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Recent circulation changes at intermediate depths (Upper Polar Deep Water) in the Beaufort Gyre inferred from water column distribution of ^{230}Th

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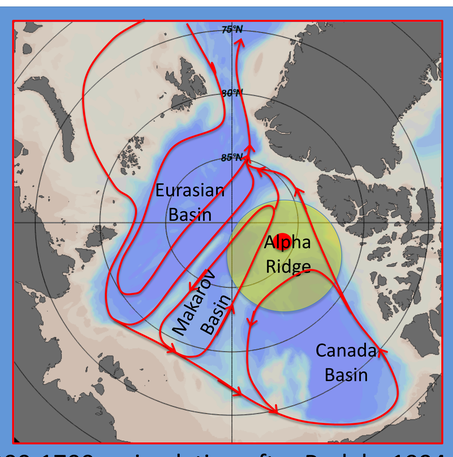
Mid-depth circulation

^{230}Th signals

other tracers

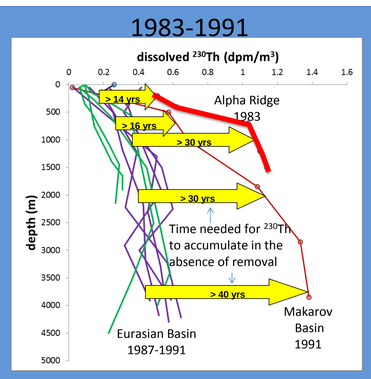
before 2004: splendid isolation of Alpha Ridge

The world's record steepest ^{230}Th profile was observed in 1983 under heavy ice above the Alpha Ridge, inferring a water column with very little exchange. The lack of ventilation was confirmed by low CFC concentrations and the pathway taken by reprocessing-^{129}I.



200-1700m circulation after Rudels, 1994

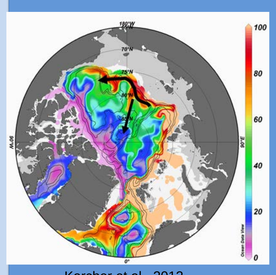
1983-1991



At the Alpha Ridge, isolation under permanent ice cover allows ^{230}Th to accumulate to record high activities

^{129}I at 240m (10^7 at/L)

2000



Karcher et al., 2012

CFC

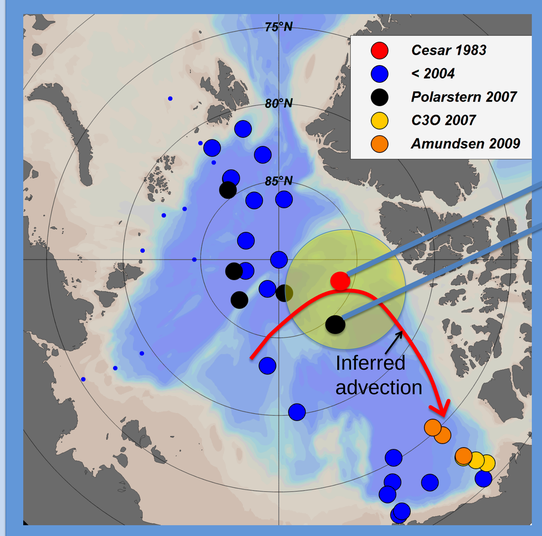
CFC data from 1996-2005 confirm old age near Alpha Ridge (Smethie et al., 2000, Tanhua et al., 2009).

2007-2009

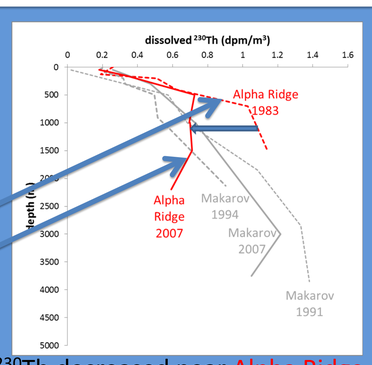
After 2004, surface- and Atlantic Layer-water circulation changed in relation to the change of the Arctic Oscillation (Karcher et al., 2012).
In 2007, a ^{230}Th profile taken on the Canada Basin side of the Alpha Ridge showed reduced ^{230}Th activity below 500m depth.

