Metal Earth: a multidisciplinary academic project using deep geophysical methods to understand localization of mineral deposits in Archean rocks

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The main goal of the Metal Earth project is to improve the understanding of mineral endowment in Precambrian rocks. The focus is using new and existing geological observations, geochemistry, geochronology and geophysical data to compare differences between transects that cross metal endowed and lesser endowed Archean greenstone belts.

The new geophysical data collected include physical properties measurements on outcrop, hand-samples and in boreholes. Three types of active-source seismic data have been collected: regional reflection seismic data is intended to image down to the Moho; high resolution reflection seismic data were collected over some crustal scale structures associated with mineral deposits; and large offset refraction data were acquired in a few cases. The refraction data will be inverted using full waveform inversion methods, in the hope that some vertical changes in velocity can be identified at major structures. An experimental survey that acquired passive seismic data for a period of 40 days was tried on one of the transects. Regional broad-band magnetotelluric (MT) data have been collected on and around the traverses and higher resolution Audio MT data has been collected over some of the crustal scale structures. Finally, gravity data were acquired along the traverses. The regional reflection data showed strong sub-horizontal reflections in the mid-crust and below, while the high-resolution surveys were better able to image features in the top 10 km, including some of the crustal structures. Some vertical structures are evident on refraction data (so far processed using the first arrivals only). The MT data shows large and primarily horizontal conductive features in the mid crust and in many cases sub-vertical conductive features associated with crustal structures. The gravity and magnetic data is able to infer subsurface geometry in the upper crust when there are strong contrasts in density and magnetic susceptibility.

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