The crustal structure of the Northeast Greenland continental shelf across the extension of the West Jan Mayen Fracture Zone

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G E U S

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Abstract EGU2020-2296

Refraction line BGR17-2R2

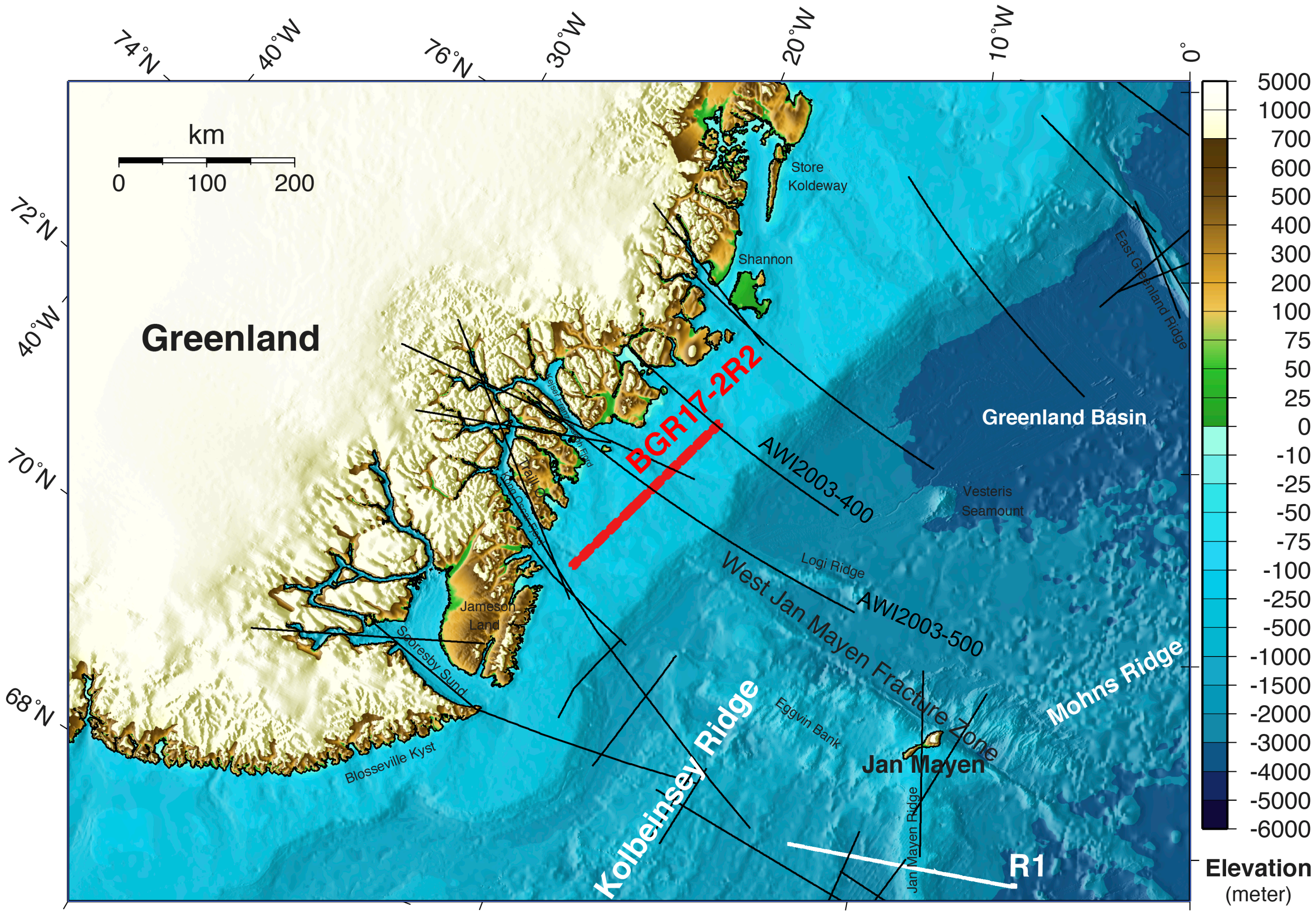
Acquired during cruise MSM67 on board RV Maria S. Merian in 2017.

