NRL Report 6438

Some Turbidimetric Observations in the East Siberian Sea During July-September 1964

E. A. Abbott and A. J. Hiller

Techniques Branch
Sound Division

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NAVAL RESEARCH LABORATORY
Washington, D.C.

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ABSTRACT

The East Siberian cruise of the USS Burton Island (AGB-1) offered a unique opportunity to obtain turbidimetric measurements inexpensively on a cooperative basis. In addition to routine oceanographic data obtained during the cruise, personnel of the U.S. Navy Oceanographic Office obtained turbidity data on many of the water samples taken during the survey. The measurements were made with a Hellige turbidimeter furnished by the U.S. Naval Research Laboratory. The purpose of this effort was to obtain data on the time and spatial stability of particulate material in the sea in various locations. Other research is bearing out evidence that turbidity layers are also sound-scattering layers and may play a basic role in acoustic volume reverberations. The turbidity profiles of the various locations and other oceanographic data such as temperature and density presented in this report are thus part of a more comprehensive program aimed toward understanding the ocean environment.

The results showed relatively high levels of turbidity which could change rapidly with time. These observations can be explained by the relative shallowness in the area, turbidity currents from the Kolyma River, and the dirty ice conditions which existed.

PROBLEM STATUS

This is an interim report on a continuing problem.

AUTHORIZATION

NRL Problems S01-18 and S01-26
Projects ASW 213-000/6521/F101-99-01
and SR 104-03-01-8136

Manuscript submitted May 17, 1966.

Fig. 1 - Ship of opportunity used (USS Burton Island)

SOME TURBIDIMETRIC OBSERVATIONS IN THE EAST SIBERIAN SEA DURING JULY-SEPTEMBER 1964

INTRODUCTION

In keeping with the Navy's growing interest in oceanography and the increasing evidence that turbidity layers are also sound scattering layers which may play a basic role in acoustic volume reverberation (1), this laboratory accepted an opportunity to place a Hellige turbidimeter on the USS Burton Island (AGB-1), Fig. 1, for her FY 1964 Arctic cruise. This opportunity presented an inexpensive means to increase and further develop our turbidimetric background information under many conditions and from a wider selection of geographical areas. We have been engaged in a limited number of turbidimetric measurements for several years in Atlantic waters, but this was our first opportunity to receive water sample information from the Pacific region, an area not readily accessible to us.

In general the USS Burton Island's Cruise 31428 went as follows: The ship left Seattle, Washington on July 1, 1964 for Kodiak, Alaska. On July 8 the Burton Island left Kodiak for the Bering Strait and the East Siberian Sea. Upon completion of station 12 (Fig. 2) the ship returned to Seattle for repairs, arriving on August 3. On August 15 the Burton Island again put to sea, making a one day stop in Kodiak before returning to the East Siberian Sea to complete her survey. The ship completed her survey on September 29 and headed back to Kodiak, Alaska, to disembark personnel. The ship then continued on to Seattle, Washington, arriving October 11, 1964.

In addition to this report another report covering the other phases of the trip is under preparation by Mr. Robert Lockerman of the U.S. Naval Oceanographic Office.

DESCRIPTION OF TESTS

The instrument used for the sea water turbidity measurements was a low-range Hellige turbidimeter with a reference range of 0 to 150 ppm SiO_2 (Fig. 3). This instrument uses a unique principle based on the Tyndall effect in which light passing upward through a sample of water is matched against a light from the side scattered upward by the suspended particles in the water. When the variable center lighting matches the outer portion of the sample, the dial number on the side of the instrument is read. This number is then used to determine the turbidity of the sample by referring to a calibration curve for that particular Hellige turbidimeter and bulb.

Prior to the departure of the Naval Oceanographic personnel a short instrument indoctrination period was given at NRL. However, only Mr. James Beller was able to attend. He was shown the use of the instrument and had a standard deviation test conducted and recorded as he operated the instrument. The results are shown in Table 1.

During the cruise the breakdown of the operation of the Hellige by stations was as follows: Mr. Robert Valitski, 28 stations; Mr. James Beller, 27 stations; Mr. Robert Lockerman, senior scientist on board, four stations; and Mr. Robert Rushton, one station.

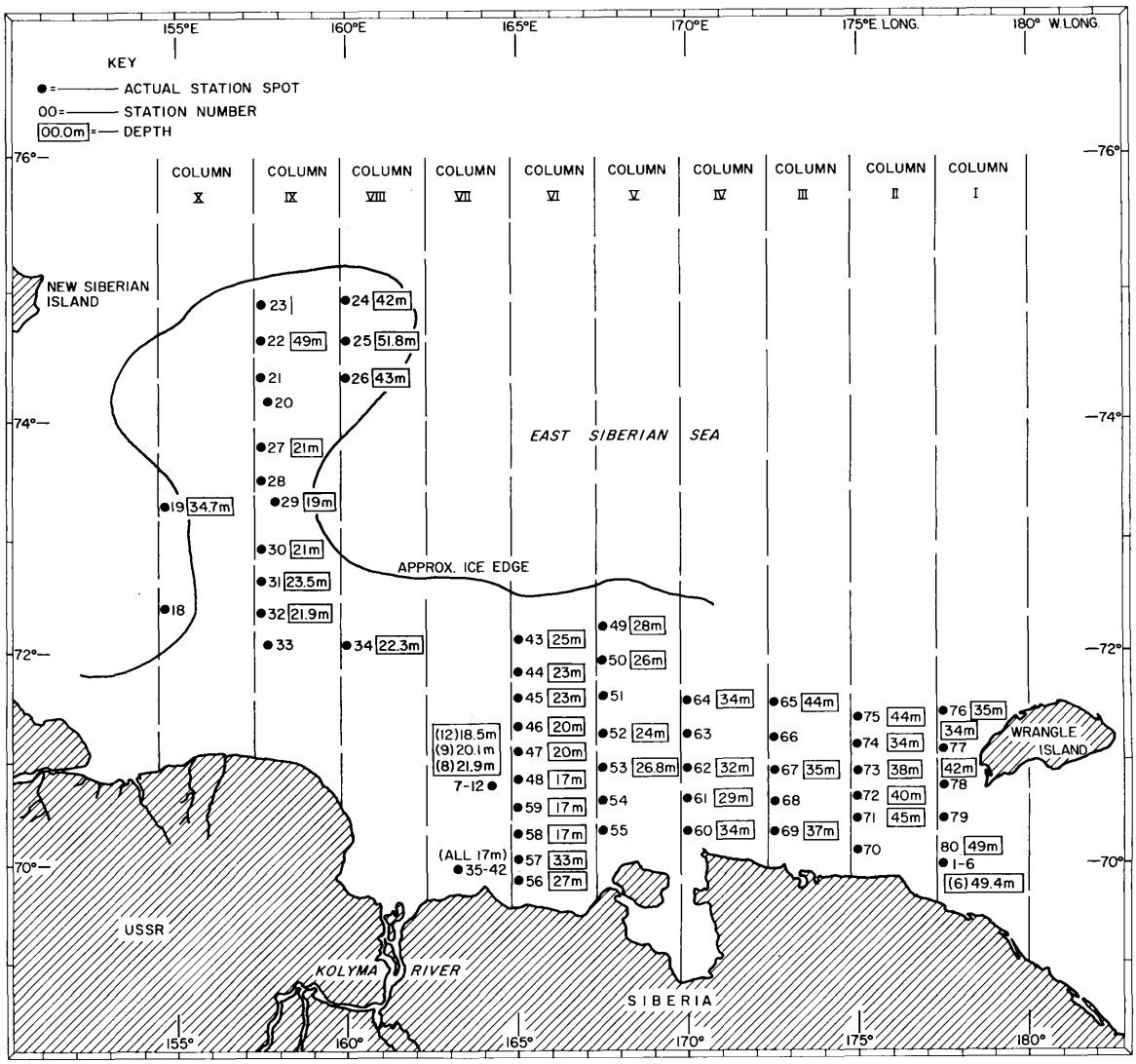

Fig. 2 - Stations at which turbidity measurements were made and the depths (in rectangles) at the stations

