Figure F1. Bathymetric map showing the locations of Expedition 403 sites. Sites U1618 and U1619 are on the eastern and western terminations of the Vestnesa Ridge, respectively; Site U1620 is on the Svyatogor Ridge; Sites U1621 and U1623 are on the Bellsund drift; Site U1622 is on the deeper area of the Storfjorden TMF; and Site U1624 is on the Isfjorden drift. Locations of the Konsfjorden (KF), Isfjorden (IF), Bellsund (BS), and Storfjorden (SF) glacial troughs are shown along the western margin of Svalbard. The Molloy Transform Fault (MTF) is parallel to and south of the Vestnesa Ridge and connects the ultraslow-spreading Knipovich Ridge to the Molloy Ridge. MD = Molloy Deep. Previously drilled ODP Site 909 is located on an abyssal hill south of the MTF, ODP Site 908 on the Hovgaard Ridge, and ODP Site 986 between the Knipovich Ridge and the Svalbard margin.

Figure F2. Modern oceanographic configuration of the North Atlantic Ocean. A. Schematic circulation of surface currents (solid curves) and deep currents (dashed curves) that form a portion of the AMOC. The North Atlantic Current, transporting warm and salty NAW, derives from the Caribbean Gulf Stream; its name changes along the European coasts and becomes the WSC at the northernmost tip flanking the western margin of Spitsbergen. Modified after Curry (2010) (permission for use via Creative Common 3.0). B. Details of northernmost Atlantic Ocean current configuration. ESC = East Spitsbergen Current, YP = Yermak Plateau, FS = Fram Strait (Bathymetry IBCAO v. 3; Jakobsson et al., 2012).

Figure F3. Seismic profile across Isfjorden drift (Figure F1) plotted below the WSC velocity (cm/s) pattern (modified after Rebesco et al., 2013). The velocity profile of WSC presents two cores: a strong shallow core of WSC transporting warm NAW (30–40 cm/s) causes sediment erosion and/or bypass in the upper continental slope and shelf, whereas a low-velocity deep core (~1500 m water depth; 5–10 cm/s) transporting NSDW promotes deposition with growth of the Isfjorden drift. White cross (arrow's tail) = WSC northward-flowing direction.

Figure F4. Schematic cross-section views of depositional processes that contribute sediment to contourite depositional system during different climate regimes. Shallow and deep cores of the WSC change depth and strength between glacial and interglacial stages. Crossed circles (arrow's tails) = northward-flowing WSC.

Figure F5. Drilling operations, Expedition 403. Sites and holes are organized (left to right) in order of operation, except for Holes U1623D–U1623G, which were drilled upon return to the site following operations at Site U1624.

Figure F6. Seismic profile along northwest–southeast Seismic Line CAGE20-5-HH-02-2D showing the location of Site U1618 annotated with interpreted Reflectors R1, R5, and R7 and the maximum penetration depth of 414 mbsf. Interpreted locations of a fault and possible gas chimney are indicated.

Figure F7. Headspace hydrocarbon C_1/C_2 ratios versus downhole temperatures for each site, Expedition 403. Diagram includes shaded anomalous versus normal zones. The relationship between C_1/C_2 ratios and downhole (i.e., sediment) temperature is one criterion to evaluate the nature of hydrocarbon occurrence. Anomalously low C_1/C_2 ratios suggest the presence of migrated thermogenic hydrocarbons (Pimmel and Claypool, 2001; JOIDES Pollution Prevention and Safety Panel, 1992).

Figure F8. Paired linescan core images and X-radiographs of representative features, Expedition 403. X-radiographs: black = high density. Scale bar = 1 cm. A. Lithologies and sedimentary structures. Top left: sand with layered and dispersed clasts. Top center: interbedded silty clay and silt layers. Top right: silty clay containing abundant sand patches interpreted as iceberg-rafted sediment pellets. Right: debrite with contorted muddy clasts in a muddy matrix. Bottom left: dropstone. Bottom center: laminated silty clay. Bottom right: diamicton. B. Sedimentary authigenic minerals. Top left: yellowish orange sand-sized authigenic carbonate grains. Top right: authigenic iron sulfide nodules (greigite). Bottom left: authigenic carbonate nodules (light brown). Bottom right: black-yellow-brown laminations and selective enrichment (black laminae) and authigenic carbonates (yellow laminae) in an overall quartz and clay mineral–rich bulk sedimentation (brown sediments). (Continued on next page.)

Figure F9. Lithostratigraphic summary, Expedition 403. The longest record from each site is included. The biozone scheme follows Martini (1971) and the revision by Razmjooei et al. (2023) for the boundaries of the upper nannofossil biozones NN20 and NN21.

