# Seismic Reflection Interpretation of Gas Hydrates and Permafrost in the High Arctic of Canada.

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## ABSTRACT

Gas hydrate and ice have similar acoustic properties and either can markedly increase the velocity of relatively porous rock if replacing water in pore space. Seismic reflection profiles may exhibit interpretable phenomenon related to reflectivity changes at the base of ice-bonded permafrost, and at the base of gas hydrate stability. Seismic data over the Sverdrup and Franklinian basins provide examples of permafrost seismic expression in strata ranging in age from Tertiary to Devonian. Profiles exhibit near-horizontal reflections or amplitude changes on near-surface dipping reflectors, placing the base of ice-bonded permafrost up to 880m below surface.

The seismically-derived base of ice-bonded permafrost in thick sandstones ties closely to breaks on borehole resistivity logs and checkshot surveys. The base of ice-bonded permafrost, derived from the seismic response of thin porous beds within fine-grained strata, tie near the –1.5°C isotherm on temperature logs but 100 m deeper than the interpreted base of ice-bonding on resistivity logs in fine-grained strata. A comparison of synthetic to observed seismic for this situation suggests both the shale and thin sandstone ice levels, may be inferred on seismic data.

Remote estimation of the 0°C isotherm through seismic permafrost recognition can constrain local geothermal gradients and depth to the base of theoretical hydrate stability. An example of anomalous seismic expression at two levels on the same seismic profile has been interpreted as the permafrost base above a hydrate base. This estimates the depth to base hydrates, infers the near-surface geothermal gradient, and defines a hydrate stability envelope.