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GEOTRACES

ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

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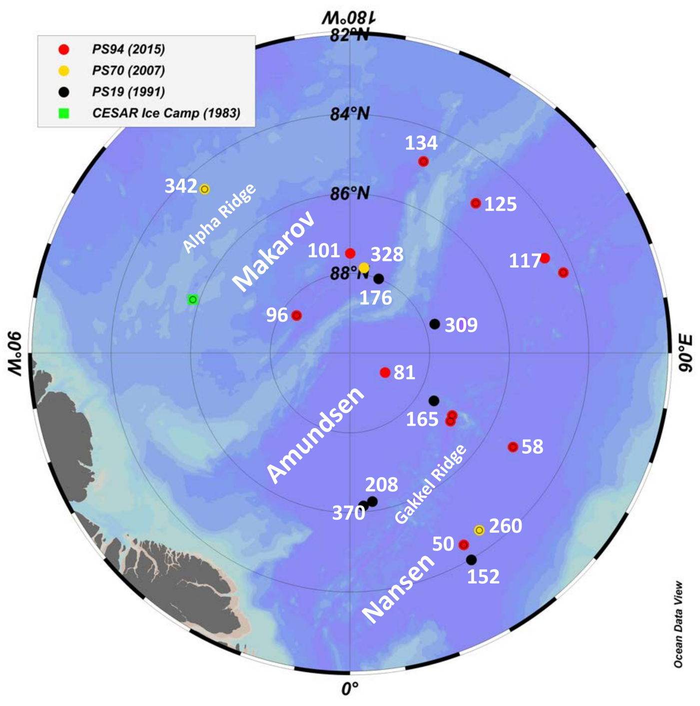
^{231}Pa and ^{230}Th in the Arctic Ocean 1991-2015: Changes in the Eurasian and Makarov Basins

Introduction

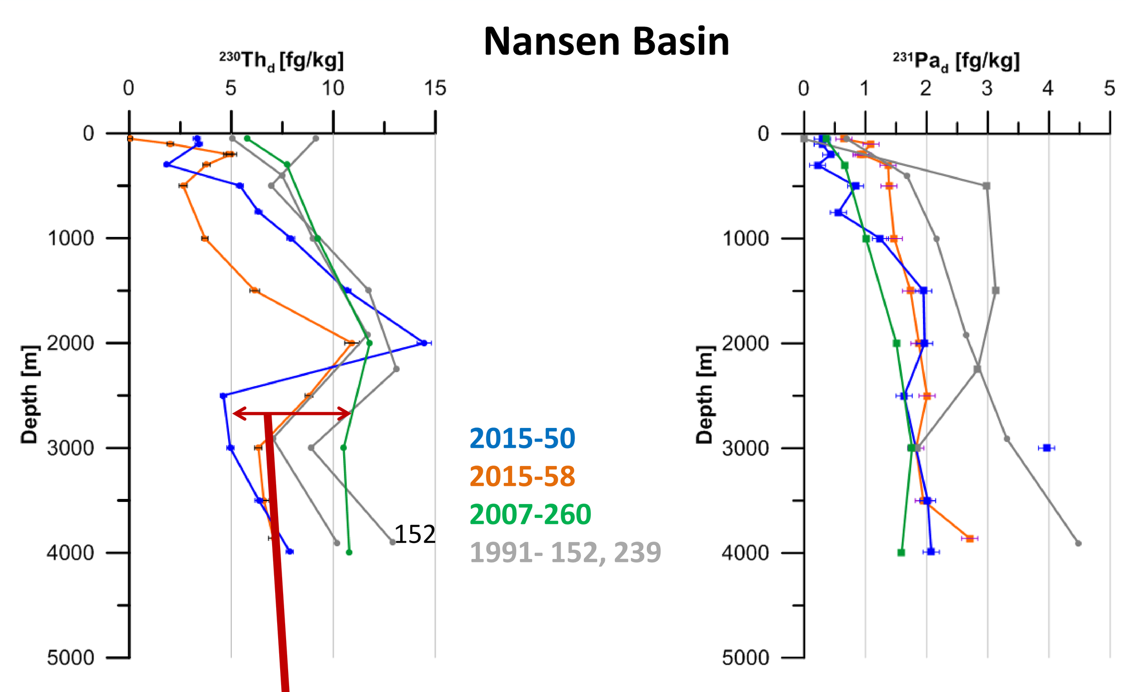
Both particle fluxes and deep water circulation may respond to climate change in the Arctic Ocean. This study discusses temporal changes in dissolved ^{230}Th and ^{231}Pa concentrations in the context of climate change. We compare results from 1983 **[1]**, 1991 **[2]** and 2007 and 2015. We present results of dissolved ^{231}Pa and ^{230}Th collected in the Nansen-, Amundsen- and Makarov Basins of the Arctic Ocean. Our aim is to determine, which factors change ^{230}Th and ^{231}Pa concentrations and distribution in the central Arctic Ocean over time. We use dissolved CFC-11 and dissolved Fe data from the 2015 **GEOTRACES** cruise to underpin our hypotheses.

