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Tracing Water Masses and Riverine Inputs in the Arctic Ocean with Dissolved ^{10}Be and ^{9}Be

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The Arctic Ocean basin is confined by landmasses similar to the Mediterranean. There is only little deep water formed seasonally on the shelves of the Arctic Ocean despite the low temperatures. This is due to a freshwater lid originating from the Arctic rivers, which most of the time covers the surface of the Arctic Ocean. The deeper Arctic Ocean water masses can thus only be renewed at comparatively low rates via the only deep connection to the Atlantic Ocean, the Fram Strait. Surface water mass exchange occurs with the Atlantic Ocean through the Fram Strait and Barents Sea and with the Pacific Ocean through the Bering Strait. Biogenic particulate fluxes in the central Arctic Ocean are very low due to perennial sea ice cover and detrital particle fluxes from either eolian or riverine sources are also very low.

We present the first comprehensive set of dissolved ^{10}Be (cosmogenic) and ^{9}Be (continental sources) depth profiles from water samples of all major basins of the Arctic Ocean, which were collected during the AWS2000 expedition with the US coast guard icebreaker “Polar Star” and the Swedish Arctic Ocean 2001 expedition with the research ice breaker “Oden”. Due to the weak particle reactivity of Be and the low particulate fluxes, Be isotopes can serve as quasi-conservative tracers for different origins of water masses (Atlantic Ocean, Pacific Ocean, Arctic rivers).

Our results show relatively uniform concentrations of both Be isotopes at depths below

500 m and thus also a constant $^{10}Be/^{9}Be$ ratio of $7x10^{-8}$. This value is intermediate between deep-water ratios from the Atlantic and Pacific Oceans. In the upper water column large variations are observed. The upper 100 m of the central Arctic profiles (Amundsen and Makarov Basins) are characterized by up 5 times higher concentrations of ^{9}Be (similar to Nd and Hf) and up to twice as high ^{10}Be concentrations as the deeper waters. This corresponds to a pronounced salinity minimum caused by freshwater input from the Siberian rivers. The corresponding surface and halocline water $^{10}Be/^{9}Be$ ratios are only $2x10^{-8}$. This suggests that considerable amounts of Be in the central Arctic Ocean are supplied by the Siberian Rivers, which are characterized by $^{10}Be/^{9}Be$ ratios as low as $0.5\text{-}1x10^{-8}$. This is in contradiction to the expectation that trace metals are efficiently scavenged on the shallow and wide Siberian shelves. Comparison of the surface ocean ^{10}Be variability with data obtained 10 years ago, when the salinity minimum was absent in the Eurasian Basin, clearly shows that Be isotopes are a reliable quasi-conservative water mass tracer in the Arctic Ocean, which allow the assessment of water mass mixing relationships.