Oceanographic Structure Near the Western Terminus of the Alaskan Stream.*

Kiyomitsu Kitano

I. Introduction.

One of the most favorable salmon fishery grounds was found in the summers from 1952 to 1965. This sea area corresponds to the western terminus of the Alaskan Stream which flows to the west along the southern side of the Aleutian Islands as a narrow-swift band of low salinity and warm water.

Recently, Favorite (1965) presented an excellent review of the Alaskan Stream with a short summary which contains the historical background. Ohotani (1965) defined the domain of the Alaskan Stream by the vertical 4.0°C or 3.75°C isotherm at the depth of 150 meters or 200 meters in a vertical section.

Favorite (1965) indicated that the Alaskan Stream is continuous as far westward as long. 170°E., when it divides, sending one branch into the Bering Sea and one southwestward which joins the eastward flowing Subarctic Current at about long. 165°E. The Komandorskie Ridge may influence the surface flow in the area.

However, Ohotani (1966) says that the Alaskan Stream extends as far west as long. 167°E., and it is divided into three major branches with tongue-like structures. One of the branches extends to the south along long. 170°E. The second branch extends to the west along lat. 50°N. as far west as long. 162°E. and the third branch extends to the south off Komandorskie.

The purpose of this study is to make a further detailed description of the distribution of various properties at the western terminus.

II. Sources of data.

The training ship "Oshoro-maru" which belongs to the Faculty of Fisheries, of Hokkaido University carried out oceanographic observations over the Subarctic Region between June and August of 1964. The data was reported under No. 9 of "Data Record of Oceanographic Observations and Exploratory Fishing" which was published by the Faculty of Fisheries in 1965.

The research vessel "Hokko-maru" which belongs to the Japanese Fisheries Agency also cruised over the waters during May to August in 1964. The data of the "Hokko-maru" quoted in this paper are observed values not interpolated and the station numbers 33, 34, 36 and 43 mean

Table 1. The cruised periods by each vessel.

<table>
<thead>
<tr>
<th>Names of Vessel</th>
<th>Station numbers</th>
<th>Cruised periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oshoro-maru</td>
<td>2-20</td>
<td>June 7-12</td>
</tr>
<tr>
<td>Oshoro-maru</td>
<td>30-38</td>
<td>June 15-17</td>
</tr>
<tr>
<td>Oshoro-maru</td>
<td>116-127</td>
<td>August 11-15</td>
</tr>
<tr>
<td>Hokko-maru</td>
<td>1-16</td>
<td>May 17-June 14</td>
</tr>
<tr>
<td>Hokko-maru</td>
<td>33-34, 36, 43</td>
<td>July 20-August 2</td>
</tr>
</tbody>
</table>

the observation positions of the bathythermograph. The chemical analyses for salinity of water obtained by the Hokko-maru were performed at our laboratory.

The cruised periods of each vessel are shown in Table 1 and the oceanographic stations of the Hokko-maru are indicated by the mark △ and the stations of the Oshoro-maru are indicated by the mark ○ in Fig. 1.

![Figure 1](image1.png)

**Figure 1.** Station positions, summer 1964. The marks B₁, B₂, B₃ and B₄ show the sites of sectional observation along the meridional plane and the marks A₁, A₃ and A₅ show the sites of sectional observation along the latitudinal plane.

### III. Horizontal distribution of temperature.

(1) Temperature at 10 m. depth.

The isotherms during June at 10 m. depth are indicated by the solid lines and the isotherms during August are indicated by the dotted lines in Fig. 2. These isotherms represent conditions

![Figure 2](image2.png)

**Figure 2.** Distribution of temperature (°C) in 10 metres depth, summer 1964.
in the mixed layer in summer and are considered to be more representative of the prevailing conditions than those at the sea surface according to Dodimead et al. (1963).

Water warmer than 6.0°C. extends over the eastern sea area from approximately long. 175°E. and over the southern sea area from approximately lat. 47°N. This warm water region may be generated by the westward advection of the Alaskan Stream and also by the northward flow of the warm Subtropic water.

The southern sea area off Komandorskie is generally covered by cold water of less than 4.0-5.0°C. This cold water may be generated by the southward flow of the Oyashio water which in turn is generated along the east coast of Kamchatka.

The intermediate region between the warm water region and the cold water region is generally characterized by a zone of relatively moderate oceanic front. Here we find elongated tongue-like warm water masses and isolated cut-off warm water masses which are the result of the warm Alaskan Stream diffusing westward refer to the charts produced by Mishima et al. (1955), Hirano et al. (1964) and Kitano (1968, 1964, 1965 a).

