

CHEMICAL ANALYSIS OF SEDIMENT OF THE JAPAN TRENCH

Ryoji Higano, Yutaka Nagaya, Masaru Shiozaki and Yoshio Seto

Received March 1, 1961

Abstract

Deep sea sediment of Japan trench was collected and analyzed by Japanese Hydrographic Office.

The results of analysis show some interesting difference in chemical composition in comparison with the other deep sea sediment.

Introduction.

Recently, some researches of geological history have made a progress by means of analysis of sediments taken from the deep sea (Petterson, H. 1947-1948), while the problem of radioactive waste dispersal into the sea is becoming important and in this respect, further investigations of deep sea are desired.

In Japan, these investigations have been carried out actively in recent years, but few chemical analysis of sediments of Japan Trench has been made.

This report presents a result of chemical analysis of major elements, organic carbon and organic nitrogen in sediment collected at the northern part of Japan Trench (Lat. 37° 29' N., Long. 143° 53' E.).

The sample used is a middle portion of the 30 centimeters core taken by the observation ship "Takuyo" in August, 1959.

1. Treatment of Sample.

The sample was taken from 7065 meters deep, where 2 to 3 degrees of bottom slope was found, and it was divided into three portions of each 10 centimeters long (upper, middle and lower portions), then stored in a refrigerator.

When the middle portion of the core was taken out for analysis, no liquid was found on it, but its surface was washed with distilled water to remove contamination of iron derived from the interior of the sampler.

2. Methods of Analysis.

1. Silicium, Titanium, Aluminum and Water.

The ordinary methods for silicate analysis were employed (Iwasaki, I.)

2. Iron.

Reduction by zinc amalgam, followed by a titration with 0.01-mol

KMnO₄ solution (Hamaguchi, H. 1952).

3. Manganese.

After SiO₂ in 0.1g of sample was decomposed by HF and H₂SO₄, HNO₃ and H₂SO₄ were added and it was heated on procelain basin, then the sulfate was treated with AgNO₃ and (NH₄)₂S₂O₈, and MnO₄⁻ ion concentration was measured by use of a spectrophotometer (Hamaguchi, H. 1952).

4. Calcium and Magnesium.

By adding buffer solution, pH of a portion of sample solution, the residual of that used for SiO₂, Fe₂O₃ and Al₂O₃ determinations, was adjusted and 0.1g of KCN was added as masking agent, then the sample was titrated with 0.01-mol E.D.T.A. solution using E.B.T. solution as a indicator. On the other hand, Mg⁺⁺ ion was titrated individually after Ca⁺⁺ ion was separated as calcium oxalate from the solution.

5. Sodium and Pottasium.

The sample was treated by Berzelius'es method, then pottasium was measured as chloroplatinate.

6. Phosphorus.

0.1g of sample was treated with HF, HNO₃ and H₂SO₄, following with NaHSO₃, Na₂S₂O₃ and ammonium molybdate, then the concentration of molybdenum blue was measured by use of a spectrophotometer (Ikeda, N. 1952).

7. Organic Nitrogen.

0.1g of sample was treated by Kjeldahl's method and NH₄⁺ ion concentration was measured colorimetrically.

8. Organic Carbon.

0.1g of sample was treated with KIO₃ and phosphoric acid treated at 300°C, and CO₂ gas was absorbed into Ba(OH)₂ solution (Kiba, T. 1958), then residual Ba(OH)₂ was titrated with HCl.

9. Adsorbed Chloride.

After chloride adsorbed on 0.2g of sample was extracted with hot water, the solution was concentrated, then titrated with AgNO₃ using uranin solution as an indicator.

3. Results and Discussion.

Results of analysis are given in Table 1. In Table 2, these values are recalculated to obtain the composition free from H₂O, organic compounds and adsorbed salt. Values obtained by H. Hamaguchi (1939) for the sample taken from 6020 meters deep and 200 miles southward from our sampling station are shown in the same table for a comparison.

1. Silicium.

Usually, the finer the sample, the lower the contents of resistates, such as SiO_2 , due to dilution with hydrolyzates and oxidates. However, although more than 90 % of this sample is

TABLE 1.

Composition	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO_2	MgO	CaO
%	60.17	0.52	12.37	4.64	0.08	2.09	1.93
	Na_2O	K_2O	H_2O	P_2O_5	Org-N	Org-C	Cl
	6.63	0.93	12.03	0.07	0.07 ₆	0.8 ₆	0.02 ₃

TABLE 2.

Composition	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO_2	MgO	CaO
%	68.52	0.59	14.09	5.28	0.09	2.38	2.20
%*	59.98	0.73	17.14	9.27	0.50	3.20	2.11
	Na_2O	K_2O	P_2O_5	* Collected at 38°-04' N, 143°-55' E; depth 6020 m.			
	5.72	1.06	0.08				
	5.22	1.51	0.28				

finer than 300 mesh, SiO_2 content is unusually high.

