X. BOTTOM SEDIMENTS

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Method of investigation

Sediment samples recovered from the surveyed area are represented by 4 samples by dredges, 16 samples by Okean-70 grab and 3 samples by piston corer (Table X-1). In this article, a larger part of description is given to the observation results on the samples by the grab obtained through nearly the whole area. The Okean-70 grab could take undisturbed samples of bottom sediments in most cases. For observation of the sequence in the uppermost 30 cm thick part of surficial sediments recovered by the grab, a sampling cylinder of venyl chrolide with an inside diameter of 120 mm was penetrated into the sediments in the grab to obtain a column of undisturbed samples, immediately after recovering the grab on board. After careful observation on the columnar samples thus obtained, each of the samples were cut every 5 or 10 cm to examine the composition. Samples thus cut were washed with a 250 mesh sieve, and the volume ratio of the materials that remained on sieve to bulk samples were calculated. Furthermore, the residues on the sieve were observed under the microscope to examine the relative ratio of the

Table X-1 Sampling stations and results of observation.

St. No.	Sample No.	Depth (m)	Sediments
111	D50	1,340	Calcareous ooze, with manganese crust
112	D51	2,900	Calcareous ooze, with manganese crust
113	D52	1,660	Calcareous ooze, with manganese crust
114	P12	5,000	Siliceous-calcareous ooze
115	G39	5,190	Siliceous ooze/Siliceous-calcareous ooze
117	G40	4,950	Siliceous-calcareous ooze
121	G42	5,450	Siliceous ooze/Siliceous clay, with Mn-n of 19 kg/m^2
122	D53	5,635	Siliceous clay, with Mn-n. of 9 kg/m^2
124	G43	5,200	Siliceous clay, with Mn-n. of 8.5 kg/m^2
125	D54	5,170	Siliceous ooze, with Mn-n. of 11 kg
126	G44	5,010	Siliceous-calcareous clay, with Mn-n. of 15 kg/m^2
127	P13	5,230	Dark brown clay
128	D55	2,880	Calcareous ooze, with manganese crust
129	G45	5,259	Siliceous ooze, with Mn-n. of 12 kg/m^2
130	G46	5,270	Siliceous ooze, with Mn-n. of 0.1 kg
131	G47	5,228	Siliceous clay/Siliceous ooze, with Mn-n. of trace
132	G48	5,164	Siliceous-calcareous ooze, with Mn-n. of 14 kg/m^2
133	G49	5,277	Siliceous ooze/Siliceous clay, with Mn-n. of 2 kg/m^2
134–1	G50–2	5,524	Siliceous clay/Siliceous ooze, with Mn-n. of trace
136	G51	5,338	Siliceous ooze/Siliceous clay, with Mn-n. of trace
138	P14	5,480	Siliceous ooze/Clay, with Mn-n. of trace
142	G52	5,150	Siliceous clay, with Mn-n. of 1 kg/m^2
143	G53	5,152	Siliceous-calcareous ooze, with Mn-n. of 26 kg/m^2
144	G54	5,300	Siliceous clay/Clay, with Mn-n. of 7 kg/m^2
145	G55	4,930	Siliceous-calcareous ooze/Calcareous clay, with Mn-n. of 1 kg/m^2
146	G56	5,610	Siliceous clay/Clay, with Mn-n. of 5 kg/m^2
147	P15	5,356	Clay, with Mn-n. of trace

contents of siliceous and calcareous remains and minerals. Based on the results by above-mentioned procedure, the types of sedimentary facies of deep sea sediments were identified, following Frazer et al. (1972).

Characteristics and distribution of sediments on the sea floor

On the basis of the results of compositional analysis on board, the sediments of this area were classified as follows: 1) calcareous ooze, 2) siliceous ooze and/or clay, 3) siliceous-calcareous ooze and/or clay and 4) deep sea clay.

Fig. X-1 shows the horizontal distribution of sedimentary facies types, being modified from Frazer et al. (1972). As shown in the figure, *calcareous ooze* is distributed on and near the seamounts and guyots situated in the eastern and northern parts of the surveyed area. The calcareous ooze is composed of numerous remains of planktonic foraminifera and is represented by coarse-grained foraminiferal sand of a white color. It includes pumice less than 3 cm in size, with a greyish brown color. The semiconsolidated aggregations of foraminiferal grains are also included in the sample from St. 128.

