Understanding the limitations of geophysical inversions: Defining expectations for the non-specialist

Clare O'Dowd, Cameco Corporation, Saskatoon, Canada

As geoscientists, we are often faced with interpreting sparsely sampled datasets in hopes of developing a better understanding of the underlying geology. In many cases the geological target is hundreds of metres below surface, with numerous overlying layers that add to the complexity of the geophysical response including: glacial overburden, lateritic terrains, saline ground water, or deep sedimentary basins. While geological, geochemical, and petrophysical information play a crucial role in developing our geological interpretations, geophysics is heavily relied upon for identification of prospective domains, corridors, and drill targets, particularly at great depths or in environments with limited other information. Paradigm shifts in increased computing power over the past two decades have enabled geophysicists to work with much larger, multi-component datasets, and squeeze more and more out of the geophysical data, allowing us to model and visualize exploration environments in three dimensions.

This change in technology has provided us with a powerful communication tool which enables us to visualize the geology … or does it? When the non-specialist (or even the specialist) sees or speaks to a geophysical inversion they may refer to it in geological terms; and while the response came from the underlying geology, the geophysical image or inversion is not directly mapping geology. Geophysical inversions are an attempt to recover the physical property distributions from measured geophysical data. Thus, they are inherently non-unique and may require some form of constraint to produce a geologically reasonable result. In addition to the applied or inferred constraints, the interpretation of the resultant product requires a solid understanding of the caveats associated with the numerous confounding factors associated with the data including, but not limited to: noise, accuracy, depth of investigation, resolution, survey design, and physical property contrasts. In this presentation we visit a number of questions frequently heard in the uranium exploration industry, using real-world examples of several potential and active field geophysical methods. Our objective is to assist the specialist and non-specialist in communicating realistic expectations of inversions with a focused understanding of on scale, resolution, and target definition to best represent the geology in terms that lead to exploration success.

C. O'Dowd, C. Keller; K. Patterson