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2022

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Updated postglacial marine limits along western Hudson Bay, central mainland Nunavut and northern Manitoba

McMartin, I., Gauthier, M.S. and Page, A.V.

Abstract

A digital compilation of updated postglacial marine limits was completed in the coastal regions of central mainland Nunavut and northern Manitoba between Churchill and Queen Maud Gulf. The compilation builds on and updates previous mapping of the marine limits at an unprecedented scale, making use of high-resolution digital elevation models, new field-based observations of the marine limit and digital compilations of supporting datasets (i.e. marine deltas and marine sediments). The updated mapping also permits a first-hand, knowledge-driven interpolation of a continuous limit of marine inundation linking the Tyrrell Sea to Arctic Ocean seawaters. The publication includes a detailed description of the mapping methods, a preliminary interpretation of the results, and a GIS scalable layout map for easy access to the various layers. These datasets and outputs provide robust constraints to reconstruct the patterns of ice retreat and for glacio-isostatic rebound models, important for the estimation of relative sea level changes and impacts on the construction of nearshore sea-transport infrastructures. They can also be used to evaluate the maximum extent of marine sediments and associated permafrost conditions that can affect land-based infrastructures, and potential secondary processes related to marine action in the surficial environment and, therefore, can enhance the interpretation of geochemical anomalies in glacial drift exploration methods. A generalized map of the maximum limit of postglacial marine inundation produced for map representation and readability also constitutes an accessible output relevant to Northerners and other users of geoscience data.

1. Introduction

During and following the last deglaciation in Canada, the surface of the Earth, depressed by the weight of the waning Laurentide Ice Sheet (LIS), was inundated by marine waters far inland above the present sea level. Evidence for the postglacial marine invasion includes the presence of marine shells, marine mammal bones, raised marine beaches and fine-grained offshore marine sediments as high as ~215 m above sea level (asl) in central mainland Nunavut and northern Manitoba (e.g. Prest et al., 1968; Shilts, 1986; Dyke, 2004). Early during deglaciation as the ice sheet began to thin and retreat, the earth's crust started to rebound even though parts of the ice still covered the coastal areas. Glacial rebound was rapid at first but then slowed down progressively. Land emergence continues today at a rate of approximately 9 mm/year along western Hudson Bay because of the delayed response in the recovery of the deep mantle (James et al., 2021). As the rate of land uplift offsets global sea-level rise, a relative-seal level fall is thus observed around Hudson Bay and over much of the Canadian Arctic Archipelago.

The upper level of marine action, defined as the marine limit, forms a discontinuous trimline marked by maximum wave-washing limits, high raised boulder beaches, wave-cut notches in till and high-level marine-limit deltas along the western side of Hudson Bay, Committee Bay and Queen Maud Gulf (e.g. Shilts, 1986; Giangioppi et al. 2003; Simon et al., 2014; Gauthier, 2016; Randour et al., 2016; McMartin et al., 2021). The elevation of the marine limit provides an important reference for the glacial isostatic adjustment (GIA) which represents the response of the solid Earth to past and present-day changes in the former ice thickness. However, because the marine limit formed successively as the ice retreated and is thus asynchronous (e.g. Andrews, 1989), the elevation of the marine limit can vary significantly over a short distance. Mapping the marine limit is therefore a complex undertaking but is useful in Quaternary studies to reconstruct ice-sheet retreat patterns and model glacio-isostatic rebound. In the interior of the LIS close to the former Keewatin Dome, it is particularly important for the estimation of the current relative sea-level fall which may impact shoreline communities and the construction of nearshore sea-transport infrastructure (Lemmen et al., 2016). Delineating the extent of the marine limit is also important to assess the presence of marine sediments characterized by distinct permafrost and ground ice features, or to determine the potential influence of secondary marine processes on surface sediment composition, and, therefore, can contribute to cost savings and efficiency in planning terrestrial infrastructures or in surface mineral exploration methods.

In this Open File we provide an updated compilation of mapped marine limit segments in central mainland Nunavut and northern Manitoba between Churchill and the Arctic Ocean (Fig. 1). A continuous limit of marine inundation is interpolated from these updated marine limits, making use of high-resolution digital elevation models (DEMs), marine limit elevations measured in the field (Gauthier, 2016; McMartin et al., 2021), and the compilation of marine deltas, sediments and shorelines from various sources. This mapping is the first regional endeavour to cover such a large area of central Canada (~500,000 km^2) since the ˈarea of maximum marine overlapˈ shown on the Glacial Map of Canada at the national scale by Prest et al. (1968). Time-transgressive marine limits and elevations of deglacial marine-limit surfaces reflecting the maximum post-glacial rebound in North America were provided in Dyke et al. (2003) and Dyke et al. (2005) at the continental scale but these compilations did not show the maximum area of marine inundation at any one time or include the most recent mapping and detailed elevations extracted from newly available DEMs. This publication provides a detailed description of the mapping methods and a preliminary interpretation of the results, and includes georeferenced, digital compilations of updated marine limits with elevation statistics, recorded marine-limit elevations from field observations, locations of mapped marine features (i.e. deltas, sediments), the interpolated continuous marine limit, and a generalized map of the inundated areas.

