P-Wave Modelling of the East Greenland Volcanic Margin North of the Jan Mayen Fracture Zone

Max Schroeder, Wilfried Jokat - Alfred Wegener Institut für Polar- und Meeresforschung

Alfred Wegener Institut für Polar- und Meeresforschung - Columbusstrasse - D-27568 Bremerhaven - Germany - Tel.:+49(0)471 4831-1237 - E-mail: maschroeder@awi-bremerhaven.de - Internet: http://www.awi-bremerhaven.de

Introduction

Between the Jan Mayen and Greenland Senya Fracture Zone the continent–ocean transition off East Greenland is less well known in contrast to the well explored and studied volcanic rifted margin off Norway. The deeper structure of the East Greenland margin conjugate to the Vøring Plateau is of special interest. One of the main targets is to estimate the amount of magmatic material which intruded into the crust or underplated compared to the Vøring Plateau, which is a huge magmatic complex off the Norwegian margin. Existing gravity and magnetic data off East Greenland do not support the presence of a feature like the "Vøring Marginal High" yet. Although MCS and potential field data exist along the East Greenland margin, the data density is insufficient to image lateral variations in the deeper structure, which can be expected from comparison with the conjugate margin off Norway.

The Expedition ARK XIX/4 - Fig.1+2

In 2003 new seismic refraction data were acquired on four profiles by "RV Polarstern" to investigate the deep structure of the East Greenland continental margin and its transition from continental to oceanic crust (**Fig. 1,** only three profiles are shown). Most transects were located in the prolongations of the fjord profiles of earlier investigations between 72°N and 76°N. Parallel to the deployment of ocean-bottom-hydrophones (OBH) and seismometers (OBS), MCS data were recorded with a 3000m long streamer along the 300 - 450km long profiles.

One striking feature, which most likely was connected with the initial break-up, is marked by a pronounced negative anomaly (**Fig. 2**, between black dashed lines). The anomaly runs parallel to the coast for more than 400km between Kong Oscar Fjord at 72°N and south of Shannon Island at 75°N (Schlindwein, 1998). Its shallow and deeper structure was not known before the experiment. Thus, the refraction profiles were extended landwards to better image its deeper seismic structure. In addition, high resolution aeromagnetic and ship borne gravity data were gathered to provide constraints on its extension.

East Greenland - AWI Seismic Refraction Profiles

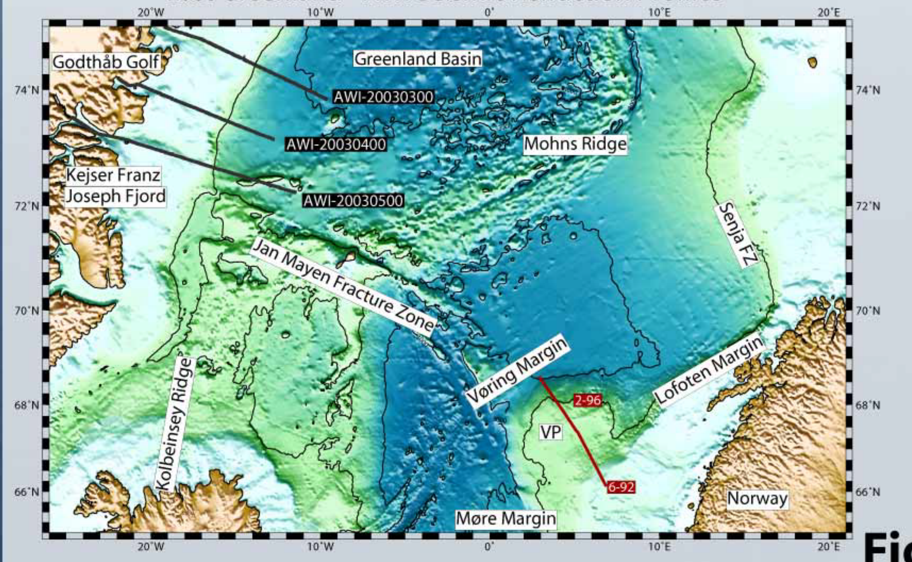
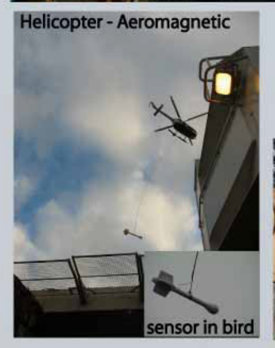


