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Depositional evolution of the Melville Bay trough-mouth fan, NW Greenland

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The continental margin of NW Greenland bordering northern Baffin Bay is characterized by major sediment accumulations, known as Trough-Mouth Fans (TMF). The fan depocentres represent intense sediment dispersal at the terminus of ice streams that during cold climate periods provided major drainage routes of the northern Greenland Ice Sheet into Baffin Bay. The imprint of paleo-icestreams is seen by erosional troughs crossing a >250 km broad shelf region, which caps a series of sedimentary basins containing thick Mesozoic-Tertiary strata packages. This presentation provides an overview of the seismic stratigraphic division, depositional architecture and examples of seismic facies of the Melville Bay TMF using a 5-10 km grid of industry-quality 2D seismic data (TGS). The focus will primarily be on the inception and early stage of glacial fan development. Comparing the present-day topography with the regional geology shows that the paleo-icestreams exploited the Cenozoic infill of former rift basins that are more conducive to erosion than the adjoining ridges and structural highs. The TMF sequence is constructed by a series of progradational seismic units that represent successive steps in location of ice stream terminus and associated depocenters. The slope fronts of the prograding units show abundant signatures of sediment instability and mass-wasting but evidence of along-slope current-driven processes is also recognized presumably linked to interglacial sea level high-stands. The topset of each unit is characterized by planar erosion that merges landward into hummocky positive geometries with low internal reflectivity. These features are generally interpreted as subglacial landforms, e.g. terminal moraines and ice-contact deposits, associated with grounding zone wedges. Unlike the most recent TMF units deposited in front of the present trough, the oldest glacigenic units have built out from a Neogene sediment prism that forms the core of modern shallow-water banks. These topographic highs probably formed anchoring points facilitating the initial expansion of inland ice onto the shelf. The pre-glacial Neogene package displays typical contourite features concentrated along the mid-shelf region, while further basinward it is marked by intensive erosion and down-slope mass transport in the form of mega-slides. Our results suggests that shelf glaciation in these parts could have been facilitated by tectonic adjustments (e.g. relative fall in sea level) related to phases of tectonic uplift during latest Miocene and Pliocene/early Pleistocene. The present work contributes to a better understanding of the internal complexity of TMF systems as well as the underlying long-term mechanisms that evoked the Late Cenozoic development of the Greenland Ice Sheet.