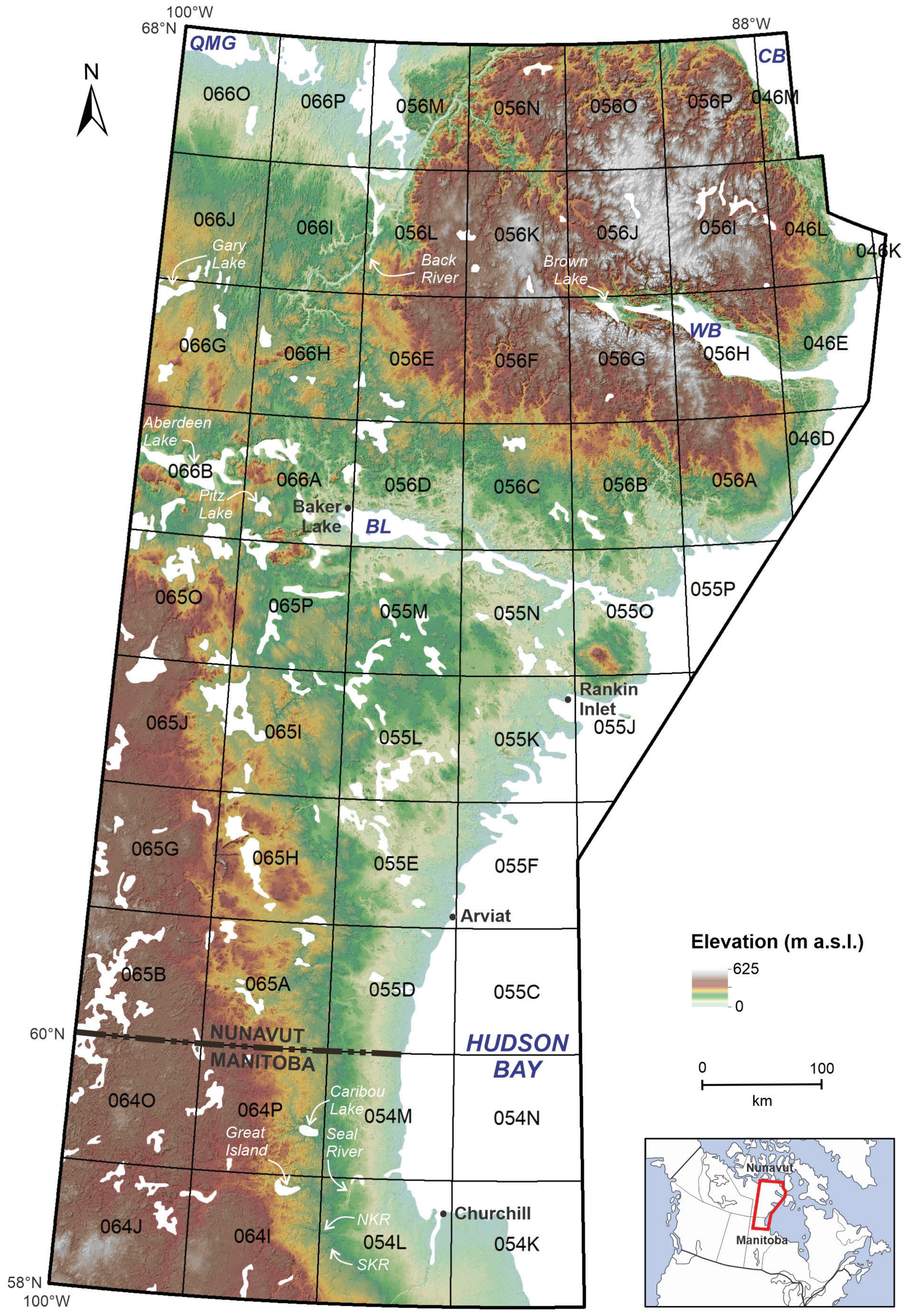

Figure 1. Location map of the study area in central Nunavut and northern Manitoba. Hillshaded Canadian Digital Elevation Model (CDEM) at the 1:250 000 scale (Natural Resources Canada, 2017). National Topographic System (NTS) 1:250 000 scale map outlines are shown for reference. QMG: Queen Maud Gulf; CB: Committee Bay; WB: Wager Bay; BL: Baker Lake; NKR: North Knife River; SKR: South Knife River.

2. Methods

2.1 Data sources

The starting point for updating the marine limits were the previously mapped linear features from GSC Open File 8717 in central mainland Nunavut (Behnia et al., 2020) and data within MGS GeoFile 1-2022 in Manitoba (Gauthier, 2022a). Other sources of information included marine deltas, shorelines and sediments compiled from published maps (various GSC maps in Nunavut – references in McMartin et al., 2021; in Manitoba – references in Dredge et al., 2007 and Gauthier, 2016), and field elevation measurements of the marine limit (same references as previous). Elevations recorded with an altimeter have a precision of ±1 m and those collected using the handheld Garmin GPS-12™ are accurate to within ±5 m (see Randour et al., 2016). Photographs of marine limit features from the field in Nunavut are shown on Figure 2.

In Nunavut, the reference elevation dataset for extracting the elevations of the marine features was the 2-m ArcticDEM elevation model (Porter et al., 2018). The interpolation of the continuous marine limit made use of this DEM, as well as a hillshade derived from the ArcticDEM (see McMartin et al., 2021), and a set of 5-m elevation contours derived from the ArcticDEM (reduced for manageability). In Manitoba where the ArcticDEM is unavailable, elevations were extracted from the Canadian Digital Elevation Model (CDEM) at the 1:50 000 scale (Natural Resources Canada, 2017) and the 1:50 000 scale CanVec elevation 10-m contours (Natural Resources Canada, 2021) were used in the interpolation of the continuous marine limit. The vertical accuracy of the ArcticDEM downloaded as a mosaic corrected to ICESat is in the order of ±1 m (Candela et al., 2017) and that of the CDEM ranges between 1-15 m depending on the location in northern Manitoba.

2.2 Updating the mapped marine limit features

2.2.1 Nunavut

The marine limits in OF 8717 compiled from various published map sources or from desktop mapping using high-resolution imagery (Fig. 3) were updated to correct topology issues, low-resolution mapping, poor georeferencing, or misinterpretation of features. They were first edited after creating a topology in ArcGIS; self-overlap, self-intersect and dangles were removed, and split segments were joined. The remaining marine limits were then updated based on: 1) verification against the extracted statistics of the mapped segments (see below); 2) some detailed mapping using higher-resolution imagery (i.e. World Imagery from ArcGIS Online, selected airphoto mosaics); and, 3) further consideration of field interpretations and elevation measurements.

Basic statistics were computed for each mapped segment to help assess the accuracy and precision of the mapping using the Zonal Statistic as Table tool in ArcGIS (see section 2.2.3 for details). These included the elevation median, mean, minimum, maximum, majority, minority, range, variety, and standard deviation. Segment length was generated with the Calculate Geometry tool. Mainly the median, the range and the length were used in the assessment. The median is used to minimize the influence of the extreme values. The range (difference between the minimum and the maximum) was used instead of the standard deviation because it is more intuitive to understand from a mapping perspective although they are both closely related. Segments with a range of >40 m in elevation were systematically redrawn to increase accuracy. The remaining individual lines with a range between 15 and 40 m elevation were classified as "high-range" and divided in 4 categories, i.e. those where: 1) significant parts of the line crossed many elevation contours; 2) minor parts of the line crossed some contours; 3) the line traversed some channels (low areas), significantly affecting the minimum elevation value; and, 4) the line was generally correct but offset with respect to contours. Follow-up verifications were made on all these high-range lines. Some features were redrawn more accurately resulting in a decrease in their elevation range. Still, in areas with a significant slope, namely along the rocky cliffs of southern Wager Bay, the range in elevation remains above 20 m for 69 segments due to the sensitivity of the mapping in steep terrain or the lower vertical accuracy of DEMs in steep/sloped terrains (Fig. 4).