Figure F10. Important biostratigraphic microfossils encountered during analyses of sediments, Expedition 403. Foraminifers: 1. *Cassidulina teretis* (403-U1619A-25X-CC). 2. *Neogloboquadrina atlantica* (umbilical view) (403-U1619A-45X-CC). 3. *Neogloboquadrina pachyderma* (umbilical view) (403-U1621A-1H-CC). 4. *Cibicides grossa* (umbilical view) (403-U1619A-45X-CC). Calcareous nannoplankton: 5. *Emiliania huxleyi* (403-U1621C-1H-2W, 60 cm). 6. *Gephyrocapsa caribbeanica* (403-U1618A-7H-1W, 50 cm). 7. *Reticulofenestra asanoi* (403-U1623A-41X-3, 63 cm). 8. *Helicosphaera sellii* (403-U1620B-24X-CC). 9. *Reticulofenestra pseudoumbilicus* (403-U1619A-55X-CC). Dinocysts: 10. Cyst of *Protoperidinium stellatum* (403-U1618A-14F-CC). 11. *Filisphaera filifera* (403-U1618A-10H-CC). 12. *Habibacysta tectata* (403-U1619A-14F-CC). 13. Cyst of *Protoceratium reticulatum* (403-U1624B-4H-4A, 69–81 cm). 14. *Islandinium brevispinosum* (403-U1618A-14F-CC). 15. *Islandinium minutum* (403-U1624B-5H-CC). 16. *Brigantedinium* sp. (403-U1621C-4H-4A, 82–92 cm). Acritarchs: 17. *Lavradosphaera canalis* (403-U1620D-45X-CC). Diatoms: 18. *Fragilariopsis fossilis* (403-U1623A-41X-3, 107 cm). 19. *Neodenticula seminae* (403-U1623A-33X-5, 38 cm). 20. *Proboscia curvirostris* (403-U1621A-9H-1, 72 cm). 21. *Thalassiosira jouseae* (403-U1619A-19F-1, 79 cm).

Figure F11. Histograms illustrating variability of ARM coercivity, Expedition 403. Values are tracked by the ratio of the ARM after 30 mT peak alternating field demagnetization to the initial ARM. Higher values indicate greater resistance to demagnetization. Green vertical shading = range of values observed in authigenic greigite and siderite nodules. Gray vertical shading = range commonly observed in near-surface samples that we interpret to be consistent with the properties of the primary detrital magnetic mineral assemblage. Further rock magnetic, mineralogical, and microscopic investigation will help improve our understanding of what drives the distributions of ARM coercivity in these regions.

Figure F12. Seismic profile along northwest–southeast Seismic Line CAGE20-5-HH-11-2D showing the location of Site U1619 with interpreted Reflectors R1, R5, R7, and R8 and the maximum penetration depth of 627.9 mbsf.

Figure F13. Approximate age-depth relationship, Expedition 403. Biostratigraphic constraints from calcareous nannofossils, planktonic foraminifers, diatoms, and dinocysts (stars); magnetic reversals (squares); and a polynomial fit to select age constraints (dark solid line) are shown. Depth and age ranges for the stratigraphic constraints are indicated with light horizontal and vertical lines, respectively. Top: 2020 Geologic Timescale (Gradstein et al., 2020). Bottom: benthic $\delta^{18}O$ compilation of Westerhold et al. (2020), which uses data from a Ceara Rise stack (Bickert et al., 1997; Wilkens et al., 2017), ODP Site 1264 (Westerhold et al., 2020), and IODP Site U1337 (Drury et al., 2017; Tian et al., 2018) in this interval. Estimates of atmospheric CO_2 concentration from the compilation of The Cenozoic CO_2 Proxy Integration Project (CenCO2PIP) Consortium (2023) from boron proxies (blue), phytoplankton proxies (yellow), and paleosols (red) are shown (Andersen et al., 1999; Badger et al., 2013, 2019; Bolton et al., 2016; Brown et al., 2022; Da et al., 2019; de la Vega et al., 2020; Dyez et al., 2018; González-Lanchas et al., 2021; Henehan et al., 2013; Jasper and Hayes, 1990; Martínez-Botí et al., 2015; Rae et al., 2021; Seki et al., 2010; Sosdian et al., 2018; Tanner et al., 2020; Zhang et al., 2017, 2019, 2020). Black line = Bereiter et al. (2015) compilation of atmospheric CO_2 reconstructed from Antarctic ice cores (Ahn and Brook, 2014; Bereiter et al., 2012, 2015; MacFarling Meure et al., 2006; Marcott et al., 2014; Monnin et al., 2001, 2004; Petit et al., 1999; Rubino et al., 2013; Schneider et al., 2013; Siegenthaler et al., 2005). Key climate transitions and isotopic stages that these new records capture are indicated. iNHG = inception of Northern Hemisphere glaciation, Mio-Plio = Miocene–Pliocene transition.

Figure F14. Seismic profile along southwest–northeast Seismic Line Svyatogor2014_3D-XL222 showing the location of Site U1620 with interpreted Reflector R7 and the maximum penetration depth of 616 mbsf. Interpreted location of the underlying basement, multiple faults, and free gas are also shown.

Figure F15. A. Seismic profile along northwest–southeast Seismic Line CAGE21-1-HH-05 showing the projected location of Site U1621 and the location of Site U1623 with interpreted Reflectors R1–R4a and the maximum penetration depth of 216 mbsf (Site U1621) and 370 mbsf (Site U1623). B. Seismic profile along northwest–southeast Seismic Line CAGE21-1HH-03 showing the projected locations of Sites U1623 and U1622 (penetration = 46.5 mbsf).

Figure F16. Seismic Line EG-01A showing projected location of Site U1624, evident mass gravity deposits associated with past shelf edge glaciations, interpreted reflectors (R1–R4a), and maximum penetration depth to 258 mbsf. CDP = common depth point.