

Down, across and along: sediment deposition and erosion on the glaciated southeast Greenland margin

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Abstract: *The Southeast Greenland continental shelf, slope and rise are subjected to along- and across-slope erosional and sedimentary processes. Turbidity currents flow through valley systems downslope and create large channel-levée sequences, orientated perpendicular to the slope. Meanwhile strong ocean currents sweep along the slope and rise and over the shelf, bringing in new sediments from other region, interacting with downslope sediment transport processes or eroding sediment. The different processes prevail at different depths and their imprint has changed over time. Climatic changes (glacial vs. interglacial times), but most likely also tectonic processes have a large effect on where and when which processes dominate.*

Key words: *Greenland, Irminger Sea, glaciated continental margin, bottom current, turbidity current.*

INTRODUCTION

The southeast Greenland continental margin represents an area where many different types of erosional and depositional processes interact. Sediment is transported from onshore to the deep basin in many different ways along many different paths, but it is also swiped into the Irminger basin by a lot of different ocean currents and icebergs (see Fig. 1). This area is characterised as a 'glaciated continental margin' (Nielsen et al., 2005). Ice masses have directly (i.e. severe erosion and large-scale deposition) and indirectly (i.e. iceberg rafted detritus and meltwater plumes) played an important role in delivering sediment to the shelf and slope.

The continental margin is not morphologically uniform. The SE Greenland shelf dips landwards. It is up to 500km wide in the northern part, but it becomes remarkably narrower (45-55km) in the south. In the northern part there are two large shelf crossing troughs. Further to the south more, but smaller and narrower troughs are found. The slope morphology is strongly affected by powerful, southward flowing geostrophic bottom currents in combination with glacial-induced down-slope mass transport (Clausen, 1998; Rasmussen et al., 2003).

DATA & RESULTS

Seismic data collected since the 1970's on the southeast Greenland shelf, slope and rise was brought together and re-evaluated. Along the entire SE Greenland slope there is a morphological step at ca. -1750m water depth which corresponds to a moat zone, with a large drift complex just south of it.

Clausen (1998) and Rasmussen et al. (2003) identified three main seismic sequences along the SE

Greenland margin between 62 and 64°N. They are separated by unconformities of late Miocene, Early Pliocene and Mid Pliocene ages. The seismic facies of the two youngest sequences suggest a mixed deposition from both bottom currents and turbidity currents.

However, Clausen (1998) and Rasmussen et al. (2003) only focussed on a small area of the southern part of SE Greenland margin, where large channel-levée/drift sequences, almost perpendicular to the slope, are present. In the north, such structures are completely absent and further south they are less clear. This indicates that there is no one-size fits all story for this glaciated margin.

DISCUSSION & CONCLUSION

The morphological difference between the northern and southern part of the SE Greenland margin indicates a different evolution and domination of different sedimentary processes in time and space. A succession of multiple glacial-interglacial cycles has been central in determining which sedimentary process (downslope vs. alongslope) could dominate when and where.

The Greenland Ice Sheet itself has had an influence on the formation and location of the shelf troughs, which were most likely formed by ice streams and on the supply of sediment to the SE Greenland margin.

However, the ages of the unconformities separating the different seismic unit correspond well with periods of uplift in the area (Japsen et al., 2014). This age synchrony accentuates that we need to consider the interplay of several (e.g. climatic, oceanographic and tectonic) process drivers. The spreading evolution of the Reykjanes spreading ridge was crucial in changes in shape and depth of the Irminger Sea (Ehlers et al. 2013), impacting sediment accommodation space

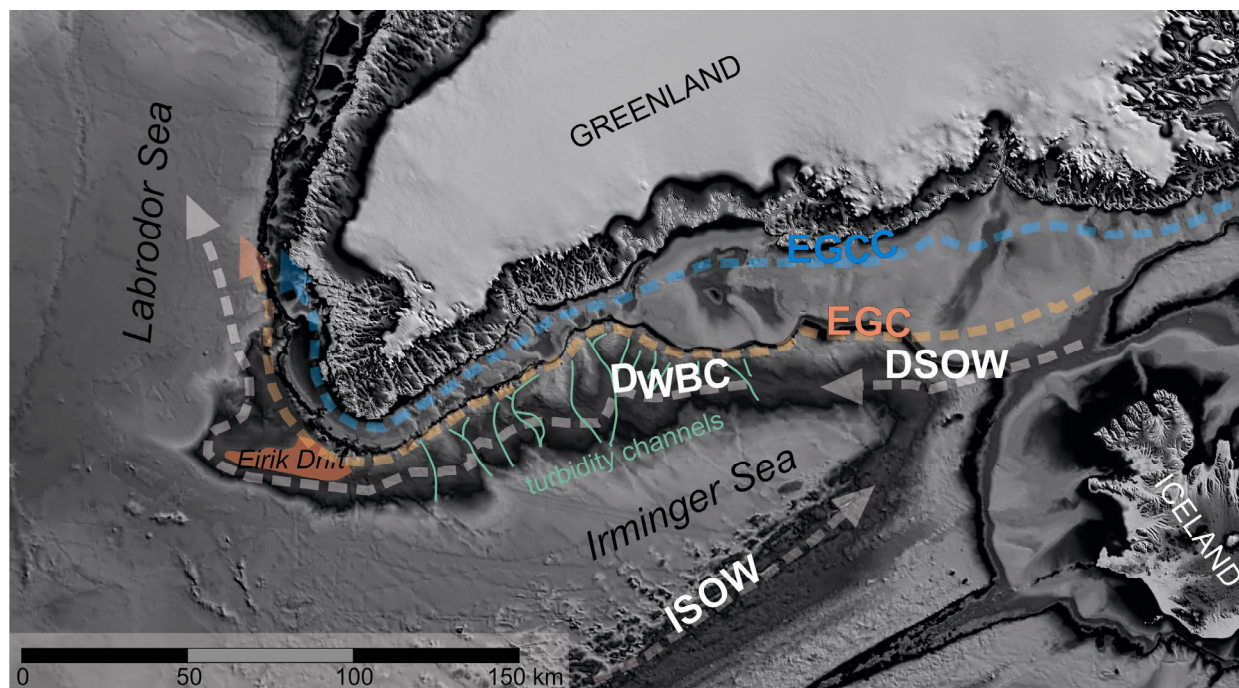


FIGURE 1: Extract of the International Bathymetric Chart of the Arctic Ocean (IBCAO) (Jakobsson et al., 2012) showing the southern tip of Greenland. The boundary currents sweeping along the slopes of the Irminger Sea are indicated with dashed lines: DWBC = Deep Western Boundary Current; EGC = East Greenland Current; EGCC = East Greenland Coastal Current; ISOW = Iceland Scotland Overflow Water; DSOW = Denmark Strait Overflow Water. Green lines indicate some of the turbidity channels that are present on the continental slope providing across slope erosion/sedimentation processes.

(more essential for the northern shelf) and ocean current formation and location. Differences in accommodation space were crucial in the northern (less space) and southern (more space) development of the SE Greenland shelf.

Linking the different seismic facies and drift sequences from the SE Greenland margin with the Eirik drift (Müller-Michaelis et al., 2013) emphasizes the importance of ocean current dynamics in the process of the sediment distribution and drift formation. Here we see a clear link between tectonic movements, the opening/closing of oceanic gateways and ocean current activity.

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