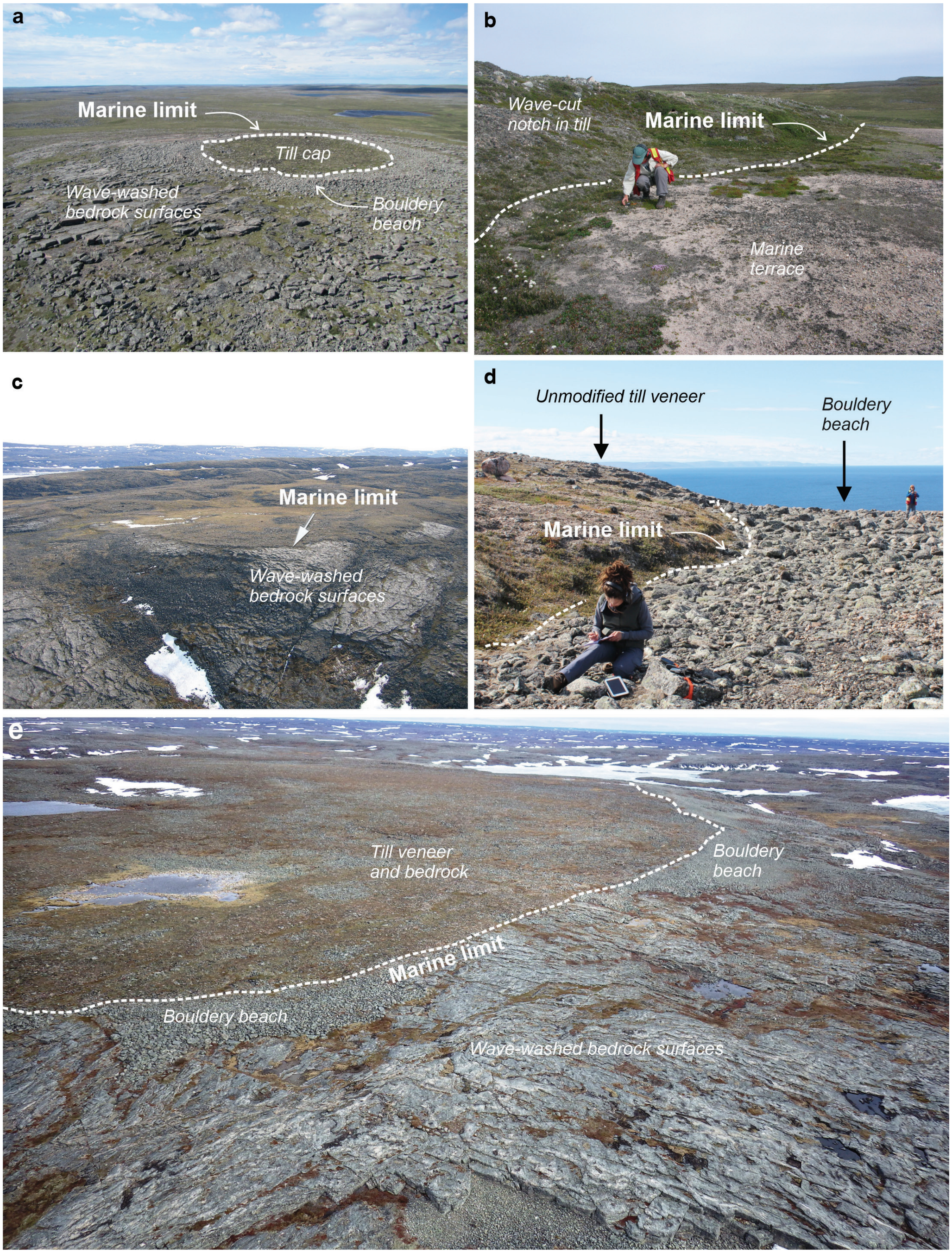

Figure 2. Field photographs of marine limit settings in Nunavut. a) Limit surrounding unmodified till cap at 108 m asl in NTS 56D near Quoich River (from McMartin et al., 2017). NRCan photo 2022-396. b) Wave-cut notch in thick till at 125 m asl in NTS 56H north of Wager Bay. NRCan photo 2022-397. c) Washing-limit trimline at 110 m asl in NTS 56G east of Forde Lake (from Dredge and McMartin, 2005). NRCan photo 2005-014. d) Limit between bouldery beach and unmodified till veneer at 113 m asl in NTS 56H south of Wager Bay (from Randour et al., 2016). NRCan photo 2022-398.e) Washing limit at 154 m in NTS 56B east of Lorillard River (from McMartin et al., 2015a). NRCan photo 2022-399.

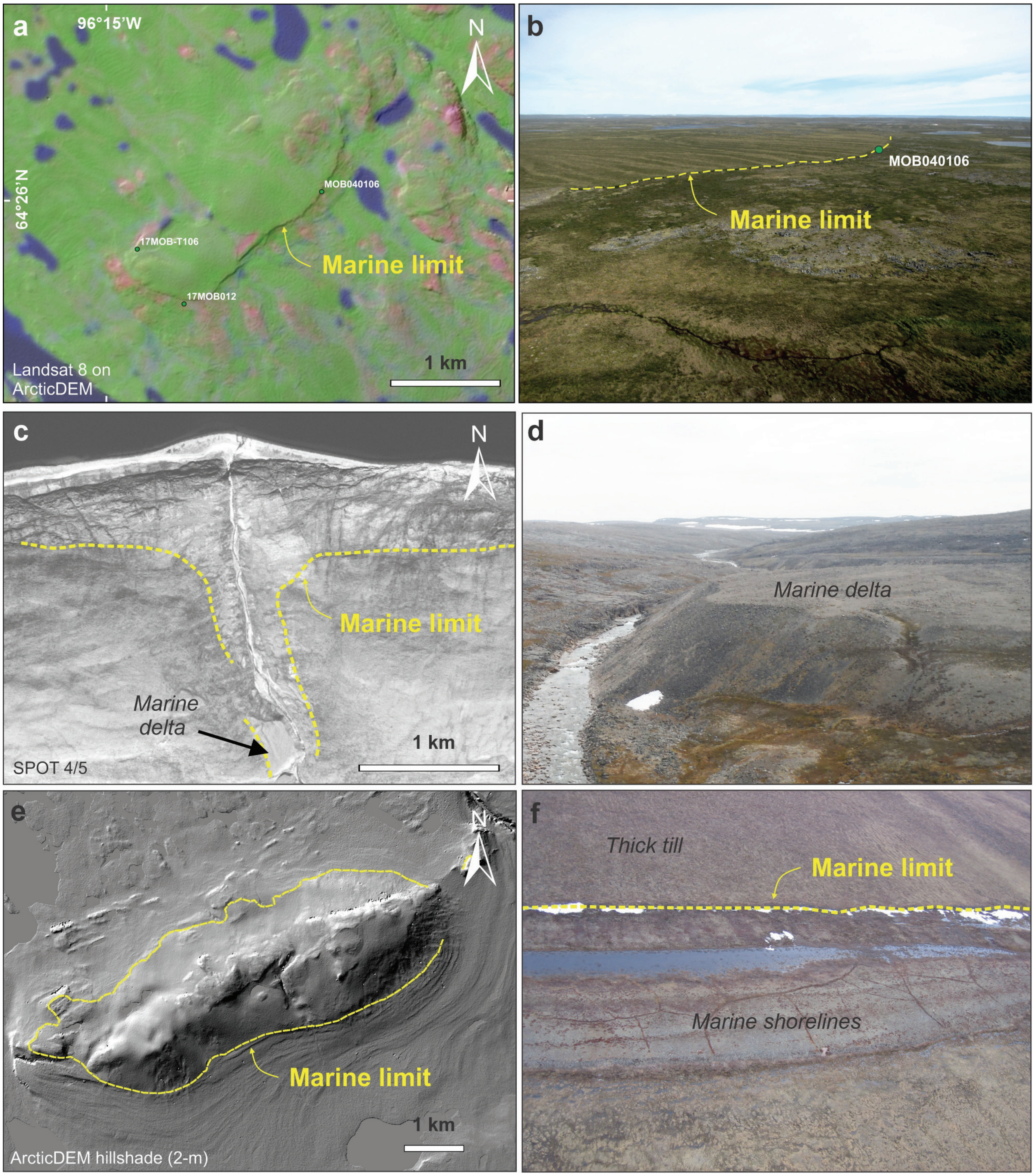

Figure 3. Marine limit features shown on various remote imagery with adjacent field photographs. a-b) Trimline at 118 m asl in NTS 66A west of Baker Lake with thick solifluncted till above and reworked till below (from McMartin et al., 2021). NRCan photo 2022-400. c-d) Marine limit defined by raised marine delta at 122 m asl in NTS H south of Wager Bay (from Randour et al., 2016). NRCan photo 2022-401. e-f) Wave-cut notch in till at 126 m with raised shorelines and wave-washed till below in NTS 66A north of Pitz Lake. NRCan photo 2022-402.

