Properties and distribution of lower crustal bodies on the mid-Norwegian margin

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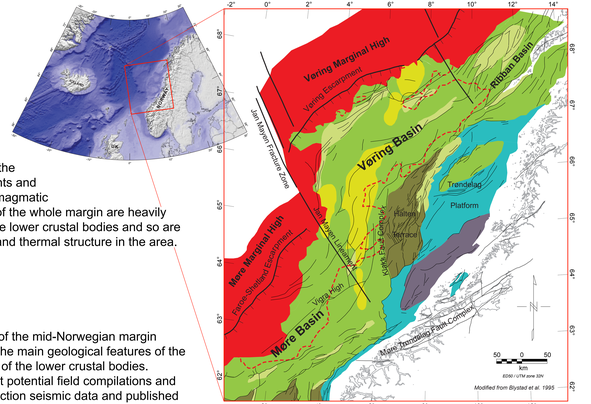
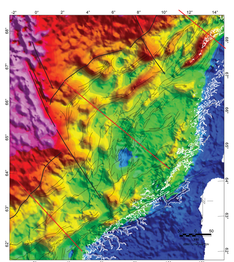
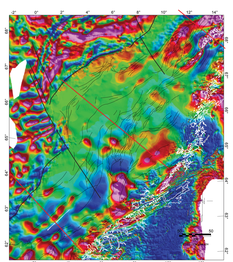
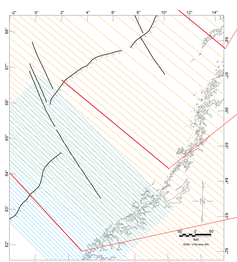
Introduction

The mid-Norwegian margin comprises the Møre, Vøring and Lofoten-Vesterålen margin segments. Anomalously high velocity and high density bodies have been detected in the lower crust on the margin. The lower crustal bodies (LCB) are pronounced on the Møre and Vøring margins segments and have mainly been interpreted as magmatic underplate. Evolutionary models of the whole margin are heavily affected by the interpretation of the lower crustal bodies and so are estimates of vertical movements and thermal structure in the area.





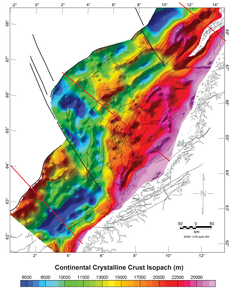


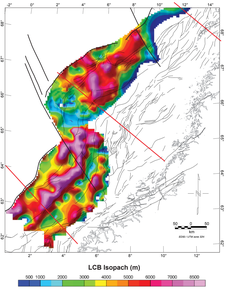


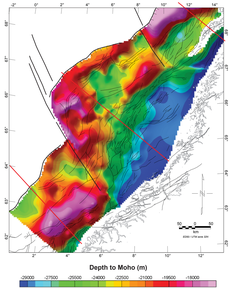
3D Models

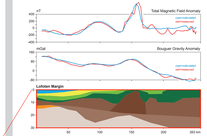
3D density and magnetic models of the mid-Norwegian margin segments were compiled to map the main geological features of the margin and define the distribution of the lower crustal bodies. The models utilize the most recent potential field compilations and are constrained by extensive reflection seismic data and published refraction profiles. Further constraints on the model were attained from studying the isostatical state of the lithosphere and thermal modelling. We present a map showing the distribution of the different lower crustal bodies and discuss the implications for the structural and thermal evolution of the margin.