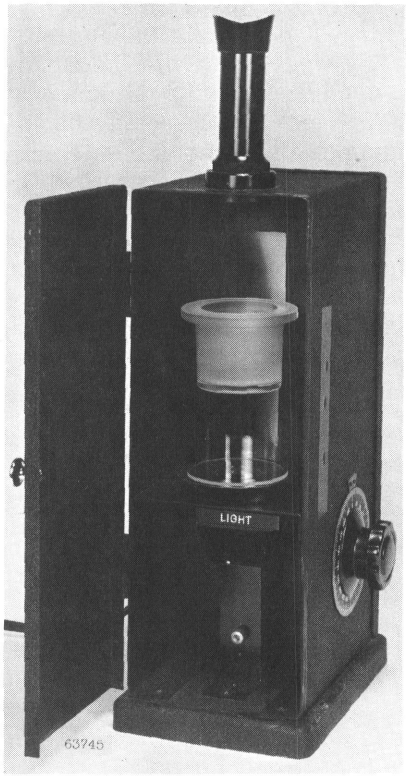

Fig. 3 - Hellige Turbidimeter

Table 1
Test of Performance by Mr. James Beller on a Particular Hellige Turbidimeter (Model 7430, Bulb A)

Scale Reading (On the Dial in Fig. 3) For Different Solutions		
Sea Water; Shaken; Light-Density Filter; Mirror Closed	SiO_2 in Distilled Water; Light-Density Filter; Mirror Closed	
	Stirred	Shaken
6.5	38.5	34.0
7.0	38.5	35.5
7.0	38.0	32.5
7.0	39.0	33.0
7.0	38.0	32.0
7.0	39.0	33.0
7.0	39.0	34.0
7.5	40.0	32.5
7.0	39.0	31.5
7.0	39.0	34.5
7.0*		34.0*
Std. Dev. 0.24	0.59	1.23

*Observed by C.W. Klee of NRL.

The oceanographic stations from which the largest portion of the Hellige measurements were obtained came within a region extending westward from the Bering Strait to the New Siberian Island (Fig. 2). The procedure used in obtaining the sea water samples followed the generally accepted practice for Nansen casts; in this case the first sample was used for oxygen determination, the second sample for phosphate determination, and the third sample for turbidity measurements. The sea water allocated for turbidity studies was placed in a plastic bottle and then into a room temperature water bath for 1 to 1-1/2 hours before being placed in the Hellige instrument for reading. The purpose of the water bath was to prevent condensation on the sides of the glass tube in which the sample was placed at the time of reading. In addition to allowing the water samples to warm, the Hellige was shock mounted on a laboratory bench approximately at midship to minimize the effect from the ship's vibration, pitch, and roll.

RESULTS

The graphical presentations include depth, turbidity, temperature, and σ_t (a function of density).* The graphs in Figs. 4 through 14 represent the plotting of the 60 turbidimetric data sheets with the exception of stations 33, 54, and 68 which did not have depth information on the Hellige record sheet. Stations 13, 14, and 15 were in the Bering Straits rather than the East Siberian Sea, and station 4 was in the Chuckchee Sea; hence they have been included only for information purposes under the category miscellaneous stations.

The plotting with respect to station numbers is not in sequence, because not all stations included turbidity measurements, and the plan of presentation was to be from east to west and northward from the coast of Siberia to the ice boundary. The plotting is thus in sequence for the column numbers shown in Fig. 2.

DISCUSSION AND OBSERVATIONS

Discussion with the Naval Oceanographic Office personnel who went on this cruise indicated that both the ice and the water were quite dirty. An average turbidity figure, excluding any depth differentiation, of approximately 5 ppm seems to substantiate this, especially when compared to turbidities of approximately 0.5 ppm or lower in areas of the Atlantic that we have tested. One possible reason for this could be the heavy discharge of particulate matter from melting ice. Another possible cause may have been the relatively shallow depth of the water in which the stations were taken, the average depth of all stations reported in this area being about 30 meters.

In addition to a relatively high particulate count, an interesting observation obtained from this study was the change in turbidity with respect to time at one location: that of stations 35 to 42. Here the turbidity was recorded seven times at 6-hour intervals and showed some interesting turbidimetric profile fluctuations. Possible explanations for the fluctuations in turbidity might be (a) turbidity currents heavy with silt from tidal or other land washing conditions occurring along the Kolyma River and extending out to sea, (b) the effect of a rise in wind force and sea state on the shallow-water situation, or (c) a combination of these.

The main conclusion to be made from this report is that more opportunities of this nature should be presented to laboratories engaged in oceanographic research.

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*$\sigma_t = 10^3$ (density - 1) mg/cm^3, where the density is calculated from in-situ measurements of temperature and salinity.

ACKNOWLEDGMENTS

The authors wish to extend sincere thanks for a job well done to the members of the U.S. Naval Oceanographic Office for their efforts under adverse conditions in obtaining the scientific information described in this report. In particular, we wish to thank Mr. Robert Lockerman, senior scientist on board, and Mr. Robert Rushton for background information and Mr. Robert Valitski and Mr. James Beller for obtaining the larger portions of the sea water turbidity measurements.

In addition, we wish to thank Mr. Charles Klee for instructing Mr. Beller in the operation of the Hellige Turbidimeter and for obtaining the information contained in Table 1.

REFERENCE

1. Hiller, A.J., Mathes, R.H., and Ricalzone, L.C., "Ocean Surface Effects," Report of NRL Progress, p. 37, Sept. 1965

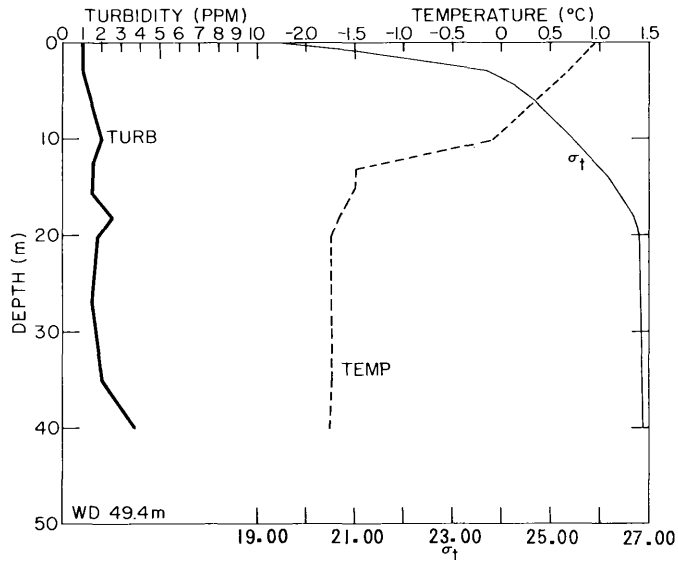

Fig. 4a - Column I observations at station 6
(2200 hours GMT, July 15, 1964)

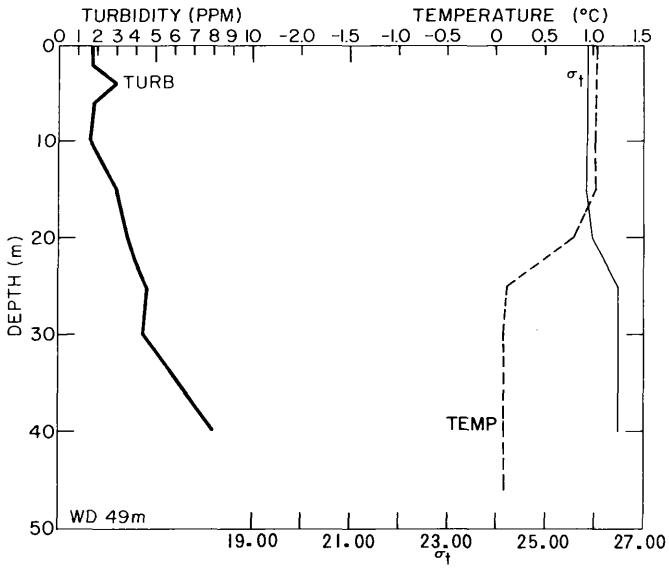

Fig. 4b - Column I observations at station 80
(2300 hours GMT, September 29, 1964)

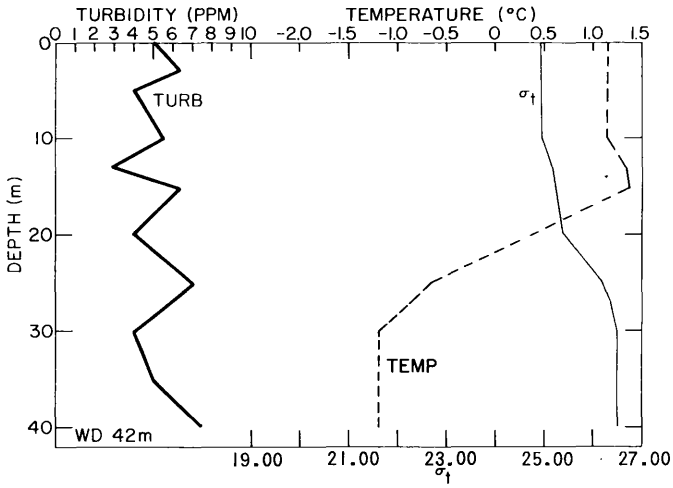

Fig. 4c - Column I observations at station 78
(1500 hours GMT, September 29, 1964)

