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Vertical Sections of ^{230}Th and ^{231}Pa in the Water Column off Southwest Africa: The Interplay between Particle Flux and Hydrography

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The distribution of the natural radionuclides ^{230}Th ($T_{1/2}$= 75.7 kyr) and ^{231}Pa ($T_{1/2}$= 32.5 kyr) in the water-column is controlled by two main processes: the vertical particle flux and the ventilation of water masses. In oceanic areas where ventilation time scales are longer than the scavenging residence times (τ) of ^{230}Th (τ ~20-40 yr) and ^{231}Pa (τ ~50-200 yr) ^{231}Pa/^{230}Th ratios stored in sediments are used as tracers for the particle flux and related paleoproductivity. This ratio may also provide information on water mass advection rates in those regions where ventilation rates are of the same order or shorter than the residence times of these isotopes.

It is difficult to decide which of these two processes is most important for the distribution of ^{230}Th and ^{231}Pa in the water column and in the sediments. Hence the interplay between hydrography and particle flux in regulating the oceanic distribution of these isotopes needs to be studied.

The area off western South Africa is most promising for such an investigation because on the one hand it is characterized by high particle flux due to upwelling off Namibia. On the other hand this area is important within the context of the global thermohaline circulation: it is believed, e. g. that about 30% of the North Atlantic Deep Water (NADW) reaches the Antarctic Circumpolar Current via the eastern South Atlantic.

We studied the water column distribution of total and particulate ^{230}Th and ^{231}Pa on a section from the south Angola Basin to the Cape Basin. The depth resolution as well as the regional spacing of the sampling locations combined with high precision mea-

surements (using HR-ICPMS) allows for the first time to display a vertical section of total ^{230}Th concentrations along the area investigated. This kind of presentation allows to identify gradients in the ^{230}Th concentrations related to the hydrography: i) in the central southern Angola Basin the ^{230}Th concentrations in NADW are slightly higher than in the same water mass in Cape basin suggesting different sources and/or mixing histories of NADW; ii) advection of NADW associated with the Namib Col Current is characterized by high ^{230}Th concentrations in the Cape Basin; iii) the Antarctic Bottom Water in the western Cape basin shows very high ^{230}Th concentrations which is interpreted to be due to advection of ^{230}Th enriched waters from the Antarctic Circum Polar Current. Near the ocean margin the relation between ^{230}Th and hydrography is less obvious and boundary scavenging seems to control the distribution of ^{230}Th.

The ^{231}Pa concentrations measured in NADW of the Cape and Angola basins are the highest measured so far in the Atlantic. This can be explained by an export of ^{231}Pa from the North Atlantic associated with the meridional transport which causes the ^{231}Pa concentrations to increase along the flow path of NADW towards the south. Since the upwelling region off Namibia is not a major sink for the particle reactive radionuclides, ^{231}Pa enriched NADW is a source of ^{231}Pa in the Southern Ocean.