CHAPTER G: MAGNETIC MODELING OF NORTHEAST TANACROSS

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INTRODUCTION

Two magnetic modeling studies were performed to assist with the geologic interpretation of the map area. A sub-regional unconstrained magnetic susceptibility model was produced to compare the depth extent of the magnetic intrusive rocks of the Taurus prospect area and the Pika and Fishhook prospect area. A series of forward magnetic models was created to determine the likely depth extent and dip of the amphibolite and serpentinite (MDlau) unit.

SUB-REGIONAL MODEL

The unconstrained magnetic inversion of the Northeast Tanacross map area was performed using MIRA Geoscience's VPmg software resulting in a 3D magnetic susceptibility model. The unconstrained model is a merge of a smaller, more detailed inversion and a larger coarser inversion using VPmg's incision option. MIRA Geosciences provided technical support for creating the Northeast Tanacross map area model.

The detailed inversion model of the Northeast Tanacross map area has a horizontal cell size of 100 meters by 100 meters and is 2 kilometers in depth extent. The input data for this model were from the DGGS Ladue survey (Burns and others, 2020). The final regional model was used as the starting model and basement for the map area inversion.

The regional model extends between 18 and 92 kilometers beyond the Northeast Tanacross map area as shown in figure 1. This model has a horizontal cell size of 1000 meters by 1000 meters. The input data for the regional model was from the Alaska and Yukon magnetic compilation (Oneschuk and others, 2019). These data were upward continued to 500 meters by DGGS staff prior to performing the inversion. Three regional inversions with different starting models were calculated. The starting magnetic susceptibility was 100 x 10^{-3} SI, 10 x 10^{-3} SI, and 1 x 10^{-3} SI. A starting model of 10 x 10^{-3} SI was used for the final regional model.

Figure 2 shows an oblique view of the final Northeast Tanacross map area 3D model. The magnetic model is shown as a susceptibility shell with a value 17.5 x 10^{-3} SI that encloses modeled values greater than 17.5 x 10^{-3} SI. The susceptibility shell is colored by elevation. Important prospects, magnetic geology, the project area, and select waterways are also included in figure 2. The modeled magnetic body is tens of kilometers in horizontal extent and 15 or more kilometers in depth, and extends to the south and below the Bluff and Taurus prospects as seen in figures 1 and 2. In contrast, the Pika and Fishhook prospects sit on a smaller magnetic body that is a few kilometers in horizontal and vertical extent. The regional models show a larger and deeper magnetic body associated with the Taurus prospect regardless of the starting magnetic susceptibility of the regional model. The root of the VABM Lode unit is also visible in figures 1 and 2.

AMPHIBOLITE AND SERPENTINITE (MDlau) UNIT MODELS

A series of forward models were performed on the magnetic signature of the amphibolite and serpentinite (MDlau) unit shown in figures 1 and 2. These forward models were performed to provide geometrical and orientation constraints on the geobody associated with the observed magnetic anomaly. The forward models were performed using MIRA Geoscience's VPmg software. The model geometries were created from an inter-

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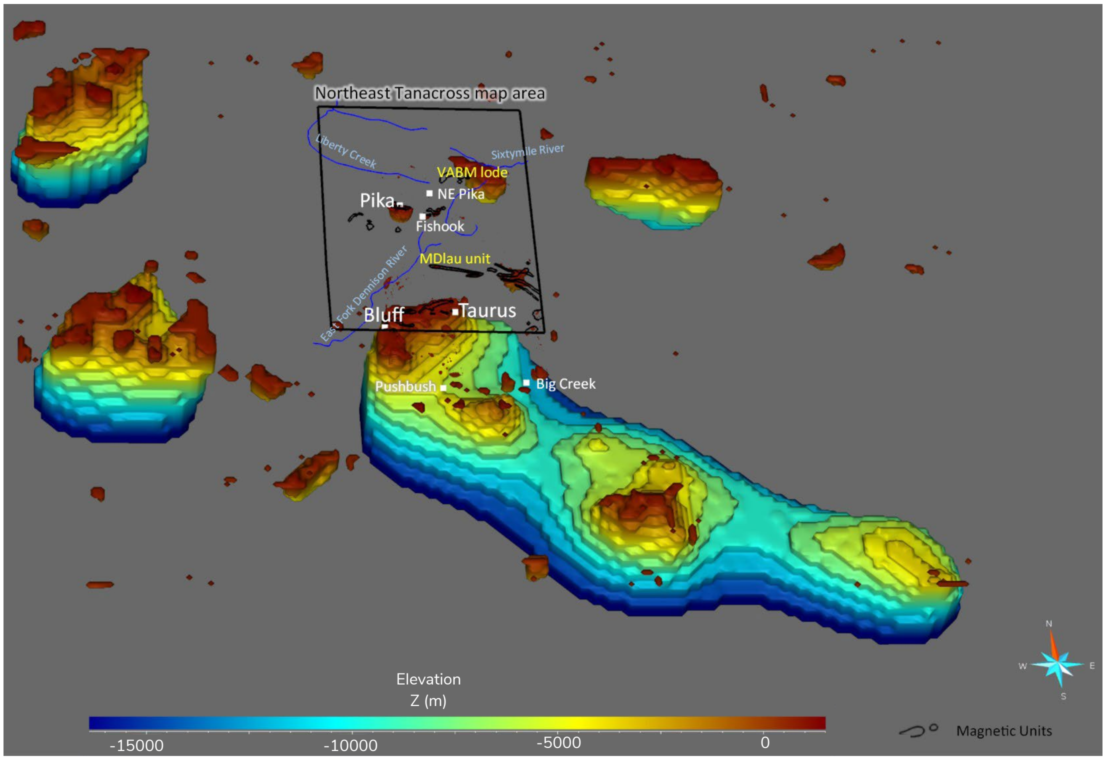

