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Methane Seeps in the Sverdrup Basin: Evidence for Historic Gas Generation and Migration

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Summary

The Arctic Islands hold 25% of Canada's proven gas reserves, mostly in the Carboniferous and younger Sverdrup Basin. Known commercial gas is located in Jurassic and Cretaceous clastic sediments associated with conventional structural traps; mostly unroofed salt-cored anticlinal domes. Predicted undiscovered reserves exceed 85 TCF. Actual gas resources in the basin could be significantly larger if untested plays are considered. One aspect of regional gas resource assessment is characterization of ancient methane seep sites in the basin. In modern settings, methane discharging into sea water is oxidized to CO_2 forming localised zones of carbonate over-saturation. The resulting deposited carbonates have stable isotope values characteristic of a methane source. Ancient methanogenic carbonates of likely similar origin have been found across the Sverdrup Basin, including previously studied marine carbonate-seep mounds that supported cold-water benthic communities during the Early Cretaceous (Albian). Some of these localities are associated with fault zones implying a structural influence on gas migration to surface. Broad occurrences of cold water $CaCO_3$ polymorph precipitates (glendonites or 'rose' rocks) in Cretaceous shales also have methanogenic isotope signatures, suggesting more wide-scale release of methane. Newly recognised localities of large carbonate mounds associated with salt diapirs further demonstrate gas leakage. However their age is unconfirmed. One site of modern-day diapir-related methane discharge, on Western Axel Heiberg Island, also has thermogenic signatures. Combined, these sites from across the Sverdrup Basin provide evidence for an important gas generation and migration phase during the Cretaceous, with gas seepage continuing down to the present.