29 ocean bottom seismometers

Air gun source (4840 cub. in.)

Line is located on the East Greenland shelf in extension of the West Jan Mayen Fracture Zone (WJMFZ). Igneous centres and extrusive lavas are found in the vicinity of the line; seaward dipping reflectors are observed north of the WJMFZ (Hopper et al. 2004).

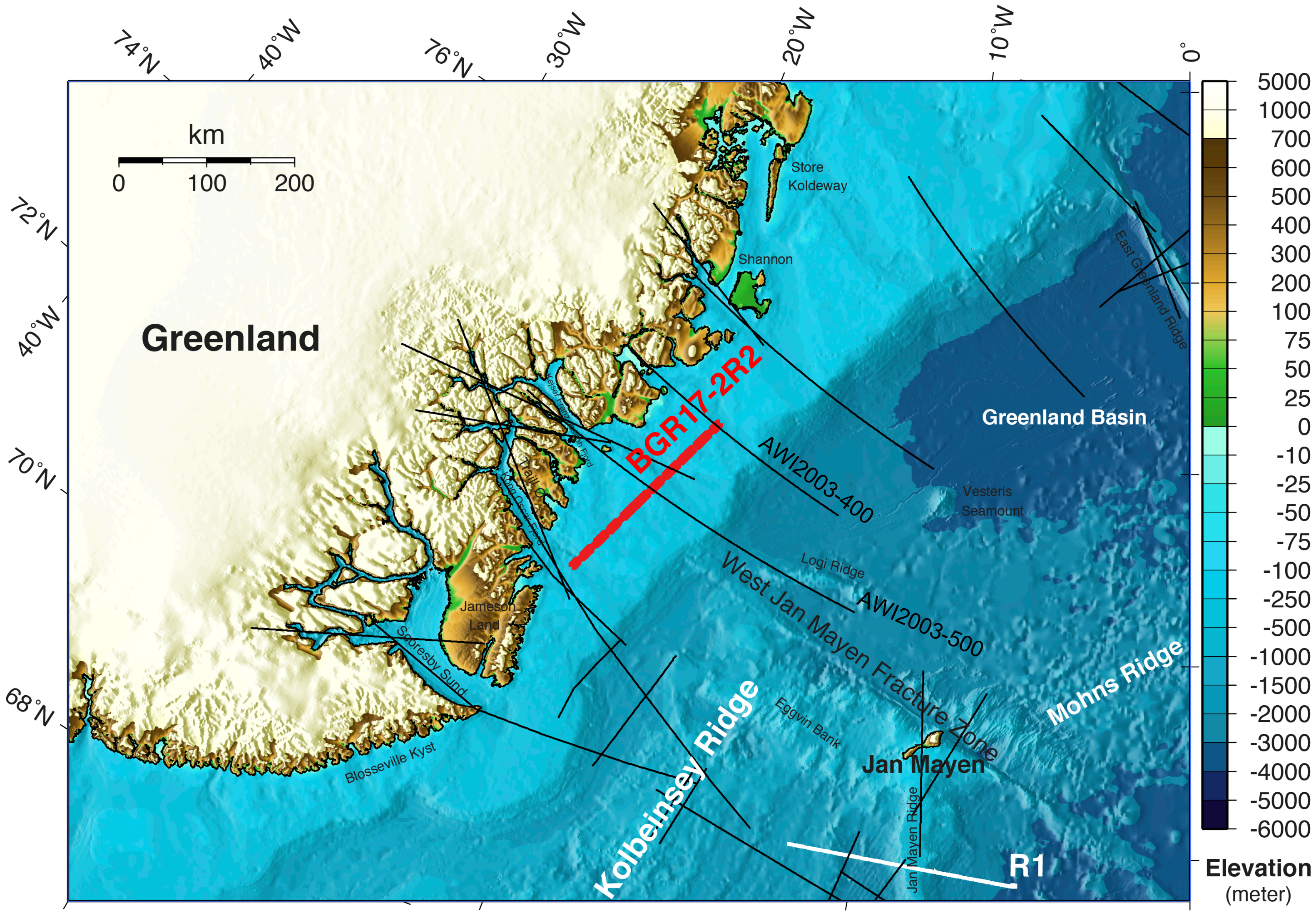
Data were analyzed in RAYINVR (forward and inverse modelling) and TOMO2D (tomography) employing a Monte Carlo scheme.



