Correcting airborne gravity data for overburden thickness using transient electromagnetic data

R Caron[1], C Samson[1], M Bates[2], M Chouteau[3]

[1]Earth Sciences, Carleton University, Ottawa, Ontario
[2]Sander Geophysics, Ottawa, Ontario
[3]Département des génies civil, géologique et des mines, École Polytechnique, Montréal, Canada

Large areas of bedrock in Canada, such as in the interior plateau of British Columbia and in the Abitibi mining region, are covered by a thick glacial overburden. The presence of this overburden hampers exploration efforts by hiding geological features from direct observation. Another undesirable effect is related to the laterally-varying thickness of the overburden which can create spurious anomalies in potential field data. In gravity data, these anomalies can be of a similar size and amplitude as a signal from a deeper target, such as an ore body, and can be mistaken for a target of economic interest. Such misinterpretation can result in an expensive drilling campaign. A new methodology is introduced that corrects airborne gravity data for changes in thickness of overburden overlying glacially eroded bedrock. The approach is tested for a 81 x 37 km^2 area from the Quest-West survey in the Nechako interior plateau of British Columbia, Canada. A bedrock topography map was created by inverting helicopter transient electromagnetic data. The inversions were conducted independently every 25 m using 2-, 3-, and 4-layer near-surface models, the depth to bedrock was interpolated across the area. The resulting bedrock topography map was employed to correct airborne gravity data for changes in overburden thickness. The overburden and bedrock were modelled as separate layers and assigned constant densities of 1.80 and 2.65 g/cm^3, respectively. The gravity correction methodology is based on the typical Bullard corrections with an additional correction for the gravitational acceleration contributed by changes in overburden thickness. Along a 30-km east-west line of interest across the survey area, the maximum overburden thickness ranged from 0 m to approximately 300 m, corresponding to a gravity correction of up to 10 mGal. The application of the bedrock topography correction revealed unprecedented geological details such as subtle faults, local sediment accumulations, and geological units.