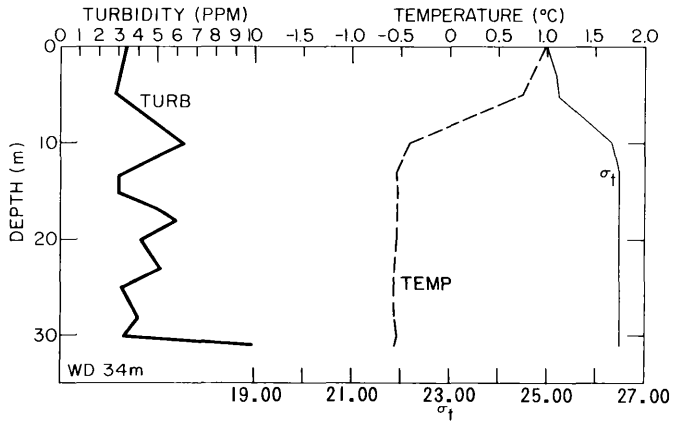

Fig. 4d - Column I observations at station 77
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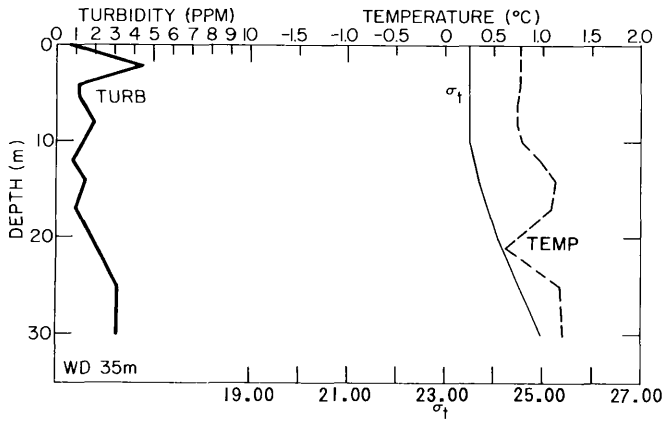

Fig. 4e - Column I observations at station 76
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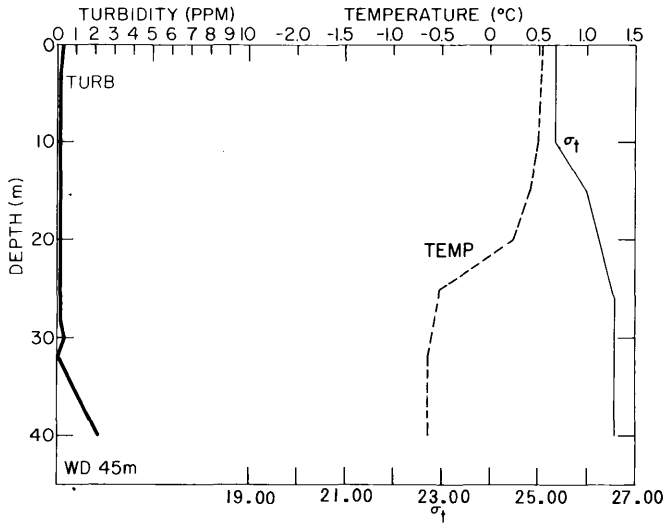

Fig. 5a - Column II observations at station 71
(1300 hours GMT, September 28, 1964)

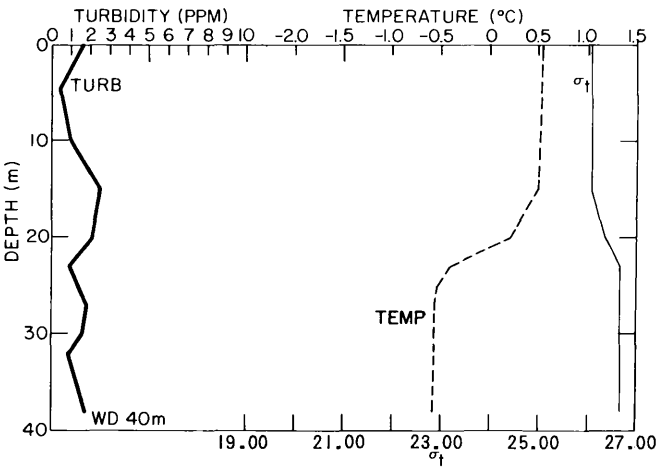

Fig. 5b - Column II observations at station 72
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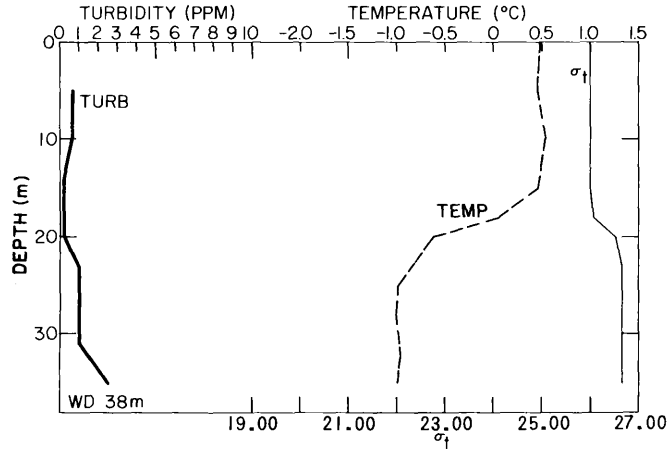

Fig. 5c - Column II observations at station 73
(1800 hours GMT, September 28, 1964)

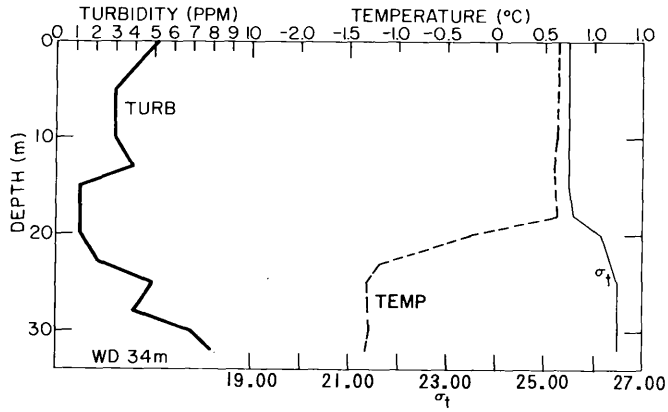

Fig. 5d - Column II observations at station 74
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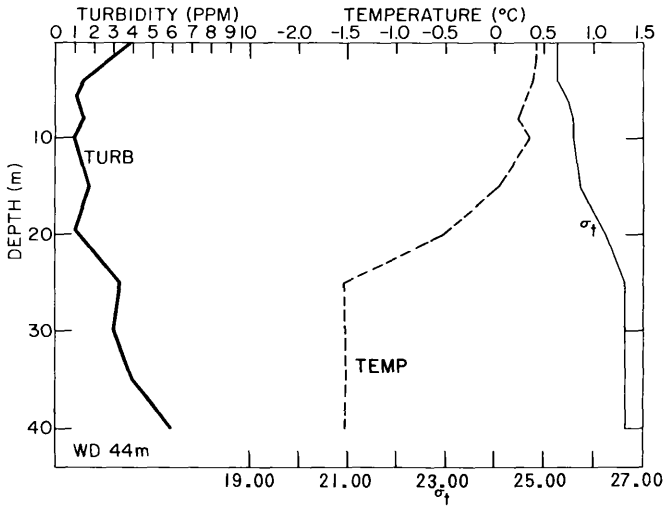