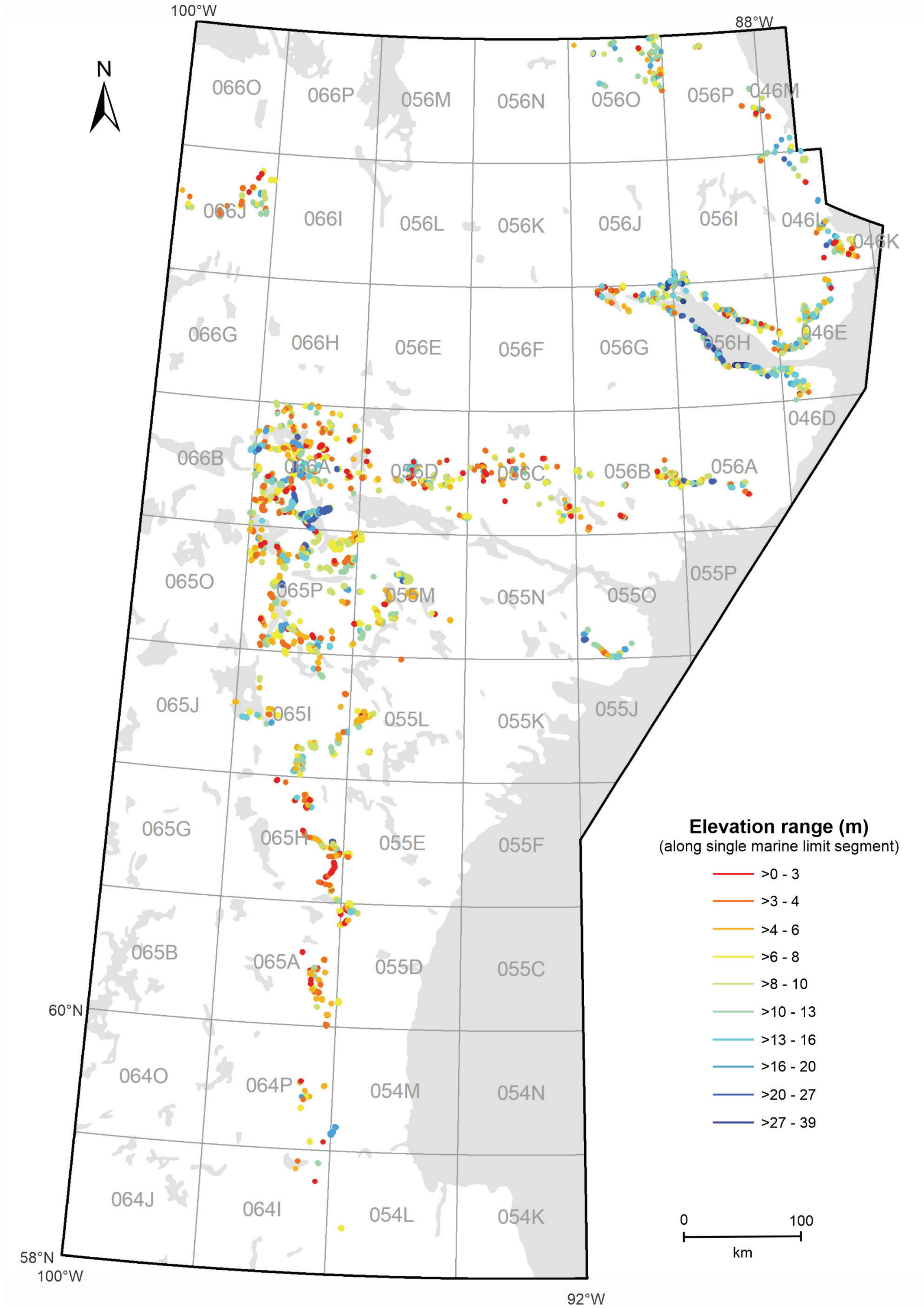

Figure 4. Range in elevation for each marine limit segment mapped across the study area. A natural breaks (Jenks) classification is used that better highlights the maximum ranges. Particularly high ranges (>20 m) shown in dark blue occur along the steep rocky cliffs of Wager Bay in NTS 56H and around large hills of the Dubawnt Supergroup rocks in the Schultz Lake map area (NTS 66A). These reflect the sensitivity of the mapping along high slopes and/or the lower vertical accuracy of DEMS over steep terrains.

Outliers with much higher or lower median elevations (±20 m) than local marine limit segments were assessed. Misinterpreted linear features such as trimlines of other nature (i.e. large subglacial meltwater channels, various bedrock scarps, and sharp discontinuities unrelated to marine processes), glaciolacustrine limits and shorelines, and marine shorelines well below the local marine limit were deleted. Segments with a length <10 m were also deleted; these are trivial at the scale of our regional mapping. In the end, a total of 161 features originally mapped as marine limits were deleted resulting in a decrease in number from 1738 (as published in OF 8717) to 1577. Although this update improves the mapping presented in OF 8717, there are nonetheless some remaining areas that may have been overlooked or that require additional mapping. In particular, along the west-central boundary of the study area, largely within the Thelon River drainage basin, marine limits remain poorly mapped because they are confused with glacial lake limits and shorelines.

2.2.2 Manitoba

In Manitoba, marine and lacustrine features were originally mapped using 1:60 000 scale airphotos, SPOT imagery (Geobase®, 2005–2010) and the Canadian Digital Surface Model (CDSM) mosaic (GeoBase®, 2014). Many were ground truthed (see references in Gauthier, 2016). In 2022, trimlines and beaches were updated using ArcMap Basemap imagery and ALOS World 3D digital elevation models (30-m resolution; Japan Aerospace Exploration Agency Earth Observation Research Center, 2022), together with further consideration of field data and reinterpretation of features. A total of 18 marine limit segments were identified at local sites in northern Manitoba and used for the interpolation of the continuous marine limit.

Similar to the Nunavut marine limits, basic statistics were computed for each mapped segment in Manitoba but using the CDEM. In comparison to the Nunavut datasets, the elevations extracted in northern Manitoba may be less accurate and less precise because of the lower mapping accuracy (see below) and the lower spatial (pixel) and vertical resolution of the CDEM. The elevation range on single marine limit segments in Manitoba varies from 2 to 20 m (Fig. 4).

