Geophysical Research Abstracts, Vol. 7, 05166, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05166

Early Tertiary oblique compression in the western Vøring Basin, Norwegian Sea and its implications for pre-break-up deformation in ocean margin basins

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Continental break-up is a key stage in the transition from 'rift to ridge' during lithosphere extension. At break-up, deformation in the upper continental crust is dominated by extensional faulting; however, tectonic *shortening* perpendicular (or near-perpendicular) to the rift axis is possible in certain circumstances. We present structural and stratigraphical interpretations of a 3-D seismic reflection dataset from the SW Nyk High to infer oblique compression (i.e., transpression) in the western Vøring Basin, Norwegian Sea immediately prior to, or synchronous with the initial opening of the NE Atlantic Ocean.

The Nyk High is a ∼NE-trending, Late Cretaceous to Early Tertiary structural high defined by a thick sequence of Upper Cretaceous to Lower Tertiary sediments that dip towards the SE. These sediments are cut by normal faults with throws up to 1500 m. Across-fault sediment thickness variations and stratigraphic onlap relationships show that the normal faults were active during Campanian to early Palaeocene extension, prior to separation of Norway from Greenland ca. 55 Ma (Palaeocene to Eocene transition). Sediments preserved in the hanging walls of these rift-related normal faults are deformed by two populations of folds: one set is oriented clockwise of fault strike; the other is oriented parallel to fault strike. Stratigraphic relationships show that both sets of folds formed during latest Palaeocene to earliest Eocene times and post-date

extensional faulting. We interpret these folds as having developed during minor sinistral transpression, which was partitioned between ∼NE-SW sinistral strike slip reactivation of the normal faults and ∼NW-SE coaxial shortening (folding) within fault hanging walls. Strain partitioning is inferred to have been a response to the rheological contrast between fault hanging walls (which comprise a thick sequence of shale prone syn-rift sediments) and fault foot walls (which are characterised by a greater proportion of more highly compacted pre-rift sediments and a relatively thin syn-rift sequence).

Early Eocene plate reconstructions show that the Nyk High was oriented counter clockwise to the line of continental break-up, whilst basin modelling studies suggest that the axial region was elevated due to magmatic underplating and the presence of hot, thermally buoyant asthenospheric mantle at shallow depths beneath the incipient plate boundary. We speculate that oblique compression in the western Vøring Basin was driven by ∼NNW forces arising from the differential topography and the density anomaly beneath the elevated axial region. More generally, compressional deformation should be expected along passive margins where there is evidence for uplift and widespread magmatism immediately prior to continental break-up.