The southern sea area off Komandorskie was generally covered by warm water of 8.0-9.0°C. in August. The range of temperature increase during June to August can be roughly estimated in a range of 4.0-5.0°C, and the rate of temperature increase can be roughly estimated in a range of 0.5-1.0°C per 10 days.

(2) Temperature at 100 m. depth.

The general feature of isotherms in 100 m. depth reflects mostly the effects of advection, mixing and internal wave motion rather than seasonal heating.

Fig. 3 shows the isotherms of 100 m. depth. The most prominent feature is a predominant

westward penetration of warm water of more than 3.0°C. with a tongue-like structure as far west as approximately longs. 164-165°E. along lats. 50-51°N. This penetration should be considered a further extension of the warm water of more than 4.0°C. in the vicinity of longs. 180-175°E.
The oceanic frontal zone which shows a relatively sharp temperature gradient of 1.0-3.0°C was clearly indicated in the sea area of longs. 164-165°E along lats. 49-50°N.

On the other hand, the existence of cold water less than 1.0°C in the eastern sea area off Kamchatka shows the effects of severe winter cooling and the southward flow of cold Oyashio water.

(3) Temperature at 200 m. depth.

Fig. 4 shows the isotherms of 200 m. depth. The westward intrusion of warm water of more than 4.0°C is found as far west as longs. 164-165°E along approximately lat. 50°N. The warm water penetration with a tongue-like structure in 100 m. and 200 m. depths supports evidence of the predominant effect of westward advection by the Alaskan Stream in these subsurface layers.

IV. Dichothermal and methothermal temperature structure.

One of the most prominent features of the vertical temperature structure over the Subarctic Region is a coupling phenomenon with a dichothermal and methothermal structure. The dichothermal temperature distribution is primarily determined by the degree of winter cooling and secondarily by the effects of advection and mixing.

Uda (1955), Koto (1958), INPFC (1964), Favorite (1965), Ohotani (1965) and others presented the general features of dichothermal temperature distributions. Recently, Ohotani (1966) presented the seasonal patterns which are obtained in ten-day terms during summers of 1958-1964.

Fig. 5 shows the minimum temperature distribution in dichothermal layer in the summer of 1964. The general features are very similar to those of the temperature distribution in 100 m. depth. The cold water region less than 1.0°C in the eastern sea area off Kamchatka gives evidence of severe winter cooling and a southward flow of cold Oyashio water. A tongue-like branch of cold water stretched to the east along the northern side of the warm water of more than 3.0°C and other cold water branches are found in the sea area near Komandorskie and Attu.
Figure 5. Distribution of temperature (°C) in dichothermal layer, summer 1964.

The warm water extended to the west as far as longs. 164–165°E, reflecting the effect of the westward advection by the Alaskan Stream. Favorite (1965) states that a sharp discontinuity at long. 165°E. is considered to denote the western terminus of the Alaskan Stream.

Fig. 6 shows the maximum temperature distribution in the methothermal layer in the summer of 1964. Ohotani (1965, 1966) found that the maximum temperature was characterized by a temperature of nearly 4.0°C. The warm water extension of more than 4.0°C. into the Bering Sea along the meridional plane of longs. 170–175°E. indicates a northward flow across the Aleutian Chain. The westward spreading of warm water of more than 4.0°C. as far west as approximately long. 163°E. shows the advection effect by the Alaskan Stream. Favorite (1965) noted that the temperature maximum stratum may be considered to extend approximately to long. 162°E.
V. Vertical sections of temperature.

In order to clarify the details of thermal profiles in three dimensional scale, several vertical sections of temperature along meridional and latitudinal planes were presented in Figs. 7-13. The cruised periods and engaged vessels for each section are shown in Table 2 and the locations of each section are indicated in Fig. 1.

Table 2. The cruised periods for each section.