Fig. 1



5 x 9 L G-guns

Acknowledgements:
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Magnetic Anomalies & Seismic Refraction Profiles

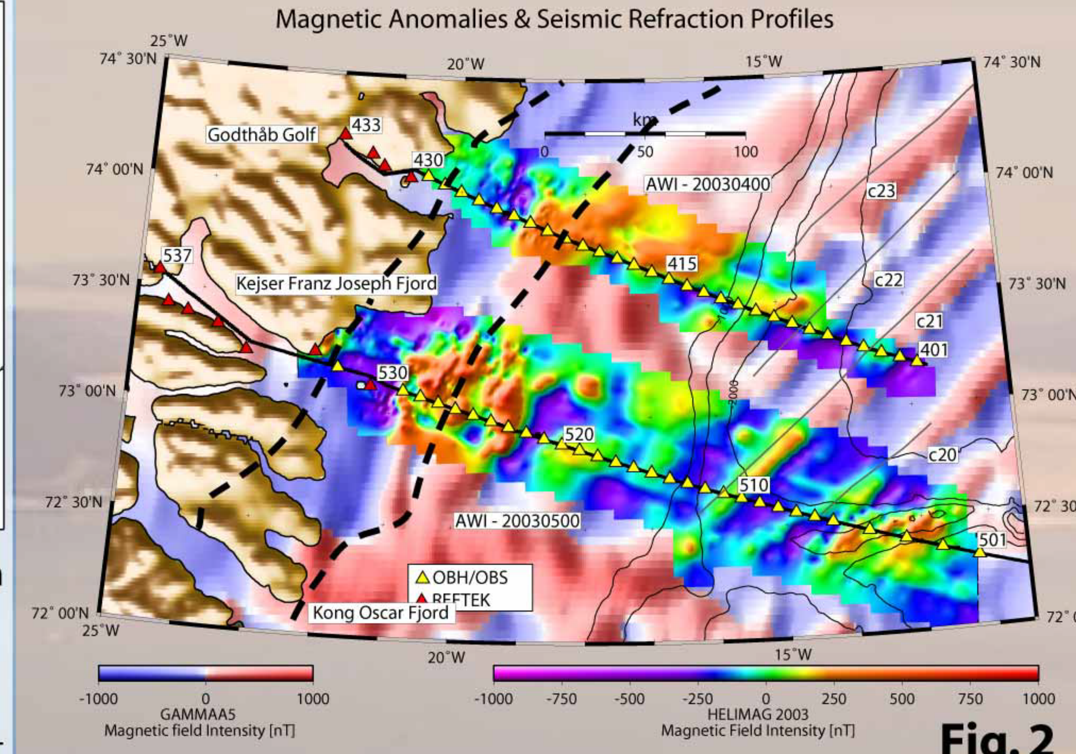

Fig. 2

Magnetic Anomalies - Fig. 2

The aeromagnetic survey HELIMAG 2003 was operated during the expedition ARK-XIX/4 and performed by helicopter in 100m altitude and with a line spacing of 5km. In total 7500 km were flown and cover the area over the seismic refraction profiles AWI-20030400 and AWI-20030500. The data yield high frequent variations within the pronounced negative anomaly and eastward. The wavelengths of the variations are approx. 5km with amplitudes of roughly 100nT. The negative anomaly extends east-west over a distance of 50km and a correlation with a basement high is assumed (see Fig. 3).

Crustal Structure - Fig.3+4

Along profile AWI-20030400 the crustal thickness changes from the western continental crust of 29km to the eastern oceanic crust of approx. 9km. The transitional crust extends over almost 190km and appears as well as the continental crust highly magmatic intruded. In the west the transitional crust termination is estimated to correlate with the western end of the magnetic anomaly. On the eastern end it is assumed that the transitional crust includes the magmatic high, which appears in the slope, and terminates with the onset of the oceanic crust. This is determined of the velocity-depth function in combination with the magnetic spreading anomaly C22. The basement high is in excellent agreement with the general trend of the magnetic and gravity data. A Cenocoic/Mesocoic sediment basin is bordered by the basement high in the west and a magmatic high in the east, which is derived from MCS data and refraction data as well.

