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Norway and adjacent sedimentary basins during Cenozoic times - sediment fluxes, accumulation rates and mass balance

Bartosz Goledowski, Søren Bom Nielsen, and Ole Rønø Clausen

Aarhus University, Faculty of Science, Department of Earth Sciences, Aarhus C, Denmark (bartosz.goledowski@geo.au.dk, +4589421109)

This study investigates the varying sediment fluxes from the Scandinavian landmass during Cenozoic times and calculates a mass balance from the observed accumulation rates. As no onshore information is available, we use offshore data from adjacent sedimentary basins (the North Sea and the Norwegian shelf) to calculate the amount of erosion. The data comprise a dense grid of seismic 2D lines and well data to constrain stratigraphy and sediment velocity. The results comprise sediment volumes at the time of deposition, accumulation rates in meters per million years for 5 depositional units in three areas - Southern North Sea, Central and Northern North Sea and the Norwegian shelf. The mass balance is estimated in the presence of uncertainties in sediment release and dispersal, post-depositional sediment redistribution or removal, and the loss of mass due to chemical dissolution. Considering that the paleo-landscape of Norway in Paleocene-Eocene times was of fluvial type, we have restored the smoothed hypsometry of the Scandinavian mountains in the presence of flexural isostasy. This approach agrees with the ICE hypothesis (Nielsen et al., 2009), which avoids the controversial tectonic rejuvenation of topography during the Cenozoic by suggesting that the Scandinavian Caledonides are surviving remnants of the original Silurian mountain range. The traditional tectonic control on erosion rates is replaced by a much more profound influence of climate, climate change and related erosional processes (e.g. Alpine-type glacial erosion, periglacial processes). We find that tectonic activity related to the final stage of opening of the North Atlantic controlled the high sediment input during Paleocene to Early Eocene times, without invoking surface uplift. Subsequent Cenozoic epochs were tectonically quiet, but the climate changed dramatically. The cooling at the greenhouse-icehouse transition (Eocene-Oligocene boundary) could be a trigger for development of Alpine-type glaciers at high elevation which are efficient erosive agents. This could explain abrupt changes in lithology and correlations between paleontological cooling indicators with sedimentary patterns observed on seismic data. However, the regional depositional pattern shows no significant change in accumulation rates at the Eocene-Oligocene transition. Increases in sediment accumulation occur rather locally. A major sediment outpour occurred during last 3-4 million years. The study area therefore shares the global pattern of a few-fold increase in sediment production during Pliocene and Holocene times. This correlates with the climate cooling, increased frequency of climate change and intense glacial erosion in Scandinavia. Therefore, climate is regarded as the only agent controlling erosion rates during this period.