SFD® (Stress Field Detection) and its Integration with Seismic in Kharan Forearc Basin and its Implications for Hydrocarbon Exploration in a Frontier Area

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Abstract

The SFD® technology, applied in numerous basins around the world, uses a unique quantum method to extract stress field anomalies and hence trapped reservoir information from the gravitational field. The gravity field acts as a carrier of stress induced energies that are the contributors to the gravitational field potential. Unlike traditional gravity measurement methods, the SFD® sensor can dynamically (integration of signal over time) and selectively (through resonance) interacts with the gravity field and, as a result, is able to detect perturbations associated with trapped fluids (oil, gas and/or water) in the subsurface.

The Kharan Forearc Basin in Pakistan covers an approximately 30,000 km^2 area and is entirely obscured by superficial deposits of the Kharan desert. The regional geological analysis has been carried out by studying outcrops at Raskoh Range (Volcanic Arc) and Makran Accretionary Prism located just in north and south of Kharan Forearc Basin respectively. The analysis shows that unexplored Kharan Forearc Basin could be a primary target for a potential Palaeogene petroleum system, a near perfect analogue of some of the world's producing forearc basins (Cook Inlet Basin, Alaska and Salin Basin, Myanmar). The trapping mechanism, which is one of the key elements of a petroleum play, is difficult to envisage properly in the Kharan Forearc Basin due to presence of sand dunes at the surface, which enveloped the structural configuration of Kharan Forearc Basin.

For the purposes of locating an entrapment mechanism, a total of 1900 line km of SFD® data was acquired covering most of the Kharan Forearc Basin. The survey results have provided a series of high graded areas showing potential trapped reservoirs. A regional seismic survey has also been acquired recently, which covered part of the anomalous areas identified by SFD®. Preliminary seismic interpretation and its integration with SFD® results have shown a reasonable correlation and an overlap of the SFD® identified anomalies and structural/stratigraphic leads indicated on seismic.

In addition to the SFD® survey in Kharan Forearc Basin, the SFD® data was also acquired for templating purpose over some of the producing oil and gas fields in the Suleiman Ranges and Middle Indus Basin of Pakistan. The SFD® results over these fields provided a calibration point for SFD® data as well as demonstrating the technology's validity. These examples have further demonstrated that technology is applicable and conveniently applied for various structural/stratigraphic settings and field sizes. This study presents a case where integration of SFD® survey and 2D seismic have has helped in mitigating the risk associated with trap failure as well as allowing a ranking of the identified structural/stratigraphic leads on seismic data in the frontier Kharan basin. The drilling of these leads will eventually provide a further test of the SFD® technology in such exploration settings.