Bathymetry data: IBCAO version 3.0 (Jakobsson et al. 2012)

Main objectives

- Identifcation of margin segmentation
- In particular the signature of the landward extent of the West Jan Mayen Fracture Zone (associated with a change of breakup age from Paleocene in the north to Oligocene/Miocene in the south)
- Timing, distribution and origin of basaltic intrusives and extrusives



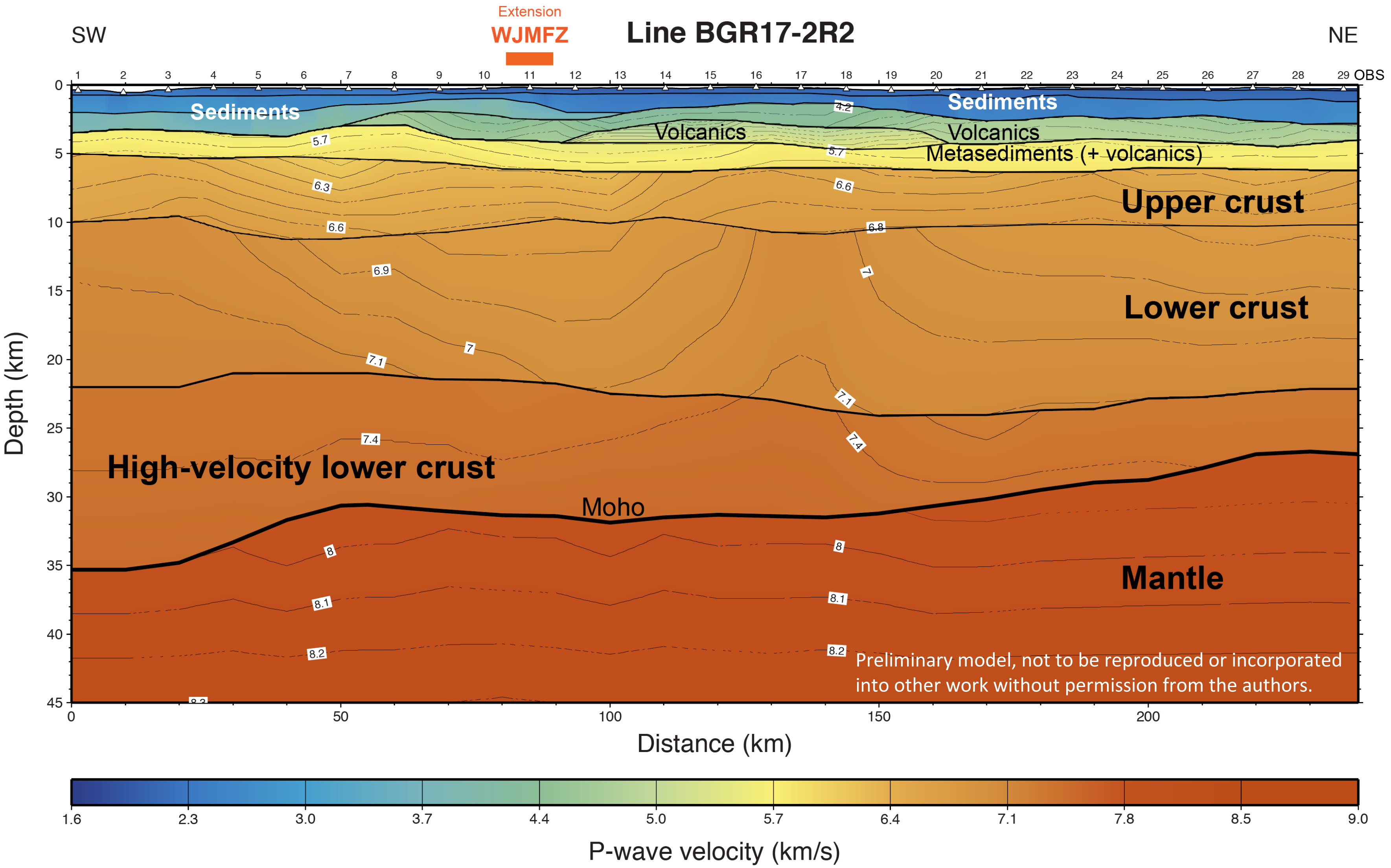
Bathymetry data: IBCAO version 3.0 (Jakobsson et al. 2012)

