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Biogeochemical fluxes along the Storfjorden continental slope (Svalbard Islands, Arctic) impacted by dense shelf water cascading: one-year mooring deployment

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Biogeochemical fluxes have been monitored for one year off Storfjorden (Svalbard Islands, Arctic Ocean) where dense, Brine-enriched Shelf Water (BSW) forms seasonally. BSW is generated by strong winter cooling that enhances ice formation and brine rejection forming dense water that sinks to the bottom of the fjord, flows over the outer fjord sill and sinks towards Fram Strait. This process may entrain large amounts of sediments, including organic carbon and other components, and may also alter seafloor sediment geochemistry and affect the deep-sea ecosystem as observed in other continental margins. The western continental margin of the Svalbard islands is also influenced by the warm West Spitsbergen Current (WSC) that carries relatively warm (6-8˚C) and salty (35.1-35.3) Atlantic Water north into the Arctic Ocean. Therefore, atmospheric and oceanographic forcings are expected to influence deep biogeochemical fluxes. To investigate particle fluxes, including C export to the deep, and the near-bottom current flow along the presumable pathway of cascading waters, 4 mooring lines equipped with sediment traps, current meters, and temperature and salinity recorders were deployed along the continental slope from July 2010 to July 2011 at 1000,1250,1500 and 2000 m of water depth. Seabed sediment sampling was also performed to characterize the sediment and its geochemical properties along the path of BSW and WSC.

While the mean total mass flux (TMF) between August and December 2010 was quite low (0.25 to 0.5 g m^{-2} d^{-1}), in February-March 2011 a marked increase was recorded at all stations, with values up to 11.6 g m^{-2} d^{-1} at 1000 m, increasing at the near bottom and decreasing northwestward along the slope. Particles were mainly lithogenic. After, TMF decreases to values slightly higher than those recorded during the previous year (1.5 to 5.5 g m^{-2} d^{-1}). When mass fluxes peaked, water masses were warmer (-0.5˚C to 1˚C) and more saline. Currents were maxima (up to 40 cm s^{-1}), directed toward NW. All findings converge to highlight that the mechanism of particle delivery was by laterally advection of resuspended material from the seabed triggered by dense BSW cascading. Because of the cold plume of cascading dense waters entrains and mixes with the relatively warm intermediate Atlantic Water, it appears as a heat source for the bottom ambient Norwegian Sea Deep Water, while is still driven by its salinity excess.