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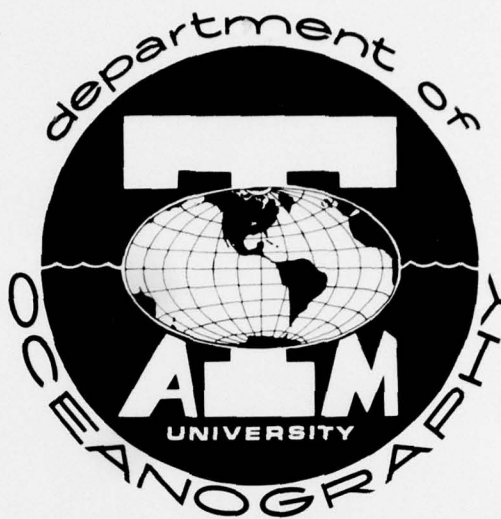


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VERTICAL DISTRIBUTION OF BIOGENIC ELEMENTS  
IN PORE WATERS OF THE BERING SEA

by

E. D. Zaitseva

TECHNICAL REPORT

(Translation)

by

Leo A. Barnard

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20. Abstract (cont.)

liter

PO<sub>4</sub> mg/liter.

159 mg/l for ammonia-nitrogen. Nitrogen was also determined in the surface horizon and found to vary between 0.04 and 0.29%. In some cases, phosphate also showed an increase in concentration with respect to depth but the range was only 0.2 - 7.5 PO<sub>4</sub> mg/l. Silicate values varied widely and no definable trends were noted. The range of values observed was 11.0 - 30.9 mg-SiO<sub>2</sub>/l. Concentrations of these biogenic elements in the pore fluids are attributed to the regeneration of biogenic material deposited in the sediments. Regeneration occurs in the uppermost layers for the most part and in some cases continues in deeper layers.

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TECHNICAL REPORT

Translation of

VERTICAL DISTRIBUTION OF BIOGENIC ELEMENTS  
IN PORE WATERS OF THE BERING SEA

by

E. D. Zaitseva

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## Abstract

### VERTICAL DISTRIBUTION OF BIOGENIC ELEMENTS IN PORE WATERS OF THE BERING SEA

Piston core samples of Bering Sea sediments were squeezed to obtain the interstitial fluids. Horizons sampled and reported are for 0, 2, 4, 8 and 16 m. These fluids were subsequently analyzed for alkalinity, ammonia, phosphate and silicate. Alkalinity and ammonia concentrations in the pore fluids increased uniformly with respect to depth. The ranges of concentration reported are 2.5 - 73.7 mg-equivalents/l for alkalinity and 0.2 - 159 mg/l for ammonia-nitrogen. Nitrogen was also determined in the surface horizon and found to vary between 0.04 and 0.29%. In some cases, phosphate also showed an increase in concentration with respect to depth but the range was only 0.2 - 7.5 PO<sub>4</sub> mg/l. Silicate values varied widely and no definable trends were noted. The range of values observed was 11.0 - 30.9 mg-SiO<sub>2</sub>/l. Concentrations of these biogenic elements in the pore fluids are attributed to the regeneration of biogenic material deposited in the sediments. Regeneration occurs in the uppermost layers for the most part and in some cases continues in deeper layers.

Translator  
L. A. B.

The distributions of biogenic elements (P, Si, N and others) in the ( ? pore fluids ? ) of marine sediment cores have come to the attention of geologists and geochemists in connection with investigations of diagenetic processes. There is very little material about this question in the literature.

S. V. Bruevich, R. M. Pevznyak and others <sup>(2)</sup> have studied the question of the vertical distribution of biogenic elements in the ( ? pore waters ? ) in the freshwaters of lake Bicera. Some data concerning this question have been obtained for lake Baikal by K. K. Votintsev <sup>(5)</sup>. S. V. Bruevich and E. G. Vinogradov <sup>(3)</sup> determined the vertical distribution of biogenic elements in the northern, central and southern Caspian (Sea) <sup>(4)</sup>.

