Contribution of the vertical mixing to the nutrient flux in the Luzon Strait

*Takeshi Matsuno[1], Eisuke Tsutsumi[1], Tomoharu Senjyu[1], Akie Sakai[2], Lee Keunjong[3], Ichiro Yasuda[3]

1. Research Institute for Applied Mechanics, Kyushu University, 2. Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, 3. Atmosphere and Ocean Research Institute, University of Tokyo

As a part of the project, Ocean Mixing Processes : Impact on Biogeochemistry, Climate and Ecosystem (OMIX), performed since 2015, turbulence intensity and a role of vertical mixing on biological environments have been investigated in the region around the Kuroshio. We have already found that turbulent mixing is enhanced in the Tokara Strait, south of Kyushu Island, where the Kuroshio interacts the complicated bottom topography. We chose the Luzon Strait as another study area to examine roles of intensified turbulent mixing. It is well known that large amplitude internal waves are frequently developed and strong turbulence is expected in the Luzon Strait.

A field campaign, KH-17-5-2, was conducted onboard R/V Hakuho-maru in November, 2017 based on the OMIX project. In the latter half of the cruise, we visited the Luzon Strait and carried out turbulence measurements using two types of micro-structure profiler along with CTD casts. Fluorescence and nitrate sensors were also attached on the CTD frame. We set an observation section between 121º 30’ E and 123º 00’ E along 21ºN. The western part of the section crosses prominently bumpy topographic area in the eastern part of the Luzon Strait while the eastern part is located in the western end of the Philippine Sea and deep without any topographic irregularities. The Kuroshio flows from east of Philippines to east of Taiwan passing through the Luzon Strait, sometimes meandering into the South China Sea. Intensified vertical mixing could be generated not only caused by internal waves but also by interaction between the Kuroshio and the bottom topography in the strait.

Our observation shows intensification of turbulent energy dissipation over shallow bottom topography in the western part of the section, 10^{-7} ~10^{-6} (W/kg), which is 10^{2}~10^{3} times larger than that in the eastern part. The elevated turbulence is likely to related to breaking of internal waves which is suggested by wavy structure of isopycnals above the topography. Interestingly, vertical profiles of fluorescence show that chlorophyll concentration is significantly high in the surface layer shallower than 100 m in the western part of the section, while it shows a subsurface maximum around 100 m in the eastern part. This suggests that strong vertical mixing could supply nutrients to the surface layer for the primary production from deeper water around the bumpy topography.
Consequence of the intensified turbulence in the strait could be found in the T/S diagram obtained along the section. Salinity maximum around $\sigma_q = 24.0$ is significantly low in the stations around the bottom topography compared with the eastern part of the section, strongly suggesting a result of diapycnal mixing around the topography.

Keywords: turbulent mixing, Luzon Strait, nutrient flux

