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The nature of the northern Jan Mayen Ridge, North Atlantic, from seismic and potential field data

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The Jan Mayen microcontinent was formed as a result of the non-volcanic separation of a continental fragment from the Eastern Greenland Margin (approx. 24 Ma). Until now the northern boundary of the microcontinent was known only from indirect evidence. In order to set it correctly two combined refraction and reflection seismic profiles were acquired in 2006 across the suspected locations of the unknown boundary. Two crustal P-wave velocity models were developed and constrained using gravity data collected during the same expedition. In addition two Vp/Vs models were made in order to understand the lithology of the deeper parts of the two profiles. Particle motion diagrams of modeled PSS waves were also studied to detect crustal anisotropy.

North of the West Jan Mayen Fracture Zone (WJMFZ) the models show normal oceanic crust, which thickens from west to east. This thickening is explained with a W—E increase in volcanic activity, which is also seen as a bathymetric high and is most likely related to the proximity of the slow spreading Mohns ridge. East of the island and south of the WJMFZ Oceanic Layers 2 and 3 have normal seismic velocity structure but higher than normal average crustal thickness (approx. 11 km). The similarity of the crustal thickness and seismic velocities to those observed on the conjugate Møre margin along the Norwegian margin confirm the volcanic origin of the eastern side of the microcontinent.

Thick continental crust is observed in the southern parts of both profiles. Thus the northern boundary of the microcontinent is found to be a continuation of the northern lineament of the East JMFZ.

The crust in the middle parts of both models is more enigmatic as the data suggest two possible interpretations – Icelandic type of oceanic crust or thinned heavily intruded continental crust. Based on published studies we prefer the former interpretation although the latter cannot be completely overruled. The Icelandic oceanic crust under the profile along the ridge is consistent with increased temperatures, which are also testified by the presence of the active Jan Mayen volcano. The Vp/vs ratios under the Icelandic crust along the profile immediately east of the ridge point to a cool crust.

The results from the particle motion diagrams (hodograms) point to intrusions in the crust in the form of dikes oriented in the direction of rifting off of the microcontinent.