
Testing the concept of altitudinal weathering zones on
Cumberland Peninsula, Baffin Island, using terrestrial
cosmogenic nuclide (TCN) exposure dating

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Fieldwork on Cumberland Peninsula has bolstered the concept of altitudinal weathering zones nowadays documented in many glaciated landscapes. Presently, the interpretation of altitudinal weathering zones is hotly debated and associated with a controversy over the maximum extent of both the Laurentide Ice Sheet (LIS) and local alpine glaciers during the Last Glacial Maximum. In particular, the question whether inter-fjord uplands remained ice-free during the last glacial cycle and thus served as biological refugia is significant. In this study, a new 1:100 000-scale map of the glacial deposits and ice flow stratigraphy of Cumberland Peninsula is constrained with TCN exposure ages throughout the peninsula and additional radiocarbon ages on mollusc shells from raised marine deposits along the coast. The TCN data reveal a significant inherited concentration of ¹⁰Be and ²⁶Al, indicating glacial erosion was insufficient to remove previously exposed regolith. This supports previous notions of cold-based glaciation on Cumberland Peninsula, particularly in thin-covered highlands. Using the youngest ages at each sample site confirms that valleys and fjords were filled with glacial ice until around $12.5 \pm 1.2 - 12.1 \pm 1.1$ ka (all errors 1σ) with subsequent retreat to the interior until $8.8 \pm 0.8 - 8.3 \pm 0.7$ ka. Separation of the LIS and local fjord ice occurred at about the same time ($12.7 \pm 1.1 - 8.6 \pm 0.8$ ka) based on a sequence of moraines damming a lake, whose shoreline sediments have been dated using a ¹⁰Be depth profile. Significantly reduced ²⁶Al/¹⁰Be ratios measured on inter-fjord uplands reveal a complex exposure history indicating one or more burial events likely due to protective cold-based ice cover. However, the timing of the last ice coverage cannot be estimated leaving the question of biological refugia during the last glacial cycle unanswered. A novel approach for estimating the timing of the last glacial plucking of exhumed pre-Quaternary tors combined with exposure dating with in situ ¹⁴C to circumvent the problem of inheritance will be applied to test the diverse interpretation of altitudinal weathering zones and address the enigma of biological refugia on uplands.