Investigating ocean currents using uranium-236 from the 1960s

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Isotope Researcher Stephan Winkler, University of Vienna, is shown in front of the "Vienna Environmental Research Accelerator" (VERA). Credit: Universität Wien

Stephan Winkler, isotope researcher at the University of Vienna, has identified the bomb-pulse of uranium-236 in corals from the Caribbean Sea for the first time. 236U was distributed world-wide in the period of atmospheric nuclear testing in the 1960s. Readily dissolved in seawater it is an ideal tool for investigating ocean currents.

In the period of atmospheric nuclear testing in the 1950s and 1960s significant amounts of uranium-236 were distributed world-wide. Despite this, uranium-236 has mostly eluded detection and clear attribution to this source. A team of three researchers based in Austria and Australia lead by Stephan Winkler have identified the bomb-pulse of this isotope in corals from the Caribbean Sea. Uranium is readily dissolved in seawater, and therefore is carried by ocean currents. This makes uranium-236 and ideal tool for investigating ocean currents. Stephan R. Winkler, Peter Steier, and Jessica Carilli publish their recent findings in Earth and Planetary Science Letters (*EPSL*).

Accelerator mass spectrometry

The atmospheric testing of nuclear weapons in the 1960s and 1950s has released many artificially produced radioisotopes into the environment. Although uranium-236 is one of the most abundant of these isotopes in the fall-out, its detection from this source has been considered impossible for a long time. With the superior sensitivity of the Vienna Environmental Research Accelerator's (VERA) heavy ion mass spectrometry system the bomb-pulse of uranium-236 has now been measured for the first time in corals from the Caribbean Sea.

This image shows Jessica Carilli, Australian Nuclear Science and Technology Organization, drilling at the Turneffe Atoll in the Caribbean Sea. Credit: Brad

Erisman 2006

Yearly banding in corals

Like trees, some coral species display yearly banding structures in their skeleton. In these skeletons uranium isotopic composition of the ocean is also recorded. It is therefore not only possible to measure the present-day uranium-236 concentration but to reconstruct the chronology of nuclear testing in retrospect.

Investigating ocean currents using uranium-236

Owing to its long half-life and still low abundance uranium-236 is irrelevant as a radiation hazard. Uranium is easily dissolved in ocean water and carried by ocean currents. This makes uranium-236 an ideal tool for oceanography. The knowledge of oceanic currents is important for understanding oceanic heat transport and therefore also important for climate research.

The most significant atmospheric tests occurred 50 years ago – in 1962 – the last test concluding on the 25th of December of that year. The uranium-236 produced in these test was deposited on the planet's surface almost completely within two years. The general pattern of fall-out is known from other radionuclides. The global fall-out is not distributed evenly between the northern and southern hemispheres: the fall-out on the northern hemisphere is about four times the fall-out on the southern hemisphere. This effect enables the investigation of inter-hemispheric water exchange using this tracer.

The core specifically chosen for this study was sampled from the Turneffe Atoll in the Caribbean Sea. While this is a location in the northern hemisphere, ocean currents carry water from the Southern Atlantic towards it. The effect of this is seen in the record. In the first 10 years after major atmospheric testing, the uranium-236 levels dropped much faster than can be explained by mixing of surface waters (and thus uranium-236) into deeper water layers. The effect is explained by the arrival of southern hemispheric waters.

Provided by University of Vienna

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