

Differentiating Gravity Responses of Glacial Sediment Cover and Mineralization in the Athabasca Basin using Constrained and Joint Inversion

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Abstract

The Canadian Shield is covered by variable glacial deposits which have generally distinct density from other sediments. Such density can mimic or mask the gravity associated with the hydrothermal alteration that is an intrinsic component of the footprint of Uranium deposits in the Athabasca Basin. Typically, the ground structure from top to bottom in the area is as follows: glacial sediment cover with a variable thickness of 25 to 120 metres, sandstone to a depth of approximately 550 metres, then unconformity and metamorphic basement. The faults and fracture zones in the area permit significant fluid flow across the unconformity. The uranium deposits, alteration (silicification) zones and graphitic faults are formed by the mineralization of these flows in the vicinity of the unconformity. Geophysical methods can in principle locate graphitic faults and alternation zones that are often spatially associated with unconformity uranium deposits. The very low resistivity of graphite and high resistivity of silicified zones allow them to be located with electromagnetic (EM) methods. Also, the gravity method can potentially delineate the zones of silicification. However changes due to the variable depth of the contact between glacial cover and sandstone can mask the signal due to the silicification. To solve this problem, we shall use constrained and joint inversion of both EM and gravity data to recover a 3D model with sediment cover and mineralization. EM data is sensitive to the thickness of the sediment cover. The thickness of the cover will be determined by 1D inversion of the EM data and the gravity response of the cover computed and removed, i.e. stripped, from the gravity response. Also the thickness of the cover will be used as a constraint in 3D gravity inversion. Finally, a joint inversion of the EM and gravity data will be attempted.

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