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XI. THE VERTICAL CHANGE OF THE CLAY MINERAL COMPOSITION IN SOME DEEP-SEA CORES RAISED FROM THE NORTHERN PART OF THE CENTRAL PACIFIC BASIN

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Samples and Method of Study

Samples for clay mineral analysis were selected at interval of about 30 cm from each core, P192, P198, and P204 and the total number of the selected samples amounted to 65. Each sample was first dispersed in distilled water and then the clay fractions less than 2 μm were collected by sedimentation. Quantitative and qualitative estimations of clay minerals are based on the methods reported by SUDO *et al.* (1961) and OINUMA (1968). The amount of each clay mineral is expressed as the percent of the total amount of clay minerals. The content of quartz was obtained from the quantitative curve which was made by X-ray diffraction intensity of the standard sample of quartz. The relative amount of clinoptilolite was measured by the intensity of the peak at 9.0 Å in X-ray dffractogram.

Results and Discussion

Analytical results of clay minerals in the sediment cores studied have shown the presence of smectite, illite, chlorite, and kaolinite. Non-clay minerals such as quartz, feldspar, calcite, and clinoptilolite were also identified. The following describes the vertical change of the clay mineral compositions in the three cores.

P192 (Fig. XI–1)

The continuous magnetic record of the core is not clear. The core exclusively contains smectite, which is 89% on the average. All samples except for one sample (55% smectite) at 170 cm from the top of the core contain more than 70% smectite. The vertical change of smectite concentration is not recognized except for the sample at 170 cm which shows relatively low concentration of smectite. The average content of other clay minerals is 5% illite, 4% chlorite, and 1% kaolinite.

P198 (Fig. XI–2)

The continuous magnetic record is recognized in the Quaternary sediments. From the lowest part of the core to the Olduvai event the concentration of smectite gradually decreases to the younger sediments and the tendency continues even after the Jaramillo event. On the other hand, from the older sediments to the younger ones the contents of illite and chlorite increase.

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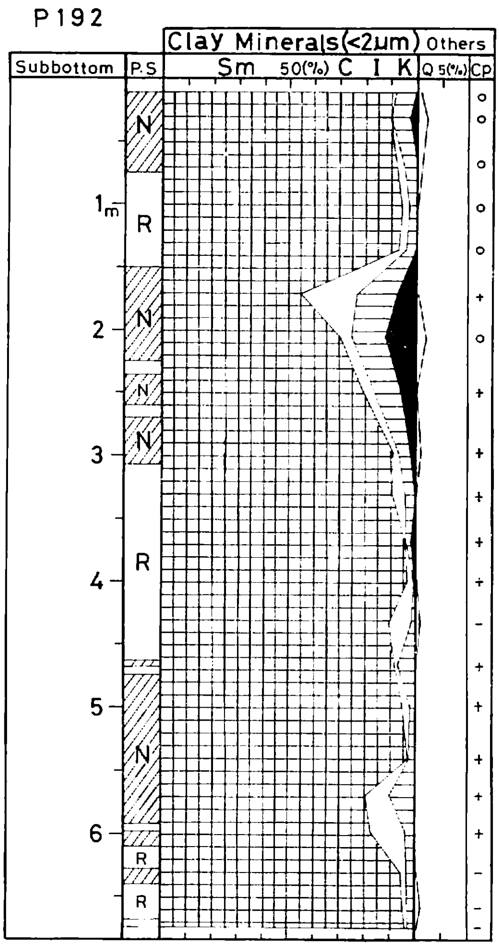

Fig. XI–1 Vertical change of clay mineral composition in P192. Sm: smectite C: chlorite I: illite K: kaolinite Q: quartz Cp: clinoptilolite P.S.: paleomagnetic stratigraphy N: normal epoch R: reversed epoch

P204 (Fig. XI–3)

The lowest part of the core contains microfossils indicating to the age of the lower to middle Miocene, though the paleomagnetic record is not clear. The part of the bottom of the core to about 150 cm long is almost dominated by smectite which shows the highest concentration in the Miocene. However, the concentration of smectite tends to decrease since the Miocene and reachs about 30% in the upper part. On the other hand, the abundances of illite and chlorite tend to increase to the upper part. The content of kaolinite is of little importance throughout the core.