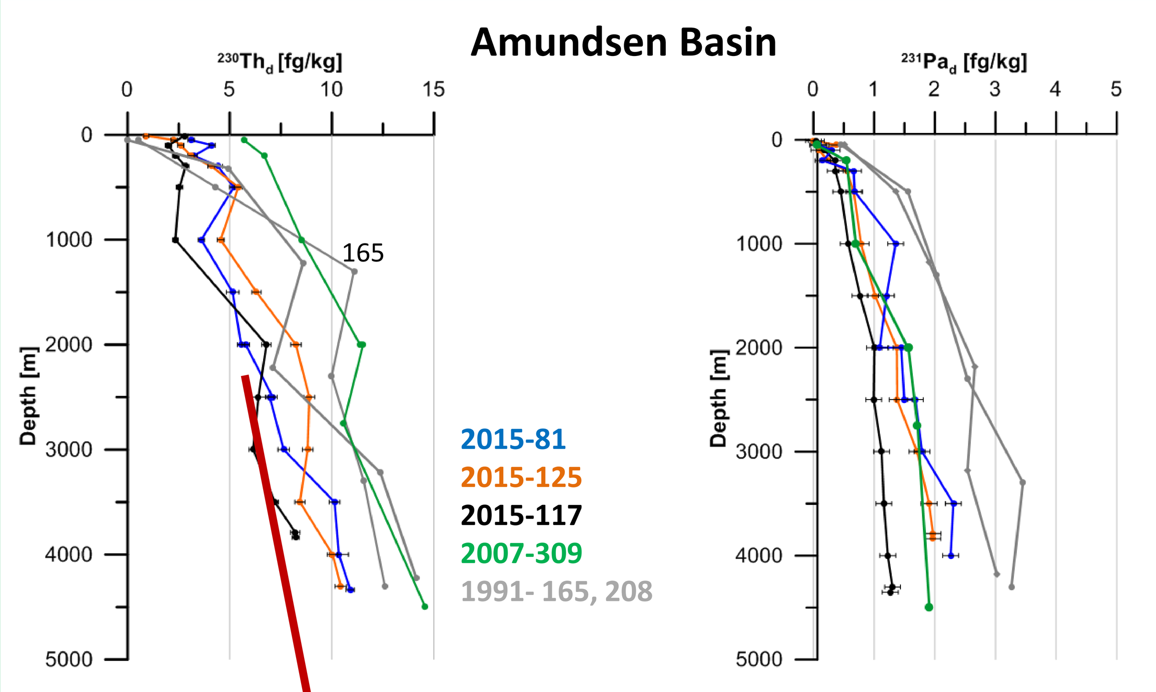


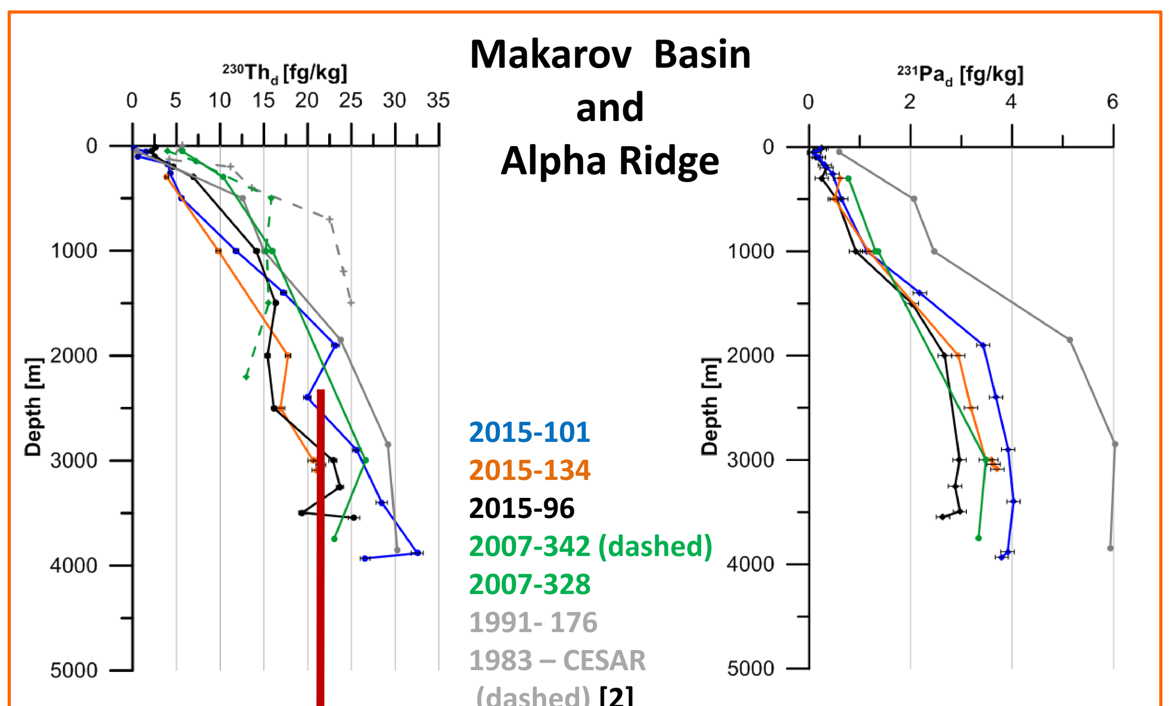
Material and Methods

Samples were taken during RV Polarstern cruises PS70 (2007) and PS94 (2015). Seawater samples of the 2015 cruise were analyzed at AWI following **GEOTRACES** methods **[3]**. The samples from 2007 were collected in the same way and analyzed at University of Minnesota following Shen et al. (2003) **[4]**.

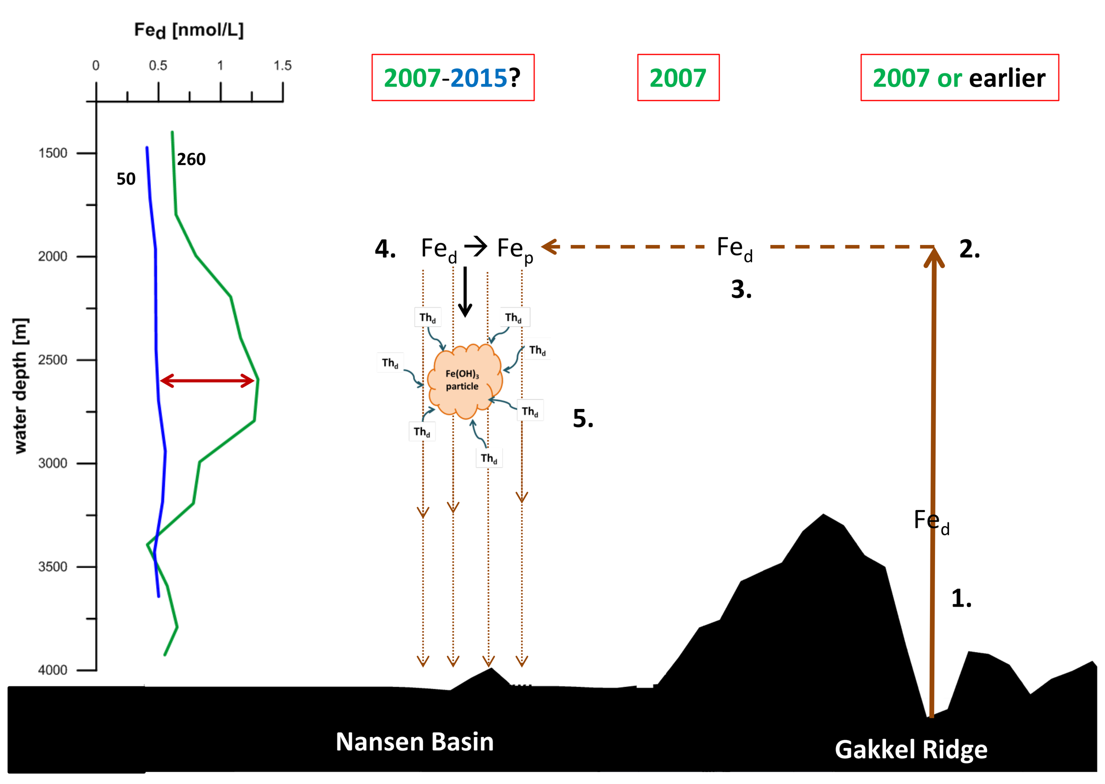
Results and Discussion: Changes over time







