

## **Airborne Gravity/Magnetic Data Interpretation, a Cost-Effective and Powerful Tool in Deciphering the Deep Structure and Paleozoic Hydrocarbon Potential in the Partition Zone of Saudi Arabia and Kuwait**

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### **ABSTRACT**

The organic-rich mudstones of the Lower Silurian Qusaiba Member (“Hot Shale”) of the Qalibah Formation and time-equivalent sediments are among the most prolific petroleum-generating systems in the Middle East. However, due to complex lithologies, it is very difficult to use seismic data to image the Paleozoic section and basement configuration in the region. The drive to explore deep oil and gas in the Partitioned Zone (PZ) in recent years has led us to apply other geophysical tools. In late 2012 to early 2013, an airborne gravity/magnetic survey covering the entire territory of the PZ was acquired and processed by UK-based ARKeX Ltd using state-of-the-art Full- Tensor-Gravity Gradiometer and Magnetic Total Intensity. The main objectives of this survey were to understand the basement configuration, structural style and possible presence of Paleozoic source and reservoir rocks deep in the PZ concession. This data set was interpreted in 2014 by CGG with close collaboration with the Chevron Energy Technology Company, Wafra Joint Operations and partners KGOC and Saudi Arabian Chevron. The interpretation process involved (1) building a high quality PZ-wide 3D density model; (2) making basement faults interpretation and crystalline basement depth estimation based on magnetic data; (3) the constructions and modeling of sixteen 2D profiles; and (4) the construction of a 3D volume-based gravity/magnetic model. The main conclusions are:

- 1) Interpretation of the new dataset supports dominantly N\_S oriented basement faults/lineaments that match published regional basement structural styles, and
- 2) A thicker pre-Khuff (Paleozoic) clastic wedge than previously estimated is now interpreted with high confidence in the western part of the PZ, hence supporting deep basin potential.

A similar study was carried out in the State of Kuwait (Parmjit, et al., 2010), north of the PZ, and their study computed similar thicknesses of Paleozoic clastic section. They also modeled the presence of an infra-Cambrian salt pillow and a high density- and high magnetic susceptibility basement intrusive. The study has demonstrated that a high quality gravity/magnetic survey is a very cost-effective tool in deciphering basement structures, especially salt structures and other geo-bodies with abnormal densities, as well as the presence of deep Paleozoic troughs in support of potential deep seated Qusaiba Hot Shale source rock deposition and preservation in the PZ.