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Submarine glacial landforms in Southeast Greenland fjords reveal contrasting outlet-glacier behaviour since the Last Glacial Maximum

Christine Batchelor^{1,2}, Julian Dowdeswell², Eric Rignot^{3,4}, and Romain Millan³

¹Norwegian University of Science and Technology (NTNU), Trondheim, Norway

²Scott Polar Research Institute, University of Cambridge, Cambridge, UK

³Department of Earth System Science, University of California, Irvine, CA, USA

⁴Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

The Southeast (SE) Greenland margin, which includes the SE sector of the Greenland Ice Sheet (GIS) and the eastern Julianehåb Ice Cap (JIC), is drained by a number of fast-flowing, marine-terminating outlet glaciers. Although the SE Greenland margin is suggested to have been highly sensitive to past climatic changes, mountainous terrain and a lack of ice-free areas have largely prevented analysis of the deglacial and Holocene behaviour of these outlet glaciers. Here we use bathymetric data, from multibeam echo-sounding acquired by NASA's Earth Venture Sub-orbital Oceans Melting Greenland (OMG) mission and from gravity inversion derived from Operation Icebridge (OIB) gravity data, from 36 fjords along the SE Greenland margin to map the distribution of more than 50 major submarine moraines. The moraines are up to 3 km long in the former ice-flow direction, reach up to 150 m above the surrounding seafloor, and span the width of the fjord.

Inner-fjord moraines are widespread along the SE Greenland margin, occurring in 65% of the surveyed fjords of the SE GIS and the JIC. Their locations beyond the oldest ice-margin position where it is known from aerial photographs and correlation with prominent terrestrial moraines suggest that the inner-fjord moraines were produced sometime during the Neoglacial (since approximately 4 ka).

Major moraine ridges are present in a midfjord setting in all of the nine fjords of the eastern JIC yet are generally absent from the deeper and wider fjords of the SE GIS. Given the distribution of published deglacial ages, we hypothesize that the midfjord moraines of the eastern JIC were formed during an ice-margin stillstand or advance that occurred during the early Holocene. It is possible that this stillstand or advance had a climatic control, for example, the 8.2-ka event that has been recorded from Greenland ice cores. The absence of midfjord moraines from the deeper and wider fjords of the SE GIS to the north suggests relatively rapid and continuous ice retreat occurred during the last deglaciation. The contrasting behaviour of the SE GIS and the eastern JIC during the last deglaciation probably reflects differences in fjord geometry and exposure to ocean heat.

