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Submarine fans on the western Barents Sea continental Margin: a test of the Earth's response to young sediment loads

Ø. Engen (1), **A. B. Watts** (2)

(1) Department of Geosciences, University of Oslo, Norway, (2) Department of Earth Sciences, University of Oxford, United Kingdom (oyvind.engen@geo.uio.no / Phone: +47-9156-0416)

The Earth's response to long-term geological processes can only be studied through discrete 'snapshots' of time and not as a continuum of forces and deformations across all time scales. These 'snapshots' include co-seismic and post-seismic deformation (up to a few hundreds of seconds), glacial isostatic adjustment (GIA; a few thousands of years), and lithospheric flexure (millions of years). The Cenozoic W Barents Sea continental margin, between Norway and Svalbard, may represent another 'snapshot' that has been little studied so far. Up to 4.5 km of sediments have been deposited on the Bear Island and Storfjorden fans since the onset of northern hemisphere glaciations ($\sim$2.6 Ma), representing a large loading event that is intermediate in age between the timescales of GIA and typical sediment loading of continental margins. The Storfjorden Fan has been emplaced on oceanic crust that ranges in age from 30–40 Ma near the margin to Recent near the mid-Atlantic spreading ridge and correlates with a large-amplitude free-air gravity anomaly 'high' of $>$100 mGal. We apply a process-oriented flexural backstripping and gravity modelling technique to determine the state of isostasy of the continental margin prior to and during sediment loading. Earlier work using this technique on the U.S. East Coast, Amazon and SW African margins has shown that the effective elastic thickness (T_e) of the lithosphere during sediment loading is roughly described by the depth to the 450˚C isotherm as determined by cooling plate models. On the W Barents Sea margin, a T_e value of 30–40 km is required to reproduce the fan gravity anomaly. This T_e value is significantly higher than that predicted for a sediment load with an average age of 1.3 Ma, oceanic crust with

an average age of 15–20 Ma, and a controlling isotherm of 450˚C (T_e = 10–15 km). Our results therefore indicate that despite its young age, the oceanic lithosphere that underlies the fan is a relatively strong structure, at least during the initial stages of loading. We examine here the implications of this high strength for the regional stress field and for the vertical motion history of the margin.