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Crustal structure of the Lofoten-Vesterålen continental margin off Norway

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By compiling wide-angle seismic velocity profiles (including several ocean bottom seismometers/hydrophones of the Euromargins 2003 OBS Experiment) along the ∼400-km-long Lofoten-Vesterålen continental margin off Norway, integrated with an extensive seismic reflection data set and crustal-scale two-dimensional gravity modelling, we outline the crustal margin structure by across-margin regional transects and contour maps of depth to Moho, thickness of the crystalline crust, and thickness of the 7+ km/s lower crustal body. The data reveal a normal oceanic crust seaward of anomaly 23 and a moderate increase in thickness towards the continent-ocean boundary associated with breakup magmatism. A steep and relatively narrow, 10-40-km-wide, Moho-gradient zone exists within a continent-ocean transition, which decreases in width northward along the Lofoten-Vesterålen margin. The southern boundary of the Lofoten-Vesterålen margin, the Bivrost Fracture Zone and its landward prolongation, appears as a major across-margin magmatic and structural crustal feature governing the margin evolution. To the south, the Moho-gradient zone continues along the Vøring margin, however it becomes offset 70-80 km to the northwest along the Bivrost Fracture Zone/Lineament. Here, the zone corresponds to a distinct, ∼25-km-wide, zone of rapid increase in crustal thickness separating the Lofoten platform from the Vøring Basin. The continental crust on the Lofoten-Vesterålen margin reaches ∼26 km thickness and appears to have experienced only moderate extension, contrasting with the greatly extended crust in the Vøring Basin farther south. There are also distinct differences between Lofoten and Vesterålen margin segments revealed by changes in structural style and crustal thickness as well as extent of elongate potential field anomalies. These changes may be related to transfer zones. Gravity modelling

shows that the prominent shelf edge gravity anomaly belt results from a shallow basement structural relief, while the elongate Lofoten Islands belt requires increased lower crustal densities along the entire area of crustal thinning beneath the islands. From modelling results and previous studies on- and off-shore mid-Norway, we postulate that middle to lower crust core-complex-development in the Lofoten Islands region, which has been denudated along detachments during large-scale extension, brought high-grade lower crustal rocks, possibly including accreted decompressional melts, to shallower levels.