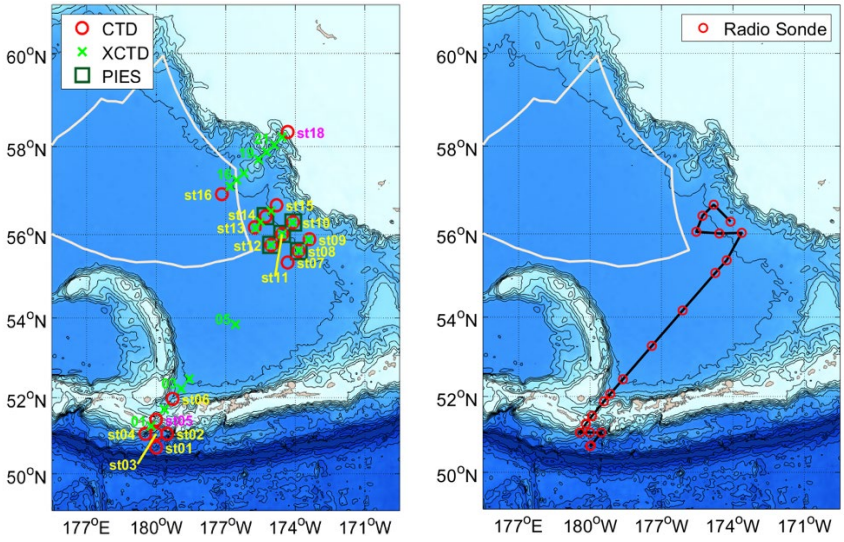
2020 RV ARAON research activities in Bering Sea

1. Research activities

On-site observation was conducted in the Bering Sea on the Korea Polar Research Institute icebreaker RV Araon from July 26 to August 2 (7 days in total) in 2020, in order to obtain data on the physical properties and ocean and atmosphere (Figure 1).



[그림 1] A station map of Arctic cruise for in-situ ocean observation (left) and along-track locations of radiosonde balloon launch (right)

2. Materials and methods

1) Ocean observations

Ocean Temperature-Salinity-Depth Measurement Equipment (CTD) & Ocean currents (LADCP) observations were performed: 1) near the Amchitka Passage (AP) where the exchange between the North Pacific and the Bering Sea occurs, and 2) on the continental slope (st.07 to st.18) where the Bering Slope Current passes. Expendable CTD (XCTD) observation was additionally performed between CTD cites to fill the gap between the sites. Temperature and salinity profiles were obtained from the surface layer to about 50 m above the floor using the ship's CTD equipment. The quality of the obtained data was improved through post-processing such as removing outliers, correction of time differences between sensors, and correction of heat, and profiles at vertical 1m intervals at each station were obtained. In the case of XCTD, a vertical 1 m interval profile from the surface layer to the depth of about 1100 m was obtained.

Using LADCP installed in the CTD frame, ocean current data were obtained during the CTD operation. The obtained data were improved by using software provided by Columbia University's LDEO laboratory, such as Shipboard-ADCP and GPS calibration, and an average profile of 8 m vertical from each station to the bottom was obtained.

