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On the Evolution of Glaciated Continental Margins

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Glaciated continental margins, continental margins where a grounded ice sheet repeatedly has been at or near the shelf break, are found at both northern and southern high-latitudes. Their evolution are in several aspects different from their low-latitude counterparts where eustatic sea-level variations possess a fundamental control on their evolution and where fluvial systems provide the main sediment input. From studies of the Norwegian – Barents Sea – Svalbard and NE Greenland continental margins we propose the following factors as the main control on the evolution of glaciated continental margins: 1) Pre-glacial relief controlling the accommodation space, 2) Ice sheet glaciology including the location of fast-flowing ice streams where source area morphology exerts a fundamental control, 3) Composition of the glacigenic sediments where the clay content in previous studies have been found to be important, and 4) Sea-level controlled both by eustacy and isostacy. From three case studies, 1) the western Barents Sea, 2) part of the North Norwegian (Troms), and 3) the Mid-Norwegian margin, the influence on these factors for the sea-floor morphology, sedimentary processes of the continental slope – deep sea and continental margin architecture are discussed. The pre-glacial relief of the mid-Norwegian and Troms margins relates to the onset of rifting and plate break-up from the early Cenozoic while for the SW Barents Sea, plate shear was followed by rifting. A wide zone of extended continental crust occurs offshore mid-Norway while this zone is much narrower offshore Troms leading to a more pronounced pre-glacial relief. Regarding sediment delivery and ice sheet glaciology the western Barents Sea exemplifies very high sediment input corresponding to an estimated average erosion of the source area of $\sim$0.4 mm/yr (SW Barents Sea), much of which is related to subglacial erosion of Mesozoic – Cenozoic sedimentary rocks from large paleo-ice streams. The mid-Norwegian margin has experienced a high sediment input from paleo-ice streams equal to an average erosion of 0.16 mm/yr in a source area dominated by crystalline rocks while the Troms margin experienced markedly lower input, $\sim$0.03 mm/yr of erosion of crystalline rocks in an low-ice-flow sector of the Fennoscandian Ice Sheet. The slope gradient of the areas of high sediment input, the SW Barents Sea slope and the mid-Norwegian margin is mostly $\sim$1 degree or less and dominated by large glacigenic debris flow deposits, outside Troms the slope is much steeper, up to 15 degrees. Here the relief includes gully-channel systems formed by turbidity currents. Off the western Barents Sea the development of large trough-mouth-fans is related to the spatial stability of paleo-ice streams over repeated peak glacials, offshore Troms smaller trough-mouth-fans implies spatially stable paleo-ice streams also here while more unstable paleo-ice streams was one of the main factors that led to the development of a prograding wedge offshore of mid-Norway. All areas have been affected by small- and large-scale submarine landslides. From a detailed study of the NW Barents Sea margin the deposits from these processes were found to represent up to one quarter of the total volume of sediments.