

North Pacific seawater radiocarbon recorded in abalone shells obtained from Otsuchi Bay, Japan

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Reconstructing past ocean currents in the coastal regions is needed to better understand the relationship between oceanographic changes and coastal ecosystems. Seawater radiocarbon is a unique proxy to understand the properties of water masses. However, the knowledge of the water mass distribution is limited to the low latitude regions as the only well-established proxy for it is reef-building corals. Alternative archives are required for high latitude regions. Here we measured $\Delta^{14}\text{C}$ values of three abalone shells using accelerator mass spectrometry (AMS) and counted the shell growth checks which were made in the winter season. Abalone shells were obtained from Otsuchi Bay, where the cold Oyashio Current and the warm Kuroshio Current converge. The Oyashio Current has more depleted radiocarbon than the Kuroshio Current. We compared $\Delta^{14}\text{C}$ values of abalone shells with the sea surface temperature anomaly in Sanriku region. $\Delta^{14}\text{C}$ values of abalone shells range from 5.4 ‰ to 31 ‰ and indicated seasonal variations. $\Delta^{14}\text{C}$ values decreased by about 5 ‰ in shell growth checks that indicates winter season. We found this decrease of $\Delta^{14}\text{C}$ values of abalone shells are consistent with the significantly mixing of water brought by the Oyashio Current. $\Delta^{14}\text{C}$ value of abalone shells clearly shows the Oyashio Current inflow in 2013, 2015 and 2017 and it can be used to reconstruct fluctuations between past water masses. In addition, the $\Delta^{14}\text{C}$ values of abalone shells are possibly affected by their habitat. Abalone at 2 m to 6 m depth exhibited higher $\Delta^{14}\text{C}$ values than those in abalone at 6 m to 10 m depth. This trend resulted from cold water from the Oyashio Current having a greater influence on deeper water. These radiocarbon records indicate past seawater conditions in northern Japan, where the Oyashio and Kuroshio currents converge, can be reconstructed using abalone shells.

Keywords: Radiocarbon, AMS, Abalone, Otsuchi Bay, Oyashio Current, Ocean circulation