2.2.3 Statistics

Elevation statistics on the mapped marine limits were derived from available elevation models: ArcticDEM (Porter et al., 2018) in Nunavut, and CDEM (Natural Resources Canada, 2017) in Manitoba. In order to extract elevation statistics by polylines, each line feature was first assigned a unique identifier. The elevation models were first multiplied by 100 (due to the inability of ArcGIS to perform these calculations on decimal data) and converted to integer datatype using ArcGIS's Raster Calculator tool. This allowed the extraction of a complete set of statistics using the Zonal Statistics as Table tool and the unique identifier field as the zone definition. The resulting tables were then joined to the attribute table of the mapped marine limit segments shapefile using the unique identifiers present in both to define the joins. The statistics were populated into the attribute table after having been appropriately converted back to float datatype and dividing by 100 to restore the decimal places. Statistical measures representing actual elevation (i.e. excluding standard deviation) are presented in whole integers due to the meter-level accuracy of the DEM resolutions (as discussed above).

The updated marine limit segments mapped in both central Nunavut and northern Manitoba is provided in a geodatabase format (Appendix 1: see >GEO>GEM_LINES in the gdb). The dataset conforms to the Surficial Data Model of the Geological survey of Canada (Deblonde et al., 2019). A simplified shapefile of the mapped marine limits with elevation statistics is also provided in this Appendix.

2.3 Mapping the continuous marine limit

The updated mapped marine limit segments were displayed in ESRI ArcMap, along with a number of supporting datasets (see Section 2.2), to carry out the desktop mapping of the continuous marine limit. In areas with few or no mapped marine limit segments or reference datasets, the marine limit was interpolated between neighbouring segments primarily using contour lines and the median elevation of the nearest segments as references. In instances where there was an elevation change between neighbouring segments of >5-m contour interval in Nunavut and 10-m contour interval in Manitoba, digitization was done manually and an effort was made to increase or decrease the elevation gradually over the intervening distance, while still following the general topography described by the contour lines. Where elevations were constant between neighbouring segments (rounded to the nearest 5 or 10 m), the contour lines were directly copied and simplified using ArcMap's Simplify Line tool using a bend simplification to eliminate curves with a diameter of less than 100 m. This simplified contour line was then used as the interpolated marine limit between the mapped segments.

Marine limits around islands were included where there was a previously mapped segment forming part of the island's interpolated shoreline, or when the elevation associated with the nearest interpolated "mainland" marine limit formed an island with a shoreline greater than or equal to 1000 m in length. This 1000 m threshold was implemented to avoid having thousands of very small islands included in the dataset, as the confidence in the accuracy of the initial mapped marine limit segments does not warrant this level of detail.

Marine limit interpolation was carried out at a scale ranging from approximately 1:8 000 to 1:12 000; while this is a finer scale than was used in previous mapping efforts (approximately 1:40 000 – see McMartin et al., 2021), it was necessary to distinguish between densely spaced contour lines, particularly using the 5-m contours derived from ArcticDEM. A shapefile of the interpolated marine limit is included in Appendix 2.

For readability in small-scale maps, a generalized version of the continuous marine limit was created. First, smaller islands were excluded (unsimplified coastlines <10 km), then the resulting line dataset was smoothed using ArcGIS's Simplify Line tool with the BEND_SIMPLIFY simplification algorithm and a simplification tolerance of 20 km (meaning curves of less than 20 km diameter). Shapefiles of the generalized marine limit (lines; polygons below and above marine limit) are provided in Appendix 2.

The supporting datasets that helped produce the interpolated marine limit (marine sediments and deltas; field elevation measurements) are included in Appendix 3. Marine shoreline mapping is still in progress and therefore is not included here. Shapefiles of the three supporting datasets and basemap data are integrated into a scalable map in a 10.6 mxd format.

3. Mapping results

3.1 Mapped marine limit features – preliminary interpretations

The distribution of the updated marine limits classified by the median elevation along each mapped segment (n=1595) is shown on Figure 5. The extracted elevations on these mapped marine limits vary from 83 to 242 m asl (±1 m in Nunavut and ±1-15 m in Manitoba). Two field stations where the marine limit was observed west of Committee Bay are also located at 247 and 251 m elevations (±1 m). Although some variations in elevation can reflect DEM vertical accuracy or mapping uncertainty, local physiographic and/or hydrological context rather than changes in water levels, important regional trends are observed in this dataset.

3.1.1 Nunavut

Regionally, the high values commonly found above the median of 140 m elevation are related to the proximity to an area of maximum ice thickness near a former ice-load centre of the LIS (i.e. Keewatin Dome). In contrast, high elevations above ~200 m asl on the west side of Committee Bay in the northeast is interpreted as incursion of the sea into depressed areas during the early phases of deglaciation. Also, the abrupt drop in the marine limit from 210 m in front of the large Chantrey Moraine System (CMS) to 160-170 m just south of the moraines reflects a long position in equilibrium at the moraine front (McMartin et al., 2015b). The proto-Committee Bay must have been open and its configuration stable over a significant time while the ice

