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Active seismic profile in east-central Greenland. Seismic explosion sources on an ice cap.

Alexey Shulgin and Hans Thybo
University of Oslo, Center for Earth Evolution and Dynamics (CEED), Oslo, Norway

Controlled source seismic investigation of crustal structure below ice covers is an emerging technique. We have recently conducted an explosive refraction/wide-angle reflection seismic experiment on the ice cap in east-central Greenland. The data quality is high for all shot points and a full crustal model is modelled. A crucial challenge for applying the technique is to control the sources. Here, we present data that describe the efficiency of explosive sources in the ice cover. Analysis of the data shows, that the ice cap traps a significant amount of energy, which is observed as a strong ice wave. The ice cap leads to low transmission of energy into the crust such that charges need be larger than in conventional onshore experiments to obtain reliable seismic signals. The strong reflection coefficient at the base of the ice generates strong multiples which may mask for secondary phases. This effect may be crucial for acquisition of reflection seismic profiles on ice caps. Our experience shows that it is essential to use optimum depth for the charges and to seal the boreholes carefully.

We also present the crustal structure model in the continental part of Greenland along the profile based on the joint reflection/refraction tomographic inversion. The model shows strong lateral variations in the crustal thickness. The modeled Moho depth is changing from 39 to 47 km. The large volume of the lower most crust is observed in the central region of Greenland, while been absent in the costal region. The observed crustal structure corresponds to the transition from the younger terrane affected by the Caledonian orogeny to the stable cratonic region. Furthermore, the presence of the Icelandic plume ca. 60-40 Ma in the study area may also have a significant effect on the crustal evolution of the Greenland Caledonides and its transition to the Greenland Craton.