The first foreign work to present quantitative data on the distribution of silica in marine pore solutions (in sediments of the near-California region of the Pacific Ocean) and quantitative data on the distribution of ammonia nitrogen, is that of Emery and Rittenberg <sup>(7)</sup>.

Sediment samples in our work were taken with a special geochemical ( ? corer ? ) during an expedition for the Institute of Oceanology AN SSSR and then were taken to the marine laboratory located at the institute. Sediment cores were taken up to 16 meters long. Pore fluids were acquired by squeezing them out in a cast-steel hand-screw press by the method of P. A. Kriukov <sup>(6)</sup>.

The microchemical analytical methods were according to S. V. Bruevich (1).

For convenient comparison of the various changes in the concentrations of biogenic elements in different parts of the sea, all determinations were done for standardized comparison horizons: 1, 2, 4, 8 and 16 meters (See Table 1).

### Results

1. Alkalinity (apparently indicating mineralized carbon from organic matter) and ammoniacal nitrogen in pore solutions showed uniform increases with respect to depth within the sediments, although gradients accumulate differently for different layers of the core. Both of these indicators increase exactly together.
2. The concentration of phosphate-phosphorus in the overwhelming majority of cases in pore fluids of the Bering Sea is shown to systematically increase downward, although substantially less than that shown for ammonical nitrogen.
3. The concentration of silicon vertically did not show any systematic increase downward but varied over a comparatively small range for each station.

4. The increase in alkalinity and biogenic elements at different stations is quantitatively and definitely different--at one station and in some sections of the core, the accumulation (in the pore fluids) was slow and in others, very fast.
  
5. Comparison of data for stations where the sediments are composed primarily of organic carbon (sta. 553) with stations where there was no organic carbon content in the sediments (most of the stations), clearly shows that most increases in the organic content of the solid phase of the sediments is matched by a like increase in the biogenic elements in the pore fluids.
  
6. Pore solutions of sediments from shallow stations of average depth (1000 - 4000 meters) characteristically showed significantly large increases in alkalinity and biogenic elements (nitrogen, phosphorus) vertically and large absolute increases in deeper sediments in comparison with upper horizons.
  
7. Looking at the variations in alkalinity and biogenic elements in the pore fluids of Bering Sea sediments several major things can be noted: the decomposition process for organic matter is not complete in the upper sediment layers, but continues to take place at a decreasing rate for some time in deeper sediments.

Our material illustrates, definitely, that this process is not complete in the upper 16 meters of marine sediments (See Figure 1). Therefore, the decay of organic matter and other related diagenetic processes are continuing in marine sediments hundreds of thousands of years after burial.

The author thanks Prof. S. V. Bruevich for guidance and continuing interest in this work.

Submitted 28 May 1954, Inst. Oceanal., Sci. Inst. of the USSR.

