Geophysical Research Abstracts,
Vol. 11, EGU2009-5610, 2009
EGU General Assembly 2009

Can phase changes be at the origin of the large subsidence of Barents Sea basins? Insights from density modelling.

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Very large subsidence, with up to 20 km thick sediment layers, is observed in the eastern basins of the Barents Sea. Subsidence started in Early Palaeozoic and finished at mid-Cretaceous. The subsidence history is marked by an acceleration of subsidence in Permo-Triassic times. The observed gravity signal suggests that the eastern Barents Sea is in isostatic balance and indicates that a mass excess is required in the lithosphere to produce the observed large subsidence. One of the most convincing candidates for this mass excess is the presence of denser than normal rocks in the crust beneath the basins. These denser rocks may result from phase changes in the lower crust.

In order to test this hypothesis density models of continental lithosphere have been computed along seismic transects crossing the eastern Barents Sea. The density distribution of crustal rocks is given by pressure, temperature, and composition dependent phase change models. Based on the local isostasy hypothesis, the subsidence and the gravity signal are then computed and compared to the observations along the seismic transects. Several models are run with varying crustal composition (mafic vs felsic). The results indicate that a densification of a lower crustal root can explain the basin geometry and observed gravity anomalies. These conclusions are tested using thermo-mechanically coupled dynamic modelling including temperature, pressure, and composition dependent density models.