

Thermal Anomalies, Petroleum Occurrence, and Implications for Oil Migration Fairways in the Beaufort-Mackenzie Basin

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Summary

Previous studies indicate multiple petroleum source rocks and potential occurrence of reservoired oils with mixed sources in different parts of the Beaufort-Mackenzie Basin. Thermal anomalies are observed in the foreland basin as well as in major fault zones and local positive structures. In contrast, temperature depressions are associated with post-Paleocene depocenters, where the records of rapid subsidence and thick post-Paleocene sedimentary successions are well preserved. The observed thermal anomalies are the result of both the tectonic and a stratigraphic framework that controls the basin aquifer architecture and hydrodynamics. Fluid migration in the porous aquifer systems and permeable fault/fracture zones transports heat, resulting in thermal anomalies along the petroleum migration fairway. Many significant discoveries are associated with anomalous high-temperature areas along major fault zones and within regional aquifer systems, indicating the preferred pathways of the fluid migration. We present the geological and geochemical evidence for the close association of anomalously high temperature and petroleum occurrence. Possible migration fairways and cross formational mixing of oils that originated from multiple sources are constrained using newly acquired data.