Lake Owen layered mafic intrusion (LOLMC). The LOLMC, part of the Paleoproterozoic Green Mountain arc, has known mineralization of PGEs, vanadium, and titanium, and has been sporadically explored for decades. The LOLMC is a partially concealed funnel-shaped intrusion with well-defined, steeply dipping layers, as revealed by geologic mapping. Strong magnetizations, including a general association between the most magnetite-rich layers and mineralization, make aeromagnetic methods important for mapping both overall geometry and internal zoning. However, previous studies were hampered by a lack of high-quality aeromagnetic data and contradictory results from rock magnetic studies. A high-resolution (100 m line spacing, 80 m clearance) aeromagnetic survey, supplemented by new ground gravity and petrophysical datasets, provides an improved understanding of the LOLMC. The LOLMC is very strongly magnetized and denser than surrounding rocks, producing a 9000 nT aeromagnetic anomaly and a 10 mGal gravity anomaly. A strongly skewed aeromagnetic anomaly, even after reduction to pole, indicates that the LOLMC's magnetization is dominated by remanence. A total magnetization direction with shallow normal inclination is estimated by studying the shape of the aeromagnetic anomaly ("Helbig's method"), which is used to aid modeling of the LOLMC geometry and magnetization. The aeromagnetic data map magnetite-rich layering, important both for imaging overall layering patterns and guiding critical mineral exploration. Patterns expressed in the aeromagnetic data are broadly consistent with the funnel-shaped geometry revealed by geologic mapping but reveal additional local details. Modeling of the gravity anomaly, constrained by interpretations of seismic reflection data, indicates that the LOLMC is cut by two Laramide thrust faults that significantly alter its geometry at depth.