Beaufort Formation chronostratigraphy and Pliocene landscape evolution: new insights into the Pliocene offshore deposits, Canada

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Pliocene (2.6–5.3 Ma) global average surface temperatures were approximately 2 ∞C warmer than at present. However, at high latitudes, Pliocene mean annual temperatures were up to 19 ∞C warmer. The Beaufort Formation (BFm), currently extending along the western Canadian Arctic Archipelago, is a fluvial deposit that formed a contiguous coastal plain and westward thickening marine clastic wedge across the continental shelf and into the Canada Basin. Its eastern extent has not been established. Based on available biostratigraphy and geochronology, the BFm was deposited during the Late Miocene through Pliocene. Intervals of Pliocene continental-shelf progradation are also recorded offshore in the Iperk Sequence, a pervasive and thick package of fluvial and marine sediment in the Beaufort-Mackenzie, and Canada basins. The Iperk Sequence is considered to be Pliocene-Pleistocene, and parts of this sequence are thought to correlate with the onshore BFm. The combination of a large sediment volume (exceeding 3 km thick), the high sensitivity to climate change at this latitude, and exceptionally wellpreserved sedimentary and fossil archives that capture the depositional and ecological environments, makes the BFm and Iperk Sequence among the best records for the study of landscape evolution during a large-scale climate change (such as the one currently ongoing).

Our research goals are to interpret and correlate the offshore stratigraphy and record of faulting to establish the history of sedimentation and progradation, the timing of faulting, the links with climate change, and the factors controlling the landscape response to climate change. Ultimately, we are attempting to test hypotheses regarding the maximum extent and thickness of the BFm and the tectonic or incision origin of the Northwest Passage.

Using recently acquired marine seismic imagery from ION Geophysical Technologies, we have for the first time (i) subdivided the Iperk Sequence in the offshore Banks Island region into its Pliocene-Pleistocene components, (ii) calculated sediment volumes, and (iii) located the Pliocene paleo-shorelines. Additionally, we are testing the hypothesis that the straits comprising the Northwest Passage were formed by Pleistocene fluvial and glacial incision, not faulting. Knowledge of how landscapes respond to large-scale climate deterioration such as the Pliocene-Pleistocene transition is critical for understanding first-order controls on ocean alkalinity and changes in sediment flux to terrestrial and marine basins. We discuss the implications of these data in relation to major transgressive sequences and landscape evolution during a period of significant climate change.

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