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Degradation of terrestrial organic carbon, primary production and out-gassing of CO_2 along the Laptev and East Siberian Seas as inferred from δ13C values of DIC

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The cycling of carbon on the Arctic shelves, including outgassing of CO_2 to the atmosphere, is not clearly understood. Degradation of terrestrial organic carbon (OCter) has recently been shown to be pronounced over the East Siberian Arctic Shelf (ESAS), i.e. the Laptev and East Siberian Seas, producing dissolved inorganic carbon (DIC). To further explore the processes affecting DIC, an extensive suite of shelf water samples were collected during the summer of 2008, and assessed for the stable carbon isotopic composition of DIC (δ13C-DIC). The δ13C-DIC values strongly deviated from the compositions expected from only mixing between river water and seawater. Model calculations suggest that the major processes causing these deviations from conservative mixing were addition of (DIC) by degradation of OCter, removal of DIC during primary production, and outgassing of CO_2. All waters below the halocline showed additions of on average 70 μM of DIC, originating from degradation of OCter in the coastal water column. This is of the same magnitude as the recently reported deficits of DOCter and POCter for the same waters. The surface waters in the East Siberian Sea had higher δ13C-DIC values and lower DIC concentrations than expected from conservative mixing, consistent with additions of DIC from degradation of OCter and outgassing of 150 μM CO_2. Depleted δ13C-POC values of -29 to -32‰ in the mid to outer shelf regions are consistent with POC from phytoplankton production, driven by DIC partly originating from degraded OCter. Overall, the isotopic composition of DIC integrates the transformation processes between organic and inorganic C in shelf waters and allows the quantification of these processes over year-long time-scales.