Post-Jurassic Events of the Continental Margin of the Norwegian Sea

Harald Brekke*, Robert W. Williams, Christian Magnus

Oljedirektoratet, Stavanger

*Presenting author (harald.brekke@npd.no)

Abstract. The continental margin of the Norwegian Sea is dominated by the deep Møre and Vøring Basins flanked by platform areas to the east and west. These basins are part of a row of similar very deep Cretaceous basins forming a major rift axis stretching from the Rockall Through in the south to the Tromsø and Vestbakken Basins in the north. This Late Jurassic to Cretaceous rift axis may be regarded a failed arm of the northward opening of the Atlantic Ocean. The subsequent thermal subsidence accommodated a large volume of Lower Cretaceous sediments in the Møre- and Vøring Basins. Detailed knowledge of these sediments is lacking because of their deep burial, but one assumes that they are dominated by shales. Continued subsidence through the Cretaceous was accompanied by further large volumes of sediments, part of which are the thick, sandy intervals in the northern parts of the Vøring Basin. Bio-stratigraphic studies of the late Cretaceous re-sedimentation history of the Vøring and Møre Basins reveal a period of un-roofing of the Lower Cretaceous to Permian sequences in the hinterland. The conspicuous absence of any Jurassic spores in the re-sedimentation record and the enormous volumes of Cretaceous sediments present put clear constraints on models for the hinterland palaeography and the Cretaceous plate tectonically related uplift history of the surrounding areas, including Greenland, the Barents Sea Shelf and Fennoscandia, and hence the distribution of possible reservoir sands. A phase of renewed tectonic activity in the Late Cretaceous within the basins themselves is demonstrated by rotated fault blocks onlapped by Coniacian and younger sequences. By the time of the final thrust of northward propagation of the Atlantic Ocean in the Palaeocene, the crust along the Cretaceous basin axis had cooled and annealed so that the breakup of the continent occurred within the western platform area west of the present Hatton-Rockall Bank and the Møre and Vøring Marginal Highs. The extensive listric faulting in the western parts of the Vøring Basin probably belongs to this break-up process forming both the Fenris and Hel Grabens and their respective flank uplifts, i.e. the Gjallar Ridge and Nyk High. The rifting was associated with regional uplift and erosion along the new rift axis reaching a maximum in Selandian times. Well data show that the degree of uplift and erosion at this time increased westwards shedding clastic sediments eastwards into the Møre and Vøring Basins. Local influx of sand from the east in the Vestfjorden and northern Møre Basin areas indicates that parts of mainland Norway were uplifted in early Palaeocene times. The phase of major breakup volcanism started at the end of the Palaeocene/beginning of Eocene creating the huge North Atlantic province of flow basalts. The old notion that the eastern limit of the “inner lava flows” represents the Thanetian palaeoshore-line is now supported by well data. Subsequent to the establishment of seafloor spreading, the continental margin has experienced subsidence and seaward tilting. The general passive subsidence was interrupted by a phase of mild compression forming domes in the Vøring Basin and around the Faroe Islands, probably in Miocene times. This seems to be a distinct unconformity due to a phase of block faulting in the oceanic crust of the Lofoten Basin, including the substantial reversal and uplift along the Jan Mayen Fracture Zone forming the Vøring Spur. These events seem to be linked to the tectonic development of the Jan Mayen Microcontinent. Recent

mapping of the Jan Mayen Ridge reveals two tectonic phases of Oligocene age: an early phase of rifting and block faulting, and a subsequent phase of compression or transpression. Both phases probably reflect the rift activity that eventually separated the Jan Mayen Microcontinent from Greenland. The Hatton-Rockall Bank shows evidence of a similar tectonic development. Since mid-Miocene times, oscillating glaciations have caused mainland uplift, erosion and the progradation of huge volumes of sediments onto the Norwegian Sea continental margin.