Aeromagnetic Modelling of the Sub-Athabasca Basement

J Mitchell, H Ugalde

Department of Earth Sciences, Brock University, St. Catharines, Ontario

The Athabasca Basin, located in the Canadian shield in northern Saskatchewan and Alberta is well known as the source for much of Canada's high-grade uranium deposits. These deposits are primarily found along the unconformable basement contact, under the Paleozoic sediments which make up the basin itself. Deposits are more likely to be found in areas with structural control traps, and reactivated fault systems. Pre-existing fault systems act as hydrothermal conductors in the emplacement of the uranium ore when they are reactivated. The sediments overlying much of the basement can be over a kilometre thick. Thus, understanding the basement structure and related fault systems are beneficial for exploration. The western basin, in particular, has seen much less exploration than the eastern basin, where sedimentary cover is thinner, and borehole data are more common. The aim of this independent study is to analyse and interpret the publicly available geophysical data for a large tract of the western basin, south of Lake Athabasca, and east of the Carswell impact structure. This area has thick sedimentary cover (generally ~1 km), therefore a better understanding of the Sub-Athabasca basement features is essential. Ground gravity surveys in the area are limited to a station spacing of approximately 12 km, which is not sufficient for the purposes of this study or any smaller scale basement geometry interpretation. An aeromagnetic and radiometric survey was flown in the area in 2010 with 400 m line spacing, and is the principle dataset used for analysis. This project involves the creation of a number of data enhancement products of the total magnetic field to understand the geometry of the Sub-Athabasca basement at depth. These data were compiled with pre-existing fault, dyke, and basement geology data provided by the Geological Survey of Saskatchewan. A first pass interpretation was performed from the integrated dataset. Subsequently, several cross-sectional lines were selected on the map and modelled in 2.5D by means of using polygonal bodies of limited size across strike. The overall integration allows the construction of a 3D model of the basement, first as a number of sections compiled in 3D, and later as a grid of basement topography compiled from all the individual models. This project shows that our understanding of the Sub-Athabasca basement is enhanced by geophysical data processing and interpretation. Imaging of basement topography and fault systems can aid in the future targeting of uranium deposits.