Siliceous ooze and/or clay are widely distributed on the central and southwestern parts of the surveyed area. In such sediments, the residues on 250 mesh sieve occupy approximately 30% for the bulk amount of each analyzed sample. The residues mainly consist of the remains of siliceous organisms of transparent or brownish colored radiolaria.

Siliceous-calcareous ooze and/or clay are found, roughly speaking, in the boundary area between calcareous and siliceous zones, and are rather widely distributed particularly in the eastern half of the area. The sediments have a brownish color. White spots of foraminifera are observed on the surface or on the cutting plane of some samples.

Deep sea clay is distributed in the northwestern corner of the area, extending to the northwest, and in a narrow belt in north-central part of this area. It is dark brown in color. The residues on the 250 mesh sieve are irregularly shaped and consist of angular

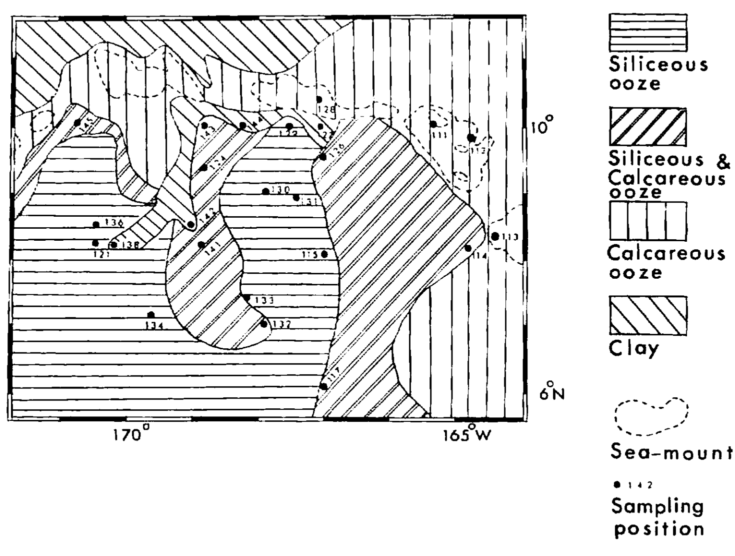

Fig. X-1 Distribution map of bottom sediments on the eastern part of Central Pacific Basin (modified from Frazer et al., 1972).