Refraction line BGR17-2R2 – P-Wave Velocity Model from RAYINVR

Preliminary P-wave velocity model developed by forward and inverse modelling of travel times (refractions and reflections) using the program RAYINVR (Zelt & Smith 1992) and tentative interpretation. In addition, gravity modeling was used to constrain Moho depth at either end of the profile.

A high-velocity lower crust (7.4 km/s) is observed along the entire length of the profile even though the break-up age is younger to the south of the WJMFZ.

Increased crustal velocities around km 140 correlate with interpreted volcanic rocks at the top.



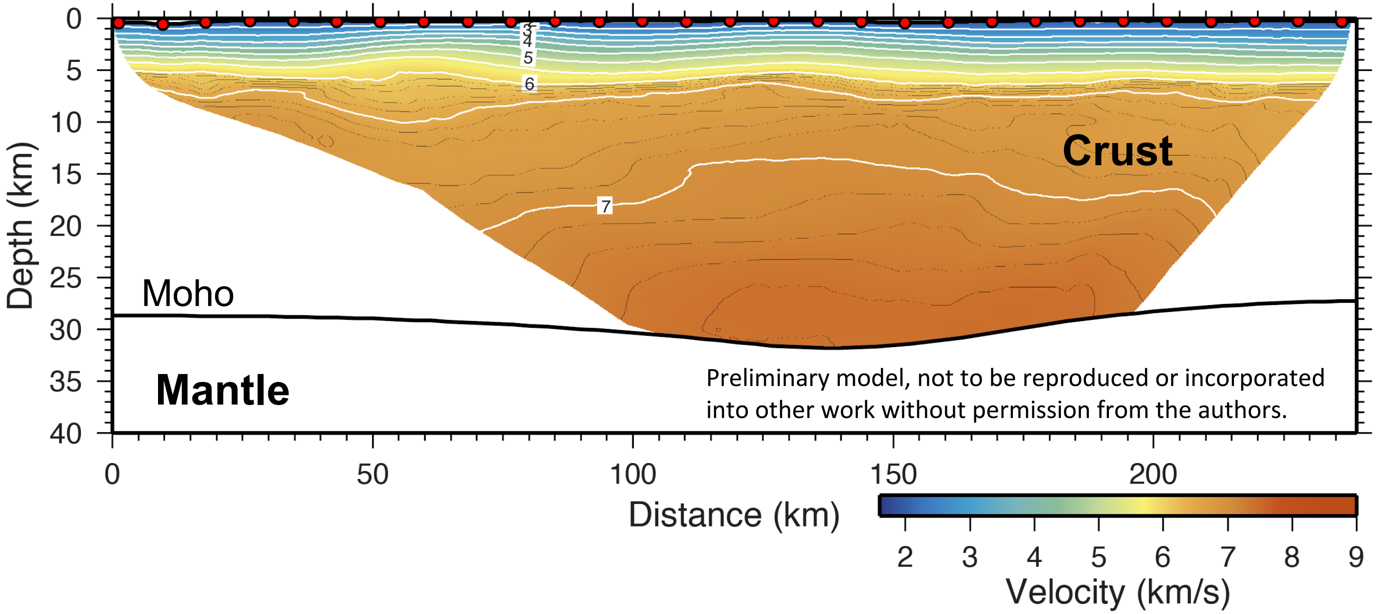
P-wave velocity model from Monte Carlo scheme using TOMO2D

Preliminary P-wave velocity model obtained from tomography (program TOMO2D; Korenaga et al. 2000) using first arrival crustal refractions and Moho reflections (P_mP). The model is the average Monte Carlo ensemble obtained from 100 different start models and random variation of travel time picks within their uncertainties.

