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129I waste used to track ocean currents for 15,000 km after discharge from nuclear plants

GOLDSCHMIDT CONFERENCE

Paris, 16th August: Radioactive 129I has travelled the equivalent of a third of the way round the globe, since being released from nuclear fuel reprocessing plants in the UK and France. The iodine's 15,000 km journey begins in the nuclear plants at Sellafield and La Hague and continues via the Arctic Ocean and then southward via the Grand Banks towards Bermuda, where it is found at very low concentrations about 20 years later. This tracer has been used to provide the most complete up-to-date, high-accuracy mapping of the oceanic currents that transport CO2 and other greenhouse gases from the atmosphere to the abyssal depths of the deep North Atlantic Ocean. These results are being presented at the Goldschmidt geochemistry conference in Paris.

Radioactive contaminants have been legally released for more than half a century from the nuclear reprocessing plants at Sellafield (UK) and La Hague (France). Scientists have recently begun to use the radioactive 129iodine (129I) as a way of tracking the movement of ocean currents. They emphasise that the radioactivity levels found in the North Atlantic are extremely low and not considered dangerous.

"What we have found is that by tracing radioactive iodine released into the seas off the UK and France we have been able to confirm how the deep ocean currents flow in the North Atlantic. This is the first study to show precise and continuous tracking of Atlantic water flowing northward into the Arctic Ocean off Norway, circulating around the arctic basins and returning to the Nordic seas in what we call the "Arctic loop", and then flowing southward down the continental slope of North America to Bermuda at depths below 3000 m" said lead researcher Dr John N. Smith (Bedford Institute of Oceanography, Canada).

The research is part of the international GEOTRACES project, which aims to use geochemical markers to follow ocean currents, and so provide precise estimates of transit times and mixing rates in the North Atlantic and Arctic Oceans. So far the 129I has been measured as far south as Puerto Rico, but the researchers assume that it will continue to flow southward into the South Atlantic and eventually spread throughout the global ocean.

Dr Smith continued, "These currents have previously been studied using dissolved CFCs (Chlorofluorocarbons) - the molecules which used to be used in fridges until banned in 1989. However, CFCs undergo ocean-atmosphere exchange which means that surface water is continually replenished with CFCs during the arctic leg of the journey, whereas the 129I plume retains the initial imprint of its input history over a long period of years**. Further, 129I is relatively easy to detect at extremely low levels using accelerator mass spectrometry methods which gives us a large measurement advantage in terms of the signal to noise ratio. Since we know exactly where the 129I comes from and when it entered the ocean, for the first time we can be absolutely sure that detecting an atom in a particular place is as a specific result of the currents".

"In many ways this is a bit like the old 'stick in a stream' game we used to play as kids - what people call 'Pooh sticks' in England - where you would drop a buoyant object in the water and observe where it comes out. Of course, it would be much better if these markers were not in the ocean at all, but they are, and we can use them to do some important environmental science".

Commenting, Dr Núria Casacuberta Arola (ETH, Zurich) said:

"The work performed by John Smith and colleagues in recent years has greatly contributed to the understanding of water circulation, especially in the North Atlantic and Arctic Ocean. The advantage of using 129I as a transient tracer in oceanography is the long half-life (15.7 My) of this isotope compared to the circulation times, and the fact that it is largely soluble in seawater. Now, major efforts are also devoted to find other artificial radionuclides with similar sources and behaviour than 129I (e.g. 236U, 237Np) so that the more tools we have, the better we will understand the ocean circulation. Recent advances in mass spectrometry (ICP-MS and AMS) allow today for very low detection limits so that we can measure very low concentrations of these isotopes in deep ocean waters".

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*For information on GEOTRACES, see http://www.geotraces.org/

**129I has a half-life of 15.7 million years

A map of the North Atlantic current is available from the press officer.

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