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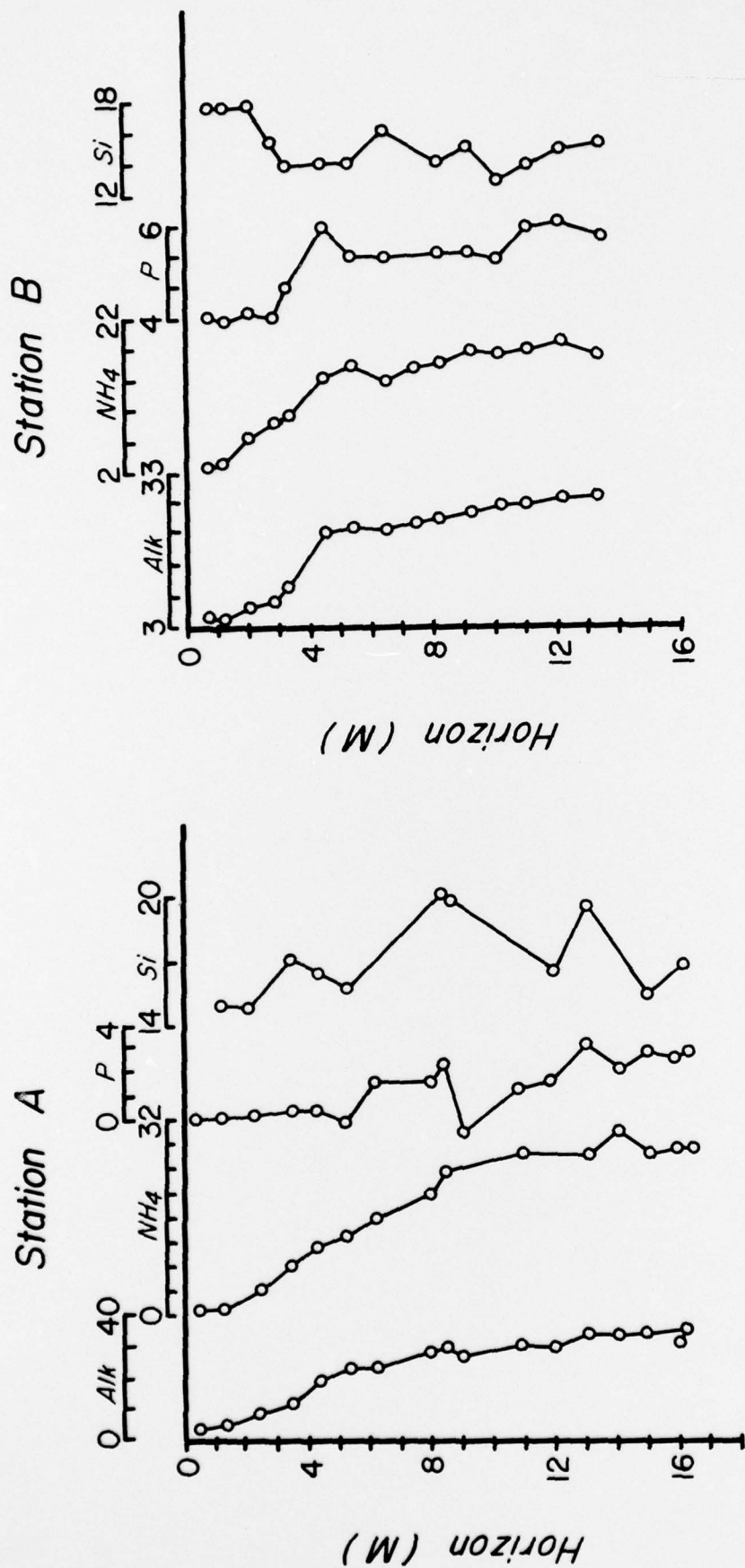


Figure 1. Vertical distribution of alkalinity and biogenic elements in pore fluids of cores from the Bering Sea. A - Sta. 540, B - Sta. 619. All concentrations are reported in milligrams/liter except for alkalinity which is in units of milligram-equivalents/liter.

Table 1. Measurements of the composition of pore fluids with depth in the sediments of the Bering Sea in 1950. (Sediment horizons are in meters from top to bottom.)

Sta. #	Nitrogen content of the upper horizon (m %)	Horizon								ammonia-nitrogen, mg/l			
		0	1	2	4	8	16	0	1		2	4	8
		alkalinity											
		(water) depth 0 - 150 m											
568	0,038	2,75	12,8	--	--	--	--	3,6	--	--	--	--	--
565	0,037	10,9	26,9	--	--	--	--	11,4	25,4	--	--	--	--
557	0,14	2,5	8,6	17,5	--	--	--	1,2	7,6	17,0	--	--	--
553	0,29	41,7	66,2	72,7	(73,7)	--	--	45,0	111,0	159,0	(145,0)	--	--
		(water) depth 1000 m											
612	0,17	2,9	3,0	6,3	(21,9)	--	--	0,92	1,3	7,5	(23,4)	--	--
		(water) depth 2000 m											
617	--	(2,6)	4,2	6,0	8,6	--	--	(1,6)	2,5	4,8	7,1	--	--
		(water) depth 3000 m											
614	--	3,0	5,2	6,5	(11,0)	--	--	0,68	2,9	3,8	(11,6)	--	--
540	0,092	(3,5)	3,8	5,7	13,5	29,2	38,5	1,7	1,8	3,6	10,5	21,5	31,8
619	0,084	(3,8)	3,8	5,9	16,8	24,4	(32,0)	(2,8)	3,2	5,9	12,4	16,5	(18,6)
615	--	(6,6)	7,5	8,8	9,4	12,2	--	(4,3)	4,5	4,9	5,4	(6,4)	--
537	0,086	2,6	5,6	8,2	(15,9)	--	--	0,24	5,3	6,0	(15,0)	--	--
618	0,088	2,6	3,3	4,3	6,5	--	--	0,61	1,9	3,0	5,0	--	--
533	--	(1,73)	10,52	--	--	--	--	(1,6)	4,1	--	--	--	--

