Impact of magmatism on the petroleum system of the Sverdrup Basin, Canadian Arctic Islands, Nunavut; a numerical modeling experiment

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This study uses numerical modeling to investigate for the first time the interactions between a petroleum system and sill intrusion in the northeastern Sverdrup Basin, Canadian Arctic. Although exploration was successful in the western Sverdrup Basin, the results in the northeastern part of the basin were disappointing, despite the presence of suitable Mesozoic source rocks, migration paths and structural/stratigraphic traps, many involving evaporites. These results were explained by invoking (1) the development of structural traps during inversion of the basin in the Eocene followed the main phase of petroleum generation and migration, and (2) the proximity of evaporite diapers that locally modified the geothermal gradient and led to overmature hydrocarbons. This project investigates the local thermal effects (positive and negative) of Cretaceous sills and

extrusive volcanism to determine their potential impact on the petroleum system.

The 1-D numerical model explores the effects of rifting and magmatic events on the thermal history of the L-24 Depot Point well near Eureka Sound on eastern Axel Heiberg Island. The thermal history is deduced from vitrinite reflectance data, fission track data, and the regional geology and when modeled, identifies when petroleum generation is possible. The subsequent introduction of units representing sills or erupted lava flows illustrates the temporal and spatial links between petroleum production and igneous activity. A comparison between classic hydrocarbon systems and magmatic systems is essential in interpreting the L-24 Depot Point model results. Modeling also makes it possible to investigate the causes of petroleum system degradation and estimate their relevance. The results are completely compatible with previous apatite fission track inverse modeling for the immediate region.

PetroMod© 1-D was the software program chosen for model construction and simulation. This program allows the user to display the results of the modeling using a range of graphical solutions that include diagrams, graphs, and overlays. In addition, a critical examination of the model results allows the user to identify knowledge gaps. This iterative process eventually leads to more robust numerical solutions and a higher quality of model results that form a basis for groundtruthing and future work.