



Grounding Zone Wedges – architecture, processes and rates of formation

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Grounding Zone Wedges (GZWs) are prominent glacial-morphological features, commonly found in high-latitude cross-shelf troughs and assumed formed during still-stands in ice stream activity. GZWs are important features as they may reflect ice stream responses to forcing from rapid changes in sea level, atmospheric and oceanic temperatures, and substrate conditions. Knowledge about GZWs has mostly been obtained from acoustic data. Here we report on three previously published shallow borings (8903, 5.1/5.2 and 3.1) that penetrate through a GZW (here named the Troll GZW) in the Norwegian Channel, NE North Sea. The Troll GZW, which is also covered by high-resolution bathymetric data, TOPAS profiles, and 3D seismic surveys, is located about 200 km south of the present day shelf edge. The GZW was formed during the retreat of the Last Glacial Maximum (LGM) ice sheet and within a region of the Norwegian Channel that is rather narrow and where seismic profiles indicate that a stack of GZWs exists. The Troll GZW is up to 65 m thick, about 20 km long in the along-flow direction, around 20 km wide, and is the largest of the GZWs identified in the Norwegian Channel. The shallow borings show that the Troll GZW is composed of 35-40% sand, of which 2-4% represent grain sizes >1mm. A slightly decrease in water content with depth, from 25% to 20%, is observed within the GZW. Shear strength measurements show higher values within the GZW, compared to those values found in both younger and older glacimarine/marine units. The Troll GZW has the same lithological characteristics as LGM Glacigenic Debris Flows that have been deposited in the North Sea Fan at the outlet of the Norwegian Channel. The Troll GZW has an acoustically layered seismic pattern, where Mega-Scale Glacial Lineations are imprinted at its surface and ice-berg plough marks are observed distally of the GZW; indicating that the Norwegian Channel Ice Stream was streaming over the Troll GZW during its formation, whereas ice-bergs breaking off the ice front drifted along the ice margin. Previous studies have shown that LGM sediments were delivered to the North Sea Fan by a rate of 8000 m³/yr per meter ice stream front. If anticipating the same rates during GZW formation the Troll GZW, which has a sediment volume of at least 14 km³, was formed in minimum 85 yrs.