<table>
<thead>
<tr>
<th>Section</th>
<th>Cruised periods,</th>
<th>Names of vessel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B₁</td>
<td>May 21–July 30</td>
<td>Oshoro-maru, Hokko-maru.</td>
</tr>
<tr>
<td>B₂</td>
<td>June 10–June 11</td>
<td>Oshoro-maru, Hokko-maru.</td>
</tr>
<tr>
<td>B₃</td>
<td>May 23–August 13</td>
<td>Oshoro-maru, Hokko-maru.</td>
</tr>
<tr>
<td>B₄</td>
<td>May 24–August 15</td>
<td>Oshoro-maru, Hokko-maru.</td>
</tr>
<tr>
<td>A₁</td>
<td>June 8–August 14</td>
<td>Hokko-maru.</td>
</tr>
<tr>
<td>A₂</td>
<td>May 24–June 14</td>
<td>Oshoro-maru, Hokko-maru.</td>
</tr>
<tr>
<td>A₃</td>
<td>May 17–August 15</td>
<td>Oshoro-maru.</td>
</tr>
</tbody>
</table>

(1) Meridional temperature sections.

Fig. 7 shows the section B₁ along long. 175°E. The warm water of more than 4.0°C. extended over the surface layer shallower than 30–50 m. depths. This warm water having a troughing structure further extended into a subsurface layer of nearly 200 m. depth at lats. 50–51°N. This troughing should be considered in the domain of the westward flow of the Alaskan Stream. According to Ohotani (1965), the Alaskan Stream has the widths of 120–160 n. miles in a section along longitude 172°W, 140°–180° n. miles in a 180° section, and 80–140 n. miles in a 172°E. section. Cold dichothermal water of less than 3.0°C. in the north of the warm water extension indicates cold water intrusion near Attu.

Fig. 8 shows the section B₂ along long. 170°E. Warm water of more than 4.0°C. was found in the subsurface layer of nearly 150–300 m. depths. This water has a sharp ridging structure at lat. 50°N. This ridging apparently shows a further continuation of the troughing portion in section B₁ and is considered as an upwelled portion after infiltration into the subsurface layer at approximate longs. 170–175°E.

The core of cold dichothermal water of less than
2.0°C. shows a maximum eastward penetration of the cold water zone near lat. 51°N. The cold dichothermal water of less than 3.0°C. in the south shows an eastward penetration through the southern side of the warm water. According to Favorite (1965), the temperature-minimum stratum is characterized by two cold cores. One exists at depths of 75 to 125 m. and is the result of local seasonal overturn and subsequent heating of the surface layer, and is usually located in the shear zone between the Alaskan Stream and Subarctic Current. The other occurs at approximately 200 to 300 m., and is caused by seasonal overturn in the northwestern Pacific Ocean where the presence of ice permits vertical mixing to a greater depth.

Fig. 9 shows section B3 along long. 167°E. Warm water of more than 4.0°C. was found in 150-200 m. depths around lat. 50°N. as a relatively small remnant. This is apparently a further continuation of the infiltrated warm water of more than 4.0°C. The cold dichothermal water of less than 2.0°C. under the sea area of station 34 shows a cold water penetration along the north of the warm water of more than 3.0°C. The cold dichothermal water of less than 2.0°C. under the sea area of station 120 shows a cold water branch near Komandorskie. The cold dichothermal water of less than 3.0°C. on the south of the warm water remnant shows a cold water elongation to the south of the warm water region.

Fig. 10 shows section B4 along long. 163°E. The cold dichothermal water of less than 1.0°C. at lat. 50°N. is that of the cold water region near the frontal zone at the top of the westward elongation of the warm water region. On the other hand, the cold dichothermal water at lat. 55°N. is that of indicates the presence of the cold water region along the eastern coast of Kamchatka.

As a result, it is evident that several branches of cold dichothermal water are penetrating over the sea area around the warm Alaskan Stream water of more than 4.0°C. The warm methothermal water of more than 3.5°C. in the subsurface layer deeper than 200 m. depth is probably the result of a complex effect of the northward spreading of Subtropic water across the polar front and the westward spreading of warm water by the Alaskan Stream.

(2) Latitudinal temperature sections.

Fig. 11 and 13 show sections A1 and A4. The cold dichothermal water of less than 3.0°C. extended along both sides of the warm Alaskan Stream water of more than 3.0°-4.0°C. as far east
as approximately long. 175°E. Favorite (1965) noted that an intrusion of cold water (of less than 3.4°C.) extends across the area considered between lat. 47°N. and lat. 50°N. and marks the approximate location of the northern boundary of the Subarctic Current.

Fig. 12 shows section A2 along lat. 50°N. The peculiar feature of warm infiltrated water at this latitude is a relatively thin tongue-like structure as far west as long. 165°E. We note a
temporary suppression at longs. 170-171°E. Of course these features can be expected to fluctuate with time and spatial changes. There is no doubt that the infiltrated warm water makes a definite contribution to the westward diffusion of the heat energy of the warm Alaskan Stream water as it undergoes seasonal and geographical fluctuations.

