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TopoGreenland: crustal structure in central-eastern Greenland along a new refraction profile

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We present the seismic structure in the interior of Greenland based on the first measurements by the seismic refraction/wide angle reflection method. Previous seismic surveys have only been carried out offshore and near the coast of Greenland, where the crustal structure is affected by oceanic break-up and may not be representative of the interior of the island. Acquisition of geophysical data in onshore Greenland is logistically complicated by the presence of an up to 3.4 km thick ice sheet, permanently covering most of the land mass. The seismic data was acquired by a team of six people during a two-month long experiment in summer of 2011 on the ice cap in the interior of central-eastern Greenland. The EW-trending profile extends 310 km inland from the approximate edge of the stable ice cap near Scoresby Sund across the center of the ice cap. The planned extension of the profile by use of OBSs and air gun shooting in Scoresbysund Fjord to the east coast of Greenland was unfortunately canceled, because navigation was prevented by ice drift. 350 Reftek Texan receivers recorded high-quality seismic data from 8 equidistant shots along the profile. Explosive charge sizes were 1 ton at the ends and ca. 500 kg along the profile, loaded with about 125 kg at 35-85 m depth in individual boreholes.

Two-dimensional velocity model based on tomographic inversion and forward ray tracing modeling shows a decrease of crustal thickness from 47 km below the center of Greenland in the western part to 40 km in the eastern part of the profile. Earlier studies show that crustal thickness further decreases eastward to ca. 30 km below the fjord system, but details of the changes are unknown. Relatively high lower crustal velocities (Vp 6.8 – 7.3) in the western part of the TopoGreenland profile may indicate past collision tectonics or may be related or to the passage of the Iceland mantle plume.

The origin of the pronounced circum-Atlantic mountain ranges in Norway and eastern Greenland, which have average elevation above 1500 m with peak elevations of more than 3.5 km close to Scoresby Sund in Eastern Greenland, is unknown. Our new results on the crustal structure provide data for assessment of the isostatic balance of the crust in Greenland, as well as for insight into possible links between crustal composition, rifting history and present-day topography of the North Atlantic Region.