It is because that this sample contains abundant silicious shells and skeletons such as diatom and radiolaria, which agrees well with the microscopic observation.

2. Titanium, Aluminum and Iron.

The contents of these chemical elements are not so different from those of usual blue mud, but these contents are greater than those in the blue mud taken at the near coast (Hoshino, M. 1960), because most parts of the sample are fine and relatively rich of hydrolyzates.

3. Manganese.

Manganese content of the sample is smaller by the factor of ten in comparison with red clay (Hamaguchi, H. 1952) collected in the southward location. It shows that despite the great depth, oxidation is not enough to precipitate the oxidates such as ferric hydroxide and manganese hydroxide.

4. Calcium and Magnesium.

Calcium content is very low. It is because of the low temperature of 1.5°C and uniform pH which make the water unsaturated with respect to CaCO_3 . CaCO_3 particles would have been dissolved in the process of their slow sedimentation.

The ratio of calcium oxide to magnesium oxide content is opposite to that of shallow water deposits, and same as those of deep sea sediments which have been reported so far.

5. Sodium and Pottasium.

The sodium content is about 5 times higher than the pottasium

content. This ratio is approximately the same as the value obtained by Hamaguchi and shows same tendency with other pelagic and deep sea sediments.

6. Phosphorus.

It is said that increase or decrease of phosphorus content of sediment is parallel to those of iron and manganese contents, because of adsorption of phosphate ion on colloidal particles of their oxidates. Phosphorous content of this sample is low as manganese content.

Phosphorus and manganese contents of the sample are similar to those of sediments collected at the Suruga Bay (Tatsumoto, M. 1952), and is lower than those of sediments from continental shelf on Pacific coast of Honsyu.

As another reason for this small content of phosphorous, we can consider that almost all of organisms in the sample consist of diatoms and radiolarias.

7. Organic Nitrogen and Organic Carbon.

The contents of organic nitrogen and organic carbon of this sample are similar to the contents of continental shelf deposits on the Pacific coast of Honshu (Hoshino, M. 1960). In comparison with those sediments of Suruga Bay and Japan sea (Hamaguchi, H. 1953), this sample shows lower content of organic nitrogen than the former.

8. C-N Ratio.

The ratio of organic carbon to organic nitrogen is very important in consideration of environment of sedimentation. When organisms in sediments are animal, the ratio is low; on the other hand, if it contains much plants or terrestrial organisms, the ratio tends to be high.

In this sample, the ratio is found to be as high as 11 which is almost equal to that of continental shelf deposit.

Since the terrestrial organisms contained in the sample might be less, most of them should consist of plants.

4. Summary.

This sample was collected at the depth of 7065 meters, about 15 centimeters below the bottom surface, it is fine terrigenous deposit containing silicious shells and skeletons; its silica content is about 10 % higher than ordinary blue mud, and aluminum content is higher than the near-shore sediments because it is very fine.

Manganese and phosphorus contents are very low, for the environment of sedimentation may not be suitable to precipitation of oxidates.

Most of organisms in this sample may be plants, because the ratio of organic carbon to organic nitrogen is high. As the upper layer water is

rich of nutrients and plankton, and as temperatures of deep and bottom water are very low, of 1.5°C, so there are abundant organisms of 1 % as organic carbon in this sample.

Acknowledgment

The authors would express thanks to Dr. Y. Miyake, Dr. M. Hoshino and Mr. T. Sato concerning for their helpful suggestions.

References

- Hamaguchi, H. 1939, Bull. Chem. Soc. Japan, Vol. 61, No. 1.
Hamaguchi, H. 1952, Bull. Chem. Soc. Japan, Vol. 74, No. 6.
Hamaguchi, H. 1952, Bull. Chem. Soc. Japan, Vol. 74, No. 12.
Hamaguchi, H. 1953, Bull. Chem. Soc. Japan, Vol. 74.
Hoshino, M. et al. 1960, Soc. Japan, Vol. 16, No. 2 Jour. Ocean.
Ikeda, N. 1952, Bull. Chem. Soc. Japan, Vol. 73.
Ikunuma, I. & Kobayashi, K. 1957, Hydro. Bull. No. 54.
Iwasaki, I. Experimental chemistry, Vol. 1, No. 9.
Kiba, T. 1958, Chemistry and chemical industry, Vol. 11, No. 9.
Pettersson, H. Reports of the Swedish Deep Sea Expedition, 1947-1948.
Tatsumoto, M. 1952, Bull. Chem. Soc. Japan, Vol. 74, No. 12.