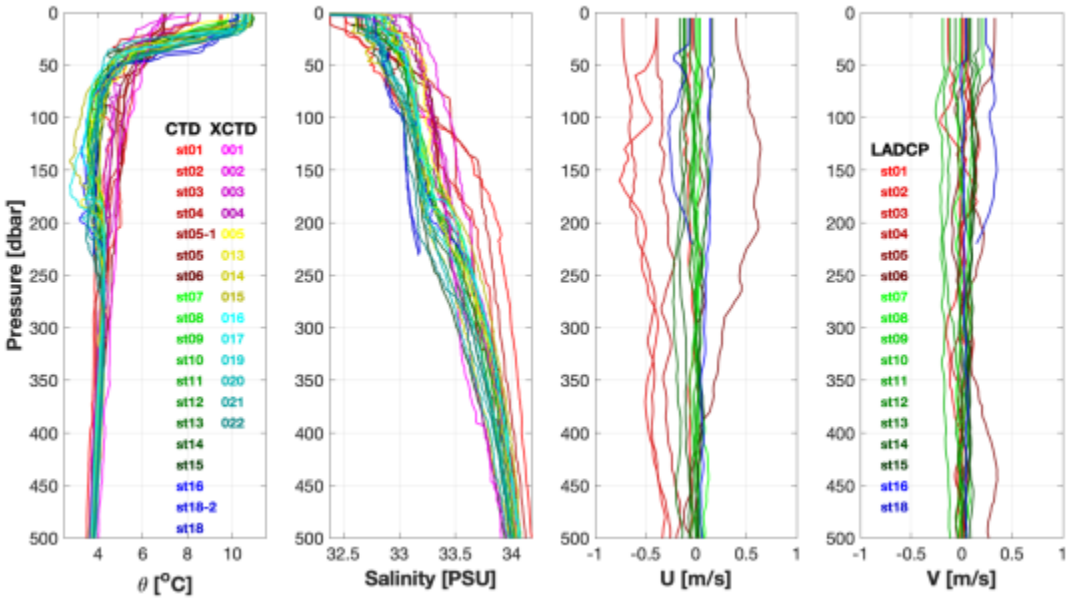
2) Atmospheric observations

A total of 20 radiosonde launches were carried out onboard IBRV Araon in the Bering Sea from July 26, 2020 (00:00 UTC) to July 30, 2020 (18:00 UTC) to obtain vertical profile data on temperature, humidity, wind direction, wind speed, and air pressure. Most of the radiosondes reached the altitude above 25 km and up to 30 km, so that they provided the meteorological profile data from the troposphere to the mid-stratosphere.

3. Scientific achievements

1) Ocean observations

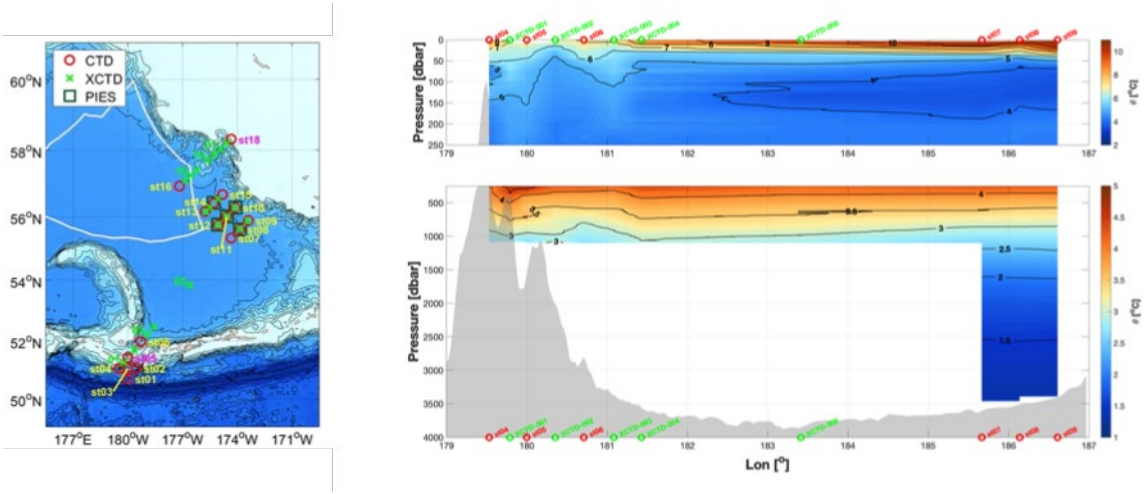
The physical properties and the structure of the ocean currents were different at the entrance of the Bering Sea (near AP) and at the top layer of the continental slope (0–500 m) (Figure 2). In the surface layer (0–50 m), the water temperature at the Bering Sea entrance to about 7–8°C and the continental slope to about 10°C, and low-temperature water was distributed at the entrance. On the other hand, at a depth of 50 to 250m, the water temperature/salt was about 5°C/33.4 at the entrance of the Bering Sea and about 4°C/33.2 at the continental slope, and low-temperature and low-salt water were distributed on the continental slope. The strong vertical stratification developed at the continental slope during the observation period due to the difference in the distribution of physical properties according to the depth of water in the two regions. The ocean current velocity in the north-south direction does not show much difference between the entrance of the Bering Sea and the continental slope of the Bering Sea, while the entrance of the Bering Sea in the east-west direction shows a considerable difference.



[Figure 2] Vertical profiles of temperature, salinity, current (zonal and meridional velocity) from CTD and XCTD

Vertical water temperature cross-section from the Bering Sea passage to the continental slope was obtained using the in-situ data obtained through CTD and XCTD observations (Figure 3). The

minimum water temperature layer was distributed from the center of the Bering Sea to the continental slope at a depth of 50–200 m. In the upper layer, thermal stratification was decreasing from the entrance to the continental slope. Oceanic mixing at the entrance of the Bering Sea was active due to the interaction between the ocean current and the topography, thereby the stratification was weak.



[Figure 3] Vertical section map of temperature crossing the red box (left) using CTD and XCTD

2) Atmospheric observations

Radiosonde vertical profiles of temperature, humidity, pressure, and wind speed and direction were obtained regularly every six hours (i.e., 00, 06, 12, and 18 UTCs). Radiosonde transferred its observation data to the ground in real time while it was ascending to the mid-stratospheric level. Figure 1 illustrates along-track locations of radiosonde balloon launch, and figure 4 shows real-time monitoring of vertical profiles and horizontal displacement obtained by the radiosonde (#3).

[Figure 4] Real-time monitoring of radiosonde. Temperature (red line), relative humidity (green line), pressure (blue line)

4. Publications

We have not yet published papers in scientific journals out of the results from the expedition. However, several papers have been presented in various meetings.