論文の内容の要旨

Variability of Kuroshio strength and its relation with ENSO/PDO during the last 100 years based on coral skeletal radiocarbon

（サンゴ骨格中の放射性炭素分析による
過去 100 年間の黒潮変動復元に関する研究）

氏名　平林　頌子

The North Equatorial Current (NEC) bifurcates into the Kuroshio Current (KC) and the Mindanao Current (MC), which are both western boundary currents in the Pacific Ocean to the east of the Philippine coast. The NEC-KC-MC current system plays an important role in global climate change because it connects tropical and subtropical areas and transports heat poleward. The bifurcation latitude of the NEC migrates on annual and decadal scales due to effects from the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) and their influence on the velocity and transport behavior of the KC and MC. Oceanographic observations have been conducted since the twentieth century to understand the relationship between western Pacific variability and climate changes and to predict future climates in response to continuing global warming. However, there is insufficient data to fully understand the mechanisms of oceanographic variability in seasonal, decadal and multi-decadal cycles of climate change with respect to ENSO, PDO and climate regime shift. Therefore, long, continuous and high-resolution datasets of oceanography and climate are urgently required.

Radiocarbon (^{14}C) in corals is a useful proxy to reconstruct water mass mixing in the ocean in the past. Radiocarbon is naturally produced in the upper atmosphere when cosmic radiation interacts with nitrogen atoms. It was also artificially produced by the atmospheric nuclear bomb testing in the 1950s and early 1960s. Once produced, radiocarbon is oxidized to $^{14}CO_2$ and mixes rapidly in

atmosphere, entering the ocean though CO_2 exchange between the atmosphere and surface ocean. Corals incorporate ^{14}C from dissolved inorganic carbon in the surface ocean in their calcium carbonate skeletons. Therefore, a high-resolution coral skeletal radiocarbon record provides a continuous past oceanographic archive, and the comparison of corals from different basins or different current areas can help reconstruct spatio-temporal oceanographic variability in the past. However, high-resolution radiocarbon measurements in corals in the temperate region such as the Kuroshio Current area has not previously been possible because of their smaller skeletal growth rates.

The main aim of this thesis is to reconstruct Kuroshio variability and its relation to ENSO/PDO over the past 100 years using coral skeletal radiocarbon. To achieve this objective, I developed a new method of high-resolution age model determination using Sr/Ca and refined a radiocarbon measurement technique for small-mass carbonates. Using these new methods, I report seasonal-scale radiocarbon data from Ishigaki in the Kuroshio Current and Currimao in the Kuroshio Loop Current regions. In this thesis, I demonstrate that corals can reconstruct physical oceanographic changes and mesoscale eddy variability in both areas of the Kuroshio and the Kuroshio Loop Current related to changes in climate modes such as ENSO and the PDO for the past 100 years in this thesis.

The results revealed that high-resolution coral skeletal radiocarbon in Ishigaki recorded the existence of three early radiocarbon spikes of nuclear bomb tests in the 1950s in the North Pacific western boundary current area. This new finding will be important in the field of nuclear physics and will contribute to understanding the mechanism of close-in fallout because no previous record farther northwest of Guam was available. These three early radiocarbon spikes revealed that the transport speed of radioactive materials from Guam and Kuroshio varied in the early 1950s and 1960s associated with the ENSO condition. Coral skeletal radiocarbon data can reconstruct physical oceanographic changes and mesoscale eddies in the western Pacific and South China Sea related to migration of the latitude of NEC bifurcation. Compared with other coral records previously reported for Guam, Palau, Langkai, Con Dao, and Hon Tre Island, the regime shift of the PDO in 1976 affects the western Pacific oceanographic features such as the strength of the Mindanao Dome, the Kuroshio Loop Current and mesoscale eddies in Kuroshio regions on decadal timescales.

The high-resolution radiocarbon dataset for the pre-1950 period, which is the period with few oceanic observations, also suggested that upwelling changes in the eastern tropical Pacific related to climate regime shift in 1900 and 1950 affected the ^{14}C contents over the western Pacific. It is also suggested that a climate regime shift might have influenced upwelling driven by the Mindanao Dome and mesoscale eddies in the Kuroshio region in the period from 1900 to 1950.

Further investigation is required to reveal the detailed mechanism of the relationship between

climate modes and western Pacific variability, but I have helped initiate this by demonstrating the potential to reconstruct oceanography based on high-resolution radiocarbon tracing using the western Pacific corals.