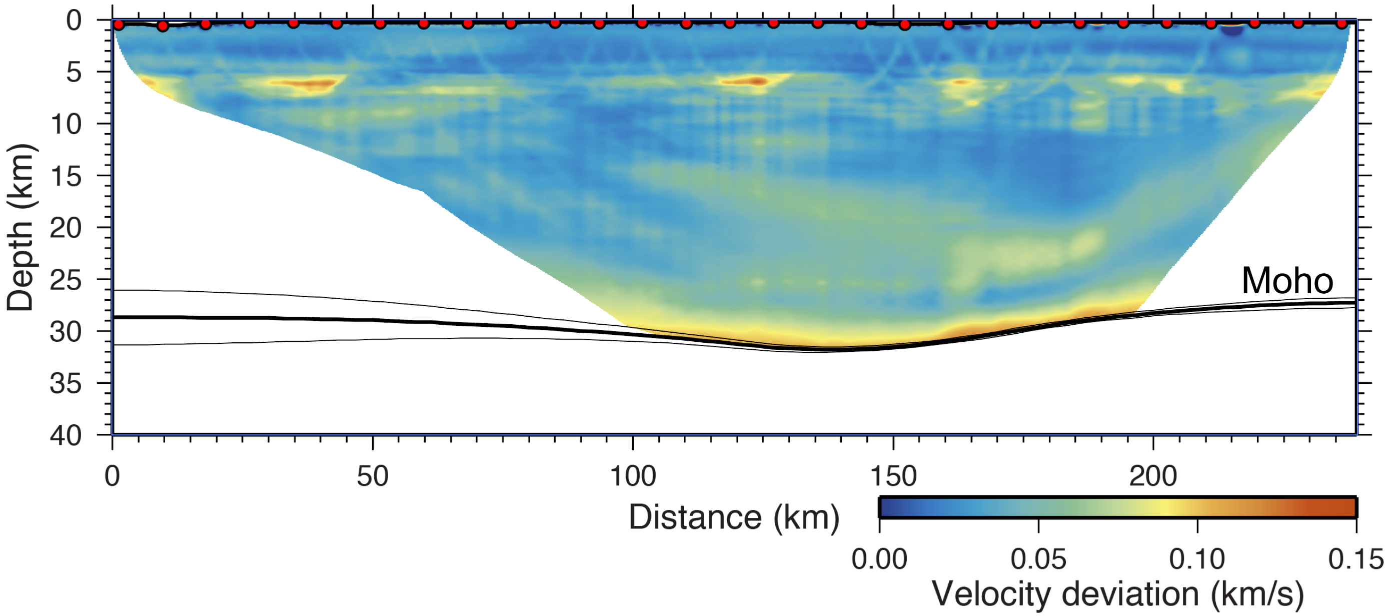
The model has no velocity discontinuities but confirms the presence of a high-veloity lower crust with maximum velocities of 7.4 km/s. Similar to the RAYINVR model, crustal velocities are increased around km 150.

The 6 km/s velocity contour at 5 km depth is a good approximation of the top of the crystalline basement.

