Darijani M, Farquharson CG, 2016, Synthetic modeling and joint inversion of seismic and gravity data for overburden stripping in the Athabasca basin, Abstract, PDAC-SMC, Toronto, ON

Gravity signatures from components of the footprints of uranium deposits in the Athabasca Basin are masked by the contribution to the measured gravity coming from glacial sediments (overburden). To solve this problem, we would like to use independent geophysical data to estimate the depth of overburden. Once the thickness of the overburden is determined, the contribution of the overburden to gravity measurements can be accounted for and the gravity data used to look for density anomalies in the sedimentary and basement rocks. In this research, the joint inversion of seismic refraction data with gravity data is assessed as a means of performing this “overburden stripping”. Since the seismic velocity of overburden is lower than that of the sandstone, it allows us to detect the interface between the layers using seismic refraction method. For the forward modeling, two layers are considered, using the real drill-hole data of the McArthur River area, in which the upper layer is the overburden (v=1600m/s and d=2g/cc) and the lower layer is sediments (v=4000m/s and d=2.42g/cc). Models are discretized by a triangular mesh. Distances between receivers and sources are 2 metres and 50 metres, respectively. Seismic first arrival travel time and gravity data were synthesized. Inversions were performed for seismic data using both L2-norm and L1-norm methods. L2-norm vertical section illustrates a good agreement with the original model. However, the interface between the two layers is not sharp which is due to the L2 regularization. But L1-norm section shows a sharper interface. Calculated data fit the observed data well. Another effective method to depict the subsurface structure using geophysical data is joint inversion. In comparison to the independent inversions, not only the density model is much improved, but also the interface has been clearly demonstrated for both density and seismic velocity vertical sections using L2-norm method. Additionally, there are good fits between observed and calculated data for both gravity and seismic methods.

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