オブダクションが海洋混合層に与える影響の評価
Method to evaluate the effect of obduction on properties in the ocean mixed layer

*川合 義美[1]
*Yoshimi Kawai[1]

1. 国立研究開発法人海洋研究開発機構　地球環境観測研究開発センター
1. Research and Development Center for Global Change, Japan Agency for Marine-Earth Science and Technology

Repeat hydrographic surveys revealed that the warming already extended to the global abyssal waters. The circulation of heat, freshwater and materials absorbed into the ocean, however, has not been investigated enough. The ocean mixed layer in the extratropics usually becomes deepest in winter or early spring due to strong surface cooling and wind stress. In the following warm season, the seasonal pycnocline is formed in the upper layer, and the remnant of the winter mixed layer below the seasonal pycnocline is isolated from the atmosphere. While some part of the isolated layer is entrained into the mixed layer again in the following winter, the other part is transported along an isopycnal surface into the permanent pycnocline irreversibly. The latter process is referred to as “subduction”, and one of the major processes by which properties of the upper layer facing the atmosphere are transferred into the ocean interior. The opposite process of subduction is “obduction”: water of the permanent pycnocline is entrained into the mixed layer when it deepens in autumn and winter. This process is also expected to be important for the atmosphere, especially its long-term variations, since it brings anomalies of temperature, carbon dioxide, and other properties in the ocean interior to the surface layer. Subduction and obduction rates are great in regions where the winter mixed layer becomes deeper.
The budget of the ocean mixed layer consists of five components: surface forcing, Ekman advection, geostrophic advection, entrainment, and residual. The sum of these five terms is equal to the temporal change rate of a quantity such as temperature and salinity. The entrainment in mixed-layer deepening is further separated into two components: the erosion of the permanent pycnocline, and the erosion of water mass that was within the mixed layer in the previous winter. The former is just obduction, and the latter means that the water mass that was in contact with the atmosphere in the previous winter is again entrained into the mixed layer within one year, which is referred to as “re-entrainment” in this paper expediently. The contribution of the obduction on the ocean mixed layer budget has not been examined. The authors proposes a method to evaluate it, and examines the budget by using the Argo MOAA GPV dataset. The effect of the obduction on temperature and salinity in the ocean mixed layer is notably large in the Bering Sea and around 40ºN west of the Date Line.

キーワード：オブダクション、海洋混合層、エントレインメント
Keywords: Obduction, Ocean mixed layer, Entrainment

