

Figure F1. Expedition 400 transect sites (yellow) in relation to existing ODP/IODP sites (white). Near-surface ocean currents: BIC = Baffin Island Current, LC = Labrador Current, WGC = West Greenland Current, IC = Irminger Current, EGC = East Greenland Current, NAD = North Atlantic drift. Ocean gateways: DS = Davis Strait, PC = Parry Channel, NS = Nares Strait, FS = Fram Strait, DS = Denmark Strait. High Arctic Pliocene and Early Pleistocene deposits (formations): 1 = Beaufort high-level terrace on Ellesmere Island (Matthews and Ovsenden, 1990; Rychczynski et al., 2013), 2 = Kap København (Bennike and Böcher, 1990; Funder et al., 2001), 3 = Île de France (Bennike et al., 2002), 4 = Store Koldewey (Bennike et al., 2010), 5 = Pingorsuit Early Pleistocene interglacial deposit (Bennike et al., 2023). Triangles = Greenland ice cores. Map produced using GMRT (v. 4.0) mapping tool.

Figure F2. Tectonic elements map of northeast Baffin Bay showing positions of the Expedition 400 seismic transect (red line) (see Figure F4) and existing deep drilling sites (ODP, IODP, and exploration wells). Adapted from Gregersen et al. (2022).

Figure F3. Expedition 400 transect site transect (red line) locations (yellow = primary sites, red crosses = alternate sites; see Figure F4) and site survey data. Solid gray lines = 2D seismic grid = TGS Baffin Bay surveys 2007–2010 (minimum spacing ~ 3.75 km). Dotted lines = 3D seismic surveys Shell-ANU-3D-2012 (dark blue) and Cairn-PITU-3D-2011 (light blue). Solid black lines = high-resolution survey LAKO 2019. Detailed shelf margin bathymetry based on industry multibeam data combined with first reflection extracted from 3D seismic data (Newton et al., 2017). Regional bathymetry (100 m contours) based on International Bathymetric Chart of the Arctic Ocean (IBCAO) v. 3 (Jakobsson et al., 2012). Multibeam bathymetry data in deepwater basin (yellow dashed line) collected by Alfred Wegener Institute (Dorschel, 2017).

Figure F4. Expedition 400 seismic profiles (black = proposed site, red = drilled site) Top: deep seismic profile BB10-5068125, courtesy of TGS (Knutz et al., 2019). Bottom: stitched high-resolution seismic data from LAKO19 profile. Triangles on top axis = positions of crossing lines (blue = deep seismic, red = high-resolution). Dotted lines = sites projected onto transect from offset positions. Megaunit A (Mu-A), a prograding sequence that is part of Melville Bugt/Upernavik TMF system, is dissected by 10 horizons (Hz) (high-amplitude reflections in topset strata with abrupt shelf breaks) that with the seabed horizon form 11 depositional units (Knutz et al., 2019). Pre-TMF Hz b1 (~late Pliocene) and c1 (~late Miocene) demarcate wavy contourites within a major slide scar that truncates Hz c1 (Knutz et al., 2015). Hz d1 (~middle Miocene), the base of a late Neogene drift prism, forms part of Mu-C. Hz d2 (~late Oligocene) is not constrained by boreholes. Melville Bay and Kivioq Ridge systems represent rift-tectonic elements modified by compression during the late Paleogene (Gregersen et al., 2013, 2016). MTD = mass transport deposit.

Figure F5. Five conceptual stages of GrIS configurations through the late Cenozoic (approximately the last 30 My).

Figure F6. Diagnostic template for proxy interpretation to provide information on glacial response and paleoenvironmental settings linked with five stages of ice sheet configuration. Left 2 columns: environmental parameters and proxy measures. Right columns: hypothesized parameter response to glaciation stages. IRD = ice-rafted debris, BrGDGT = branched glycerol dialkyl glycerol tetraethers, IsoGDGT = iso-GDGTs, HBIs = highly branched isoprenoids. Ice sheet configuration indicators: none (0), minor (+), moderate (++), high (+++), very high (++++). $^{10}\text{Be}/^{26}\text{Al}$ values based on Biermann et al. (2016).

Figure F7. A. Seismic profile (LAKO_1012) at Site U1603 on lower slope of Melville Bugt TMF adjacent to a channel along with interpreted Horizons (Hz) 7–10 and associated units (topmost is Unit 11). Vertical scale of Site U1603 line is depth (m) based on preferred time-depth model. B. Close-up of seismic survey lines in Site U1603 vicinity. Gray lines = regional 2D seismic data (TGS), black lines = high-resolution multichannel seismic data (LAKO19).

Figure F8. Lithostratigraphic summary, Site U1603. SHMSL point MS measurements filtered to exclude MS > 2 SD from mean of data set (thin red line) and depth-based rolling average of MS using a 10 m window (thick red line). The

same method was used to plot SHIL RGB Red – Blue (blue lines) and whole-round NGR (green lines). Red lines in CaCO_3 plot = intervals identified as calcareous mud (Lithofacies 2). Clast counts are centered on 10 cm intervals, and sand beds are centered on the core section (black line = depth-based rolling average of data using a 10 m window). cps = counts per second.

Figure F9. Seismic profile (LAKO_1010) at Site U1604 on the lower slope of Melville Bugt TMF along with interpreted Horizons (Hz) 7–10 and associated units (topmost is Unit 11). Vertical scale of Site U1604 line is depth (m) based on preferred time-depth model. B. Close-up of seismic survey lines in Site U1604 vicinity. Gray lines = regional 2D seismic data (TGS), black lines = high-resolution multichannel seismic data (LAKO19).