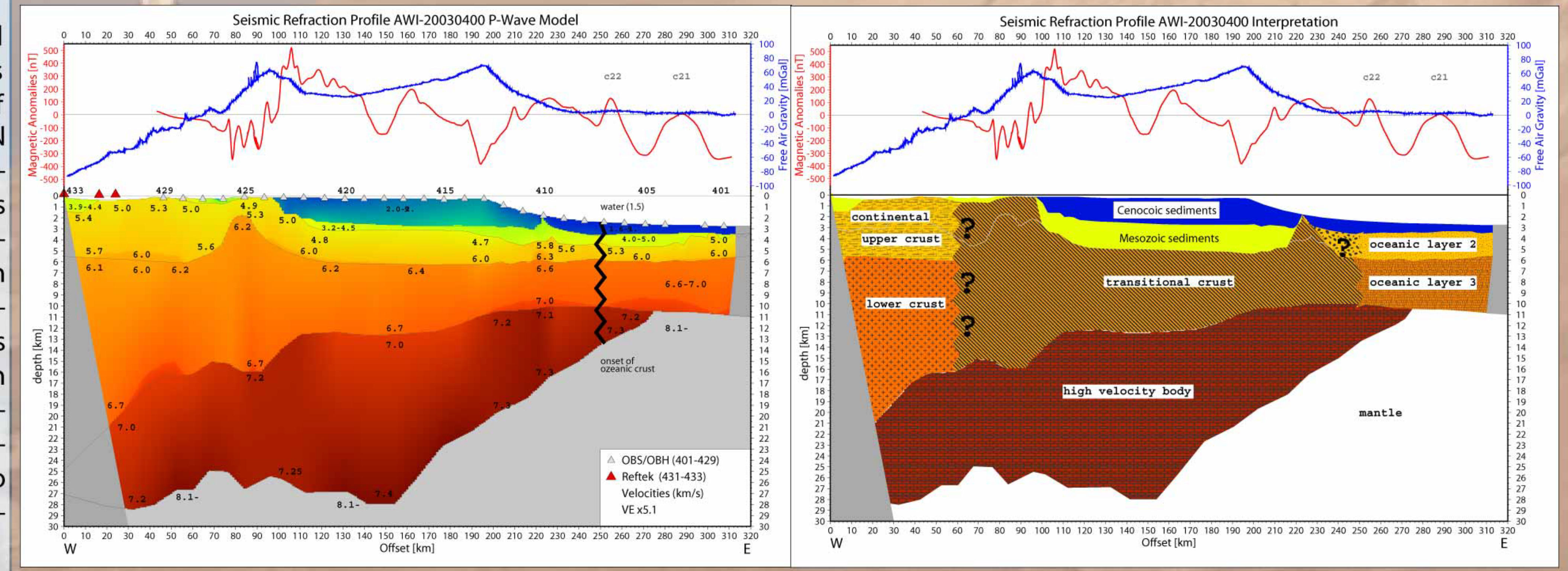

Fig. 3

In **Fig.4** four selected sections of OBHs show the interpreted phases and the fits of the forward modelling procedure as well as the ray coverage.

- OBH432 (left) represents a registration unit on the continental side of the profile with offsets of almost 200km.
- OBH422 and OBH412 (middle) were located in the continent-ocean transition zone and show the complicate structure of the basement high in the west and the magmatic high in the east. All three stations have also rays penetrating a lower crustal body which has p-wave velocities of 7.0+ km/s. This high velocity body (HVB) extends beneath the entire continent-ocean transition zone and reaches thicknesses of up to 15km.
- OBH402 shows a typical section from the oceanic crust.

Almost all stations have recorded reflections from the Moho (PmP) but only a few give us an insight into mantle velocities.