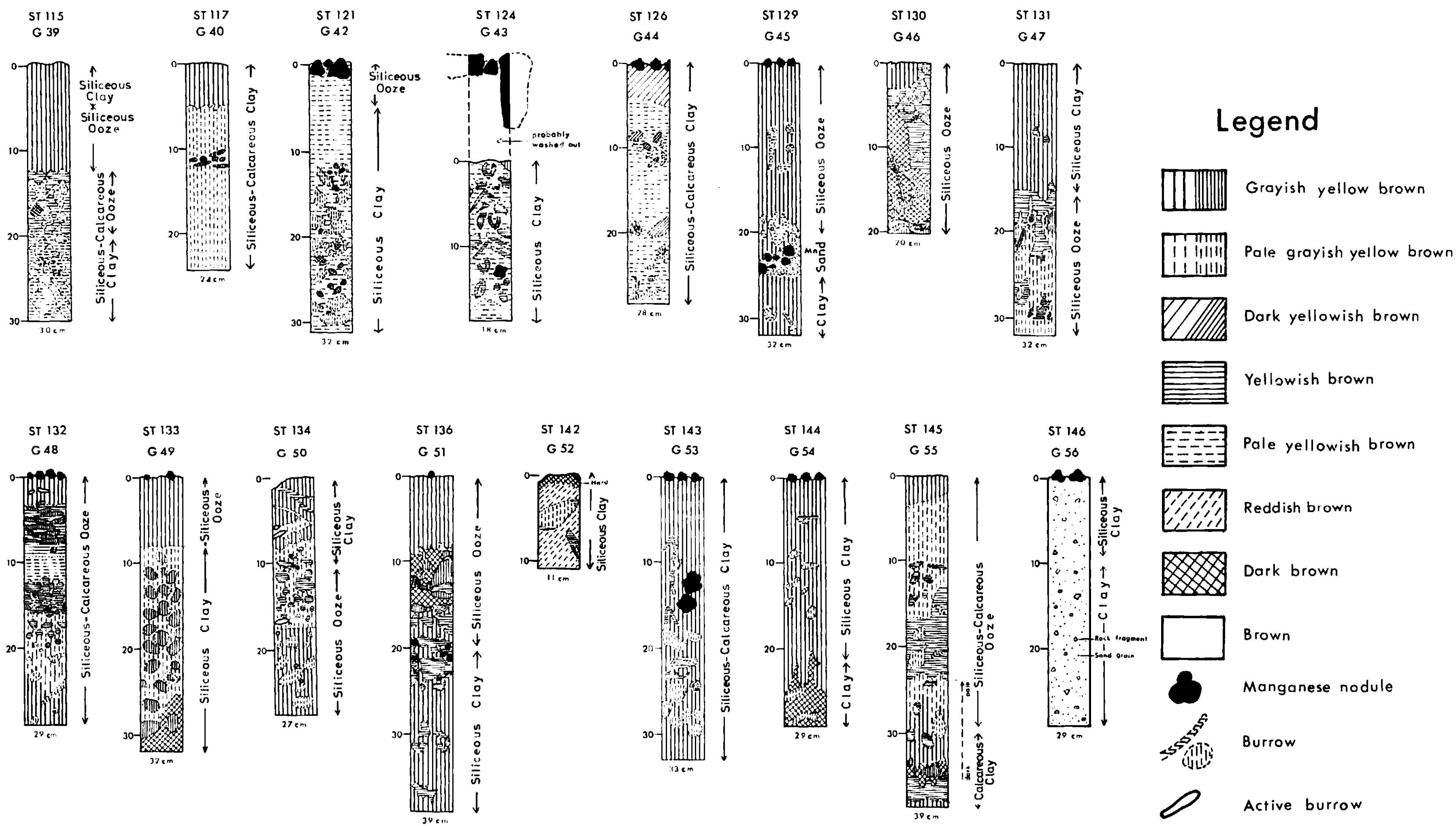

Fig. X-2 Columnar sections of samples by Okean-70 grab.

minerals which is transparent, white, or reddish and black color.

Vertical sequence in grab samples

Fig. X-2 shows the columnar section of sediments collected by the Okean-70 grab, and the results of compositional analyses on every 5 cm thick samples in each column are summarized in Fig. X-3. As obviously seen in Fig. X-2, the uppermost part (about 10 cm thick) in the columns as generally of a homogeneous color, and the lower part has strong colour variations, due to many burrows of organisms and the latter clearly shows