Figure F10. Lithostratigraphic summary, Site U1604. SHMSL point MS measurements filtered to exclude MS > 1 SD from mean of data set (thin red line) and depth-based rolling mean of MS using a 5 m window (thick red line). Higher MS is typically associated with silt, sand, and gravel. Lower MS is typically associated with dominant clay-sized particles and detrital carbonate layers. The same method was used to plot SHIL RGB Red – Blue (blue lines), SHIL RGB green (green lines), and whole-round NGR (purple lines). Abrupt increases in Red – Blue are typically associated with detrital carbonate intervals, especially when accompanied by dips in NGR and MS. NGR fluctuations highlight changes in prevalence of green-tinted muds. Red lines in CaCO_3 plot = intervals identified as calcareous mud or sand (Lithofacies 3). Clast counts are centered on 10 cm intervals, and sand beds are centered on core section.

Figure F11. A. Seismic profile (LAKO_1033) at U1605 on outer shelf of Melville Bugt, northwest Greenland with interpreted Horizons (Hz) 6–10 and associated units (topmost is Unit 11, below a veneer of younger sediments). Vertical scale of Site U1605 line is depth (m) based on preferred time-depth model. B. Close-up of seismic survey lines in Site U1605 vicinity. Gray lines = regional 2D seismic data (TGS), black lines = high-resolution multichannel seismic data (LAKO19).

Figure F12. Lithostratigraphic summary, Site U1605. Physical property measurements from discrete recovered intervals are emphasized because of discontinuous core recovery at this site. Changes in physical properties did not appear to correlate to lithologic changes. SHMSL point MS and SHIL RGB data were filtered to exclude values > 1 SD from whole mean to exclude most pebbles, cobbles, or boulders, making the plot more representative of recovered diamicton intervals; whole-round NGR data were not filtered. Light-colored dots = individual filtered measurements. Box plots at median depth of represented population show interquartile range (box), median (thick black line), and whiskers extending to 1.5 \times interquartile values. Shaded amorphous shapes surrounding box plots are violin plots of the same data; relative thickness at any x value shows relative likelihood (kernel density estimate) of a member of the population occurring at that value.

Figure F13. A. Seismic profile (LAKO19_1033) at Site U1606 on outer shelf of Melville Bugt, northwest Greenland. Horizon (Hz) b1 (red) and internal horizons (green, pink, blue) connect Site U1606 with Site U1608 (see Figure F17). Vertical scale of Hole U1606A–U1606D lines are depth (m) based on preferred time-depth model. MTD = mass transport deposit. B. Close-up of seismic survey lines in Site U1606 vicinity. Gray lines = regional 2D seismic data (TGS), black lines = high-resolution multichannel seismic data (LAKO19).

Figure F14. Lithostratigraphic summary, Hole U1606B. MS: thin red line = point MS measurements collected using the SHMSL and filtered to exclude measurements > 1 SD from mean, thick red line = depth-based rolling mean (2 m window). SHIL RGB Red – Blue data and whole-round NGR measurements are plotted using the same method. cps = counts per second. For clasts, bars are centered on the 10 cm interval.

Figure F15. Seismic profiles (A) LAKO19_1034 and (B) LAKO19_1033 at Site U1607 on inner shelf of Melville Bugt, northwest Greenland, showing interpreted Horizons (Hz) b1, c1, d1, and d2 and corresponding megaunits. Hz b1 and c1 express unconformities where part of the record may be missing. Vertical scale of Site U1607 line is depth (m) based on preferred time-depth model supported by VSI and acoustic profiler. Note that from about 350 mbsf seismic

energy is lost. Right: Close-ups of seismic survey lines in Site U1607 vicinity. Gray lines = regional 2D seismic data (TGS), black lines = high-resolution multichannel seismic data (LAKO19). Red line = position of profile in top panel.

Figure F16. Lithostratigraphic summary, Site U1607. SHMSL point MS measurements filtered to exclude values > 2 SD from mean of data set (thin red line) and depth-based rolling average of filtered MS using a 10 m window (thick red line). Same method was used to plot SHIL RGB Red – Blue (blue lines) and whole-round NGR (purple lines). Total organic carbon (TOC) in measured samples. Clast counts are centered on 10 cm intervals. cps = counts per second.

Figure F17. A. Seismic profile (LAKO19_1044) at Site U1608 on outer shelf of Melville Bugt, northwest Greenland with regional seismic Horizons (Hz) b1 and c1 and internal horizons (green, pink) that connect Site U1608 with Site U1606 (see Figure F13). Vertical scale of Site U1608 line is depth (m) based on preferred time-depth model. B. Close-up of seismic survey lines in Site U1608 and U1606

vicinity. Gray lines = regional 2D seismic data (TGS), black lines = high-resolution multichannel seismic data (LAKO19).

Figure F18. Lithostratigraphic summary, Site U1608. SHMSL point MS filtered to exclude values > 2 SD from mean of data set (thin red line) and depth-based rolling average of filtered data using a 10 m window (thick red line). Same method was used to plot SHIL RGB Red – Blue and whole-round NGR. Clast counts are centered on 10 cm intervals.

Figure F19. Coring systems used and core recovery during Expedition 400. Depths = DSF.

Figure F20. Age model overview. Chronological control is preliminary and age assignments may change with continued work. Present global sea level = 0 m. Sea level obtained using benthic (*Cibicidoides*) foraminifera $\delta^{18}\text{O}$ benthic splice and $\delta^{18}\text{O}_{\text{seawater}}$ using temperatures from Mg/Ca records (Miller et al., 2020).