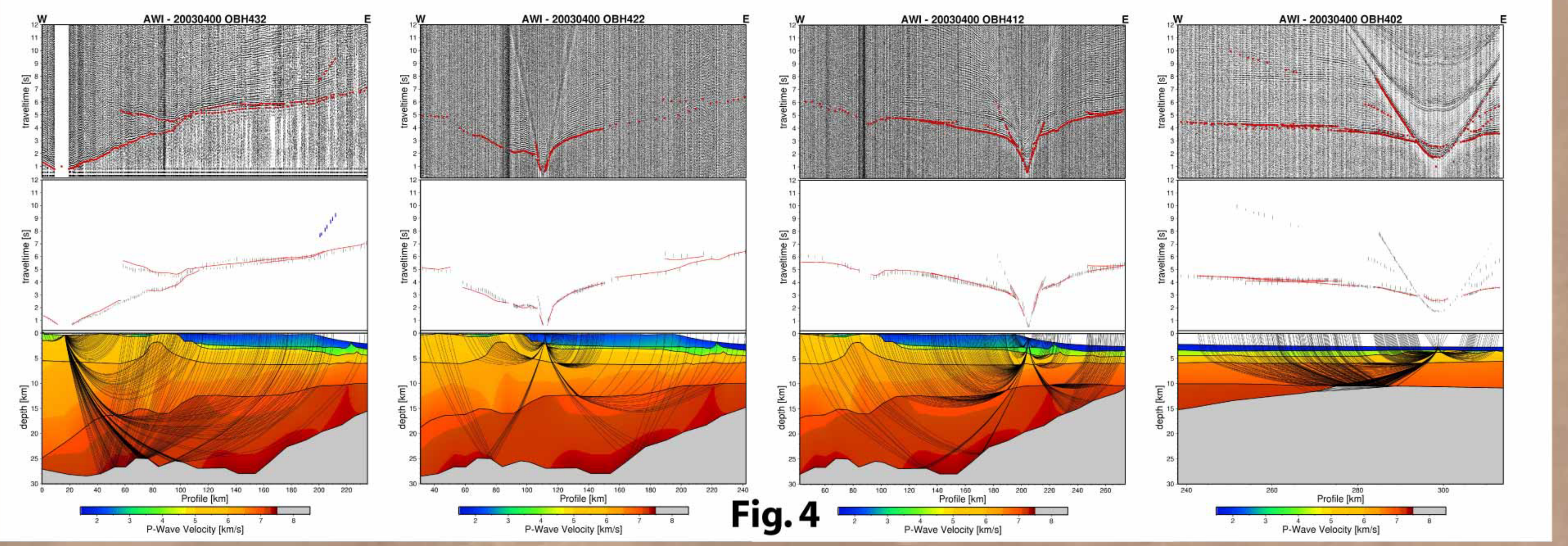

Fig. 4

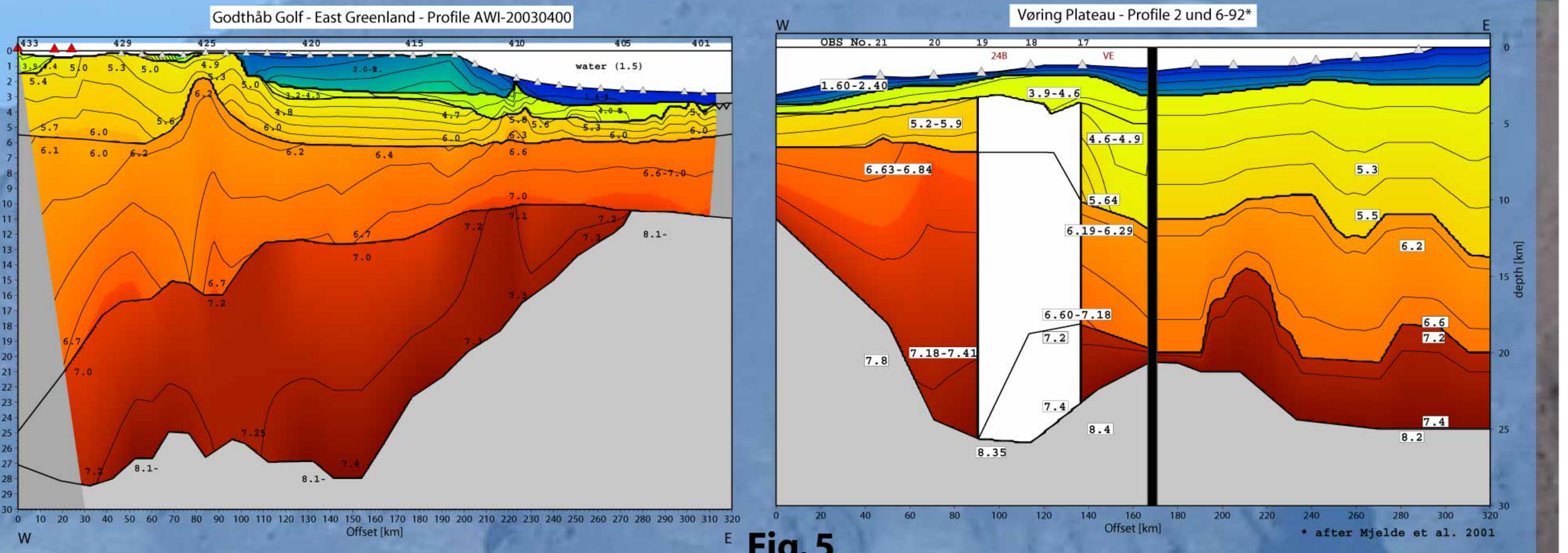

Fig. 5

Conclusions and Outlook - Fig. 5+6

A p-wave model of the seismic refraction profile AWI-20030400 shows a striking correlation with the additional acquired aeromagnetic data. The entire profile can be devided into three parts - continental crust, transitional crust and oceanic crust. The evidence of a strong magmatic activity can be assumed due to the strong variations in the velocity-depth function and a huge high velocity body extending under the entire transitional zone.

In **Fig. 5** the two p-wave models of the conjugate margins are faced to each other. These profiles are not exactly conjugate profiles. They have more or less a shift of approx. 50km in the north-south direction but are used here for a first order comparison of both margins.

The profile across the Vøring Plateau is shown in same colours and dimensions and is modified after Mjelde et al 2001.

