

Burial and Exhumation History of the Labrador-Newfoundland Margin and Implications for Hydrocarbon Exploration

Peter Japsen¹, Paul F. Green³, Johan M. Bonow², Derek H. Wilton⁴, and Alana M. Hinchey⁵

¹GEUS, Copenhagen, Denmark.

²Geovisiona AB, Järfälla, Sweden.

³Geotrack International, Melbourne, VIC, Australia.

⁴Memorial University, St. John's, NF, Canada.

⁵Geological Survey of Newfoundland and Labrador, St. John's, NF, Canada.

ABSTRACT

The stratigraphic record along the continental margin of Labrador and Newfoundland provides ample evidence for vertical movements both prior to and after break-up. In the offshore domain, major hiatuses punctuate the stratigraphic record. Along Labrador and on the Grand Banks, Lower Cretaceous rocks rest on Paleozoic rocks or Precambrian basement in parts of the area, and onshore Labrador, a Cretaceous outlier rest on basement. This indicates one or more events of exhumation that have removed pre-Cretaceous sediments on a regional scale. The first phase of major Cenozoic uplift of coastal Labrador occurred on the Oligocene–Miocene transition with the first appearance of coarse-grained quartz and igneous clasts after deep-marine sedimentation dominated during the Oligocene. Over much of the Labrador shelf, Miocene deposits are absent, and we present vitrinite reflectance and sonic data that suggest that Miocene deposits of significant thickness were present prior to late Neogene exhumation. We also present results from a pilot apatite fission-track analysis (AFTA) study that reveals a history involving a series of late Paleozoic to Cenozoic burial and exhumation episodes. This pilot study is a forerunner of a more detailed study of the onshore and offshore margin, designed to provide a coherent model of the timing and magnitude of vertical movements both prior to and after break-up, as an aid to hydrocarbon exploration. This study has three components: (1) A thermochronological study based on samples from outcrops and from onshore and offshore boreholes. (2) A stratigraphic landform analysis of the onshore study area based on mapping of denudation surfaces that will provide evidence of vertical motion using cross-cutting relationships between the denudation surfaces and stratigraphic constraints. (3) An integrated interpretation of the geological, geomorphological and thermochronological data. Failure to account for greater depths of burial prior to exhumation may lead to underestimation of the petroleum resource maturity and to erroneous estimates of the timing of hydrocarbon generation. Insights into the uplift history of a margin are important for understanding the source-to-sink system of sediment input into offshore basins and for estimating changes in migration routes. Only by investigating the burial and exhumation history of a margin is it possible to address the consequences for hydrocarbon prospectivity.