The distribution of ^{231}Pa and ^{230}Th between dissolved and particulate phases in the western North Atlantic

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^{230}Th and the ^{231}Pa/^{230}Th ratio have been widely used in marine sciences to study aspects of particle flux and ocean circulation. In particular, the ^{231}Pa/^{230}Th ratio has been shown to be a useful proxy of paleoproductivity, paleocirculation, or biogenic opal flux, depending on the oceanographic setting. Yet, it is still not fully understood what are the mechanisms that control the scavenging of both isotopes, especially the differences in their behaviour.

Here we study the distribution of ^{231}Pa and ^{230}Th in the Northern part of the GEOTRACES GA02 (Western Atlantic) section, on the basis of a comprehensive set of parameters, analyzed on five selected stations from 64ºN to 18ºN. Our data trace North Atlantic Deep Water (NADW) and Antarctic Bottom Water (AABW), allowing to test the hypothesis that the ^{231}Pa/^{230}Th ratio tracks deep water ventilation in the North Atlantic. The measurement of ^{231}Pa and ^{230}Th on particulate phases, together with their composition, provides additional constraints on depositional processes and on the role of opal on Pa scavenging in these locations.

Main features include the observation of a pronounced mid-water depth maximum in dissolved ^{231}Pa, and to some extent ^{230}Th, increasing towards the South. Near the bottom, we find increased particle concentrations in benthic nepheloid layers (BNL), accompanied by high particulate fractions for both isotopes (36-82% for ^{230}Th and 7-31% for ^{231}Pa). The relative fractions of lithogenic material (%lith) show a steadily increasing trend with depth, mostly reflecting the continuous loss of biogenic phases with depth.

The ^{231}Pa/^{230}Th fractionation factor (F) is found to be controlled by particle composition. Different trends of F with %lith are found between subtropical stations (high sensitivity of F for %lith) and subarctic stations (low sensitivity of F for %lith).