Fig. 5e - Column II observations at station 75
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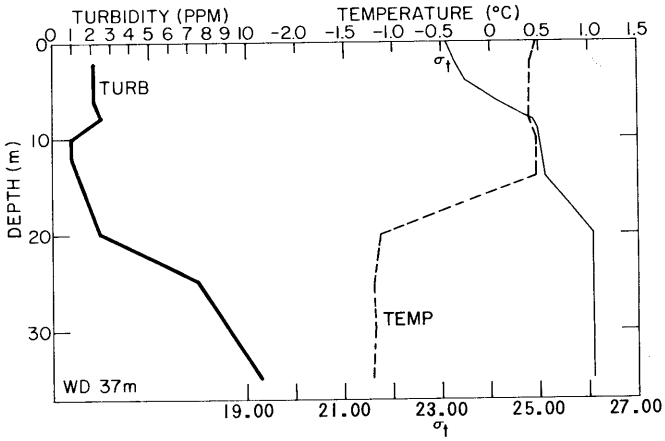

Fig. 6a - Column III observations at station 69 (0400 hours GMT, September 28, 1964)

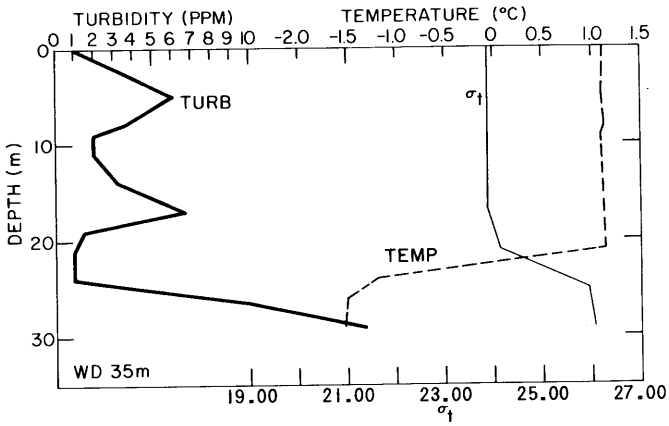

Fig. 6b - Column III observations at station 67 (1800 hours GMT, September 27, 1964)

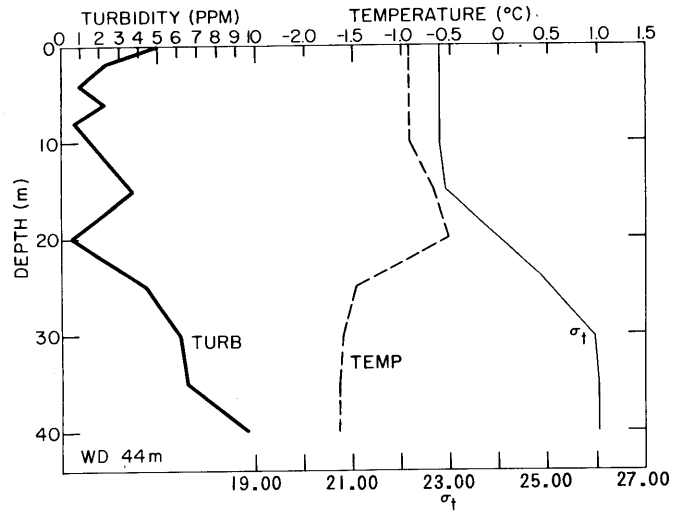

Fig. 6c - Column III observations at station 65 (1000 hours GMT, September 27, 1964)

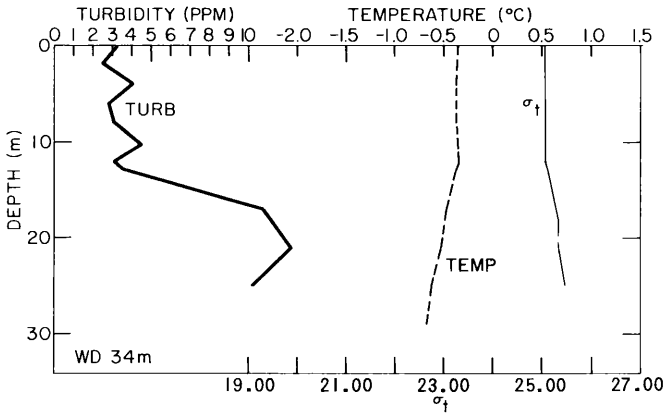

Fig. 7a - Column IV observations at station 60 (0500 hours GMT, September 26, 1964)

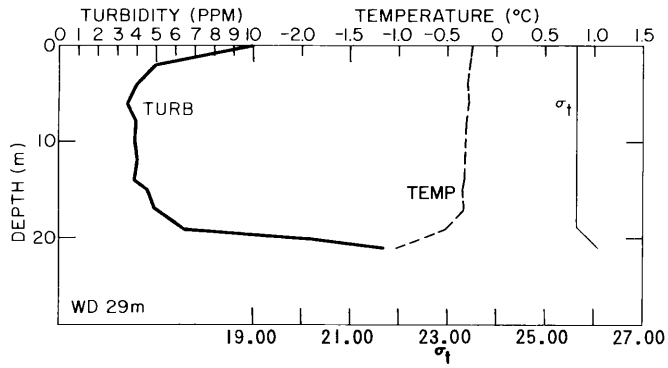

Fig. 7b - Column IV observations at station 61 (1000 hours GMT, September 26, 1964)

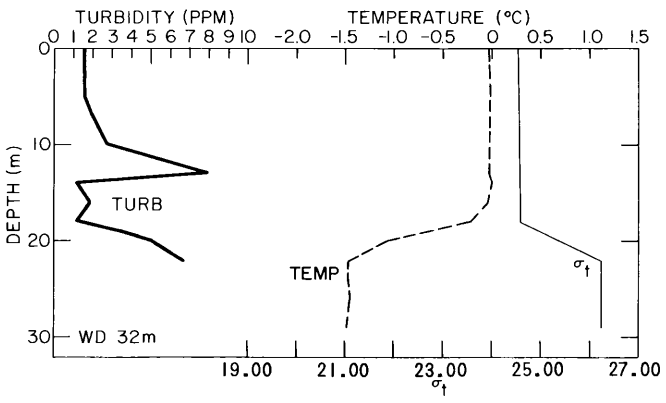

Fig. 7c - Column IV observations at station 62 (1300 hours GMT, September 26, 1964)

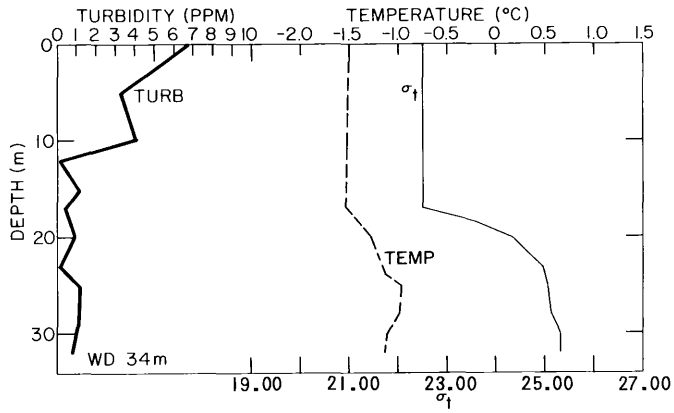

Fig. 7d - Column IV observations at station 64
(2200 hours GMT, September 26, 1964)

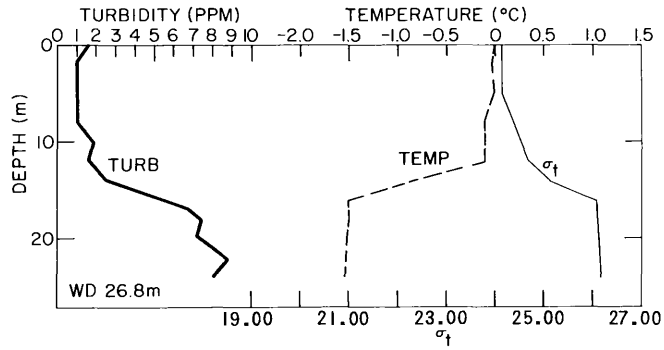

Fig. 8a - Column V observations at station 53
(1500 hours GMT, September 24, 1964)