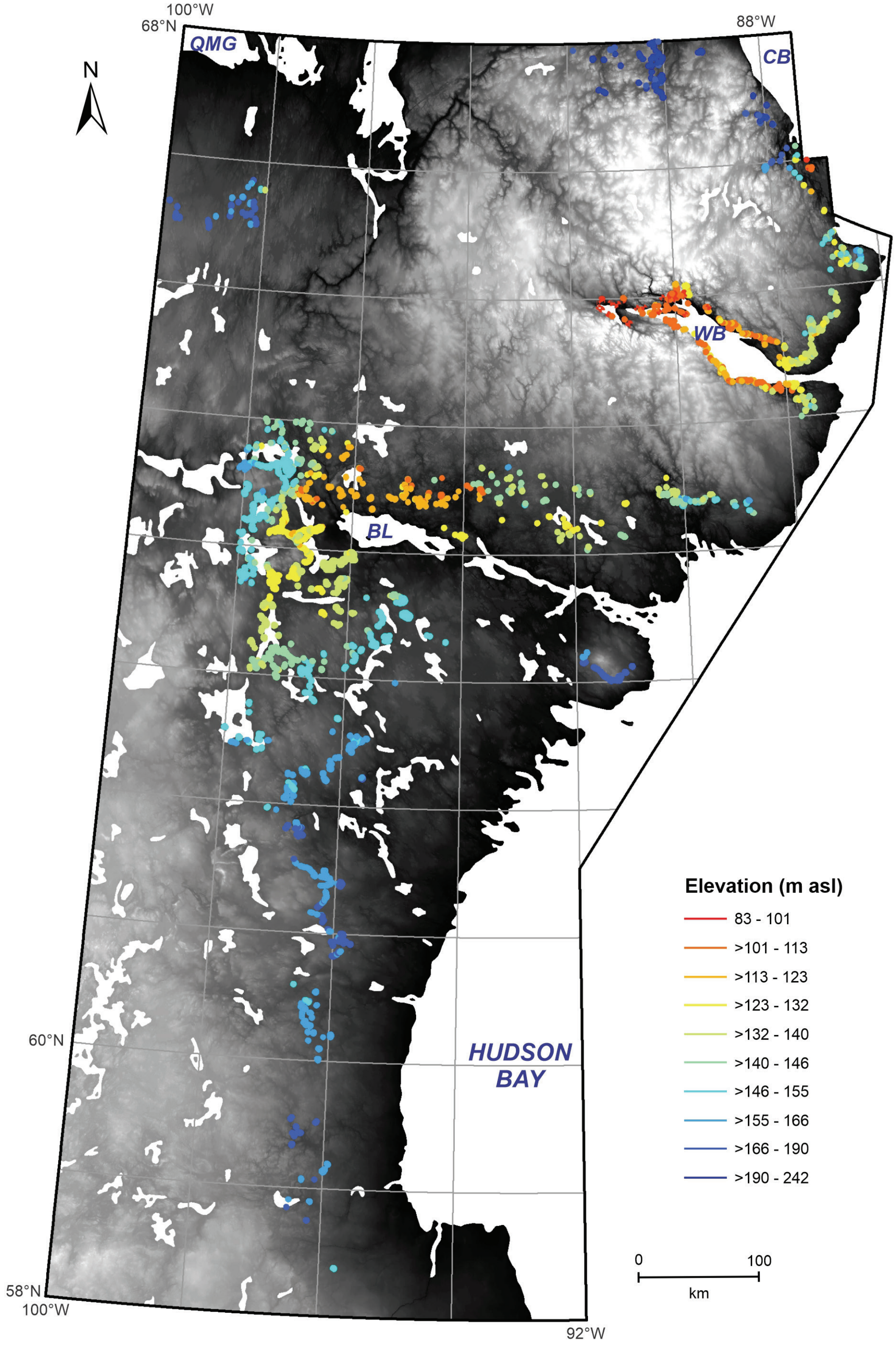

Figure 5. Median elevation of the mapped marine limit segments across the study area. A natural breaks (Jenks) classification is used that maximizes the variance between classes. The CDEM at 1:250K scale is shown in the background (lowest areas in dark grey and higher areas in light grey). See Fig. 1 for abbreviations.

margin stood at the CMS, as supported by a 1500-2000 radiocarbon year difference between marine shell ages north and south of the CMS (see McMartin et al., 2015 for complete results of radiocarbon ages). This is similar to what is observed on the east side of Committee Bay in front and behind the Melville Moraine, probably equivalent in age to the CMS (about 8000 radiocarbon years BP - see Dredge, 1990).

The particularly low elevations of 82-110 m asl in the inner Wager Bay – Brown Lake area can be interpreted as resulting from the presence of remnant ice masses under the Keewatin Ice Divide (KID), preventing incursion of the sea late during deglaciation (Dredge and McMartin, 2005). Alternatively, these lower elevations could also be related to a thinner ice cover above the high terrains located nearby south of Wager Bay during the last glaciation (Randour, 2018). However, similar elevations on marine limits at ~100 m were observed near Baker Lake and interpreted as the result of late remnant ice blocks over the very last position of the KID in low terrains, blocking invasion of the sea (McMartin et al., 2017). Such a low marine limit in the Baker Lake area indicates a relatively young deglacial age, rather than differential postglacial rebound, a situation similar to the Pitz Lake basin to the west (McDonald and Skinner, 1969). This is supported by relatively young ages on marine shells in these areas that constrain the timing of ice margin retreat (McMartin et al., 2006).

South of Baker Lake, the marine limit progressively increases southward from 125 m to about 172 m at 61˚N in southern Nunavut and then slightly decreases again to ~161 m towards the Manitoba border. These regional changes can be related to a differential glacio-isostatic response from contrasting ice loads associated with migration of the KID and/or different configurations and ages of the retreating ice margins.

3.1.2 Manitoba

The depositional environment of water-laid sediments in northeastern Manitoba is difficult to interpret. The northernmost limit of glacial Lake Agassiz is thought to be situated in this area and other ice-marginal glacial lakes existed wherever drainage was blocked by topography or ice (Dredge and Nixon, 1992; Gauthier, 2016). As such, determining the separation between lacustrine or marine influence is difficult. Throughout the entire study area in Manitoba, massive to weakly stratified marine sand was encountered below 140 m asl. The highest-elevation marine shells were collected at 100 and 103 m. At the same time though, clay interpreted as glaciolacustrine was deposited as low as 86 m on the North Knife River, and 122 m on the Churchill River (Gauthier, 2016). Lacustrine gastropods collected at 142 m on the South Knife River, situated at the surface in 0.7 m of clay, returned a radiocarbon age of 8031–8174 cal years BP (1σ, UCIAMS-135236). While missing a freshwater reservoir correction (Gauthier, 2022b), this age confirms that a glacial lake(s) existed at the ice margin at the same time and place as the incursion of the Tyrrell Sea. This complex drainage history is linked to the breakup of an ice saddle in Hudson Bay, which commenced around ~8.57 ± 0.28 ka BP and finished as late as 8.00 ka BP (Gauthier et al., 2020). Just 7 km to the southeast of the South Knife River site, ocean-facing sand beaches are situated up to 150 m asl, with marine sands at 130 m. As such, we denote a marine limit of 150 m asl for this area.

Further north along the Seal River, there are subaqueous fans and/or deltas deposited at 185 m asl in the west, down to 139 m in the east (Gauthier, 2016). Rare beaches are present in the west at 180 m. In the east, beaches at 190 m, on the east side of Mullin Lake, face toward the west, while 185 m asl beaches at the south end of Hebner Lake face to the south. There are also rare beaches at ~170 m. Silt was deposited along the west side of Great Island, between 180 and 220 m, while sand was deposited along the east side between 165 and 155 m. There are extensive well-developed beaches and washing limits at two sites to the northeast, showing the marine limit was ~165 m (59.141 -95.982 and 59.194 -95.930). As such, we tentatively denote a marine limit at 165 m for this area (Gauthier et al., 2020), acknowledging that the ocean was connected to a proglacial lake, and a precise limit is not possible to obtain.

West and northwest of Caribou Lake, a marine limit between 170 and 180 m (~175 m chosen for interpolation) is assigned to the area, based on extensive washing limits, beaches and several subaqueous fans.

In summary, the marine limit in Manitoba extends from 161 m asl at the Nunavut border to ~175 m at Caribou Lake, and decreases from ~165 m at the Seal River, 150 m at the South Knife River and ~145 m at the Churchill River. During deglaciation, the ocean was in contact with a proglacial lake (Gauthier et al., 2020), complicating the delineation of an accurate marine limit vs extensive development of marine-influenced geomorphology. More work and additional ages are needed to decipher the location of, and drivers for, the changing marine limit in Manitoba.

3.2 Interpolated continuous marine limit

The regional continuous marine limit derived from mapped marine limits and other supporting datasets is the result of a knowledge-driven approach (Fig. 6). The confidence in this interpolation reflects a combination of the mapping uncertainty, abundance and distribution of the mapped marine limits, and presence of supporting datasets. It is qualitatively evaluated here by NTS map sheet. Confidence is low when the marine limit mapping is minimal or not supported by significant datasets, and/or confused with potential glacial lake limits. It is moderate when the marine limit mapping is incomplete and/or the supporting datasets are sporadic. In addition to being more detailed than the national-scale compilation, this continuous marine limit is significantly different in many areas as shown on Fig. 7a. One of the most salient differences is the connection of the marine limit across the Back River basin (draining north into Queen Maud Gulf) and the Thelon River basin (draining east into Hudson Bay). Although time-transgressive, the regional marine limit in this area is much higher than previously interpreted, up to ~175 m asl near Gary Lake, and corresponds well with the maximum elevation of recently mapped marine sediments (Fig. 7b). Such mapping there and across the entire study area is also supported by the observation and elevation measurements of marine limits in the field (Fig. 7c) and of marine deltas (Fig. 7d). Although the interpolation is of relatively low confidence in the Thelon River basin, the extent of the marine limit in the lowlands south of Aberdeen Lake is also a major difference from previous compilations. Additional detailed mapping of glacial lake and marine shorelines is planned in this area and further west as part of on-going projects to increase the confidence and improve the reconstruction of the glacial lake and marine incursion extent and timing (Brouard et al., 2022). Figure 8 shows the generalized map of the interpolated marine limit for display at a page-size scale.

