

First detection of chlorofluorocarbons into bottom layer in the Melanesian Basin of the North Pacific

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Chlorofluorocarbons (CFCs) are a group of artificial chemical compounds that have no natural sources. The CFC concentrations in the ocean interior have been used to quantify the transit time distribution and transport time-scale since the water masses was ventilated from the formation region, and to estimate rates of formation for many water masses. In addition, the distribution of CFCs in the bottom layer indicates the pathway of the advection/diffusion of bottom waters. From 6 August to 27 September 2018, the Japan Meteorological Agency (JMA) conducted a Global Ocean Ship-based Hydrographic Investigation Program (GO-SHIP) revisit cruise at P13 section along the 165°E meridian on board the R/V Ryofu Maru. In this cruise, JMA collected data of dissolved CFC-11, -12 and -113, and detected the concentration of CFC-11 greater than its detection limit (0.006 ± 0.0011 pmol/kg) in bottom layer between 17°N and 3°S in the Melanesian Basin. This result demonstrates that the Lower Circumpolar Deep Water, i.e., a lower part of ventilated Southern Ocean water, formed after 1960s has already reached to the Melanesian Basin of the North Pacific through the Samoan Passage and across the Equator. From the high-quality historical WOCE and GO-SHIP cruise data in the South Pacific, we estimated that the advection speed of CFC-11 equivalent to current speed of bottom layer is about 1 cm/sec (315 km/year). This estimate is consistent with the results of the CMIP6/OMIP numerical modeling by the Meteorological Research Institute. Our results contribute to the understanding of the thermohaline circulation in the Pacific Ocean and the validation and upgrading of the Earth System Model for the future projection of the global warming.

Keywords: JMA 165°E section, Melanesian Basin, chlorofluorocarbons, bottom water

