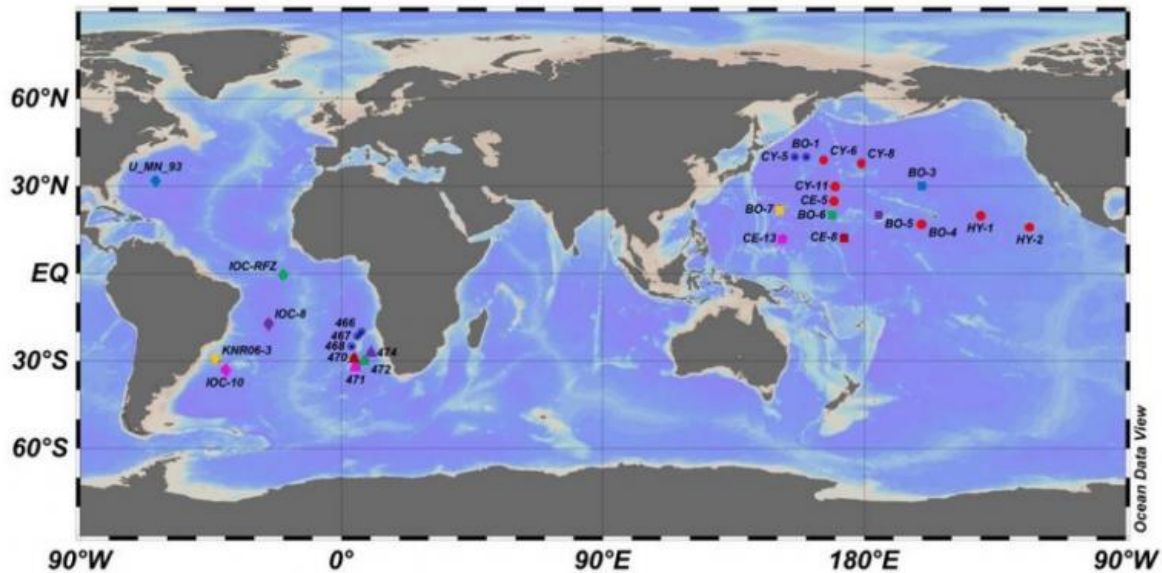


# Isotopes with ocean circulation information

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Map for the stations where  $(^{230}\text{Th})_t$  data are available and compiled in this study. Data are retrieved from previous publications 30-31, 35-36, 45-48. (The profile location colors and symbols correspond to colors and symbols used in figures 4-7.) Figure made with Ocean Data View. Credit: University of Bergen

The distribution of a radioactive thorium isotope is important in multiple aspects of oceanography. In his new publication, Yiming Luo has revisited the issue on processes influencing the distribution in the water column.

The thorium-230 isotope in the marine [sediment](#) is used by paleo researchers to calibrate and normalize particle fluxes of past times. The

isotope is present both in the [water column](#) and in the [ocean](#) sediments.

Together with the isotope  $^{231}\text{Pa}$ , they provide important information on the ocean overturning circulation. But there is a problem with regard to the basis of the application of sediment  $^{231}\text{Pa}/^{230}\text{Th}$ , which is equally fatal to the  $^{230}\text{Th}$  normalization.

"The amount of  $^{230}\text{Th}$  produced in the water column has been assumed to be removed to the local ocean sediments. But some things influence its distributions in the water column," Yiming Luo points out.

He is a postdoc at the Geophysical Institute UiB and the Bjerknes Centre for Climate Research. Recently his paper "Reinterpretation of oceanic  $^{230}\text{Th}$  profiles based on decadal export productivity (2003-2010)" was published in *Scientific Reports*, a research journal by the Nature Publishing Group.

In this pilot study, Luo has been looking at processes influencing the thorium isotope distribution in the water column. Two important processes are influencing the  $^{230}\text{Th}$  distribution in the water column.

One is scavenging, which includes the productivity by the algae in the surface ocean and removal of  $^{230}\text{Th}$  with the settling organic matter, and resuspension of marine sediments that cause enhanced  $^{230}\text{Th}$  scavenging in the bottom water. Another process is circulation, which disturbs the linear distribution of  $^{230}\text{Th}$  with water depth in the equilibrium status of  $^{230}\text{Th}$  scavenging .

"What process is most important? We assume the scavenging, and there is no consistent way to parameterize the scavenging rate, in order to interpret the  $^{230}\text{Th}$  signals. As a result, the theories used to explain the  $^{230}\text{Th}$  distributions vary from one site to another," Luo says.

The solution he suggests in his paper is a method to determine the

scavenging of  $^{230}\text{Th}$  in the [water](#) column. He has established an empirical equilibrium-state  $^{230}\text{Th}$  scavenging correlation versus estimates of export productivity from the years 2003-2010.

"This correlation demonstrates the relationship between  $^{230}\text{Th}$ -scavenging intensity and EP in the absence of advection. With this correlation, other  $^{230}\text{Th}$  profiles from global oceans are reinterpreted", he writes in the publication abstract.

Luo emphasizes two important results:

"First, the uncertainty of  $^{230}\text{Th}$  distribution interpretation is reduced, as the profiles are explained pretty well. Secondly, we can now calculate the  $^{230}\text{Th}$  scavenging by the productivity," Yiming Luo explains.

For future modeling and analyzing the  $^{230}\text{Th}$  distributions in the ocean, the new parameterization serves as a first step to better elucidate the ocean circulation in the past.

**More information:** Yiming Luo. Reinterpretation of oceanic  $^{230}\text{Th}$  profiles based on decadal export productivity (2003–2010), *Scientific Reports* (2017). [DOI: 10.1038/s41598-017-00604-y](https://doi.org/10.1038/s41598-017-00604-y)

Provided by University of Bergen

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