Figure 1. Aerial view of the final regional 3D model. The magnetic model is shown as a susceptibility shell with a value of 17.5 x 10^{-3} SI. The susceptibility shell is colored by elevation relative to mean sea level. The project area is shown with important geologic features, prospects, and select waterways.

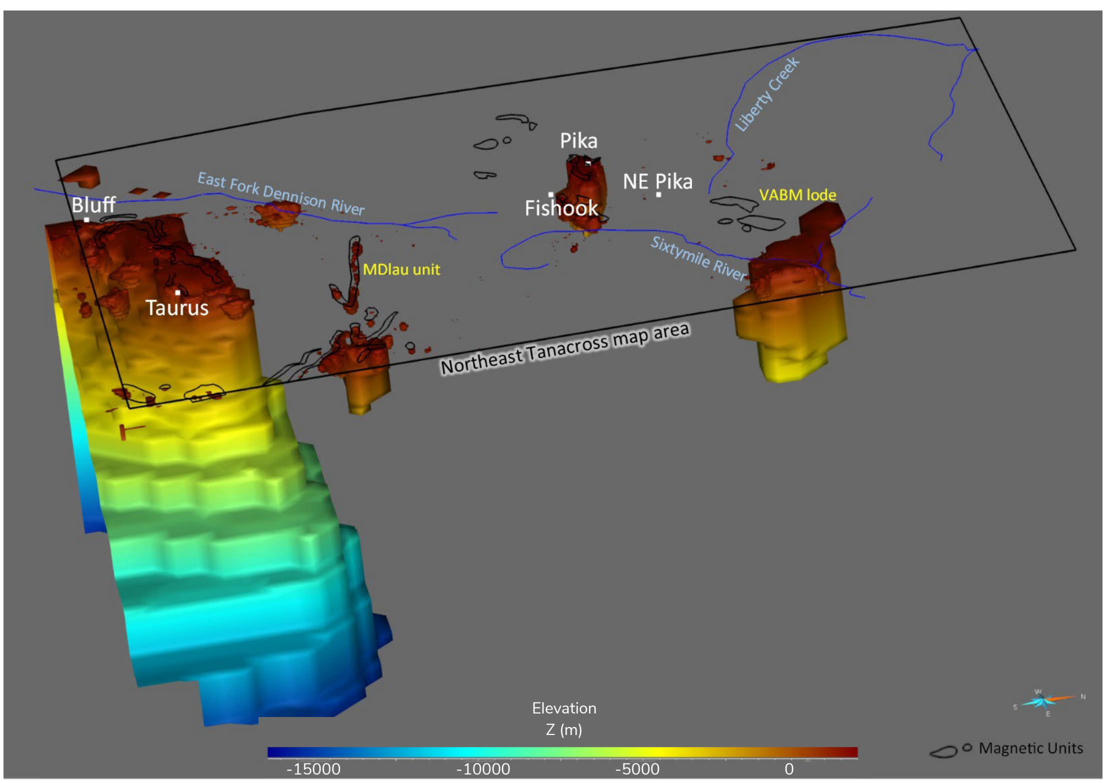

Figure 2. Final magnetic susceptibility model of the Northeast Tanacross map area shown as susceptibility shell with a value of 17.5 x 10^{-3} SI. The susceptibility shell is colored by elevation. The project area is shown with important geologic features, prospects, and select waterways.

preted surface expression of the geobody. Eight models were produced using the "Rapid Potential Field modeling of 3D dipping bodies" function of VPmg. The forward modeled data were compared qualitatively to the observed data for magnetic anomaly shape and quantitatively for anomaly amplitude. Magnetic susceptibility values from 38 outcrop samples ranged from 0.02 x 10^{-3} SI to 88 x 10^{-3} SI with a mean value of 8.6 x 10^{-3} SI.