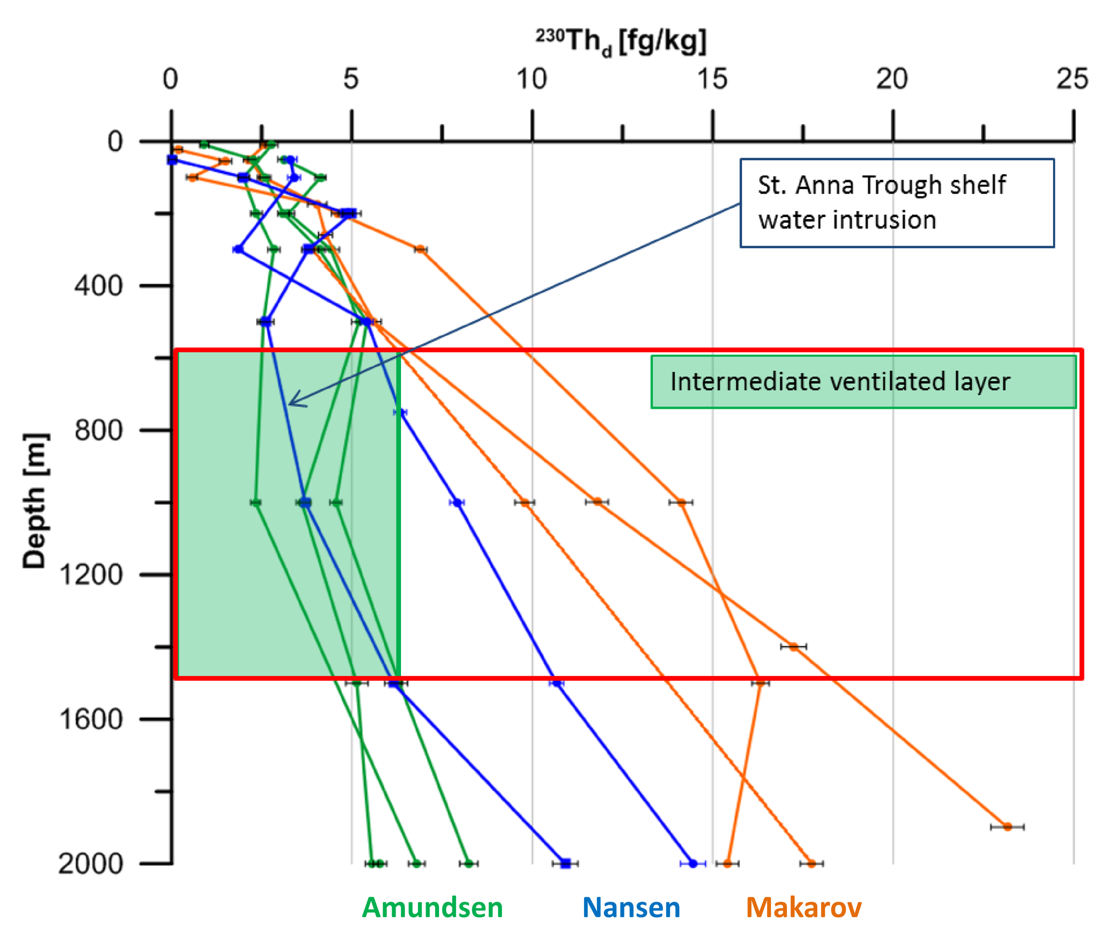
Hydrothermal Fe input and potential Th scavenging in Nansen Basin



1. Hydrothermal release of dissolved Fe in 2007 or before **[5]**
2. Complexation by organic Fe binding ligands
3. Transport to Nansen Basin. Elevated Fe in 2007 **[6]**
4. Oxidized Fe forms or reacts with particles
5. Fe removal by sinking particles scavenges and removes dissolved ^{230}Th → decrease since 2007

