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DEPARTMENT OF EARTH SCIENCE

TITLE OF THESIS: THE GENESIS AND EVOLUTION OF MAKAROV BASIN, ARCTIC OCEAN

TIME/DATE: 9:30 a.m., Tuesday, April 24, 2018

PLACE: Room 3107, The Mona Campbell Building, 1459 LeMarchant Street

EXAMINING COMMITTEE:

Dr. Carmen Gaina, Centre for Earth Evolution and Dynamics, University of Oslo (External Examiner)

Dr. Keith Louden, Department of Oceanography, Dalhousie University (Reader)

Dr. Gordon Oakey, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography (Reader)

Dr. John Gosse, Department of Earth Science, Dalhousie University (Co-Supervisor)

Dr. David Mosher, Adjunct, Department Earth Sciences, Dalhousie University and Geological Survey of Canada – Atlantic, Natural Resources Canada, Bedford Institute of Oceanography (Co-Supervisor)

DEPARTMENTAL REPRESENTATIVE: Dr. James Brenan, Department of Earth Science, Dalhousie University

CHAIR: Jure Gantar, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

Plate tectonic theory commenced with the observation that continental margins fit together like pieces of a puzzle. No such fit is readily apparent to the margins of Amerasia Basin of the Arctic Ocean, resulting in a stubborn outlier to global plate-reconstructions. This problem persists partly because of a paucity of data in the perennial ice-covered seas. Makarov Basin is well-positioned to address this problem, situated at the northern margin of Amerasia Basin, adjacent to Lomonosov Ridge. This study tests the hypothesis that this segment is a transform margin that resulted from rotational opening of Amerasia Basin. For this purpose, this study analyses the seismic stratigraphy, geomorphology, potential field and seismic velocity data of Makarov Basin and surrounding areas. The data are mainly from a unique seismic line that transects Makarov Basin and onto Lomonosov Ridge.

The sedimentary cover averages 1.9 km-thick in Makarov Basin, with a maximum thickness of ~5 km in a northern deep subbasin. The deeper successions within the subbasin host interbedded volcanic and/or volcanoclastic material. A shift in sedimentary supply, from proximal to distal, is recorded after the onset of Cenozoic rifting that separated Lomonosov Ridge from the Barents–Kara Shelf and formed Eurasia Basin. Thereafter, sedimentation is largely pelagic to hemipelagic.

The crust of Makarov Basin is typically 9 to 11 km thick, except beneath the subbasin where it is 5 km thick. The crust abruptly thickens to >20 km from Makarov Basin to central Lomonosov Ridge. Results from gravity modelling reveal that the tectonic style of the Amerasian margin of Lomonosov Ridge varies from passive rifting to strike-slip along its length. The rhomboid shape of Makarov Basin, the straight and steep morphology of the Amerasian flank of Lomonosov Ridge, the presence of numerous sub-parallel ridges created by splay faulting and the abrupt crustal transition between the two provinces is evidence of transverse/transensional tectonics along the central segment of the ridge. This result supports a rotational model of opening for Amerasia Basin, at least for its initial stages, and is a critical element to understanding the larger tectonic framework of the Arctic Ocean.