4. Summary and future work

High-resolution mapping of the maximum limits of the Tyrrell Sea on the western side of Hudson Bay and of Arctic Ocean seawaters in north-central mainland Nunavut refines the extent of postglacial seas in a large area formerly covered by the Keewatin Dome. Marine limit median elevations from Churchill, Manitoba, to areas north within the Arctic Ocean drainage basin, vary between 83 and ~242 m asl (±1-15 m). These significant changes in marine limit elevation reflect a combination of differential post-glacial rebound, as well the positions and patterns of the retreating ice margin in contact with marine waters, and therefore provide robust paleogeographic constraints for glacio-isostatic adjustment models and can help reconstruct the deglacial history of the region. The updated marine limit datasets can also inform land-use planning and coastal evolution research for infrastructure development and help understand the extent of marine action on the composition of surficial sediments, contributing to efficiency in glacial sediment exploration methods.

Future work to improve the mapping of the marine limit in the study area includes the following:
1) Differentiation of glacial lake features from marine features along the west-central boundary of the study area in Nunavut (glacial lake limits, shorelines, and spillways), and continuing into western Keewatin.
2) Completion of the remote mapping of marine features in Nunavut (marine limits and shorelines) in areas where the confidence in the continuous marine limit is low to moderate.

3) Completion of remote mapping in Manitoba using high-resolution DEM when becoming available.
4) Field work in key areas to collect observations, detailed altimeter measurements and age dating materials on marine and glacial lake features.

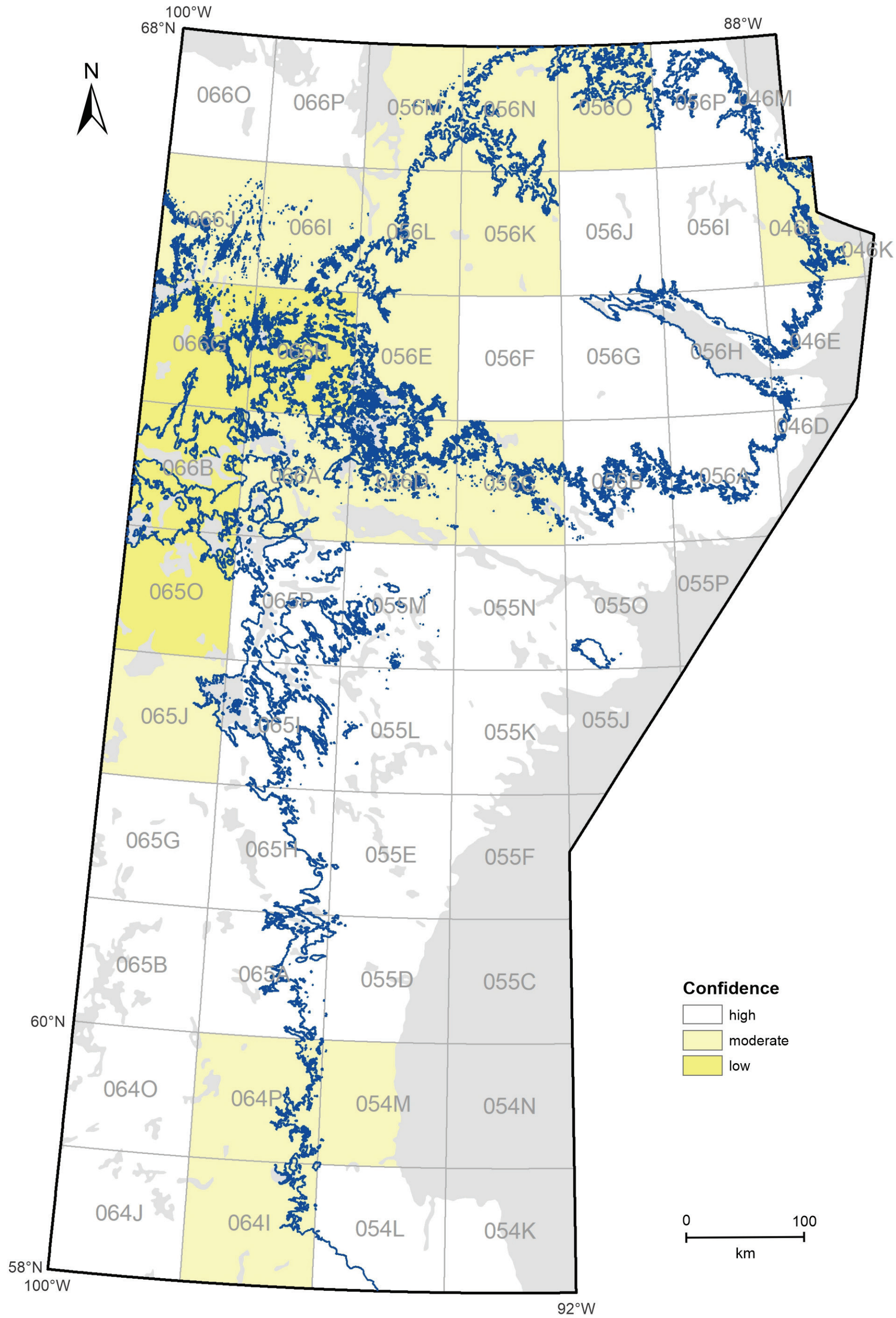

Figure 6. Interpolated regional marine limit across the study area. Confidence levels in the mapping of the continuous marine limit are shown (see text).