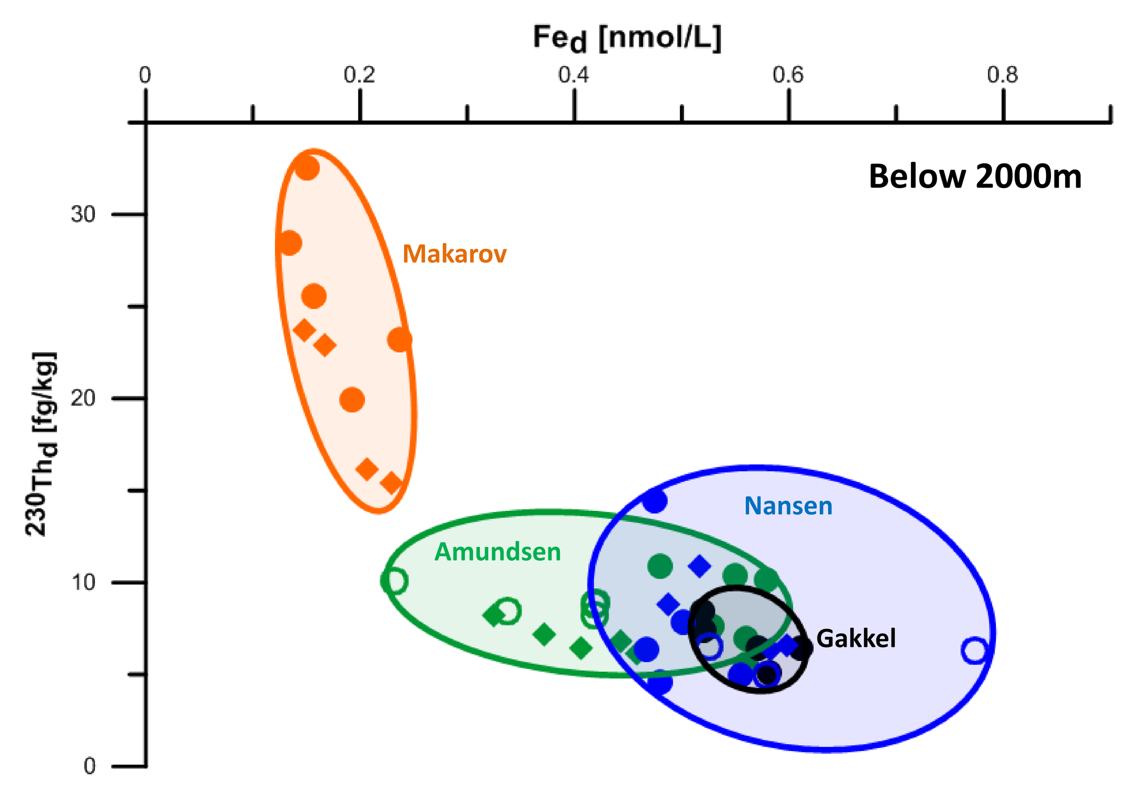
Amundsen Basin Ventilation

Dissolved ^{230}Th concentrations in the Amundsen Basin are below those from Nansen- and Makarov Basin in a ventilated intermediate layer 500-1500m. This water mass is probably ventilated with modified Fram Strait Branch Water (FSBW). This water mass experienced scavenging history on its travel through the large shelf areas (see CFC-11).



Fe - Th correlation

Dissolved Fe in deep waters is used to indicate hydrothermal events that introduce trace metals to the ocean, causing subsequent scavenging. The Eurasian and Makarov-Basins differ in Fe and ^{230}Th concentrations. High Fe is in correlation with low Th. The Nansen Basin is controlled by oxidized Fe that forms particles in contrast to the Makarov Basin. This may be explained by the absence of hydrothermal vents in the Makarov Basin.



