Extending Existing Technology to Explore Near Surface Geology With New Techniques in Acquisition, Processing and Interpretation

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ABSTRACT

Airborne gravity gradiometry was originally developed for minerals exploration in the late 1990's, and was then adopted by the petroleum exploration industry due to the high resolution of results available. In this paper we discuss extending the use of this technology further, to a field which is the combination of mining and petroleum exploration: the oil sands of northern Alberta. While carbonates and salt bodies are familiar geology for many exploration regions, in the oil sands industry they combine to create operational safety concerns. Salt features and the voids created by the dissolution of the halite and other evaporites cause safety issues for the mining of the oil sands. The oil sands of North Alberta are unique in their exploration requirements and the geological setting. The target depth is relatively shallow (200-500m) with Pre-Cambrian basement overlain by dolomites and shales, then a combination of halite, anhydrite, carbonate and shale. It is at this level that voids have been created by the dissolution of salt features, and some of the voids filled with rubble. Above this layer is the Cretaceous McMurray formation, a discontinuous oil barren layer which is overlain by the oil sand ore body. A discontinuous portion of the Wabiskaw succession is above the oil sand. This study was initially approached using feasibility models. With input from the client regarding the geological setting, a 3D feasibility model was built for voids ranging in diameter from about 10 to 30m. The 3D feasibility highlighted a number of important factors to consider before going further, which included the requirement for a lower flying height, and advanced processing and interpretation approaches. As permits for the lower flying height was not available yet, a test survey at wider line spacing and standard flying height was performed to examine the results in areas with known geology and existing seismic data. Enhanced processing techniques were applied to the acquired data and advanced instrumentation was used in the acquisition. Seismic data was integrated during the interpretation, and previously mapped horizon boundaries were compared to the survey responses. The test survey demonstrated some interesting relationships. The primary purpose for the feasibility study was determining the threshold of void detection for safety reasons, however a number of other benefits were discovered related to the improved imaging and understanding of the geology.