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The use of apatite fission track thermochronology to unravel uplift and erosion history for 2D- basin modeling in frontier petroleum basins – a case study of western Newfoundland.

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A critical factor in developing frontier petroleum plays is commonly the lack of available calibration data to increase accuracy and reliability of regional 2D-basin models. A clear understanding of the structural and sedimentary evolution of a petroleum basin is fundamental in calibrating modeled porosity, pressure, temperature, and thermal maturity. Modeling petroleum plays hosted in fold and thrust belts is inherently challenging due to composite in-sequence and out-of-sequence thrusting events, interconnected with a complex burial history.

This research will present apatite fission track data to constrain uplift, erosion, and temperature history of a frontier onshore petroleum system in western Newfoundland, which is situated at the structural front of the Canadian Appalachian orogen. The east portion of the Anticosti Basin (western Newfoundland), located at the deformational front of the Appalachian orogen, offers itself as an ideal place to study a petroleum system hosted in a fold and thrust belt. The underlying intricate geology created an active onshore petroleum system that, despite past exploration and limited exploitation, remains unsuccessful in terms of economic oil production.

The geologic history of western Newfoundland has significant implications for the current petroleum system. Neoproterozoic continental breakup was followed by the development of a passive continental margin. During the Taconian (Ordovician), Salinian (Silurian), and Acadian (Devonian) orogenies, westward thrusting imbricated continental slope and rise deposits of the passive margin, creating thrust sheets of repeated Lower Paleozoic strata. Additionally, the post-Devonian burial history is poorly understood, yet crucial to oil and gas generation and migration.

Apatite fission track thermochronology relies on ionization damage in the crystal lattice, which is generated by the flight paths of ^{238}U fission fragments. Subsequent annealing of the damage is temperature dependent, and reveals the thermal history of a mineral. The relative standard error for relative ages of the fission track grains in apatite is 5-10%.
This method will provide reliable data on one of the most essential calibration aspects for sedimentary basins: thermal evolution of a basin over time. It will further allow for a detailed understanding of the burial history and enable reliable restoration of the structural evolution of the fold and thrust belt in western Newfoundland to advance knowledge of the petroleum system and local geology.

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