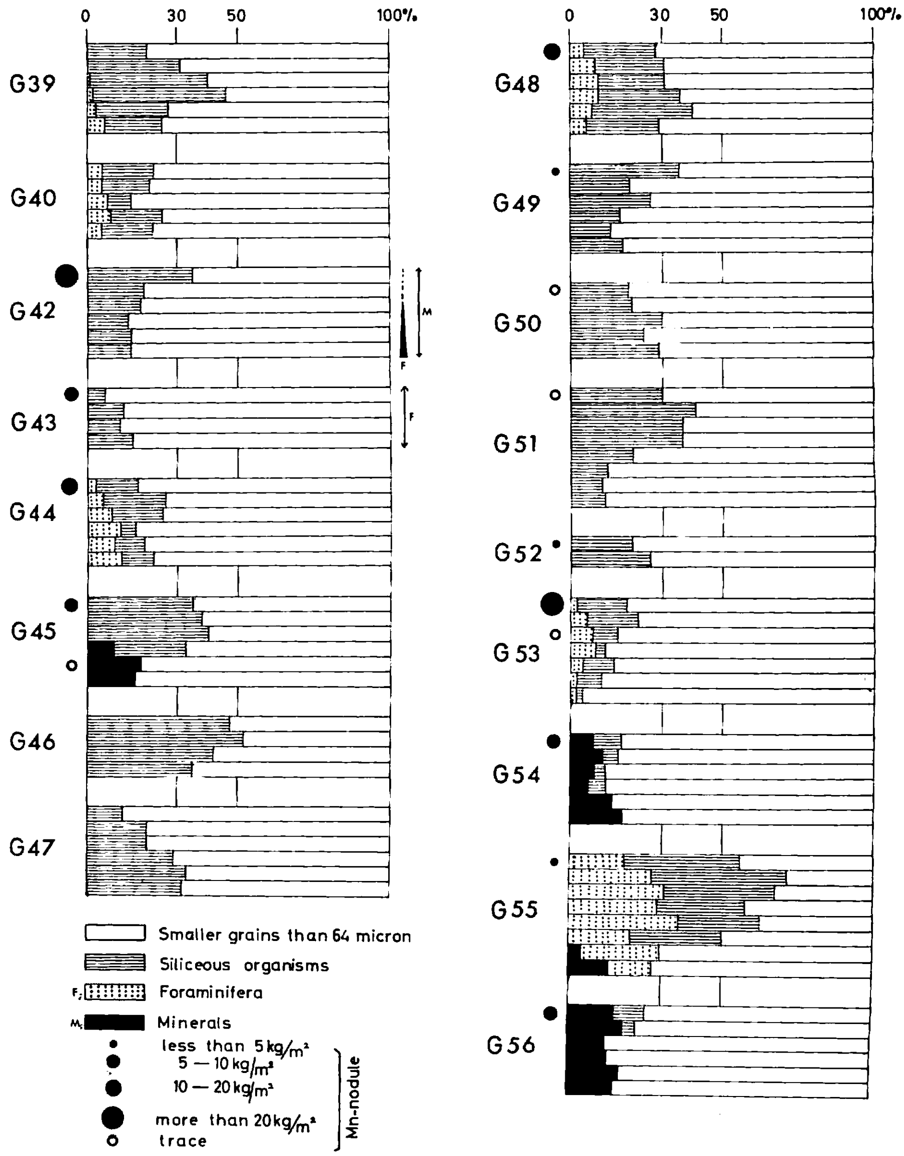

Fig. X-3 Compositional sequence in each grab sample.