Figure 3 shows the eight forward models produced using VPmg. Models that dip steeply to the north show the best fit based on anomaly appearance. Models with magnetic susceptibility of 10 x 10^{-3} SI did not produce an anomaly with the same magnitude as the recorded data. The 120-meter-thick, 60-degree-north-dipping model produced an anomaly of similar magnitude and shape to the recorded data. The MDlau unit is

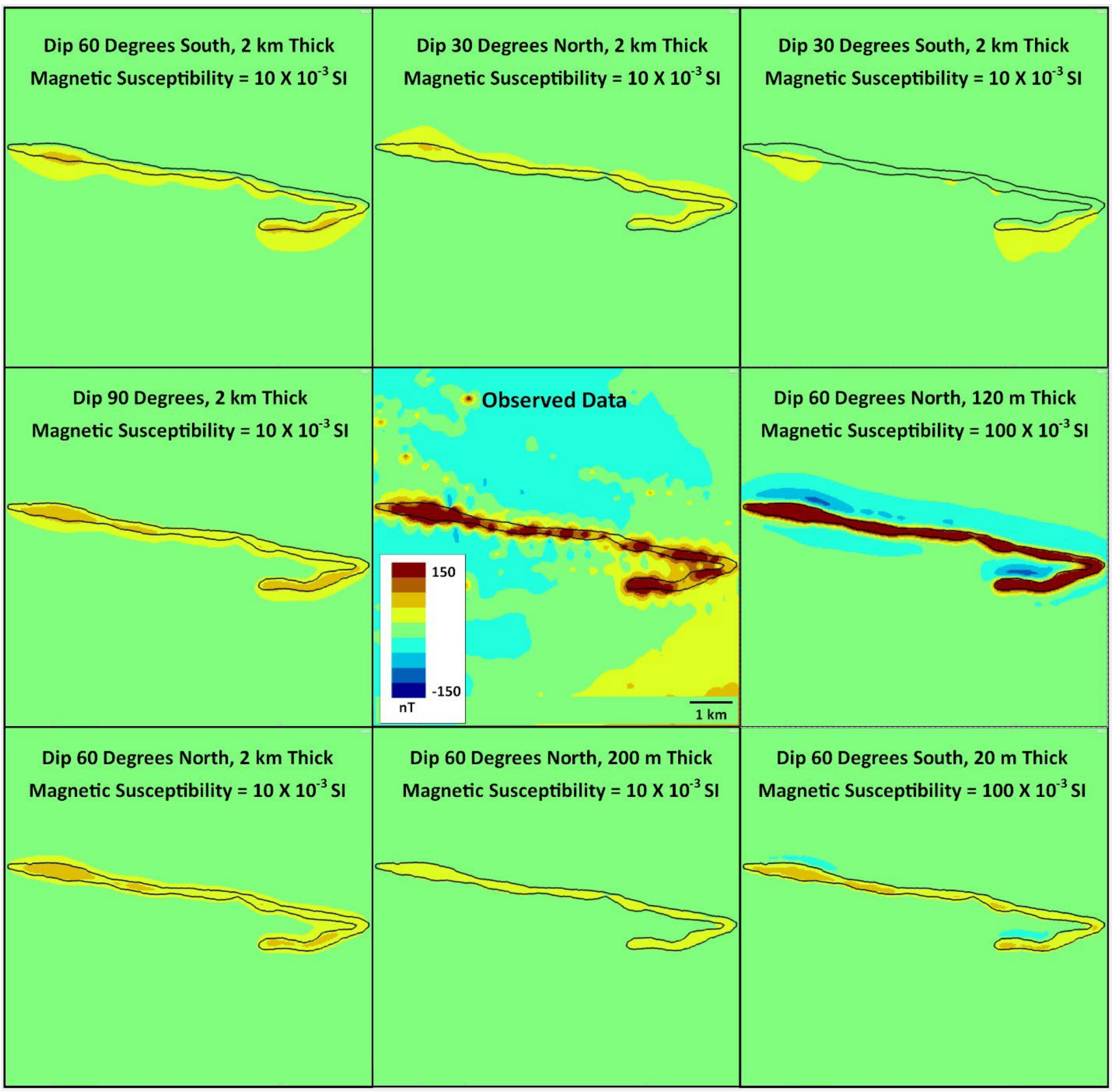

Figure 3. Results of eight forward magnetic models. Residual magnetic data are shown. The image in the center shows the observed data. All magnetic data share the same colorbar and map-scale.

interpreted as dipping steeply to the north, with a depth extent of more than 100 meters and a magnetic susceptibility greater than 10 x 10^{-3} SI.

SUMMARY

The sub-regional unconstrained inversion shows a thick and large magnetic body under the Taurus prospect region. Magnetic bodies under the Fishhook and Pika prospects are isolated and have smaller depth extents. The thick magnetic body beneath the Taurus region is truncated at the Sixtymile fault that follows the East Fork Dennison and Sixtymile Rivers. Its magnetic signature is consistent with both Late Cretaceous Taurus granodiorite (Ktgd). The Taurus-Bluff area contains locally abundant secondary magnetite, veins of which may be found in the Late Cretaceous intrusions as well as in the surrounding rock (Doug C. Kreiner, personally commun., 2020), another element adding to the magnetic signature of the region.

The magnetic forward models indicate the amphibolite and serpentinite (MDlau) unit is greater than 100 meters in thickness and dips steeply to the north. We interpret this body to be a dike due to the steep dip of the body, its thickness, cutting relations with the Lake George augen gneiss (MDag), and its Mississippian age (Wypych and others, 2020).

Results of geophysical models modeling are inherently non-unique. Other models than those presented may fit the data.

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