

## Research on the effect of a submarine installation type artificial upwelling generating structure

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### Purpose

By developing to the seabed the artificial mound imitated in a ridge or mound, a submarine installation type artificial upwelling generating structure (artificial submarine mountain range) supplies the comparatively abundant nutritive salts near the seabed in a euphotic zone using the energy of flows, such as a tide style, and tries to aim at multiplication of a fishery living thing. Although the height of this structure is ten percent - about twenty percent of depth of water and is far small-scale compared with a natural reef, mound, etc., the different characteristic from natural geographical feature also has considering it as the effective form where having steep form and those for prevailing currents were taken into consideration etc.

The reappearance calculation by analysis and the numerical simulation of a real ocean space observation result considers that according to what kind of mechanism supply into the euphotic zone of the nutritive salts by a structure small-scale in this way produces this research and what amount of effects can be expected.

### Result

The distribution structure of water mass was able to be visualized from the acoustic reaction intensity distribution acquired by ADCP observation. The result was able to check the taking phenomenon of generating of the internal wave (lee wave) by the side of the mound lower stream, and the lower layer water to the upper water etc. Moreover, a possibility that broken of an internal wave and internal hydraulic jump had occurred was seen.

In order to reproduce the internal wave and taking phenomenon which were acquired by observation, as a result of carrying out a numerical simulation, the pattern and taking phenomenon of the internal wave were able to be reproduced in general. Moreover, mixture by breaking wave of an internal wave and the mixed phenomenon by internal hydraulic jump were also reproduced by simulation calculation.

In turbo map observation, the example as which a difference is regarded by intensity-of-turbulence distribution in the mound upper stream and lower stream side was checked. Also in the numerical simulation, the difference in the same intensity-of-turbulence distribution was able to be reproduced to some extent.

However, although the large-scale whirlpool occurred intermittently back [ artificial mound ] on non-stratification conditions and the upwelling effect by it going up with self-induced velocity was checked, it was not able to be checked in observation and the numerical simulation of the stratification period.

However, under stratification conditions, an internal wave may occur, the flow velocity distribution changed by this, an increase and smoothing of the flow velocity shear arose, and it was thought that this contributed to a perpendicular mixture phenomenon. That is, it is thought that the fixed rate of the upwelling effect by the artificial mound is based on promotion of the perpendicular mixture by shear mixture. Moreover, phenomena, such as breaking wave of an internal wave, internal hydraulic jump and taking, are seen, and when such a phenomenon arises, perpendicular mixture with a bigger scale than turbulent flow mixture may arise.

Moreover, in order to check the nutrition salt amount of supply into the euphotic zone by the perpendicular mixture which considered the flow velocity shear produced from an internal wave as the cause, calculation which changed the flow velocity in the state where there is no flow velocity shear was performed to the upper stream side under the stratification condition. As a result, the effect of perpendicular mixture is strongly related with the generating conditions of an internal wave (lee wave), and it became clear that there are the ratio and relation of depth of water and an internal wave wavelength.