The two cores, P198 and P204 have shown the vertical changes of the clay mineral compositions that the abundance of smectite shows the highest in the Miocene to Pliocene and tends to decrease to the younger sediments while those of illite and chlorite tend to increase to the Quaternary age. Increase of smectite abundance and

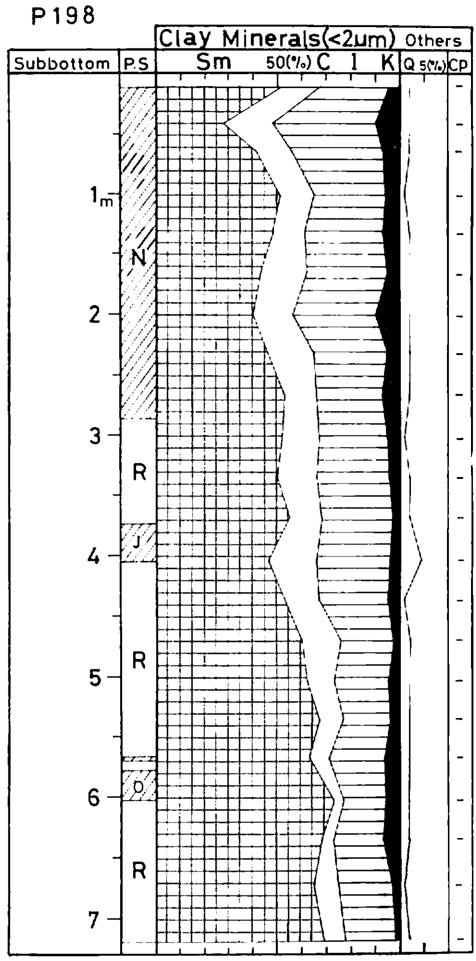

Fig. XI–2 Vertical change of clay mineral composition in P198. Sm: smectite C: chlorite I: illite K: kaolinite Q: quartz Cp: clinoptilolite P.S.: paleomagnetic stratigraphy N: normal epoch R: reversed epoch J: Jaramillo event O: Olduvai event

decrease of illite and chlorite concentrations have continued during the Quaternary age.

There are two possible explanations on the vertical change of the clay mineral compositions in the deep-sea sediment cores. One is the case that a diagenetic effect occurred in sediment cores and as a result the clay mineral composition changed. However, this idea has not been supported by many workers. The other explanation is based on the change of climate which followed to the enhancements of continental weathering, glaciation, surface run-off, and wind activity as suggested by Jacobs and Hays (1972).

In addition to these factors pointed out by them, the author considers that volcanic activity on land or at submarine close to the study area is also an important factor controlling the vertical change of the clay mineral composition in the present cores. This inference is based on the mineral composition as seen in P192 of which is com-

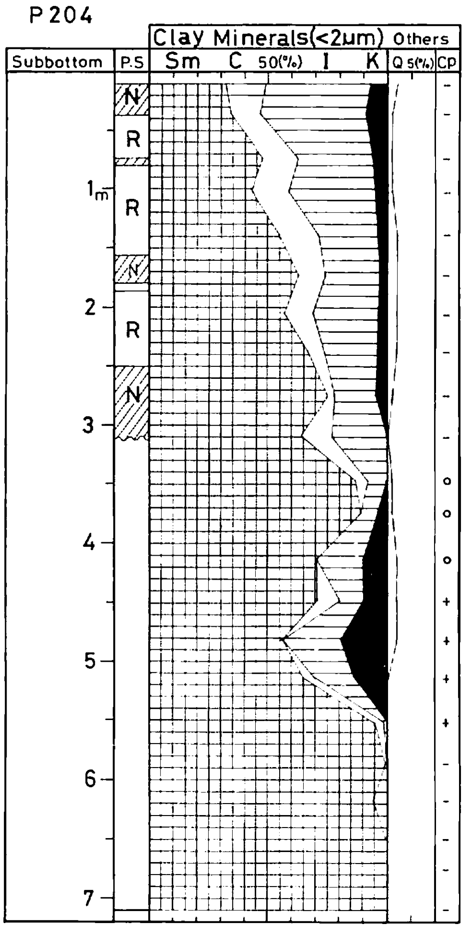

Fig. XI-3 Vertical change of clay mineral composition in P204. Sm: smectite C: chlorite I: illite K: kaolinite Q: quartz Cp: clinoptilolite P.S.: paleomagnetic stratigraphy N: normal epoch R: reversed epoch

posed exclusively smectite and abundant zeolite-clinoptilolite.

The co-existence of smectite and clinoptilolite strongly suggests them to have been formed under submarine volcanoes. BONATTI (1967) reported that zeolite-phillipsite and smectite in the south Pacific deep-sea sediments were formed under submarine volcanic activity.

Volcanic activity of the area study under consideration had continued during the Paleogene to Miocene and become fainter in the Pliocene (MENARD, 1964; OPDYKE and FOSTER, 1970).

In summary, the enrichment of smectite abundance in the Tertiary sediments is closely related to volcanic activity and it is decreased in the younger sediments by a dilution effect of detrital clay minerals such as illite, chlorite, and kaolinite which were transported by windborne and currents from continents where weathering, glaciation, surface run-off, and wind activity have been enhanced by the change of climate since late-Cenozoic era as suggested by JACOBS and HAYS (1972).

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