Variations in the North Pacific Subtropical Mode Water distribution around the Ryukyu Islands

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The North Pacific Subtropical Mode Water (NPSTMW) is a vertically homogeneous water mass distributed in the northwestern part of North Pacific subtropical gyre. In recent years, changes in the formation and distribution of NPSTMW under global warming have attracted considerable interest because the NPSTMW absorbs large amounts of heat and carbon dioxide from the atmosphere in its formation region. The Ryukyu Islands, southwestern Japan, are located between Kuroshio and NPSTMW. Many shallow-water carbonate sediments and fossils recording paleoenvironmental conditions of surface-to-subsurface waters extends around the islands. Consequently, the area around the Ryukyu Islands is an ideal field for understanding the long-term variations in the physical/chemical composition and distribution of the NPSTMW, such as those under glacial and interglacial conditions. However, limited studies have challenged delineating characterization and variations of subsurface water around the Ryukyu Islands, which have yet to be fully revealed. Therefore, we analyzed temporal variations in subsurface ocean structure around the Ryukyu Islands over the past 30 years to specify the factors controlling the variations in the NPSTMW distribution of this area.
We defined the thickness of the NPSTMW-related layer as the difference between the pressure at σ_θ = 24.7 kg m^{-3} and σ_θ = 25.6 kg m^{-3}, using CTD data observed through the OK and PN lines by the Japan Meteorological Agency between 1987 and 2021. We used the thickness as an indicator of NPSTMW volume. The results indicated that the Kuroshio-origin and NPSTMW-origin seawaters were irregularly influenced around the Ryukyu Islands, especially on the East China Sea side, every few years. On a longer timescale, variations in the thickness of the NPSTMW and Kuroshio were highly correlated, suggesting that both the NPSTMW and the Kuroshio are strongly related not only in the NPSTMW formation region but also around the Ryukyu Islands.

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