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The crust and upper mantle of central East Greenland – implications for continental accretion and rift evolution

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The geological evolution of the North Atlantic Realm during the past 450 Myr, which has shaped the present-day topographic, crustal and upper mantle features, was dominated by the Caledonian orogeny and the formation of the North Atlantic and associated igneous activity. The distinct high altitude-low relief landscapes that accompany the North Atlantic rifted passive margins are the focus of a discussion of whether they are remnant and modified Caledonian features or, alternatively, recently uplifted peneplains.
Teleseismic receiver function analysis of 11 broadband seismometers in the Central Fjord Region in East Greenland indicates the presence of a fossil subduction complex, including a slab of eclogitised mafic crust and an overlying wedge of hydrated mantle peridotite. This model is generally consistent with gravity and topography. It is shown that the entire structure including crustal thickness variations and sub-Moho heterogeneity gives a superior gravity and isostatic topographic fit compared to a model with a homogeneous lithospheric layer (1). The high topography of >1000 m in the western part of the area is supported by the c. 40 km thick crust. The eastern part requires buoyancy from the low velocity/low density mantle wedge. The geometry, velocities and densities are consistent with structures associated with a fossil subduction zone. The spatial relations with Caledonian structures suggest a Caledonian origin. The results indicate that topography is isostatically compensated by density variations within the lithosphere and that significant present-day dynamic topography seems not to be required. Further, this structure is suggested to be geophysically very similar to the Flannan reflector imaged north of Scotland, and that these are the remnants of the same fossil subduction zone, broken apart and separated during the formation of the North Atlantic in the early Cenozoic (2).

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2) Schiffer, C., Stephenson, R.A., Petersen, K.D., Nielsen, S.B., Jacobsen, B.H., Balling, N. and Macdonald, D.I.M., 2015. A sub-crustal piercing point for North Atlantic reconstructions and tectonic implications. Geology, 43, 1087-1090.