Conclusions

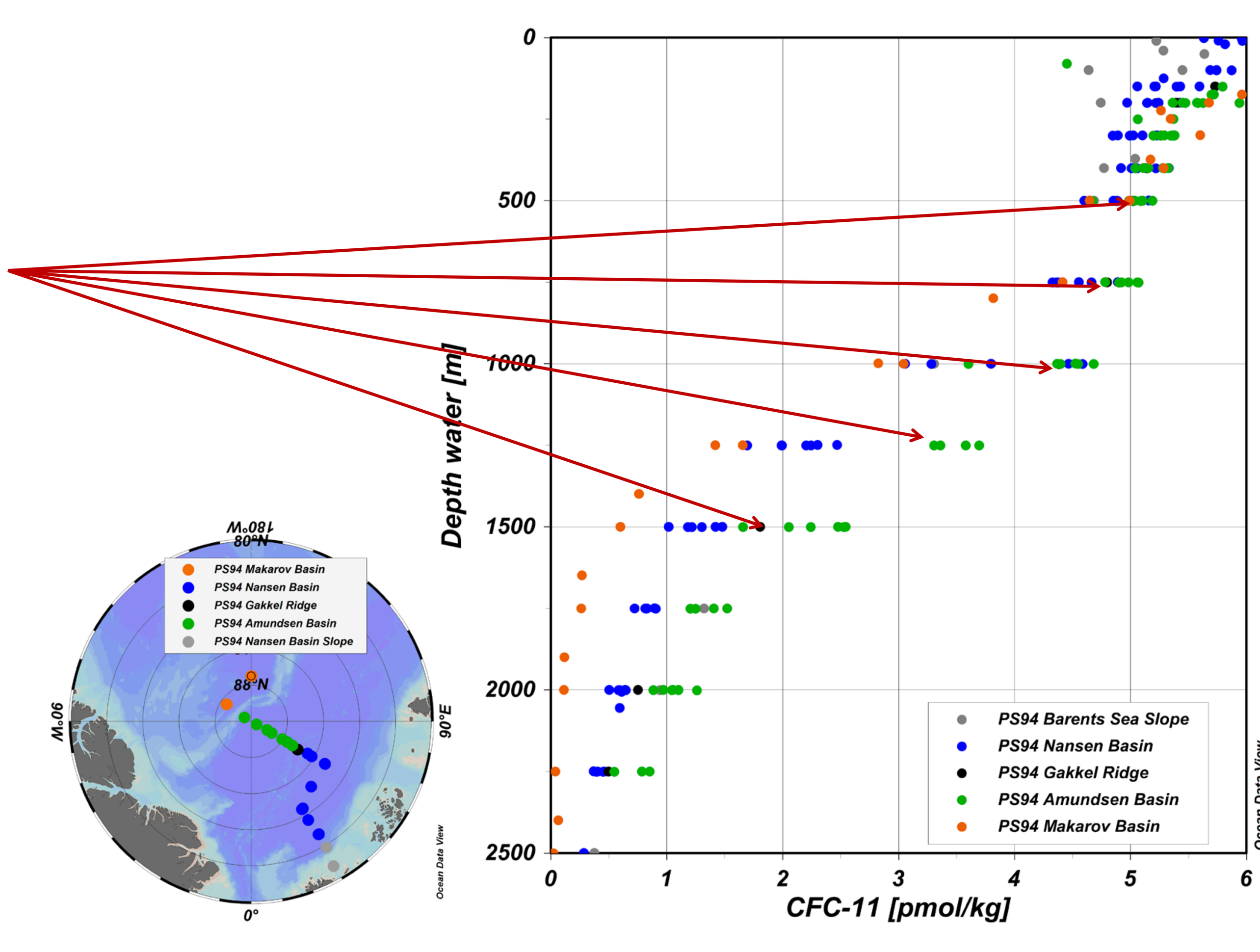
1. Temporal changes in Th and Pa concentrations in the Nansen Basin are caused by scavenging removal. Probably by hydrothermal activities at the Gakkel Ridge.
2. Ventilation of the Amundsen Basin with waters containing low concentrations of ^{230}Th, ^{231}Pa reduces ^{231}Pa and ^{230}Th concentrations (FSBW).
3. High concentrations in the Makarov Basin are due to long residence times of the water masses (CFC-11) together with low particle fluxes., maybe due to the absence of hydrothermal vents (Fe-Th).

Ventilation and water mass ages

CFC-11 data show higher concentrations in the Amundsen Basin than in the Nansen- or Makarov Basin, <u>indicating younger water mass ages implying more recent ventilation</u>.

We think this is controlling the Th and Pa profiles in the Amundsen Basin: Water with Atlantic origin flows through the Siberian shelves and is entering the Amundsen Basin after undergoing scavenging history at the shelves and slopes. This change is carried downwards by reversible scavenging.

The Makarov Basin water is older than that of the Eurasian Basins. Therefore, Th and Pa can accumulate accordingly.



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