Gravity Gradiometry: Theory and Regional Prospect Generation

Mark A Davies (ARKeX Ltd)

Exploring in difficult terrain and complex geology is challenging for any technology and traditionally in frontier areas potential field techniques are often utilised since surveys can be performed relatively easily, especially from the air.

Using potential fields in a basin scale study is extremely valuable to understanding the fabric of a basin; however, in order to understand intra basin detail, higher resolution data is required. Often this is in the form of ground based measurements such as ground gravity data.

Until recently an airborne technique capable of high bandwidth and high resolution that could provide detailed sub surface information was not available. Airborne gravity gradiometry is such a technique where the increase in bandwidth (over conventional data) allows a more complex but significantly more accurate workflow to be applied, thus allowing the interpreter to isolate the signal of the target geology. This benefit is especially true where the terrain and shallow earth 'geological' complexities often overprint signal from underlying targets.

Gravity Gradiometry imaging (GGI) is a powerful geophysical technique that provides a superior measurement of the earth's gravitational field compared to that obtained with conventional gravity surveys. While a conventional gravity survey records a single component of the three-component gravitational force, usually in the vertical plane, Full Tensor GGI measures the derivative of all three components in all three directions. Being a differential measurement, Full Tensor GGI is inherently more sensitive to the distance of a mass anomaly, which has in the past led workers incorrectly to believe that it is only of use when resolving shallow structures. Indeed, GGI has been used successfully to resolve targets at depths in excess of 7km.

Recent advances in processing allow the integration of gravity gradient data with that of more regional gravity datasets such as sparse ground gravity, regional gravimetry and satellite data (Barns & Davies, 2008). Combining datasets in this way serves to increase the bandwidth even further.

This paper will discuss the technique and workflows used; the benefits, limitations and how it has been used in a number of thrust and fold belt setting to identify prospects, drive leasing decisions, plan seismic programs, improve the imaging of seismic data with an integrated imaging workflow and drill wells. The talk will demonstrate the lifespan of gravity gradient data from acquisition right through to field development.

Barnes G, Dyer N, Davies M. (**2008**). Optimum use and integration of airborne gravimetry and gravity gradiometry. *EAGE, Rome, Italy. 9th – 12th July 2008.*