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Cenozoic paleobathymetry of the Atlantic-Arctic oceanic gateways: implications for paleo-ocean circulation

Eivind Straume, Carmen Gaina, and Sergei Medvedev

Centre for Earth Evolution and Dynamics (CEED), Department of Geosciences, University of Oslo, Oslo, Norway
(e.o.straume@geo.uio.no)

We present a new model for paleobathymetry/topography of the Arctic region, especially focusing on the most important oceanic gateways to the Arctic Ocean (i.e. Greenland-Scotland Ridge and the Fram Strait). It has been suggested that the tectonic evolution of the Arctic may have played an important role in regional and global changes in ocean circulation and climate in the Cenozoic time (66 – 0 Ma). By opening the NE Atlantic Ocean and later the Fram Strait, the North Atlantic, the Nordic Seas and the Arctic Ocean were connected. This was an important step towards the modern-day-type deep water formation in the Nordic Seas, which is a major component of today's Atlantic Meridional Overturning Circulation (AMOC). Realistic paleobathymetry/topography of these gateways is therefore very important for paleo-ocean circulation and paleoclimate models. However, detailed reconstructions of the Atlantic-Arctic oceanic gateways are often undervalued in global paleobathymetric reconstructions, and this may result in considerable errors in paleoclimate models. Our paleobathymetry model is based on an updated plate tectonic kinematic model and incorporates new constraints on sediment thickness, crustal thickness, and a paleo-topographic model of the circum-Arctic region (including Greenland and Scandinavia). It also includes a new model for dynamic support by the Iceland mantle plume through time, with long-term variations ($\sim$ 10 Myr) in plume activity, and short-term pulsations (1 – 5 Myr) recorded by the v-shaped ridges straddling the Reykjanes Ridge South of Iceland. We show a series of realistic reconstructions of the Cenozoic Arctic and the Atlantic-Arctic oceanic gateways that shed more light on how Arctic plate tectonics and mantle processes may have influenced the complex transition for a warm greenhouse climate to a cold icehouse climate in the Cenozoic time.