

## **Crustal Scale Seismic Surveys in Search for Gawler Craton Iron Oxide Cu-Au (IOCG) under Very Deep Cover**

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**Abstract :** Iron oxide copper gold (IOCG) deposits constitute important sources of copper and gold in Australia especially since the discovery of the supergiant Olympic Dam deposits in 1975. They are considered to be metasomatic expressions of large crustal-scale alteration events occasioned by intrusive actions and are associated with felsic igneous rocks in most cases, commonly potassic igneous magmatism, with the deposits ranging from ~2.2 -1.5 Ga in age. For the past two decades, geological, geochemical and potential methods have been used to identify the structures hosting these deposits follow up by drilling. Though these methods have largely been successful for shallow targets, at deeper depth due to low resolution they are limited to mapping only very large to gigantic deposits with sufficient contrast. As the search for ore-bodies under regolith cover continues due to depletion of the near surface deposits, there is a compelling need to develop new exploration technology to explore these deep seated ore-bodies within 1-4km which is the current mining depth range. Seismic reflection method represents this new technology as it offers a distinct advantage over all other geophysical techniques because of its great depth of penetration and superior spatial resolution maintained with depth. Further, in many different geological scenarios, it offers a greater '3D mapability' of units within the stratigraphic boundary. Despite these superior attributes, no arguments for crustal scale seismic surveys have been proposed because there has not been a compelling argument of economic benefit to proceed with such work. For the seismic reflection method to be used at these scales (100's to 1000's of square km covered) the technical risks or the survey costs have to be reduced. In addition, as most IOCG deposits have large footprint due to its association with intrusions and large fault zones; we hypothesized that these deposits can be found by mainly looking for the seismic signatures of intrusions along prospective structures. In this study, we present two of such cases: - Olympic Dam and Vulcan iron-oxide copper-gold (IOCG) deposits all located in the Gawler craton, South Australia. Results from our 2D modelling experiments revealed that seismic reflection surveys using 20m geophones and 40m shot spacing as an exploration tool for locating IOCG deposit is possible even when hosted in very complex structures. The migrated sections were not only able to identify and trace various layers plus the complex structures but also show reflections around the edges of intrusive packages. The presences of such intrusions were clearly detected from 100m to 1000m depth range without losing its resolution. The modelled seismic images match the available real seismic data and have the hypothesized characteristics; thus, the seismic method seems to be a valid exploration tool to find IOCG deposits. We therefore propose that 2D seismic survey is viable for IOCG exploration as it can detect mineralised intrusive structures along known favourable corridors. This would help in reducing the exploration risk associated with locating undiscovered resources as well as conducting a life-of-mine study which will enable better development decisions at the very beginning.

**Keywords :** crustal scale, exploration, IOCG deposit, modelling, seismic surveys

**Conference Title :** ICGGEE 2016 : International Conference on Geosciences, Geophysics and Environmental Engineering

**Conference Location :** Miami, United States

**Conference Dates :** March 24-25, 2016