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Four Years of North Pacific Mode Water Evolution: A Fukushima Tracer Perspective

Alison M. Macdonald, Sachiko Yoshida, Steven Pike, Ken O. Buesseler, Irina I. Rypina, and Steven Jayne
Woods Hole Oceanographic Institution, Physical Oceanography, Woods Hole, United States (amacdonald@whoi.edu)

Here we presents the results of a investigation which uses the tracer information provided by the 2011 direct ocean release of radio-isotopes, (137Cs, ∼30-year half-life and 134Cs, ∼2-year half-life) from the Fukushima Daiichi nuclear power plant to better understand the pathways, mixing and transport of water in the North Pacific Ocean. The main focus is the analysis of cesium observations obtained from the spring 2015 CLIVAR/GO-SHIP occupation of the P16N line in the eastern North Pacific. Nearly four hundred 20 L radionuclide samples were obtained on this cruise between 29 April and 26 June 2015 covering the 152°W line from 3°N to the Alaskan Shelf off Kodiak (56.4°N), crossing the Alaska Gyre at ∼55°N and making a short (200 nm) line extending from the outer edge of U.S. EEZ coming into Seattle, just to the south of the Canadian border and Line-P. Samples include both profiles from the surface to 1000 m and surface/subsurface pairs that provide an average 1° latitude spacing along 152°W. A clear Fukushima signal is apparent from the surface down to 400 m. The core signal lies at between 0-200 m at about 40°N where Subtropical Mode Water density water outcrops. The densest waters with Fukushima isotopes lie at ∼440 m in the bottom density range of Dense-Central Mode Water. There is a weak, but detectable signal in the Alaska Current to the north off both Kodiak and Sitka. The deepest detectable 137Cs (weapon's testing) signals are found at and to the north of 45°N at 900-1000 m. There is detectable, background level 137Cs as far south as 3°N, but as of spring 2015 the southernmost 134C signal was found above 200 m at 30°N. This horizontal and vertical pattern of Fukushima radionuclides traces the path of mode waters from their formation regions in the western North Pacific to their outcrop in eastern basin over the four years since their release.