

Seismic and well-log inference of gas hydrate accumulations above the Umiak and Ya Ya gas fields, Northwest Territories

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Abstract

The Mackenzie Delta in Canada's Northwest Territories hosts many permafrost-related gas hydrate accumulations that were indirectly discovered or inferred from conventional hydrocarbon exploration programs. In particular, gas hydrate intervals characterized with high saturation show high resistivity and high P- and S-wave velocity on well-log data, and are typically found in sand-rich horizons. As demonstrated at the Mallik site, the velocity contrast between highly saturated gas hydrate-bearing sediments and unconsolidated water-bearing sediments is significant and allows their detection on seismic data. Here, we use 2D and 3D seismic reflection data acquired by industry on Richards Island to map and characterize gas hydrate accumulations beneath a thick permafrost area of the Mackenzie Delta. Specifically, we show new seismic evidences of gas hydrate accumulations near the Ya Ya and Umiak significant discovery licenses. The presence of gas hydrate was previously inferred from well-log data in several boreholes located in those areas. All seismic data were re-processed following an AVO-compliant flow that preserved relative amplitude relationships. On such data, the strong acoustic impedance of gas hydrate produces strong amplitude seismic reflections. The seismic signature of gas hydrates is confirmed by seismic-to-well correlation in areas where borehole logs are available. Results indicate that gas hydrate accumulations occur in structurally-controlled plays typical of conventional oil and gas traps found in this area, and further demonstrate that gas hydrates are part of the regional petroleum system.