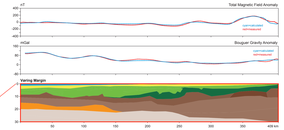
Cretaceous Highs
Cretaceous Basins
Platform and shallow Terrace
Tertiary Domes and Arches
Terraces and Spurs
Permo-Triassic Basin
Lava Flows
Sill Intrusions

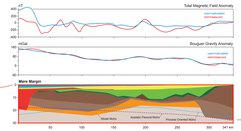








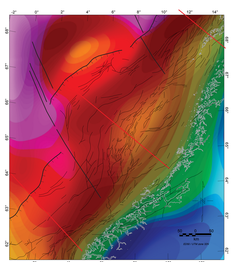


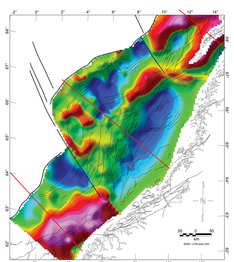


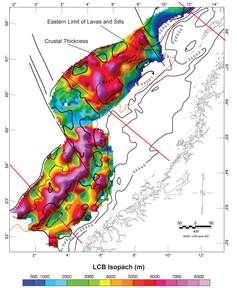
	Density (kg/m³)	Susc. (SI*10⁻³)	Rem (Q)
Water	1030	0	0
Sediments	2100-2600	10-100	0.2-0.4
Cretaceous	2300-2500	30-150	0.2-0.3
Pre-Cretaceous	2600-2650	30-200	0.2-0.3
Oceanic Crust / Lava flows	2700	2000	2
Continental Basement	2680-2750	700	0.5-0.7
High Velocity Basement	2800-2850	1000-1500	0.5-0.6
Lower Continental Crust	2870-2950	1000-2000	0.4-0.5
Lower Crustal Body	3100	500-750	0.4
Mantle	3300	0.200	0.0.4

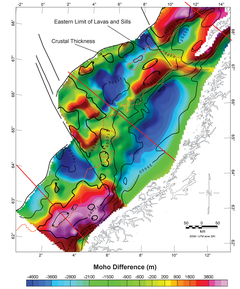
Isostatic Considerations

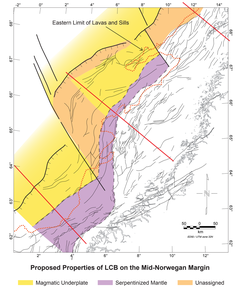
Isostatic flexural Moho was calculated (T_e=10) and compared to the model Moho. The difference map demonstrates how the model Moho is deeper than the isostatic Moho close to the escarpments but shallower in the center of the basins. Because a high density body is part of the model, while it is not part of the isostatical calculations, it is problematic to explain the shallow model Moho without assigning the high density body to a density mantle anomaly. In order to reconstruct this Moho configuration with isostatic and flexural considerations a process oriented approach is needed. T_e=5 value during rifting and T_e=25 during sedimentation managed to reconstruct the Moho geometry below the Møre basin.











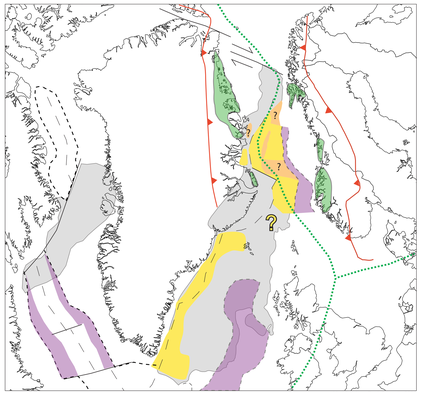
Indications of origin

The mid-Norwegian margin tectonic evolution includes three events that each can be related to the generation of high velocity lower crust.

1) High grade metamorphism during the Caldonian orogeny. Such rocks are exposed both onshore Norway and East Greenland. The intervening margins must have been subject to similar high grade metamorphism.

2) Slow and extreme extension during the Cretaceous rifting led to serpentinization of exhumed mantle.

3) Rapid opening of NE Atlantic in Eocene time led to large melt generation along the break-up axis.



Implications

The heat flow in a given basin will vary strongly depending on which of above mechanisms generated the LCB.

HOT

COLD

Underplating
Significant crustal/lithospheric thinning
Thick magmatic underplate adds significant heat

Serpentinized mantle
Significant crustal/lithspheric thinning, but slow and not so hot
No heat from a magmatic body
Some heat from exothermic reaction

Remnants from Caledonian root
No thermal addition

Acknowledgement

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