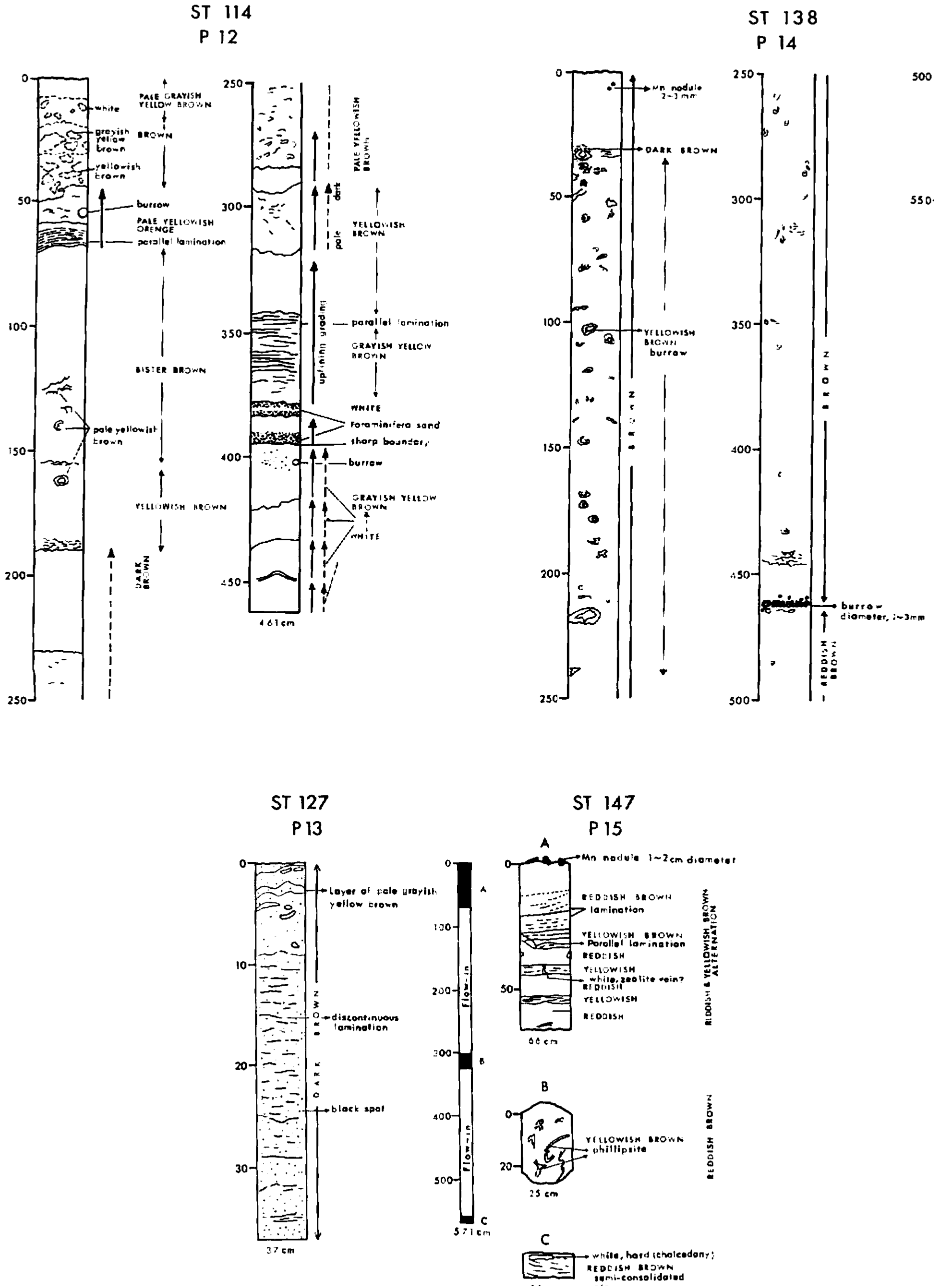

Fig. X-4 Columnar sections of piston cores, including one gravity core (St. 127).

bioturbation*. Consequently, the sediments of the lower part of the column show the complex color pattern.

Fig. X-3 implies that the volume ratio of coarser materials greater than 64 microns are less than 30% in siliceous clay and siliceous-calcareous clay, 30–70% in siliceous ooze and siliceous-calcareous ooze and less than 20% in deep sea clay.

Shark's teeth, rounded pumice fragments and benthic foraminifera were observed in the residues on the 3 mm mesh sieve about each of the samples. From microscopic observation, the color change in the sediments is likely to be caused by the difference of the abundance of stained radiolarian tests included within the sediment.

Vertical sequence in piston cores

Figs. X-4, 5 demonstrates the characteristics of the piston cores including those from the northwest to the surveyed area.

The upper part (about 50 cm thick from surface) of the core samples of *St. 114* consists of siliceous-calcareous ooze, and the underlying about 2 m thick part is represented by clay. The lower half of the core is represented by siliceous ooze, partly intercalated with calcareous ooze. In siliceous ooze part, turbidite-like sedimentary structures of grading and parallel lamination are well preserved. The coarser grains in the graded beds consist of foraminifera and manganese micro-nodules. Throughout the core the quantity of residues on the 250 mesh sieve tends to decrease upwards in general, but it rapidly increases in the uppermost part of the core, and also the color of the sediment change gradually upwards from a pale to dark brownish color.

The short core of *St. 127* obtained by gravity corer consists of dark brown clay which has the residue on 250 mesh sieve less than 30%.

The core of *St. 138* consists of rather uniform clay, brown (in the upper part) and reddish brown (in the lower part) in color, including many burrows which are yellowish brown in color. Residues on the 250 mesh sieve occupy only less than 15% throughout the core and they have a very small amount of *Radiolaria*. Manganese micro-nodules are also found in the uppermost part of the core.

Relationship between the distribution of sediments and manganese nodules

Fig. X-3 shows an interesting general tendency between the relation of the population density of manganese nodules and sedimentary facies type in the surveyed area. As shown in the figure, it is clearly shown that manganese nodules are very scanty or lacking in areas of siliceous ooze and clay but are densely concentrated on the bottom surface of siliceous-calcareous clay which is including foraminiferal remains of less than 5%.

Clay minerals

Nine sediment samples were preliminarily observed by X-ray diffraction for the determination of clay mineral by S. Aoki. The clay fraction finer than 2 micron was collected by sedimentation techniques. Some of the analytical results are shown in Fig. X-6. According to S. Aoki, clay minerals such as illite, montmorillonite, chlorite and kaolinite were identified in all of the samples. Non-clay minerals such as quartz and feldspar were also observed in most of the samples and calcite in several samples.

