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The Cenozoic sedimentary record offshore Norway - constraining vertical motions in time and space

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To improve the understanding of temporal and spatial relationships between uplift/erosion onshore and subsidence/deposition offshore (”source-to-sink”) we have used a seismic sequence stratigraphic framework to reconstruct the Cenozoic basin architecture/evolution offshore Norway. Most of the Neogene succession in the North Sea and the mid-Norwegian continental margin comprises Plio-Pleistocene sediments deposited in response to rapid/massive uplift and erosion during Northern Hemisphere glaciations. However, there is evidence in the offshore sedimentary record that tectonic uplift was initiated earlier (?Oligocene-Miocene) and we have studied this issue to better separate the effects of tectonic uplift and the isostatic response to erosion. Early Tertiary rifting and breakup in the NE Atlantic also gave rise to differential vertical movements within parts of the study area. The sedimentary architecture and breaks are related to tectonic uplift of surrounding clastic source areas, thus the offshore sedimentary record provides the best age constraints on the Cenozoic exhumation of the adjacent onshore areas. Major depocentres sourced from the uplifted Shetland Platform and areas along the incipient plate boundary in the NE Atlantic formed during Late Paleocene-Early Eocene times. A local source area also existed in western Norway. Uplift along the Sorgenfrei-Tornquist Zone caused erosion into top chalk along the SE North Sea basin flank. Thick Eocene units in the North Sea were mainly sourced from the west, while Fennoscandia was probably covered by sea during Middle-Late Eocene times. At the Eocene-Oligocene transition, southern Norway became uplifted. The uplift in combination with prograding units from both the east and west gave rise to a shallow threshold in the northern North Sea, separating deeper waters to

the south and north. The uplift and shallowing continued into Miocene time when a widespread hiatus formed in the northern North Sea, as indicated by biostratigraphic data. Miocene brackish water is reported in Denmark indicating restricted communication with NE Atlantic. Miocene outbuilding from north into the SE North Sea was massive and prograding clinoforms are also observed within the Miocene Kai Formation offshore mid-Norway. Coastal progradation of the Molo and Utsira formations reflects Late Miocene-Early Pliocene uplift and erosion of mainland Norway. The Late Pliocene basin configuration was dominated by outbuilding of thick clastic wedges in response to uplift and glacial erosion of eastern source areas. Considerable Late Pliocene uplift of the eastern basin flank is documented by the strong angular relationship and tilting of the complete Tertiary succession below the Pleistocene unconformity. Thick Pleistocene sedimentary fans were deposited at the slope in front of bathymetric troughs formed by ice-streams. With better age and structural control we can focus on key processes in the Cenozoic geological evolution.