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Mapping a Clastic Sedimentary Strata using Magnetic Data

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ABSTRACT

The cost and speed of acquiring Gravity and Magnetic data makes it a commercially viable method to delineate sedimentary basins, especially at early stages of hydrocarbon exploration. Magnetic data is primarily used to infer depth to basement, as the igneous basement measure high magnetic susceptibility (1000-10,000 in µCGS units) relative to overlying sedimentary rocks with lower magnetic susceptibility (0-1,500 in µCGS units). In this study we used a spatial wavelength filter of 3500m to isolate a magnetic anomaly, which is found to correlate with clastic sedimentary unit at a shallow depth, ~ 1000m. The Magnetic anomaly was found to show strong correlation with the geological structure hosting the clastic units. 2D magnetic modeling was used to verify depth the sedimentary layer source of the observed magnetic anomaly at 3500m wavelength. 3D structural inversion used to invert for thickness of the sedimentary layer within parts of the high resolution magnetic data. The structural inversion was successful in mapping the lateral extent of the clastic sedimentary layer. However, it fell short at accurately estimating thickness of the clastic layer. The latter short come is attributed to noise contamination as well as residual magnetic anomalies from deeper sedimentary sources.

This distinct sedimentary sourced magnetic anomaly shows a positive magnetic anomaly where the sedimentary layer is present and thick, while thin or absence of the clastic unit corresponded to a negative magnetic anomaly. The overall magnetic anomaly showed unambiguous correspondence and conformity with the seismically outlined geological structure.

In this study we used high resolution aerially surveyed magnetic data that covered 110km X 290km area. The high resolution aeromagnetic data surveyed with 500m flight line spacing, a nominal 10m sampling interval at ~80m altitude. Moreover, parts of the surveyed area were overlapped to improve flight line spacing to 250m.

The outcome of this study showcases the unlocked potential of magnetic (potential field) data, that can be used at both exploration and production stages. Combined seismic reflection data and magnetic data further aides derisking planned drilling in exploration stage. With greater care magnetic data can further be used to delineate and map distinct magnetic anomalies associated to high susceptibility sedimentary units such as diamectites that contain appreciable amount of high susceptibility igneous clasts within.