Geophysical Research Abstracts
Vol. 12, EGU2010-5539, 2010
EGU General Assembly 2010

Moho and magmatism in extensional settings

Hans Thybo

University of Copenhagen, Department of Geography and Geology, Copenhagen K, Denmark (thybo@geo.ku.dk, +45 3532 2452)

The Moho is defined by an abrupt change in seismic velocity, which is often attributed to the petrological crust-mantle boundary. However, other types of transitions may explain observed pronounced seismic reflections, such as metamorphic changes in iso-chemical rocks from granulitic lower crustal rocks to eclogitic facies, pronounced shear zones, or magmatic intrusions. Therefore, it is of crucial importance to have high-resolution models of the seismic velocity around the Moho. Further, the seismic reflectivity in normal-incidence and wide-angle may provide valuable constraints on the structure at the crust-mantle boundary. In areas influenced by strong magmatism with mantle source, e.g. at rift zones and other extended regions, the resulting transition between crust and mantle may assume several forms.

New data from a >100 km long and 20 km thick non-reflective zone in the Danish Basin with extremely high seismic velocity (6.8-7.8 km/s) demonstrates that the Moho reflector at the base of the high-velocity body is interrupted in a ca. 20 km wide zone. The high velocity body is interpreted as a mafic batholith in the crust, and the Moho-free zone as the feeder channels of the batholith. Variation in seismic amplitude along the strike of the batholith provides indication for the mafic content of the deepest rocks in the body. We further observe extremely strong wide-angle reflectivity from a ca. 4 km thick zone with high velocity, extending for up to 100 km away from the batholith. We interpret this reflective depth interval as a zone of magmatic underplating in the form of sills, which intruded during the late stage of the formation of the batholith. The magma probably had the same source as the body, and it intruded along the Moho in the late stage of magmatism due to pressure changes caused by cooling.

The presently active rift zones in Eastern Africa and at Lake Baikal thicker, as well as extinct rift zones, show extremely strong reflectivity of the lower crust and upper mantle. All rifting models predict Moho uplift due to crustal thinning, and reduced seismic velocity in the uppermost mantle due to decompression or heating from the Earth‘s interior. However, seismic data from several rift zones show no or very little Moho topography that can be related to the rifting process. At all these rift zones, we observe a localized zone in the lower crust which has exceptionally high seismic velocity and is highly reflective. We suggest that rift related crustal thinning took place, but the expected Moho uplift was compensated by magmatic intrusion into the lower crust at the high-velocity zone. This finding has significant implications for modelling the evolution of sedimentary basins around rift structures.

As such, compelling evidence is emerging for a strong role of magmatism on the character of the Moho interface, not least in extensional areas.