Erosional isostasy modeling of the Northwest Passages, western Canadian Arctic Archipelago

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Lithospheric flexure is an important control on dynamic topography and geomorphic processes. Isostatic response to surface unloading is critical in predictions for past, present and future environmental changes. The Northwest Passages consist of a series of deep channels (approximately 500 m in areas), some of which are bounded by fault-line scarps. Passages were deepened by fluvial and glacial incision through Cenozoic sediments. The Beaufort Formation was a Pliocene coastal plain deposit believed to stretch from the Northwest Territories to Ellesmere Island along the western Canadian Arctic Archipelago. The fluvial sediments and marine equivalents thicken toward the Canada Basin to as much as 3 km, despite having been deposited in a short time between 3.8 and 2.7 Ma. Paleoflow directions and the upper and lower contacts of the Beaufort Formation suggest that the coastal plain was contiguous, and while the large straits may have previously existed between the islands, they were filled during the Pliocene. How may have islands in the Canadian Arctic responded to the replacement of the eroded Cenozoic sediment with glaciers or seawater? Numerical modeling for lithospheric flexure is conducted using a new open source lithospheric flexure program. From initial loads gathered from bathymetric data in the channels, isostatic response was calculated using an iterative solution. 2-dimensional models were constructed for 3 transects using this method, varying effective elastic thickness values (30 km, 60 km, and 90 km). Each model considers excavation of sediment based on a paleo topographic gradient and infilling with seawater to modern sea level. Estimated isostatic uplift ranges between 50–150 m along the northern and southern flanks of Banks Island and Prince Patrick Island. Further models include 2-dimensional modeling considering erosion on islands, 2-dimensional models including affect of glaciation, and 3-dimensional models. Additionally, the second part of the thesis looks into deposition of the Beaufort Formation, specifically looking into possible rift flank uplift or sediment loading along the eastern Beaufort Sea margin to explain distribution of the Beaufort Formation.

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