学 位 論 文 内 容 の 要 旨

博士（環境科学）　　　　氏　名　原　楠（Yuan Nan）

学 位 論 文 題 名

Cross-shelf overturning in geostrophic-stress-dominant coastal fronts
（地衡流シアー応力が卓越する沿岸フロントにおける陸棚上の鉛直循環）

Dynamics of the predominant coastal along-isobath current inside the Sea of Okhotsk, with a magnitu de of tens centimeter per second, has been unveiled via observational measurements and numerical simu lations within decades. In the meantime, our probe on the subordinate cross-isobath current, the current as a treasure trove to understand vertical movements and the possible deep mixed layer formation due t o its horizontal inhomogeneous and ageostrophic component mainly, is constrained by the observational difficulties and deficient interests.

Backscatter strength data of the Acoustic Doppler Current Profilers indicates the intense upward sediments transport within the whole column with a depth of 100m in the upstream of the East Sakhalin, suggesting a deep mixed layer formation. The water property observation in the upstream is difficult due to the sea ice coverage. While the observation, in the shelf break of the northeast of the Hokkaido Island by the icebreaker Soya in February 1997, detected a mixed layer with a depth around 300m. The mixed layer is derived from the East Sakhalin and entrained by the East Sakhalin Current(ESC). Meanwhile, the relation between the upstream winter mixing and the downstream spring broom along the ESC was uncovered.

With climate change, the deep mixed layer, as a demarcation of the coast and the open ocean, gets more attentions. Sea ice extends along the East Sakhalin and keeps its state in the whole winter, even though the sea ice, in the same latitude of the center of the sea, almost disappears because of the higher temperature water intruding from the North Pacific Ocean. The deep mixed layer is deemed as a barrier blocking the colder and warmer water exchange, and it would take an important role on the coastal sea ice survival if the global temperature rises continually in the future.

Strong wind events are considered as the essence of the strong mixing according to observations. While, we lack of understanding on how wind attend to the construction of the deep mixed layer around the shelf break.

In my doctoral study, I mainly conducted numerical simulations using an Ocean General Circulation Model, named IcedCOCO, to reproduce the circulation inside the Sea of Okhotsk and attempt to figure out the dynamics of the deep mixed layer formation. The simulation well reconstructed the ESC and a well-mixed layer named a reversed Ekman Overturning(reversed EOT). I found a great internal water stress inside the reversed EOT, which is caused by a large vertical viscosity and geostrophic current shear. Because of the reverse EOT, the surface offshore ageostrophic current is opposite to a usual wind current by the downwelling-favorable wind. The deep mixed layer

happens around the shelf break where surface currents convergent as this offshore reversed Ekman current encounters with an onshore Ekman current in the open ocean. Moreover, I conducted several sensitivity experiments to find out the reason of the coastal front's generation, and freshwater discharge from the Far East continent companying with the wind is considered driving the strong convection and further the front. The theory could be applied into various coastal regions with sizeable freshwater discharge. A scaling analysis was used to parameterize the geostrophic stress, and evaluate the values in other coastal areas where the geostrophic stress might be dominant.

For the vertical movement around the Alaska Coastal Current, we studied it solely with the high-resolution model data, Ocean General Circulation Model for the Earth Simulator version 2(OFES2), to estimate the application of the above theory.

At the end of thesis, improve room of the study was summarized.