Protocol For Thorium Collection:

Regarding Radioactive Isotope Usage Aboard R/V Atlantis for Voyage #AT 15-61

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The radioactive isotope we will be using to spike our samples is 229-Thorium, which has an activity of 15.0 dpm/g (7.0 pCi/g) in the spike solution, which also contains 4N nitric acid. It has a half-life of 7300 years. Its alpha emitting daughters will accumulate (225Ra, 221Fr, 217At, 213Po, 209Pb) and none have a half-life of greater than 15 days. In each sample, we will use approximately 5.0 pCi in solution with 4N nitric acid. There are 60 individual 15mL bottles containing 0.6mL of this solution and 10mL of water aboard the ship. Total 229-Th activity brought equals 300 pCi, and the total alpha activity is 5x greater (1.5 nCi). A small amount of beta activity (less hazardous if ingested) is also present from 225Ac and 213Po daughters.

According to the United States National Bureau of Standards, the permissible amount that can be absorbed by a vital organ, which would include ingestion, is 5.0 nCi. The amount that we are using (~30% of the permissible limit) is sufficiently small enough to cause no threat to human health aboard the ship.

For each 20 liter water sample taken, one of these spike solutions will be added. 229-Thorium is particle reactive and thus will attach itself to particulate matter in the seawater, which is subsequently filtered through a 0.45 μm filter within 48 hours, capturing all of the particulates and Thorium. Waste water is collected from flow out of the filter until it is confirmed that there is no tear in the filter, then the isotope-free waste in the container can be discarded over board. At this point, approximately 97 – 100% of the 229-Thorium will be sequestered on the filter, which we will be taking with us when we reach port. Effectively, all of the 229-Thorium brought on the ship and added to the water samples will be re-collected during sample processing and taken off the ship.