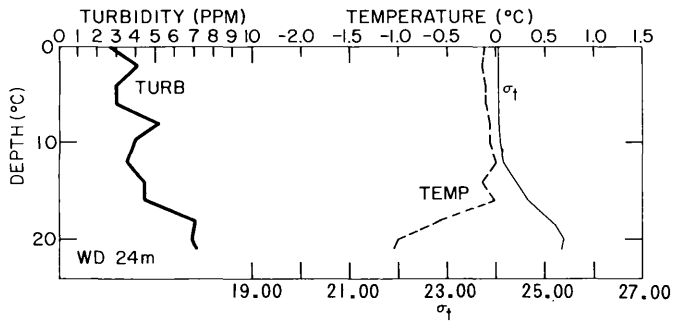

Fig. 8b - Column V observations at station 52
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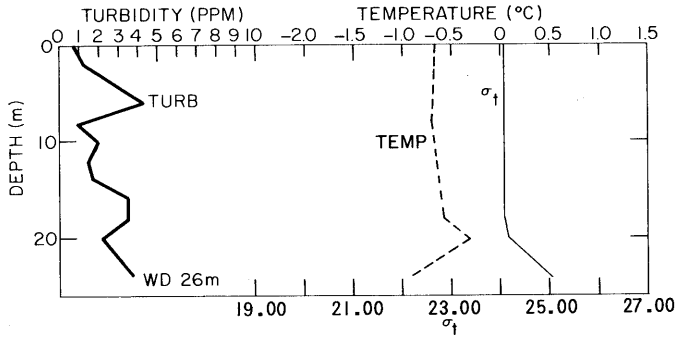

Fig. 8c - Column V observations at station 50
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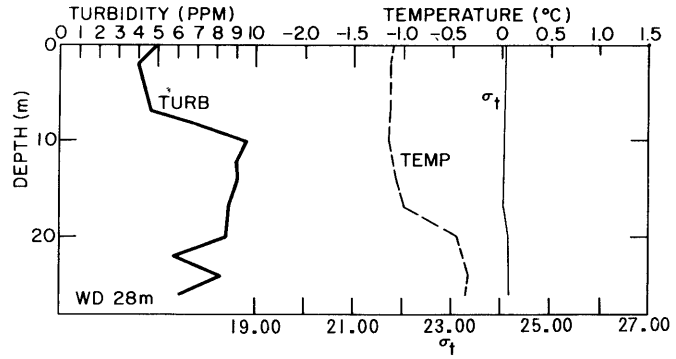

Fig. 8d - Column V observations at station 49
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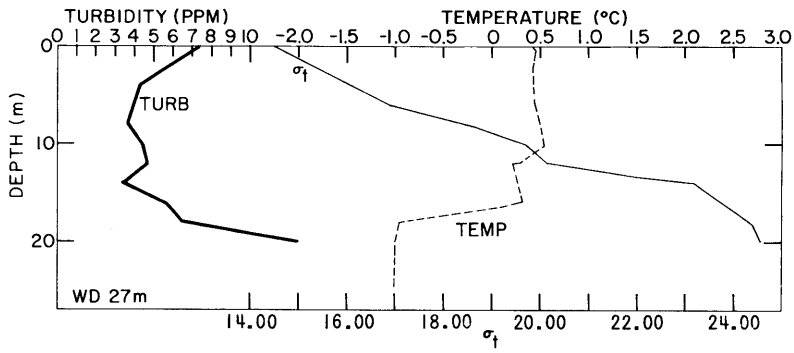

Fig. 9a - Column VI observations at station 56
(0500 hours GMT, September 25, 1964)

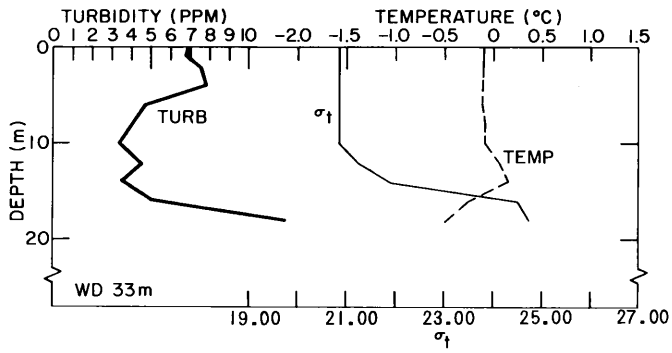

Fig. 9b - Column VI observations at station 57
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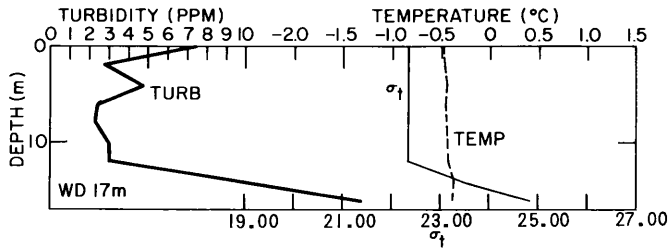

Fig. 9c - Column VI observations at station 58
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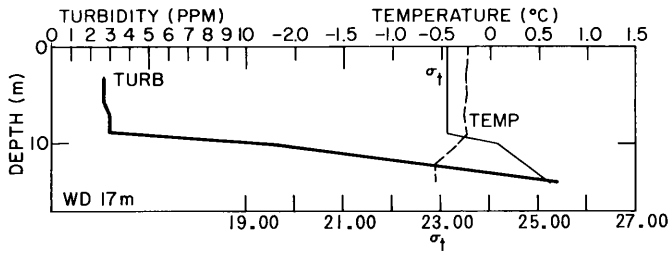

Fig. 9d - Column VI observations at station 59
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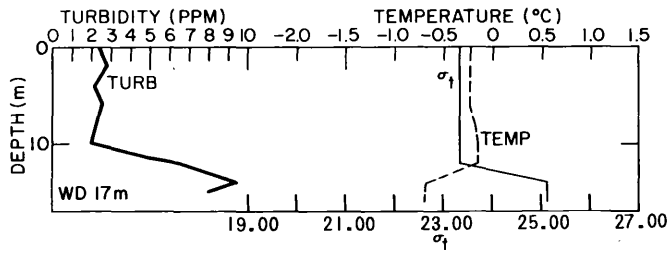

Fig. 9e - Column VI observations at station 48
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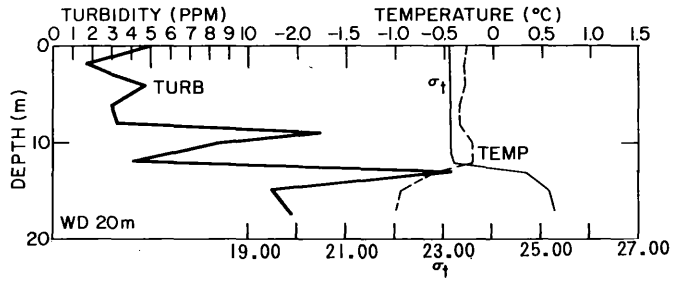

Fig. 9f - Column VI observations at station 47
(1400 hours GMT, September 22, 1964)

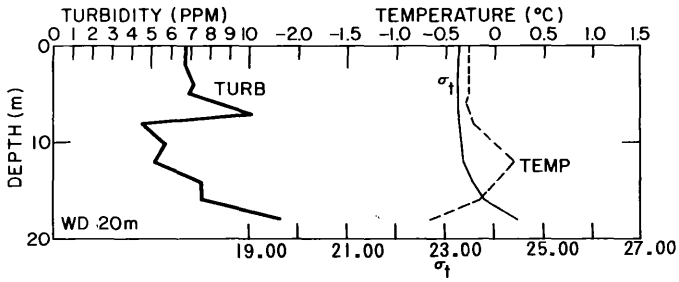

Fig. 9g - Column VI observations at station 46
(1000 hours GMT, September 22, 1964)

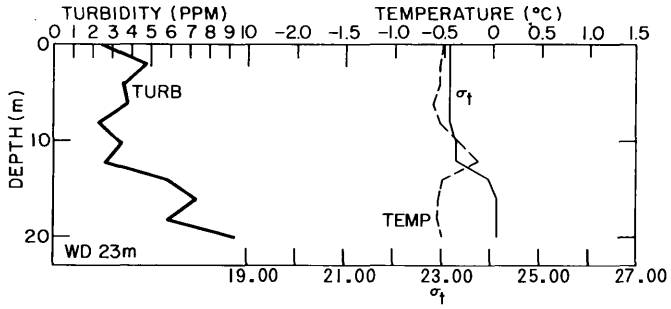

Fig. 9h - Column VI observations at station 45
(0700 hours GMT, September 22, 1964)

