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Thermohaline Fingerprints of the Greenland-Scotland Ridge and Fram Strait Subsidence Histories

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Changes in ocean gateway configuration are known to induce basin-scale rearrangements in ocean characteristics throughout the Cenozoic. However, there is large uncertainty in the relative timing of the subsidence histories of ocean gateways in the northern high latitudes. By using a fully coupled General Circulation Model we investigate the salinity and temperature changes in response to the subsidence of two key ocean gateways in the northern high latitudes during early to middle Miocene. Deepening of the Greenland-Scotland Ridge causes a salinity increase and warming in the Nordic Seas and the Arctic Ocean. While warming this realm, deep water formation takes place at lower temperatures due to a shift of the convection sites to north off Iceland. The associated deep ocean cooling and upwelling of deep waters to the Southern Ocean surface causes a cooling in the southern high latitudes. These characteristic impacts in response to the Greenland-Scotland Ridge deepening are independent of the Fram Strait state. Subsidence of the Fram Strait for a deep Greenland-Scotland Ridge causes less pronounced warming and salinity increase in the Nordic Seas. A stronger salinity increase is detected in the Arctic while temperatures remain unaltered, which further increases the density of the North Atlantic Deep Water. This causes an enhanced contribution of North Atlantic Deep Water to the abyssal ocean and on the expense of the colder southern source water component. These relative changes largely counteract each other and cause little warming in the upwelling regions of the Southern Ocean.