The oceanic crust along both profiles is almost equal in thickness and also the thickness of the continental crust including the size of the high velocity body at both margins. The rest of both models differ significantly in their shape and structure, e.g. the high velocity body off East Greenland is almost twice the size than off Norway. While the continent-ocean transition on the Vøring Plateau extends over 30-50km the transitional crust on the East Greenland side have a extension of about 190km.

During processing of the seismic refraction data a suspicious phase appeared in some sections (examples shown in **Fig. 6**). This uninterpreted phase is shown by blue picks and appears on shots from both directions. From the traveltime it is assumed that the termination of the high velocity body on the oceanic side (marked with „?") might be more complex than modelled. All attempts to model this signal were in vain so far or stood in conflict with PmP signals recorded from other registration units.

Further work will be done on this profile and on the southern profile AWI-20030500.

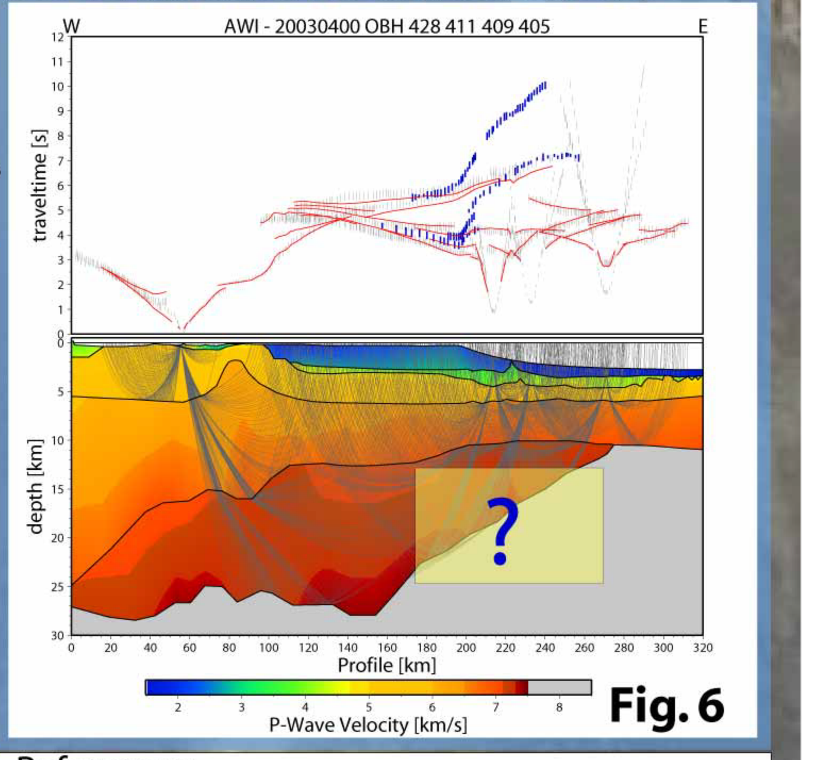

Fig. 6

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