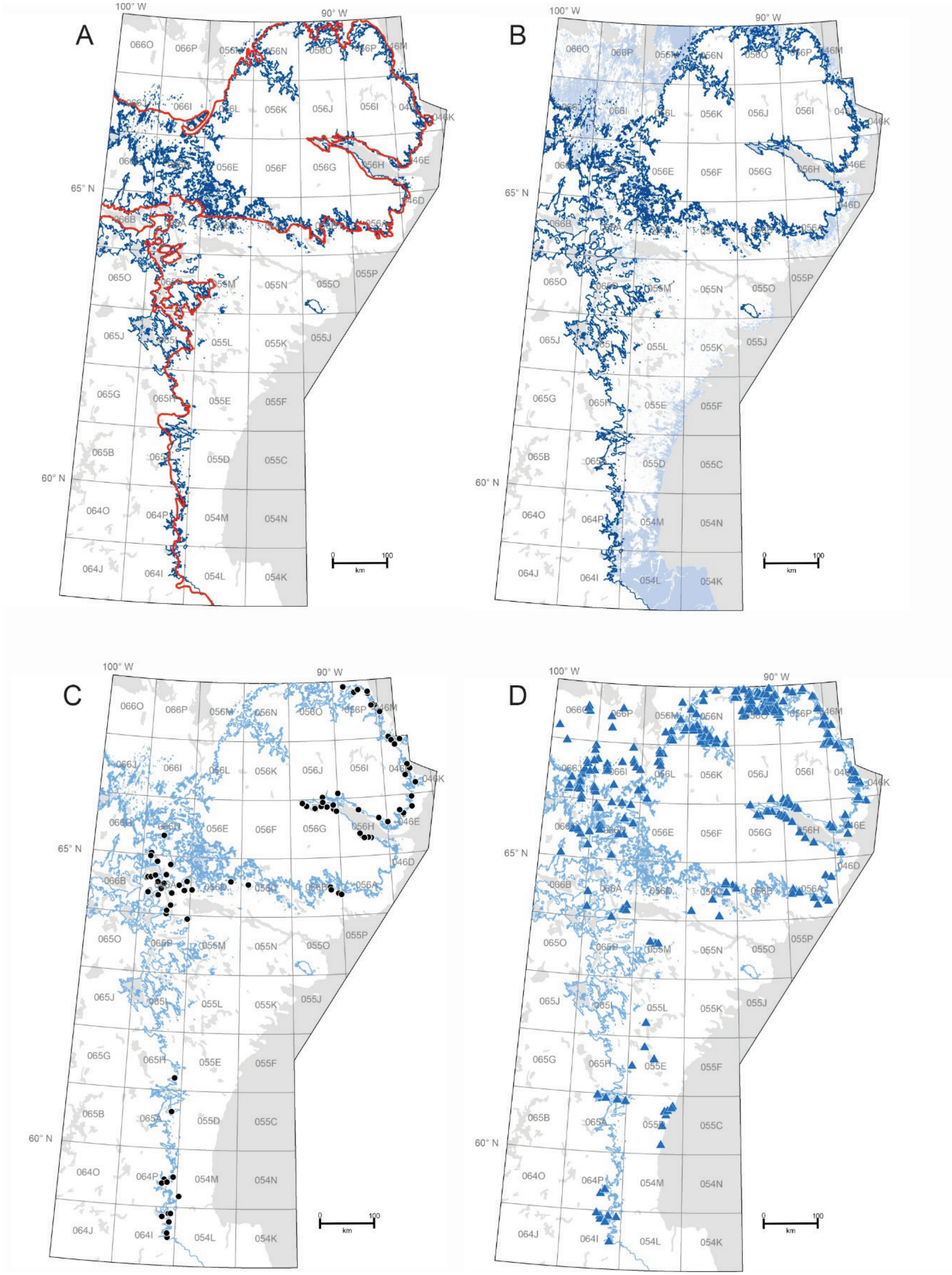

Figure 7. Interpolated regional marine limit across the study area with respect to A. Marine limit derived from Prest et al., 1968 (in red); B. Marine sediments compiled from various surficial geology maps (in light blue); C. Field measurements of the marine limit elevation (black dots); D. Marine deltas mapped remotely and/or visited in the field (blue triangles).

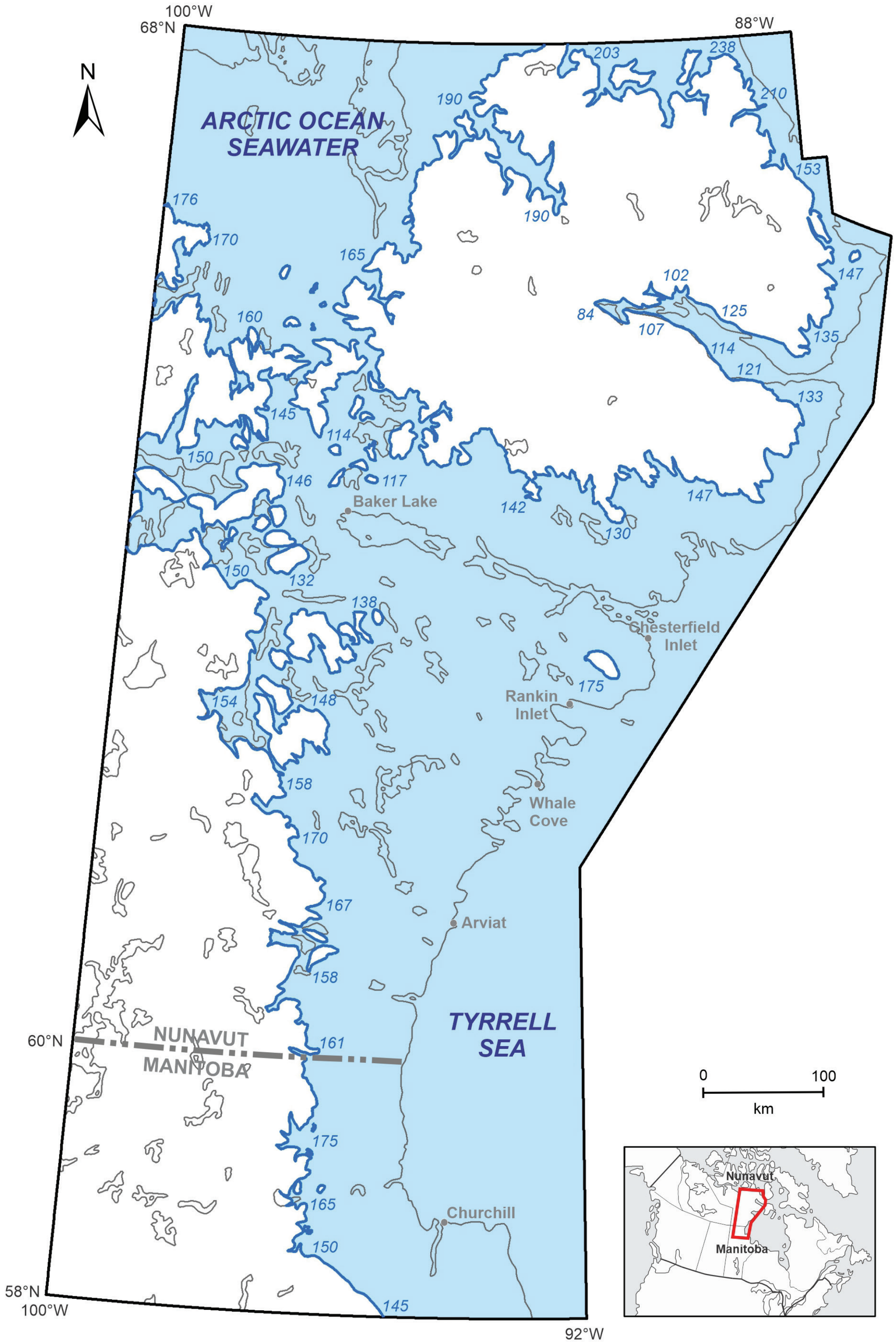

Figure 8. Generalized maximum limit of postglacial marine transgression in central mainland Nunavut and northern Manitoba. Areas below the marine limit are shown in blue. Elevations of the marine limit (in m) are given as a general reference and to show local variations.

5. Acknowledgements

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