VI. Horizontal distribution of salinity.

1) Salinity at 10 m. depth.

Fig. 14 shows the horizontal distribution of salinity in 10 m. depth. The existence of diluted

![Salinity Distribution](image)

Figure 14. Distribution of salinity (%) in 10 metres depth, summer 1964.

low salinity water of 32.4-32.8% around long. 180° shows evidence of a westward advection by the Alaskan Stream, and the existence of a high salinity water region of more than 33.2% near the Amchika pass may be the result of the upwelling effect on the northward flow of Alaskan Stream water of the bottom topography.

Favorite's (1965) indication of the presence of surface salinity in excess of 33.0%, south of the Aleutian Islands, implies a southward component of flow from the Bering Sea through one or more passes.

A relatively small portion of low salinity water of less than 32.8% at long. 175°E. and lat. 50°N. can be considered a separated portion from the mother body caused by the westward flow of Alaskan Stream. A mass of relatively low salinity water was spread over the sea area of longs. 172°E-180° (the southern sea area of the Aleutian Islands). Here we can find warm water of more than 6°C spreading in the isotherms of same depth.

The sea area of relatively high salinity water of more than 33.0% reflects the influence of the northward flow of Subtropic water. Extremely diluted water of less than 32.0% was found east of Kamchatka as evidence of ice-melted water and river drainage. Branches of diluted low salinity water of less than 33.0% further extended to the southeast over the southern sea area off Komandorskie.
(2) Salinity at 200 m. depth.

Fig. 15 shows the distribution of salinity at 200 m. depth. Here we find a pair of low salinity water bands of less than 33.6\% and a high salinity water band of more than 33.8\%, which extended along approximately lat. 50°N. We presume that these elongated regions are generated by the eastward flow of the Alaskan Stream.

On the other hand, several lower salinity regions are found in the sea area around Komandorskie. The characteristic feature of isohalines reflects mostly an undulation tendency of the halocline bottom of nearly 33.8\%.

This undulation tendency of the halocline bottom appears to be caused by divergence and convergence which may be related to the cyclonic and anticyclonic eddies accompanied by subsurface circulation in this sea area. This interrelationship between the tendency of subsurface circulation based on the geostrophic current and tendency of isohaline distributions will be discussed in further detail at chapter IX.

VII. Vertical sections of salinity.

According to Favorite (1965), northward of lat. 42°N, an excess of precipitation over evaporation and extensive runoff from coastal areas both result in a surface layer of low salinity. Salinity values increase continuously with depth, and a relatively sharp halocline usually occurs between 75 and 150 m. A striking feature of the salinity structure southward of the Aleutian Islands is the ridging of the isohalines. This ridging is continuous from the Gulf of Alaska westward beyond long. 171°E. and, as a general rule, the center of the ridge defines the southern boundary of the Alaskan Stream.

(1) Meridional salinity sections.
Fig. 16 shows section B₁ along long. 175°E. The ridging of halocline was found under the sea area of lats. 48-50°N. On the other hand, the troughing of halocline was found under the sea area of lats. 51-52°N. The coupling phenomenon of a troughing and a ridging of halocline generates a sharp inclination of halocline under the sea area around lats. 50-51°N.

We believe that the existence of a sharp inclination of halocline and diluted surface water of less than 33.0% demonstrates the influence of the westward advection of the Alaskan Stream.

The ridging under the Alaskan Stream may be caused by the divergence of deep water which was blocked at the Aleutian Chain and the upwelling effect by the cyclonic eddies generated on the shear zone of the south side along the Alaskan Stream.

Fig. 17 shows section B₂ along long. 170°E. The surface layer was generally characterized by homogeneous water of 33.0-33.2% which shows evidence of intense vertical mixing and a northward advection of the Subtropic water. The sharp inclination of halocline under the sea area of lat. 49°N. suggests the westward flow of the Alaskan Stream.

There is also found a coupling phenomenon with a ridging and troughing of the halocline in both sides of this sharp inclination of halocline. The ridging portion under the sea area of lats. 51-52°N. indicates a high salinity water region off Komandorskie.

Fig. 18 shows section B₃ along long. 165°E. The undulation of halocline became rather moderate in this section since there is no appreciable westward flow. However, the coupling of a ridging under the sea area of lat. 47°N. and a troughing under the sea area of lat. 49°N. shows an evidence of weak flow.