In the southern Beaufort Sea, ^{230}Th activities in the 500-1500m depth range increased progressively in the period 2007-2009

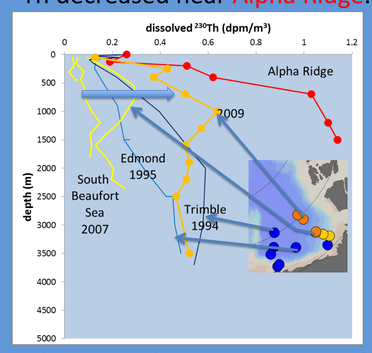
We hypothesize that both effects result from an anticyclonic circulation advecting the ^{230}Th that had accumulated over decades to the south.



New ^{230}Th and ^{231}Pa profiles were obtained during the International Polar Year 2007-2009

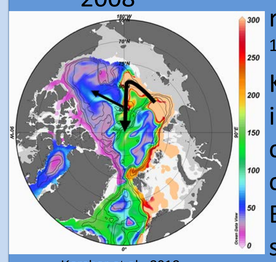


^{230}Th decreased near Alpha Ridge...



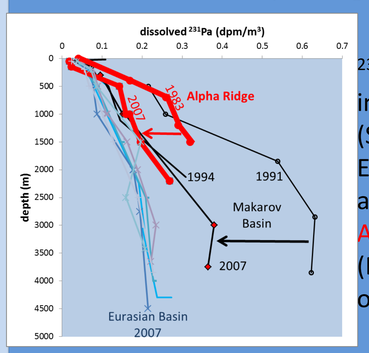
... and increased in Southern Beaufort Sea

2008



Karcher et al., 2012

The evolution of reprocessing-produced ^{129}I was interpreted by Karcher et al. (2012) to infer a transition from cyclonic to anti-cyclonic circulation of the Canada Basin, in line with the spreading of the Warm Temperature Anomaly (McLaughlin et al., 2009)



^{231}Pa decreased in **Makarov Basin** (Scholten 1991 – Edmonds 1994) and at Alpha Ridge (Bacon 1983-our data 2007)

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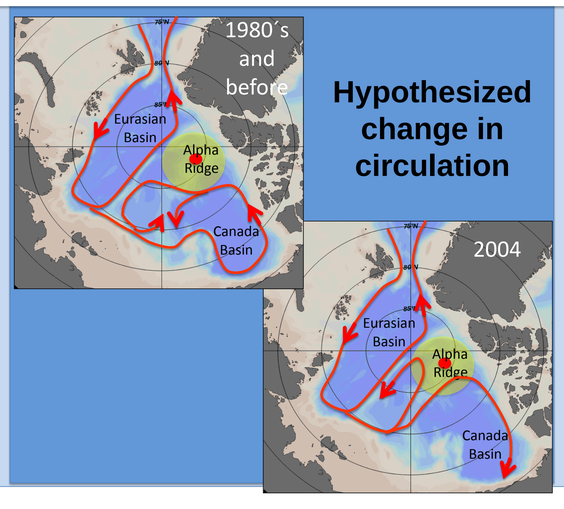
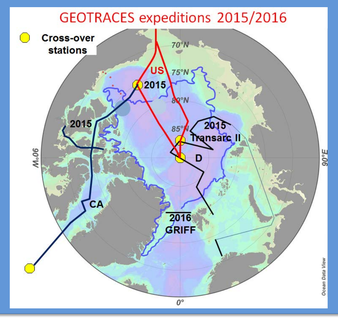


Hypothesized change in circulation

2015 GEOTRACES ^{230}Th data will tell whether this process of change has continued



Conclusions

- ^{230}Th decreased in central Arctic near Alpha Ridge
- ^{230}Th increased in southern Beaufort Sea
- These changes suggest a transition to an anticyclonic circulation in the depth range 500-2500m, consistent with circulation change at 240m inferred from ^{129}I data and -modelling.

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