ORAL PRESENTATION

Underexplored continental shelf gateways: timing, mechanisms and role of SW Barents Sea Gateway, Norwegian Arctic

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Ocean gateways connecting ocean basins are crucial for water and heat circulation, which influence global temperature, climate evolution and sediment distribution. While deep-water gateways have been a major research focus by the community, very little attention has been drawn to shallower gateways located on the continental shelves, where such circulation also takes place. In this study, we investigate the evolution of a shallow gateway in SW Barents Sea that presently connects NE Atlantic and Arctic oceans. This gateway contributes to about half of the Atlantic–Arctic water exchange, whereas the other half is occurring through the deeper Fram Strait Gateway. When and how this SW Barents Sea Gateway formed are debated and still poorly understood. Outcomes from this study will thus be relevant for regional and global models of ocean circulation. Moreover, this study will contribute to climate evolution models over longer timescale in a climate sensitive region where an Arctic amplification of warming is presently seen.

Unlike opening of Fram Strait and other typical deep-water gateways, which was the results of rifting and seafloor spreading between two continents, the reconstructions of SW Barents Sea Gateway also involve vertical tectonic components such as sediment loading, isostasy and thermal subsidence. This gateway has been affected by a complex tectonic break up in the early Cenozoic (c. 55 Ma) that involved rifting and transtensional component, and a major ice-sheet development in the late Cenozoic (c. 2.7 Ma) that involved ice loading and glacial erosion, and their isostatic compensations. These events have influenced the spatial variation and temporal evolution of the formation of this gateway. We apply a 3D sequential backstripping technique to produce paleobathymetrical maps for the early Eocene (c. 55 Ma), mid Eocene (c. 40 Ma), Oligocene (c. 33 Ma), Miocene (c. 23 Ma) and Plio-Pleistocene (c. 2.7 Ma). The main input for the model was a set of depth-converted maps interpreted from 2D and 3D seismic data that were tied to well data. Key crustal structures and parameters (e.g., Effective Elastic Thickness, Beta factor maps) were tested to generate realistic reconstructions.

Our reconstructions show that shallow marine to subaerial exposure has largely prevailed in the SW Barents Sea area from the Eocene (c. 55 Ma) to the onset of main glaciations during the Quaternary (c. 2.7 Ma). Subaerial topography was likely enough to block Atlantic Water from entering the BSG in the earliest Eocene (c. 55 Ma). However, this configuration may have allowed the water to enter at a later stage in the Eocene as observed from major basin subsidence and deepening of the structural highs in the mid Eocene paleobathymetry (c. 40 Ma). From the Oligocene (c. 33 Ma) until the onset of the Quaternary (c. 2.7 Ma), basin infilling and shallowing, and regional shelf uplift blocked Atlantic Water from entering the BSG. The slope configuration west of the SW Barents Sea allowed for contourites to be deposited by northward flowing ocean currents from the Miocene onwards.

After c. 2.7 Ma, the SW Barents Sea area deepened and transformed from a subaerial to a submarine platform due to profound glacial erosion and subsidence, and the formation of a trough-mouth fan on the continental slope. This configuration allowed for increased inflow of

Atlantic Water through the BSG. Consequently, inflow of Atlantic Water through the Fram Strait was reduced, assuming a constant volume of Atlantic Water entering this area. By constraining a maximum age of c. 2.7 Ma for the BSG, our results imply that the Fram Strait remained the sole gateway for Atlantic Water into the Arctic Ocean since its opening in the Miocene until the Quaternary, whereafter Atlantic Water was also introduced through the BSG. Finally, this study can provide an example of paleobathymetrical reconstruction for other formerly glaciated gateways in Polar areas and other shallow gateways worldwide.