Table I (cont.)

Sta. #	Nitrogen content of the upper horizon (m %)	Horizon																				
		phosphate-phosphorus, mg/ℓ								silica, mg/ℓ												
		0	1	2	4	8	16	0	1	2	4	8	16	0	1	2	4	8	16			
568	0,038	1,6	4,0	--	--	--	--	--	--	--	--	--	14,5	12,2	--	--	--	--	--	--	--	--
565	0,037	6,3	3,2	--	--	--	--	--	--	--	--	--	11,0	--	--	--	--	--	--	--	--	--
557	0,14	0,35	1,8	1,7	--	--	--	--	--	--	--	--	13,7	--	--	--	--	--	--	--	--	--
553	0,29	2,5	4,5	4,7	(7,5)	--	--	--	--	--	--	--	26,8	14,0	16,0	23,2	--	--	--	--	--	--
612	0,17	0,25	0,26	0,67	--	--	--	--	--	--	--	--	1000 m	16,2	17,2	--	--	--	--	--	--	--
617	--	0,20	(0,21)	0,40	0,77	--	--	--	--	--	--	--	2000 m	16,5	12,6	13,0	--	--	--	--	--	--
614	--	0,25	0,38	0,43	(1,2)	--	--	--	--	--	--	--	3000 m	17,0	16,2	(15,2)	--	--	--	--	--	--
540	0,092	(0,17)	0,17	0,25	0,70	1,9	3,0	--	--	--	--	--	15,5	14,7	14,7	17,5	20,7	17,5	17,5	17,5	17,5	17,5
619	0,084	(0,43)	0,39	0,46	4,4	4,4	5,4	--	--	--	--	--	(17,7)	17,7	17,7	13,8	14,4	14,4	14,4	14,4	14,4	14,4
615	--	(0,27)	0,50	0,79	0,69	0,35	--	--	--	--	--	--	(14,0)	14,0	14,1	14,6	16,8	16,8	16,8	16,8	16,8	16,8
537	0,086	0,17	0,57	0,68	(1,6)	--	--	--	--	--	--	--	15,5	26,8	30,9	29,8	--	--	--	--	--	--
618	0,088	0,22	0,26	0,31	0,95	--	--	--	--	--	--	--	13,5	18,0	12,4	12,7	--	--	--	--	--	--
533	--	(0,65)	1,3	--	--	--	--	--	--	--	--	--	(19,0)	14,2	--	--	--	--	--	--	--	--

Note: 1. Numbers in parenthesis denote samples taken not exactly at the standard horizon. The sample at Station 553 is from below an area of high biological productivity. 2. Phosphate-phosphorus and silica were analyzed by A. V. Fotiev.

Translators Notes:

1. The phrase "gruntoviy rastvor" has been translated throughout as "pore fluids" and is equivalent to the more modern phrase "ilovaya voda." It is also of interest that these two phrases are commonly mistranslated as "wet sediments", "silty-water", "dirty-water", "silt" or "sediments". The distinction is quite important.
2. The word "trubka" is translated as "corer" based on context and other authors' use.
3. The words "monalit" and "kolonka" are translated as "core" based on context.

L. A. B.

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