Distribution of ^{236}U in the North Pacific Ocean

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^{236}U is a mainly anthropogenic, rare uranium isotope with a half-life of 23.4 M yrs. In recent years, the development of accelerator mass spectrometry (AMS) has made the detection of ^{236}U in the general environment possible and research was conducted towards the application of this nuclide as oceanic tracer. ^{236}U seems well suited as oceanic tracer, because it has a well-defined, temporally resolved source function and shows conservative behaviour in seawater with a long residence time of ~ $5x10^5$ yrs. In this work, we focus on the North Pacific Ocean, where no data on ^{236}U has been published so far and will present a new pre-treatment method to treat small size (1 L) seawater samples.
Seawater samples were collected from the North Pacific Ocean in GEOTRACES cruises with *R/V Hakuhomaru*, in 2011, 2012 and 2014 (KH-11-07, HK-12-4 and KH14-6). 1 L, 5 L and 20 L of seawater samples were collected from several depths in each site, and immediately after the sampling, the water was filtered with about 0.45 mm pore-size cartridge filters. ^{238}U concentrations in seawater were measured with ICP-MS after acidification. As for 1 L of seawater samples, uranium was purified with UTEVA resin , and precipitated in only 100 µg of iron carrier to prepare targets for the measurement of $^{236}U/^{238}U$ by AMS. In the 5 L and 20 L samples, no column separation for uranium was done, but actinide elements were separated by a simple co-precipitation with iron hydroxide, which leaves the possibility of detecting several actinides (U, Np, Pu) from one sample.
Using the newly constructed target preparation procedure for the measurement of ^{236}U in small sizes of seawater samples, 5-10 times higher ion currents were achieved compared to the conventional method and ^{236}U was successfully determined on all levels of the water column. Also, measurement times could be significantly reduced, which seems promising for future applications of ^{236}U as oceanographic tracer, when large numbers of samples from vast ocean areas need to be analysed in a timely and cost-efficient way. $^{236}U/^{238}U$ isotopic ratios were highest ($7.6x10^{-10}$ to $1.4x10^{-9}$) in shallow water. From surface level to a depth of about 1000-1500 m, all depth profiles showed a steep decrease in ^{236}U concentrations and $^{236}U/^{238}U$ ratios in deep water were in the order of 10^{-11}-10^{-12}. The inventories of ^{236}U on the water column were calculated as $(3.6–7.3)x10^{12}$ atoms/m^2, which is significantly lower than for the Sea of Japan with $(1.4-1.6)x10^{13}$ atoms/m^2. These results show the lower extent of vertical transport in the Pacific Ocean and are probably an indicator for lower precipitation rates in the North Pacific Ocean. ^{236}U distributions were in correspondence to the main water masses (as defined by physical oceanographic parameters) and ^{236}U concentration patterns were similar to those of ^{137}Cs, which has been conventionally used as oceanographic tracer in this area.

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