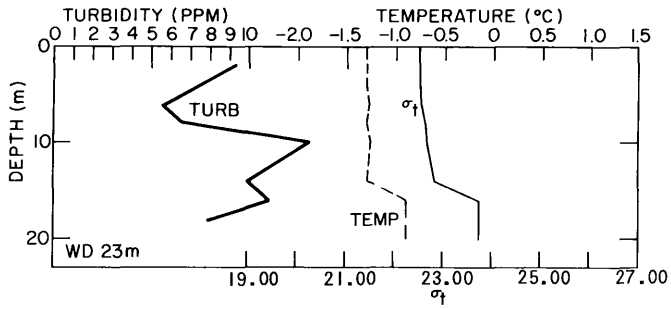

Fig. 9i - Column VI observations at station 44
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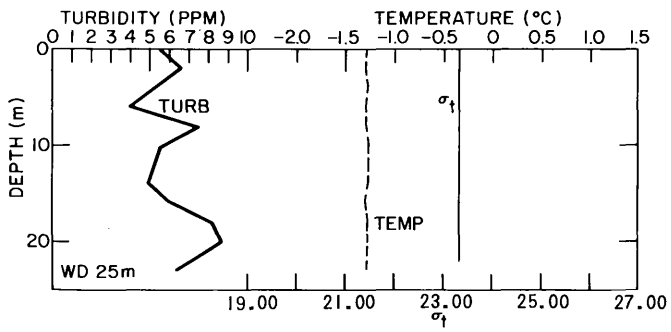

Fig. 9j - Column VI observations at station 43
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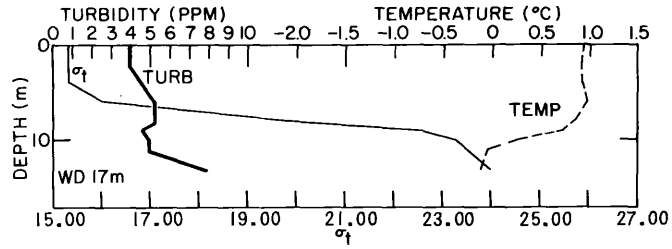

Fig. 10a - Column VII observations at station 35 (0700 hours GMT, September 18, 1964)

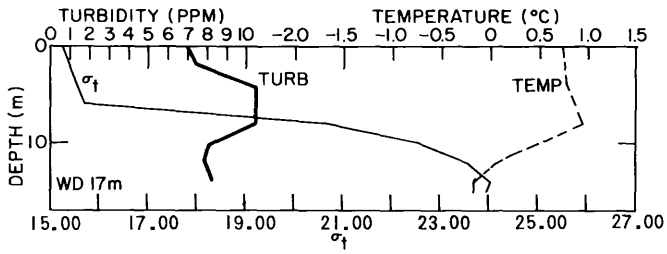

Fig. 10b - Column VII observations at station 36 (1300 hours GMT, September 18, 1964)

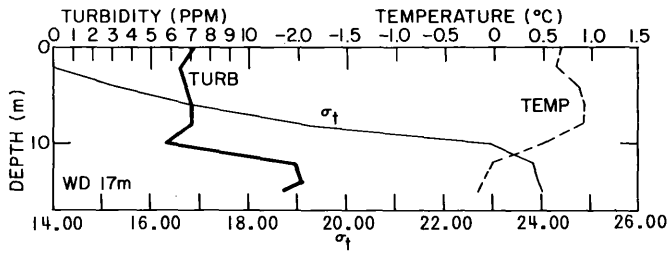

Fig. 10c - Column VII observations at station 37 (1900 hours GMT, September 18, 1964)

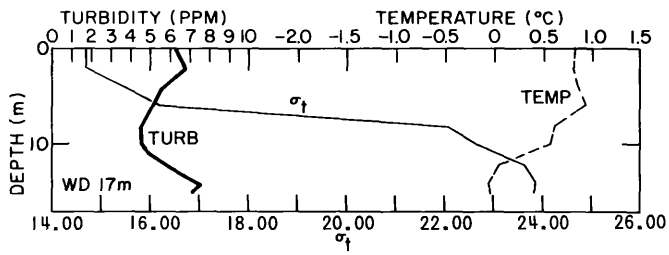

Fig. 10d - Column VII observations at station 38 (0100 hours GMT, September 19, 1964)

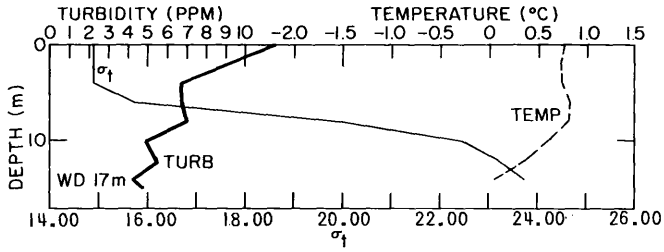

Fig. 10e - Column VII observations at station 39 (0700 hours GMT, September 19, 1964)

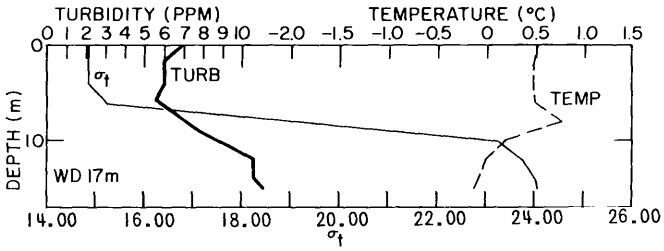

Fig. 10f - Column VII observations at station 40 (1300 hours GMT, September 19, 1964)

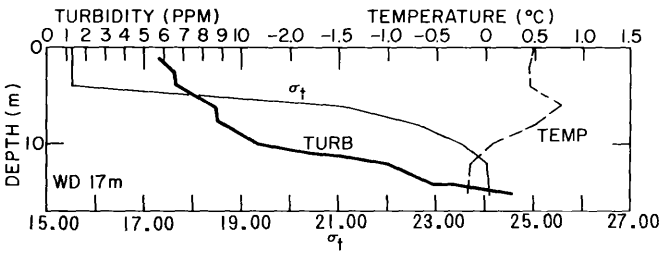

Fig. 10g - Column VII observations at station 41 (1900 hours GMT, September 19, 1964)

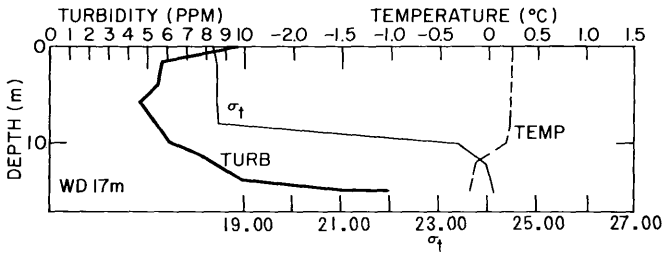

Fig. 10h - Column VII observations at station 42 (0100 hours GMT, September 20, 1964)

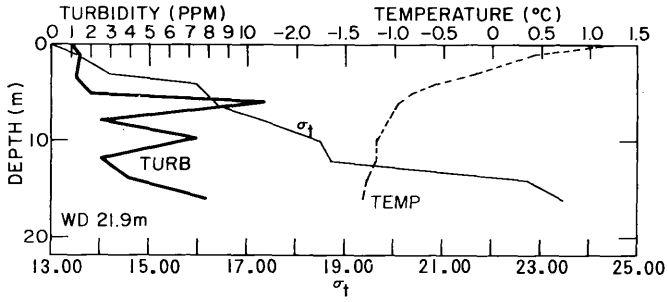

Fig. 10i - Column VII observations at station 8
(2100 hours GMT, July 19, 1964)

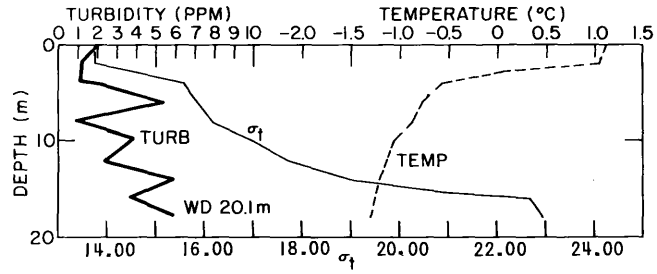

Fig. 10j - Column VII observations at station 9
(0600 hours GMT, July 20, 1964)

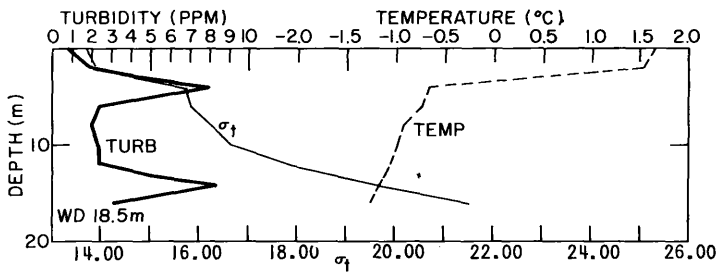

Fig. 10k - Column VII observations at station 12
(0500 hours GMT, July 21, 1964)