P-wave velocity of average Monte Carlo ensemble



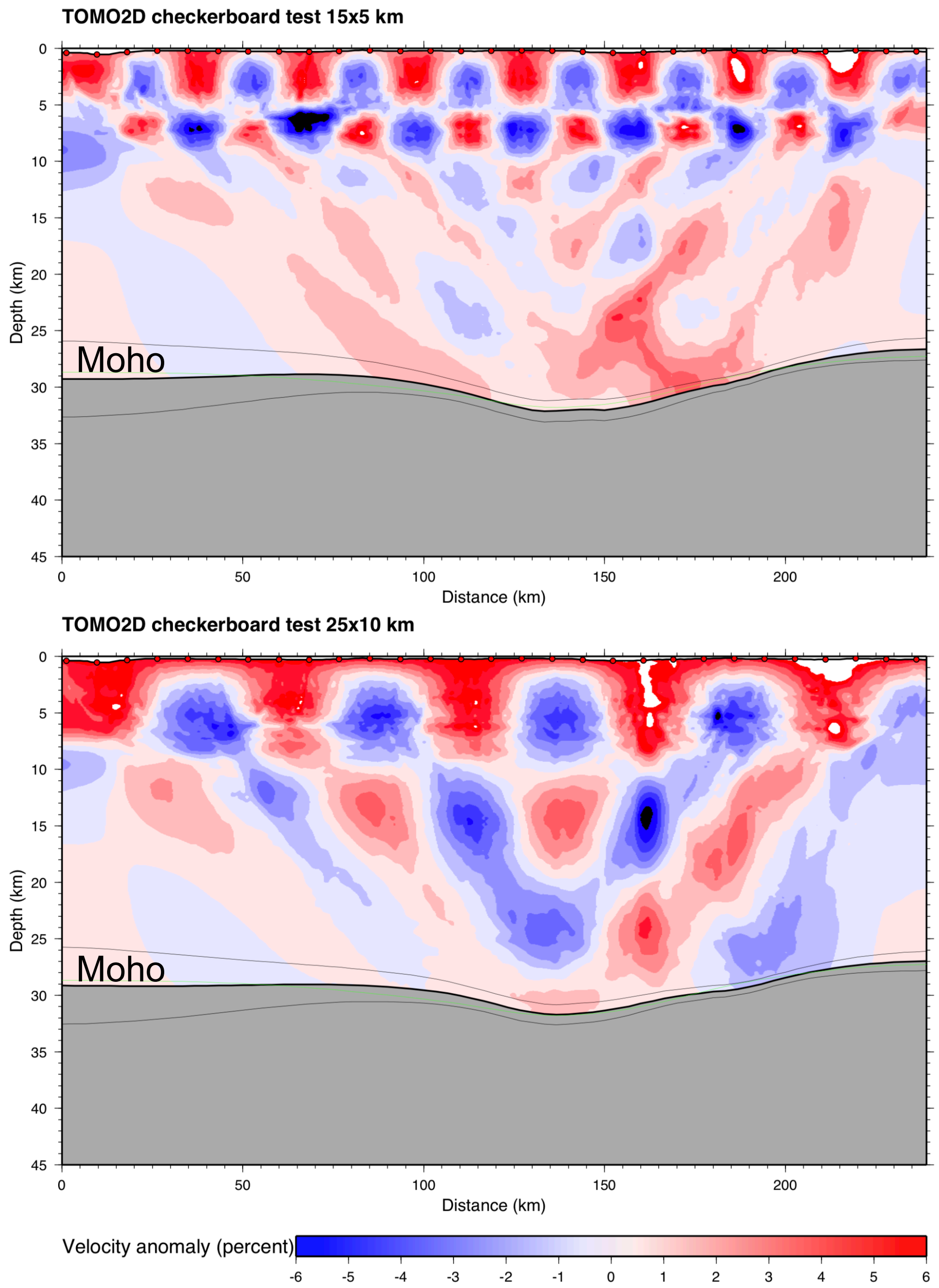
Standard deviation



Checkerboard tests

Checkerboard tests were performed in which the velocities of the average Monte Carlos ensemble (previous slide) were perturbed by ±5 % in given block size. The test reveals how much of these variations can be recovered using synthetic travel time data for the same shot-receiver pairs as in the original data.

As expected, the recovery is higher in the upper part of the model. Below a depth of 15 to 20 km, the smaller blocks (15x5 km) are difficult to recognize while larger blocks (25x10 km) can still be resolved although they appear more blurred than in the upper part.



Key results

- Crustal velocities change across the West Jan Mayen Fracture Zone (with a change of 0.2 km/s of upper crustal velocities) in support for a landward continuation of the fracture zone
- A high-velocity lower crust is identified along the entire length of the line and thins northward. This may indicate some renewed magmatic addition during the Oligocene/Miocene breakup between the Jan Mayen Micro-continent and East Greenland
- Shallow volcanics beneath 1 km of sediment cover to the north of the WJMFZ may support prolonged/renewed magmatism following the Paleocene breakup along that segment.

References

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