Insight to Western Pacific circulation from coral skeletal radiocarbon

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Radiocarbon ($\Delta^{14}C$) in seawater is used as a reliable tracer of water mass advection and mixing in water bodies. The calcium carbonate (aragonite) skeletons of reef-building corals contain annual density bands that records the $\Delta^{14}C$ values of surface water at the time at which the coral skeletons took up dissolved inorganic carbon from ambient seawater. Thus, coral skeletal $\Delta^{14}C$ records can also be used as a sensitive proxy of water mass mixing. $\Delta^{14}C$ values for the pre-bomb period can be also used for estimation of local marine reservoir age (R) and their regional offset (ΔR), which varies not only spatially, but also temporally because of changes in ocean circulation associated with climatic changes. Compiling coral skeletal $\Delta^{14}C$ datasets in the western Pacific will contribute to our understanding of the oceanography of the region and can be used for discussion of its relationship to climate change such as El Nino-Southern Oscillation.

In this study, high-resolution coral skeletal $\Delta^{14}C$ dataset during the Anthropocene and Holocene are reported from the western Pacific. Our $\Delta^{14}C$ data indicates a significant increase in $\Delta^{14}C$ from 1946 to 1994 related to atmospheric nuclear bomb testing, with more rapid increase in the South China Sea (SCS) than in the Pacific. The unusual, rapid $\Delta^{14}C$ increase (early bomb-^{14}C spikes) in the 1950s related to the “close-in fallout” found in our SCS and Ryukyu corals. Although three early bomb-^{14}C spikes have been reported from Guam and from Ishigaki, only one such spike was clearly detected in the SCS. The amplitude of the bomb-^{14}C spike in the SCS was less than half that in Ishigaki, likely due to upwelling around Luzon Island and the Kuroshio intrusion into the SCS. We also calculated ΔR during the Holocene using paired analyses of $\Delta^{14}C$ and ^{230}Th on pristine corals. An abrupt ΔR shift occurred between 5.5 ka BP and 4.0 ka BP in the northwest Pacific. Compared with the previously reported data from the Tropical East Pacific and Great Barrier reef, the timing of the shift was different because the ^{14}C content of the northwestern Pacific was affected by not only the intensity of upwelling at the Peru-Chile coast, but also by the East Asian monsoon.

Keywords: Coral, Western Pacific, Radiocarbon, East Asian monsoon, Kuroshio