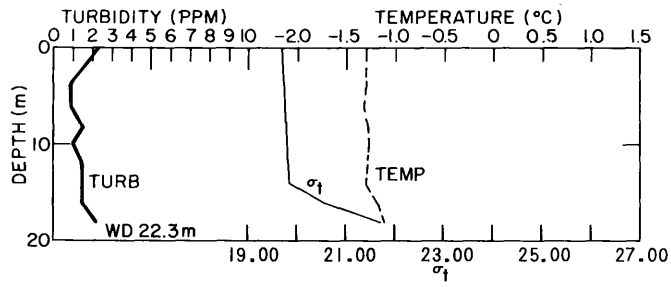

Fig. 11a - Column VIII observations at station 34 (0300 hours GMT, September 17, 1964)

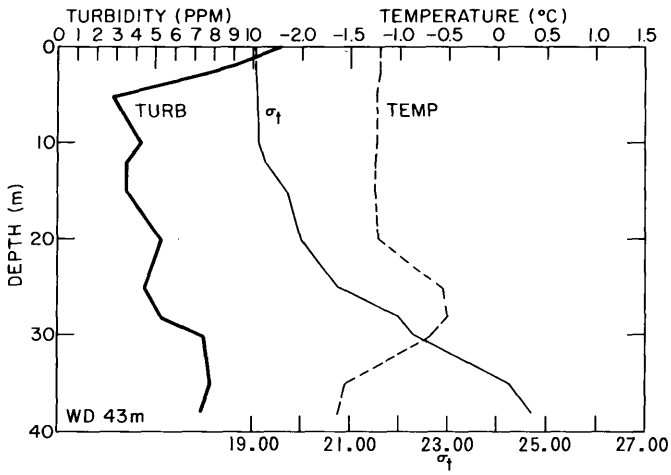

Fig. 11b - Column VIII observations at station 26 (0600 hours GMT, September 15, 1964)

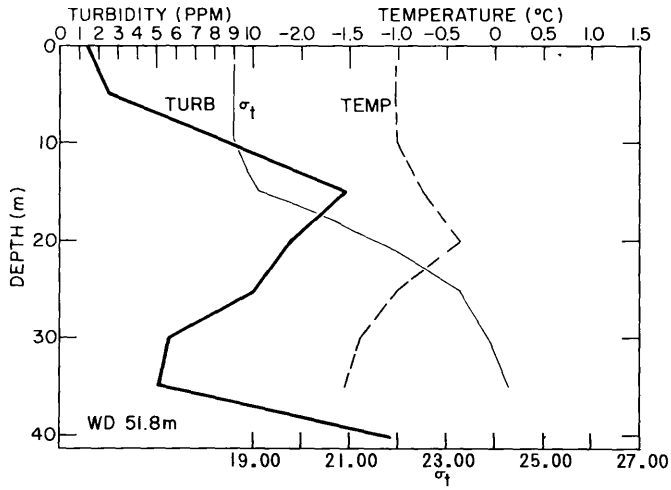

Fig. 11c - Column VIII observations at station 25 (2300 hours GMT, September 14, 1964)

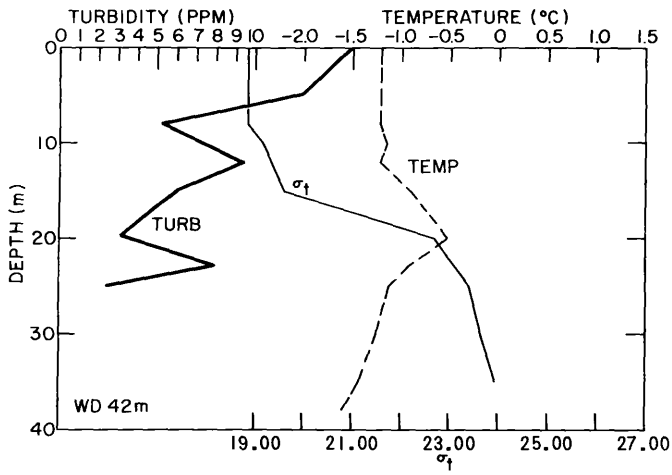

Fig. 11d - Column VIII observations at station 24 (2000 hours GMT, September 14, 1964)

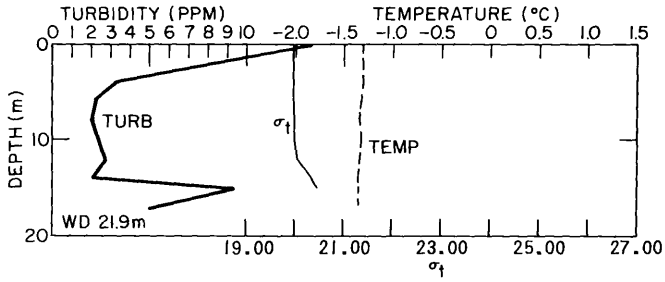

Fig. 12a - Column IX observations at station 32 (0900 hours GMT, September 16, 1964)

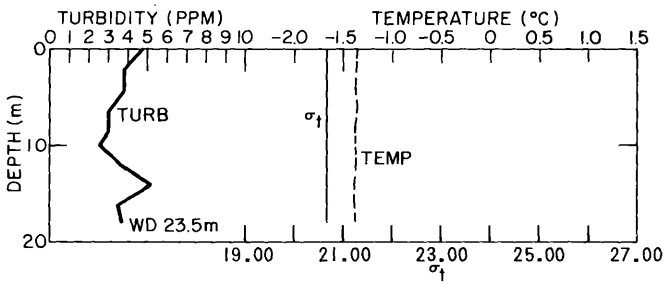

Fig. 12b - Column IX observations at station 31 (0500 hours GMT, September 16, 1964)

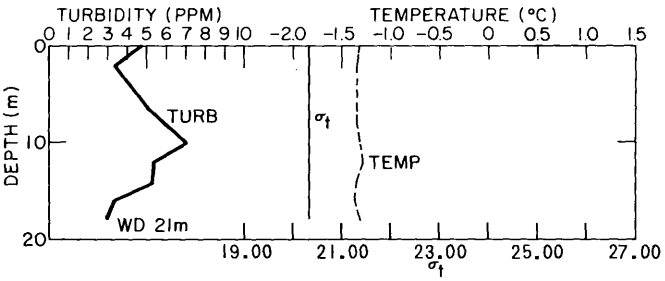

Fig. 12c - Column IX observations at station 30 (0300 hours GMT, September 16, 1964)

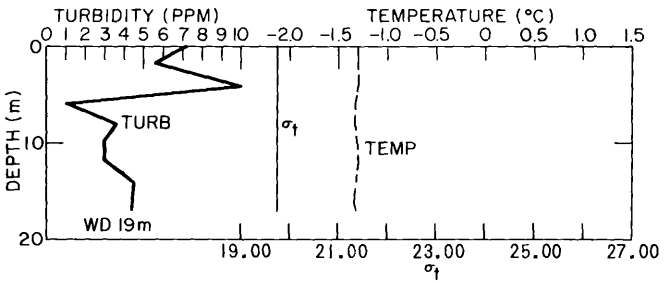

Fig. 12d - Column IX observations at station 29 (2200 hours GMT, September 15, 1964)

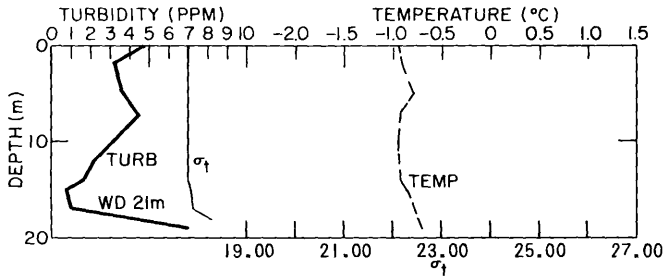

Fig. 12e - Column IX observations at station 27
(1600 hours GMT, September 15, 1964)

