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On the late Cenozoic evolution of the Norwegian Arctic continental margin

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The Cenozoic development of the Norwegian Arctic is inferred to include two main landscape-forming events; 1) the early Cenozoic onset of rifting and still ongoing sea-floor spreading resulting in the formation of the Norwegian – Greenland Sea; and 2) the late Cenozoic global climate deterioration resulting in the growth and decay of large ice sheets repeatedly covering the onshore as well as the continental shelf areas. The rifting and subsequent sea-floor spreading are interpreted to have resulted in two contrasting pre-glacial landscape types surrounding the newly formed ocean; i) a margin-parallel ridge onshore part of Northern Norway from rift-flank uplift, and ii) a mainly low-lying platform area in the SW Barents Sea where less influence of uplift in this period is seen. The landscapes were later exposed to glacial erosion during a tectonically "passive" period. In order to quantify the landscape development during the glaciations we have utilized the mass-balance approach where the volume of the erosional products have been estimated. From this, we quantified the sedimentation rate, erosion rate and total erosion of the source area. During the late Cenozoic, the continental margin off the SW Barents Sea exemplifies an area of very high sediment input corresponding to an estimated average erosion of the shelf area of ∼0.4 mm/yr, much of which is related to subglacial erosion of Mesozoic – Cenozoic sedimentary rocks beneath large paleo-ice streams preserving the pre-glacial "lowland" areas here. In contrast, the North Norwegian margin experienced markedly lower input, ∼0.03 mm/yr of erosion of crystalline rocks in a pre-glacial "highland" representing a low-ice-flow sector of the Fennoscandian Ice Sheet, resulting in an alpine relief. This implies up to one order of magnitude variation in average glacial erosion rates along the northwestern sector of the Fennoscandian–Barents Sea ice sheets. We interpret the following factors as the main control on the glacial denudation and landscape formation in this tectonically "passive" setting: 1) The pre-glacial relief controlling the morphology and size of the drainage area, 2) The ice sheet glaciology including the location and size of fast-flowing ice streams where the pre-glacial relief and its bedrock composition exerts a fundamental control, 3) The evolution of the global climate controlling the ice sheet growth and decay as well as its basal properties. For both areas, glacial erosion is interpreted to have amplified the relief of the pre-glacial landscape.