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Crustal structure of the East Greenland volcanic margin - I: Voluminous underplating north of the Jan Mayen Fracture Zone

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Deep seismic refraction data were gathered along the East Greenland rifted margin north of the Jan Mayen Fracture Zone in 2003 in the framework of the EUROMARGINS project. Investigations of the deep structure of the continental margin, and comparison with the conjugate margin off Norway, provide key constraints on margin's formation and structural evolution during and after Late Cretaceous - Early Tertiary rifting and continental break-up.

Most of the four acquired transects were located between 72˚N and 76˚N on the prolongation of fjord profiles acquired during earlier investigations. In the Godthåb Gulf and the Kejser Franz Joseph Fjord, forward travel-time modelling of ocean bottom seismometer (OBS) data established regional velocity models of the continental margins and the transition to oceanic crust. Both profiles show a continental basement high partially overlain by Mesozoic sediments, and total crustal thicknesses of 29 – 33 km. The eastward edge of the basement high correlates clearly with a positive free-air gravity anomaly. A 3 km thick sedimentary basin, with velocities of 2.0 – 2.4 km/s in the upper layer due to glacial compaction, extends for over 120 km across the East Greenland shelf along the Godthåb Gulf profile. The onset of thin (6.5 km) crystalline oceanic crust is marked by the first clear visible magnetic spreading anomaly C22.

A 3 – 4 km thick layer of glacially compacted sediments extends for almost 150 km along the Kejser Franz Joseph Fjord profile. The onset of thin (5.5 km) oceanic crust coincides with the clear anomaly C21 east of the continental slope.

Along both profiles, a wide continent-ocean transition zone appears with lateral and

vertical velocity variations. Furthermore, both profiles show a lower crustal body with p-wave velocities of 7.1 – 7.4 km/s which is interpretated as underplated magmatic material. It extends across distanceses of 180 km to 210 km, respectively. Wide angle reflections show a well constrained Moho as well as an intermittent top reflector (T) of the high velocity body. The southern profile shows marked relief of both the Moho and the T-reflector and the lower crustal body shows variations in its thickness of up to 15 km. The Moho boundary along the northern profile shows much less relief. The thickness of the lower crustal body varies by up to 19 km. From earlier investigations, a southward decrease in the amount of underplated material at the COT is observable; near Kong Oscar Fjord the underplating is thinner than in our profiles, and near Scoresby Sund no underplating was identified. The existence of voluminous underplating is direct evidence of rift-related magmatism that wasn't extruded like the adjacent flood basalts. Compared to the conjugate Vøring Margin off Norway, differences in the crustal thickness and degree of magmatic underplating are evidence for different rift formation processes.