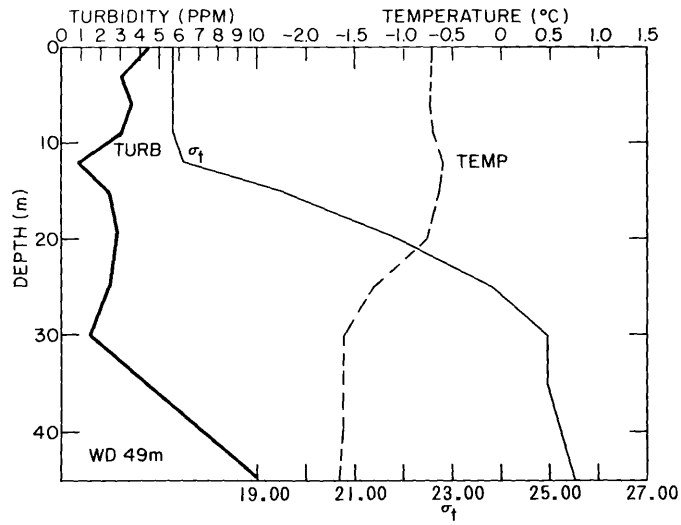

Fig. 12f - Column IX observations at station 22
(1000 hours GMT, September 14, 1964)

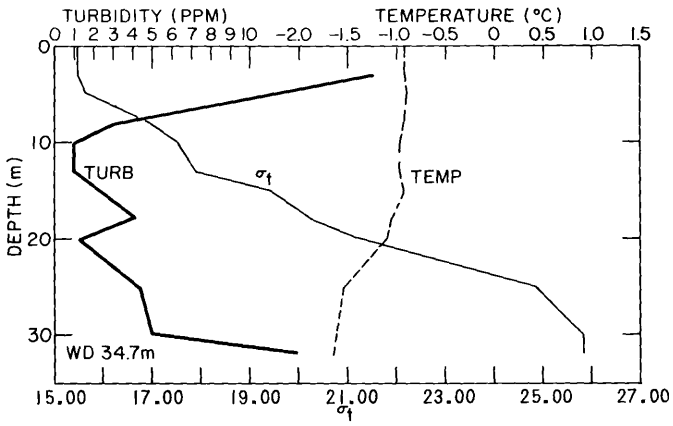

Fig. 13 - Column X observations at station 19
(1100 hours GMT, September 13, 1964)

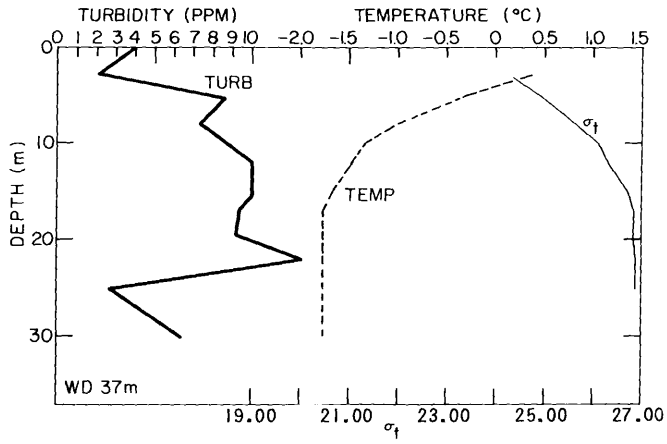

Fig. 14a - Observations at miscellaneous station 4, Chuckchee Sea (1200 hours GMT, July 15, 1964)

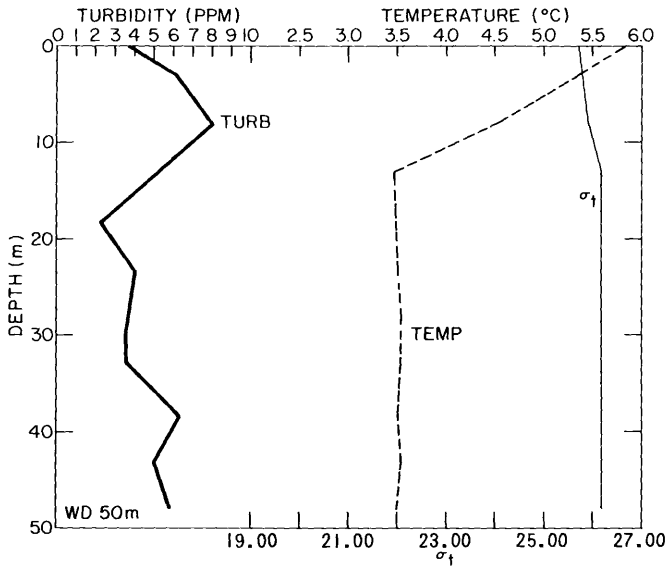

Fig. 14b - Observations at miscellaneous station 13, Bering Strait (0100 hours GMT, August 28, 1964)

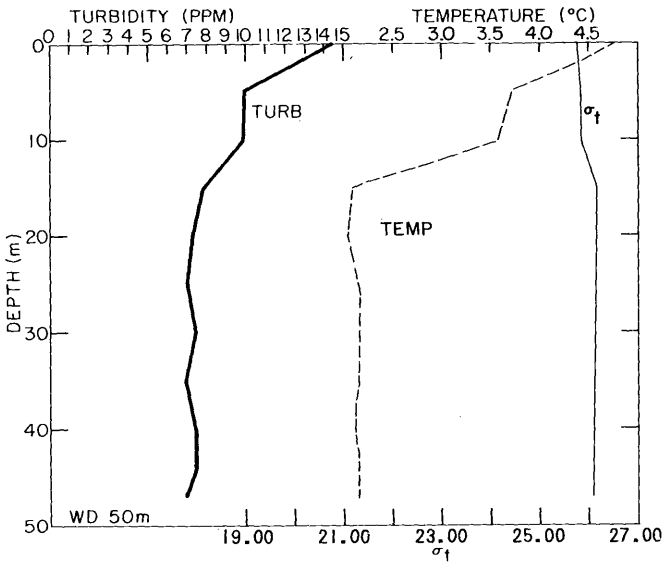

Fig. 14c - Observations at miscellaneous station 14, Bering Strait (0300 hours GMT, August 28, 1964)

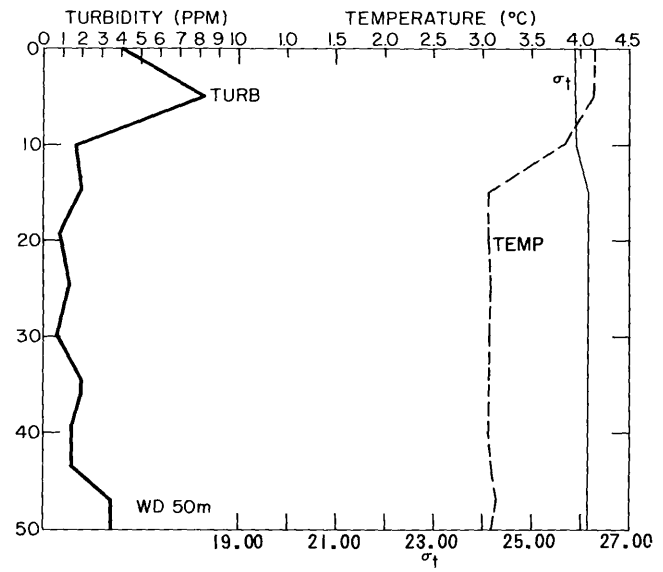

Fig. 14d - Observations at miscellaneous station 15, Bering Strait (1300 hours GMT, August 28, 1964)

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5. AUTHOR(S) *(Last name, first name, initial)*

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13. ABSTRACT

The East Siberian cruise of the USS Burton Island (AGB-1) offered a unique opportunity to obtain turbidimetric measurements inexpensively on a cooperative basis. In addition to routine oceanographic data obtained during the cruise, personnel of the U.S. Navy Oceanographic Office obtained turbidity data on many of the water samples taken during the survey. The measurements were made with a Hellige turbidimeter furnished by the U.S. Naval Research Laboratory. The purpose of this effort was to obtain data on the time and spatial stability of particulate material in the sea in various locations. Other research is bearing out evidence that turbidity layers are also sound-scattering layers and may play a basic role in acoustic volume reverberations. The turbidity profiles of the various locations and other oceanographic data such as temperature and density presented in this report are thus part of a more comprehensive program aimed toward understanding the ocean environment.

The results showed relatively high levels of turbidity which could change rapidly with time. These observations can be explained by the relative shallowness in the area, turbidity currents from the Kolyma River, and the dirty ice conditions which existed.

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Security Classification

14. KEY WORDS		LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
Oceans	Oceanographic data						
Impurities	Maps						
Turbidity	Oceanology						
Hydrographic surveying							
Arctic Ocean							
Arctic regions							
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