Fig. 19 shows the section B₄ along long. 162°E. The surface layer was generally covered by diluted low...
salinity water of less than 33.0%. Extremely diluted water of less than 32.00% was found in the sea area around lat. 56°N.

The ridging phenomenon of halocline was found under the sea area of lat. 48°N. and lats. 53-54°N., while the troughings are found under the sea areas of lats. 51-52°N. and lats. 54-55°N.

(2) Latitudinal salinity sections.

Fig. 20 shows the section A1 along lat. 47°N. Relatively weak ridging was found under the wide sea area of longs. 165-170°E. Fig. 21 shows section A2 along lat. 50°N. Low salinity water of less than 33.0% extended as far west as long. 172°E. in the surface layer as a result of the westward advection of diluted water of the Alaskan Stream.

Fig. 22 shows the salinity section A3 along lat. 52°N. Diluted water was elongated over the sea area of longs. 162-170°E. and a weak ridging of halocline was found under the sea area of longs. 162-172°E.
VIII. Water masses.

Mishima (1955), Hirano (1957), Koto et al. (1958) and Kitano (1958) classified water masses based on the T-S diagram which was introduced by Helland–Hansen (1916). As a result, we can clearly define the elongated domain of the Alaskan Stream water mass with a band state surrounded by several adjacent water masses.

Fig. 23 pictures the T–S diagram showing a distribution tendency of water masses near the western terminus in the summer of 1954. Here are classified five different water types, namely the Alaskan Stream water mass (marked by the envelope = = =), the Amchitka water mass (marked by the envelope = =), the Western Subarctic water mass (marked by the envelope = =), and the Oyashio water mass (marked by the envelope = = ).

The occupied area of each water mass is further indicated in Fig. 24. In reference to these
Figure 24. The occupied domains by each water mass. Mark A. S. shows the area occupied by the Alaskan Stream water mass, mark Ws shows the area occupied by the Western Subarctic water mass, mark Am shows the area occupied by the Amchitka water mass, mark St shows the area occupied by the Subtropic water mass and the mark O shows the area occupied by the Oyashio water mass.

figures 23 and 24, it is clear that the Alaskan Stream water mass which was marked by A. S. is elongated to the west as far west as long. 164°E. along lat. 50°N. with a band state of 50-100 mile's width.

This water mass was designated as Water Originating from the Gulf of Alaska by Mishima et al. (1957) and as Water of the Alaska Current by Koto (1958). The curve of the envelope of the Alaskan Stream water mass in the T-S diagram demonstrates a low salinity surface water mass and a high temperature range of more than 3-4°C. in the intermediate layer.

The widely distributed surrounding water mass is called the Western Subarctic water mass. This Western Subarctic water mass is characterized by a relatively low range temperature of 0-4°C. in the intermediate layer. This water mass may correspond to the Central Water of the Western Subarctic Region so named by Hirano (1957) and to the Water in the Western Subarctic Gyral so designated by Koto (1958).

There were also found several prominent water masses called the Amchitka water mass marked by Am; the Subtropic water mass marked by St. and the Oyashio water mass marked by O. in Fig. 24. The Oyashio water mass found in the eastern sea area off Kamchatka is an extremely low salinity water mass which was probably generated along the east coast of Kamchatka. The Amchitka water mass located near Amchitka Pass was characterized by high salinity water caused by the intense vertical mixing through the channel flow. The Subtropic water mass which was characterized by high salinity water may be considered as the northern extremity of the Subtropic water region.
IX. Geostrophic Currents.

Favorite (1965) estimated the velocity of the Alaskan Stream as 50-100 cm/sec from the drift and the parachute drogue. Koto (1958) and Ohotani (1965) estimated the order of velocity in a range of less than 20 cm/sec by dynamic computations. The volume transport of the Alaskan Stream is estimated in a range of less than $20 \times 10^6$ m$^3$/sec by Ohotani (1965), Favorite (1965), Bennet (1959) and Uda (1963).

Fig. 25 shows the geostrophic topography of 100 decibar surface referred to the reference level of 800 decibar surface. The geostrophic current around the western terminus was charac-

![Figure 25. Geopotential topography, 100/800 decibars, summer 1964.](image)

terized by the existence of several cyclonic eddies marked by $E_1$, $E_4$, $E_6$ and several anticyclonic eddies marked by $E_2$, $E_3$, $E_5$, $E_7$. We also find the alternative arrangement of divergence zones $R_1$, $R_2$, $R_3$ and the convergence zones $T_1$, $T_2$ with a shingle structure along the latitudinal plane.

