Scientists study ocean impacts of radioactive contamination from Fukushima nuclear plant

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Scientists from Stony Brook University's School of Marine and Atmospheric Sciences (SoMAS) are joining colleagues from the Woods Hole Oceanographic Institution, several other U.S. academic institutions and laboratories in Japan and Spain on the first international, multidisciplinary assessment of the levels and dispersion of radioactive substances in the Pacific Ocean off the damaged Fukushima nuclear power plant in Japan. The research effort is funded by the Gordon and Betty Moore Foundation.

"This project will address fundamental questions about the impact of this release of radiation to the ocean, and in the process enhance international collaboration and sharing of scientific data," said Vicki Chandler, Chief Program Officer, Science at the Gordon and Betty Moore Foundation. The shipboard research team, which includes scientists from labs in the U.S., Japan and Spain, began its work on June 4, 2011. It will collect water and biological samples and take ocean current measurements in an area 200 km x 200 km offshore of the plant and further offshore along the Kuroshio Current, a strong western boundary current akin to the Gulf Stream in the Atlantic, which could rapidly carry the radioactivity into the interior of the Pacific Ocean. Their work will build on efforts by Japanese scientists and lay the foundation for expanded international collaboration and long-term research of releases from the Fukushima plant.

In addition to bringing warm tropical waters north, the Kuroshio Current transports organisms long distances and is an important migration route for a variety of commercially important marine organisms in various stages of their life cycles. Biological samples and measurements, among the first to be collected offshore, will be gathered using a variety of filters and nets in an effort led by SoMAS's Dr. Nick Fisher, a biologist with interest and experience in studying the impacts of exposure to long-lived radionuclides on marine organisms, especially plankton.

Fisher's team will focus on phytoplankton and zooplankton at the base of the food chain, as well as the juveniles and adults of key fish species to determine the extent to which radionuclides released from the Fukushima plant are being accumulated in these organisms. "Currently, we do not know the extent to which some of these radionuclides have been bio-accumulated and passed up the local food chains, "said Fisher. "This is obviously of interest, since the principal concern about the dispersal of radionuclides in the ocean stems from the fact that they can potentially be toxic to marine organisms or even humans who consume seafood, and the potential for toxicity is dependent on the extent to which radionuclides are bioconcentrated in marine organisms."

The release of radioactivity from the partial meltdowns, hydrogen explosions and fires that began March 11 at the Fukushima plant, and the runoff from the subsequent attempts to cool the reactors represents an unprecedented release of radiation to the ocean. The total amount of radioactivity that has entered the ocean as a result of this accident is not well understood. Until now, only limited assessment of the impacts on the ocean has been undertaken.

The Japanese government and Fukushima plant owner, Tokyo Electric Power company (TEPCO), began measuring radiation in the ocean–iodine and cesium isotopes–10 days after the accident and have been monitoring the water around the reactors up to 30 km from shore, where radiation levels have been the highest. As the radiation moves offshore, it is diluted and mixed through the ocean depths along the way, so that levels of some contaminants just 15 miles offshore are 100 to 1,000 times lower than waters near the reactors. To put it in context, even these elevated levels are not far removed from the US Environmental Protection Agency drinking water standard for cesium–137 from natural radionuclide concentrations found in the ocean.

Although the elevated levels offshore pose little direct hazard for human exposure, questions remain about the impact of long-lived isotopes that can accumulate in the food chain and remain in sediment, emitting a persistent low-dose in the marine environment for years to come. Operating with the permission of the Japanese government, the ship will follow a track line from east to west and operate at 34 sampling stations, criss-crossing the Kuroshio Current. Deploying water sampling rosettes, the team will collect and analyze the samples for many radionuclides – among them isotopes of cesium, iodine, ruthenium, promethium, strontium, plutonium, radium and uranium – to learn how much contamination was released into the ocean, to assess its potential impact on marine life and human health, and to provide input to models for better understanding of contamination pathways and dispersion.

All of the samples collected by Fisher and his colleagues will be analyzed using the most sensitive techniques and tools in the world, which provide a more detailed picture of where radioactivity is and where it traveled, and to detect radiation above background levels, including radionuclides in marine organisms. Sample analysis will be performed over several months, and the end product will be a set concentration maps for many different radionuclides obtained independently by several groups allowing for inter-comparison of analytical methods. Scientists associated with the study note that these early field data will expand understanding of how radioactive pollutants travel through the ocean and the extent to which they enter marine food chains. To fully understand the long-term significance of their presence in these food webs will, however, require considerable additional research over a number of decades. The field work underway now marks a start.

Provided by Stony Brook University