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*Activities of benthic animals were also evidenced by deep sea photography as shown in another chapter of the present cruise report.

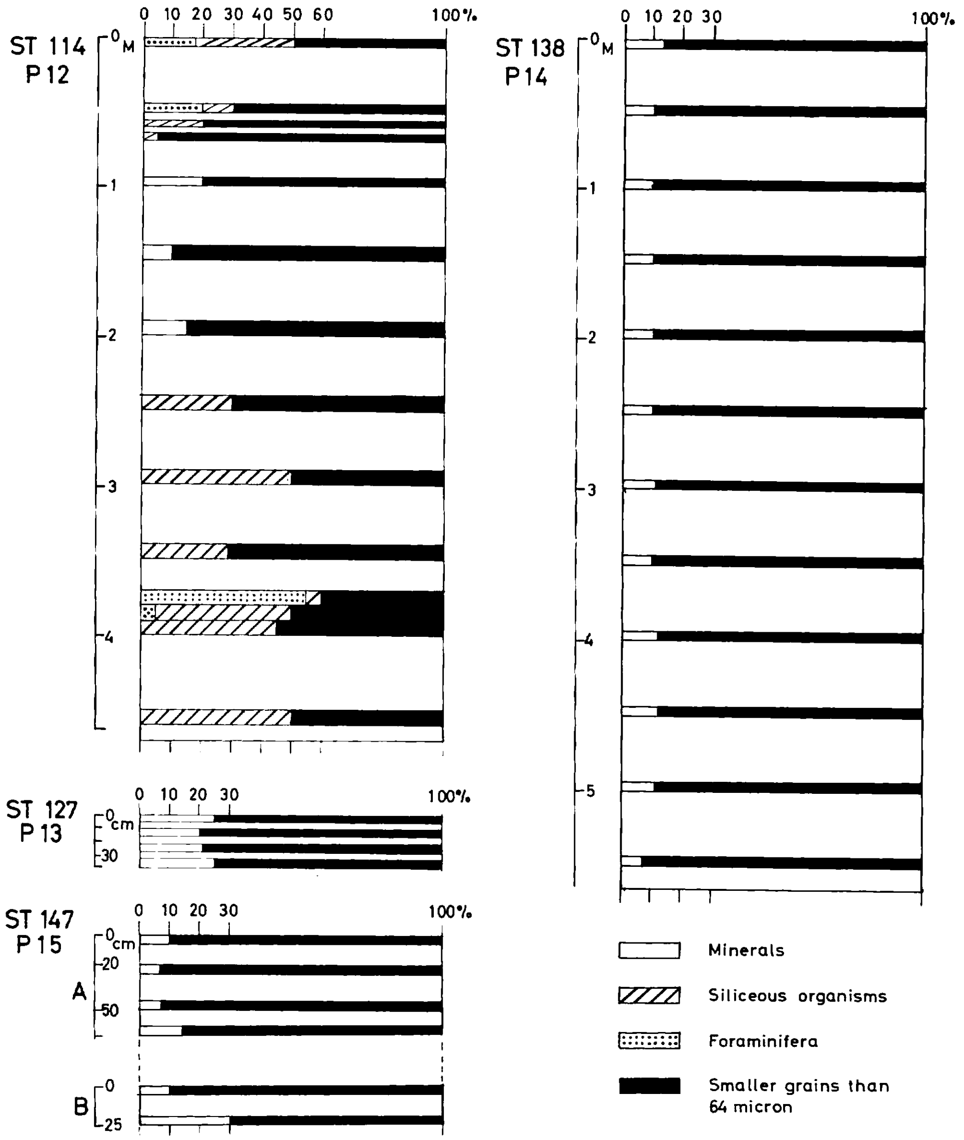

Fig. X-5 Compositional sequence in core samples.

The distribution of clay minerals varies from sample to sample. Roughly speaking, however, illite is the most predominant constituent in the larger part of samples. Chlorite is also an important constituent in all of samples. Kaolinite is, however, not significant. The detailed results of the study will be described elsewhere by S. Aoki.