The divergence zone $R_1$ which contains cyclonic eddy $E_1$ was characterized by a ridging structure of halocline and the convergence zone $T_1$ which contains anticyclonic eddies $E_2$ and $E_3$ was characterized by a troughing structure of halocline. $R_1$ zone corresponds to the shear zone between two opposing currents where one finds a number of eddies or gyralis as indicated by Favorite (1965). Koto (1958) also noted a remarkable eddy supposed to be separated from the main current.

One clearly finds that the westward flow of the Alaskan Stream as far west as longs. 168-169'E. along the latitudinal plane of lat. 50°N. The mark S shows the singular point where it branches to the northeastward and further westward. This point may correspond to the turning point of the Alaskan Stream.

The convergence zone $T_1$ was bounded by the westward flow on the south and the eastward flow on the north. The divergence zone $R_2$ contains a cyclonic eddy $E_4$ which we may deduce as the eastward penetration of cold dichothermal water. The convergence zone $T_2$ was characterized by the anticyclonic eddies $E_5$ and $E_7$. The divergence zone $R_3$ was mainly generated
by the cyclonic eddy $E_4$.

X. *Sea colour and transparency.*

Hirano (1957) presented the distribution of sea colour. Fig. 26 shows sea colour distribution in the summer of 1964. The sea water region along long. 170°E. was characterized by the sea colour in the Forel scale Nos. 3-4 which shows a possibility of northward penetration of Subtropic water as indicated in the isohalines of 10 m. depth. The sea region south of Komandorskie was
characterized by the sea colour No. 6 which shows the possibility of a prevalence of Oyashio water.

The distribution of transparency of the Subarctic surface waters was demonstrated by Uda (1963). The distribution of transparency is important as an index of pelagic productivity.

Fig. 27 shows the distribution of transparency by Secchi disc in the summer of 1964. The sea area along long. 170°E. was characterized by a relatively high value of transparency of more than 15 m. This further demonstrates the possibility of a northward penetration of Subtropic water along long. 170°E.

The eastern sea area off Kamchatka was characterized by a level of transparency of less than 10 m. This shows a spreading of Oyashio water into this sea area.

XI. Summary.

1) Generally, there were found three characteristic water regions in 10 m. depth and the range of temperature increase during June to August was estimated as 4.0-5.0°C.

2) The warm water penetration to the west along lats. 50-51°N. was found as far west as approximately longs. 164-165°E. and possessed a tongue-like structure. The oceanic front was clearly found in the sea area of longs. 164-165°E. along lats. 49-50°N. in 100 m. depth. Warm water penetration was also discovered as far west as longs. 164-165°E. in 200 m. depth.

3) A tongue-like warm water structure of more than 3.0°C extended as far west as longs. 164-165°E. in a dichothermal layer and the westward spreading of warm water of more than 4.0°C. was found as far west as approximately long. 163°E. in a methothermal layer.

4) The profile of the infiltrated warm water in the subsurface layer clearly indicates a probable elongation of the warm Alaskan Stream water in the process of diffusion further west. There were also found several elongated branches of cold dichothermal water around the warm Alaskan Stream water.

5) Extremely diluted low salinity water was found in the eastern sea area off Kamchatka in 10 m. depth and diluted water carried by the Alaskan Stream water was found near long. 180°. The relatively higher salinity water of more than 33.0% reflects influences of the northward flow of Subtropic water.

6) Troughing and ridging phenomena resulting from the undulation of the halocline bottom were found around the Alaskan Stream water. The undulation of the halocline bottom is probably caused by the cyclonic and anticyclonic eddies generated by the general features of subsurface phenomena.

7) An extended portion of the Alaskan Stream water mass was found around the western Subarctic water mass. Several water masses such as the Amchitka water mass, the Subtropic water mass and the Oyashio water mass were found in the area.

8) We determined the close interrelationship between the subsurface circulation produced by the geostrophic current and the isohaline distribution tendency in 200 m. depth. There was also found a zonal structure with divergence and convergence consequences along the latitudinal plane.

9) A northward penetration of Subtropic water with low value of sea colour was found along long. 170°E. The Oyashio water was characterized by a high value of sea colour. A low value of transparency was found near Komandorskie.
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References.