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Planning a drilling campaign in a petroleum province using high resolution 3D seismic data – IODP proposal 909

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A drilling hazard assessment has been completed for a large area of the NW Greenland-Baffin Bay continental shelf. This assessment was in relation to International Ocean Discovery Program (IODP) proposal 909 that aims to drill several sites across the shelf in an attempt to better understand the evolution and variability of the northern Greenland Ice Sheet. The assessment utilised high quality and extensive 3D seismic data that were acquired during recent hydrocarbon exploration interest in the area – a fact that highlights the risk of drilling in a petroleum province and therefore, the importance of this assessment with regards to safety.

Scattered seismic anomalies are observed within the Cenozoic sedimentary succession covering the rift basins of the Melville Bay region. These features, potentially representing the presence of free gas or gas-rich fluids, vary in nature from isolated anomalies, fault flags, stacked fluid flow features and canyons; all of which pose a significant drilling risk and were actively avoided during site selection. In areas above the Melville Bay Ridge – a feature that dominates the structure of this area – free gas is also observed trapped beneath extensive gas hydrate deposits, identified via a spectacularly imaged bottom simulating reflector marking the base of the gas hydrate stability zone. The location of the hydrate deposits, and the free gas beneath, are likely controlled by a complicated migration history, due to large scale rift-related faulting and migration along sandy aquifer horizons. In other areas, gas is interpreted to have reached the shallow subsurface due to secondary leakage from a deeper gas reservoir on the ridge crest.

It is clear that hydrocarbon related hazards within this area are varied and abundant, making it a more challenging location to select sites for an IODP drilling campaign. However, due to the extensive coverage and high resolution (up to 11 m vertical resolution (45 Hz at 2.0 km/s velocity) of the 3D seismic data available, as well as the use of recently acquired ultra-high resolution site survey lines, these features can be accurately imaged and confidently mapped. This allowed for the development of a detailed understanding of the character and distribution of fluids within the shallow subsurface, and the use of this knowledge to select site localities that maximise the potential for drilling to be completed safely and successfully if proposal 909 were to be executed.