Two samples in the northwest of the surveyed area

Two samples were collected at the stations on the way to Japan from the surveyed area:

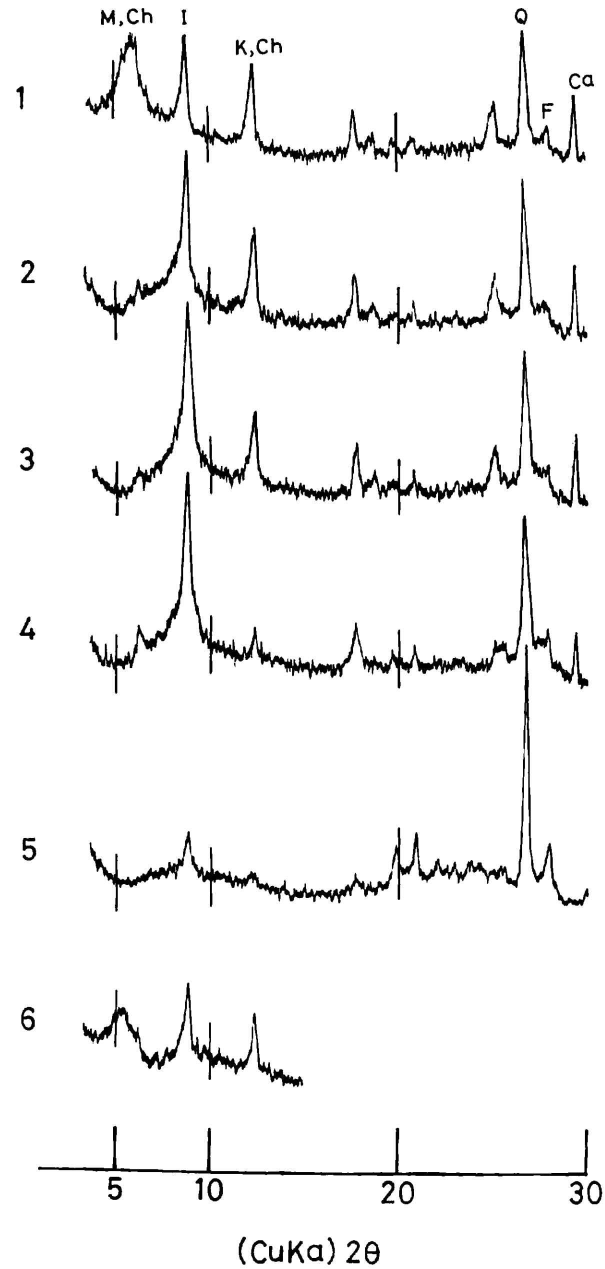

Fig. X-6 X-ray diffraction patterns of samples at St. 126.
1: untreated, 2: heated at 300°C for 1 h, 3: heated at 450°C, 4: heated at 550°C, 5: treated with hydrochloric acid, 6: treated with ethylene glycol, M: montmorillonite, C: chlorite, I: illite, K: kaolinite, Q: quartz, F: feldspar, Ca: calcite.

one came from a depth of 5,610 m (St. 146; 13°06.9'N, 173°59, 3'W) by Okean-70 grab and another from a depth of 5, 356 m (St. 147; 16°08.8'N, 177°10.9'W) by piston corer.

The sample of St. 146 is clay and the residues on the 250 mesh sieve consist of more than 20% of minerals. Zeolite, manganese micro-nodules and irregularly angular basalt fragments are observed in the residues.

The piston core sample collected from St. 147 is reddish brown in colour. Bedding structures were observed in the upper part (column A in Fig. X-4, St. 147), and veinlets of philipsite and chalcedony are present in the lower part (column B in the same figure). The lower part of the core is represented by hard semi-consolidated sediment. The volume ratio of residues on the 250 mesh sieve from this part measured less than 10%, and are characteristically composed of zeolite characteristically.

Acknowledgment: The author is greatly indebted to Dr. Saburo Aoki for his examination and data citation on the clay minerals.

Reference

Frazer, J. Z., Hawkins, D. L., Arrhenius, G., et al. (1972): *Surface sediments and Topography of the North Pacific* (*Chart Tr–34*). La Jolla. Inst. of Marine Resources, Univ. Calif. at San Diego.