DEPARTMENT OF INTERIOR

U.S. GEOLOGICAL SURVEY

# DATA ON THE GEOCHEMISTRY OF PELAGIC CLAY ON THE ABYSSAL PLAIN SURROUNDING SHIMADA SEAMOUNT, EASTERN EQUATORIAL NORTH PACIFIC

by

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## INTRODUCTION

The U.S. Geological Survey conducted a cruise on the R/V Sea Sounder (Cruise S1-79) to Shimada Seamount (17°N, 117°W; Figs. 1 and 2) to investigate the geologic, petrologic, magnetic, and bathymetric characteristics of the seamount as well as the sediments on the surrounding abyssal plain. On this cruise, seismic-reflection, 3.5 KHz and 12 KHz bathymetric, gravity, and magnetic surveys were run over the seamount and surrounding area. Gravity and piston cores of pelagic clay were collected from five stations on the abyssal plain surrounding the seamount (Fig. 2; Table 1). The geologic, petrologic, and magnetic characteristics of Shimada Seamount were described by Gardner and others (1984). The purpose of this report is to present geochemical data on 46 samples of pelagic clay from the abyssal plain surrounding the seamount.

Table 1. Summary of cores collected from abyssal plain surrounding Shimada Seamount. G, gravity core; P, piston core

| Core | Water Depth (m) | Latitude | Longitude | Recovery |
|---|---|---|---|---|
| G1 | 3,910 | 16° 48′N | 117° 56′W | 355 cm pelagic clay |
| G3 | 3,810 | 16° 27′N | 117° 47′W | 240 cm pelagic clay with Mn nodules at top |
| G5 | 3,913 | 17° 17′N | 117° 07′W | 418 cm pelagic clay with thin glass layer at top |
| P2 | 3,919 | 17° 22′N | 117° 42′W | 790 cm pelagic clay |
| P3 | 3,970 | 18° 08′N | 117° 31′W | 680 cm pelagic clay |

The area around Shimada Seamount is of particular sedimentologic and geochemical interest because it is located just north of the north equatorial Pacific biosiliceous sedimentary province and at the eastern end of the metal-rich North Pacific ferromanganese nodule province (Fig. 1). One core recovered ferromanganese nodules, and bottom photography revealed that nodules are present over much of the area around the seamount. The sediments and ferromanganese nodules within this metal-rich province have been the subjects of intensive investigations as part of the Deep Ocean Mining Environmental Studies (DOMES) program (Bischoff and Piper, 1979). In addition, the observations that Shimada Seamount is a young volcanic feature, that altered basalt was recovered in core catchers of several cores, and that a thin layer of basaltic glass was recovered at the surface of one core suggest that volcanism that built the seamount may have affected the sediments around the base of the seamount and beyond.

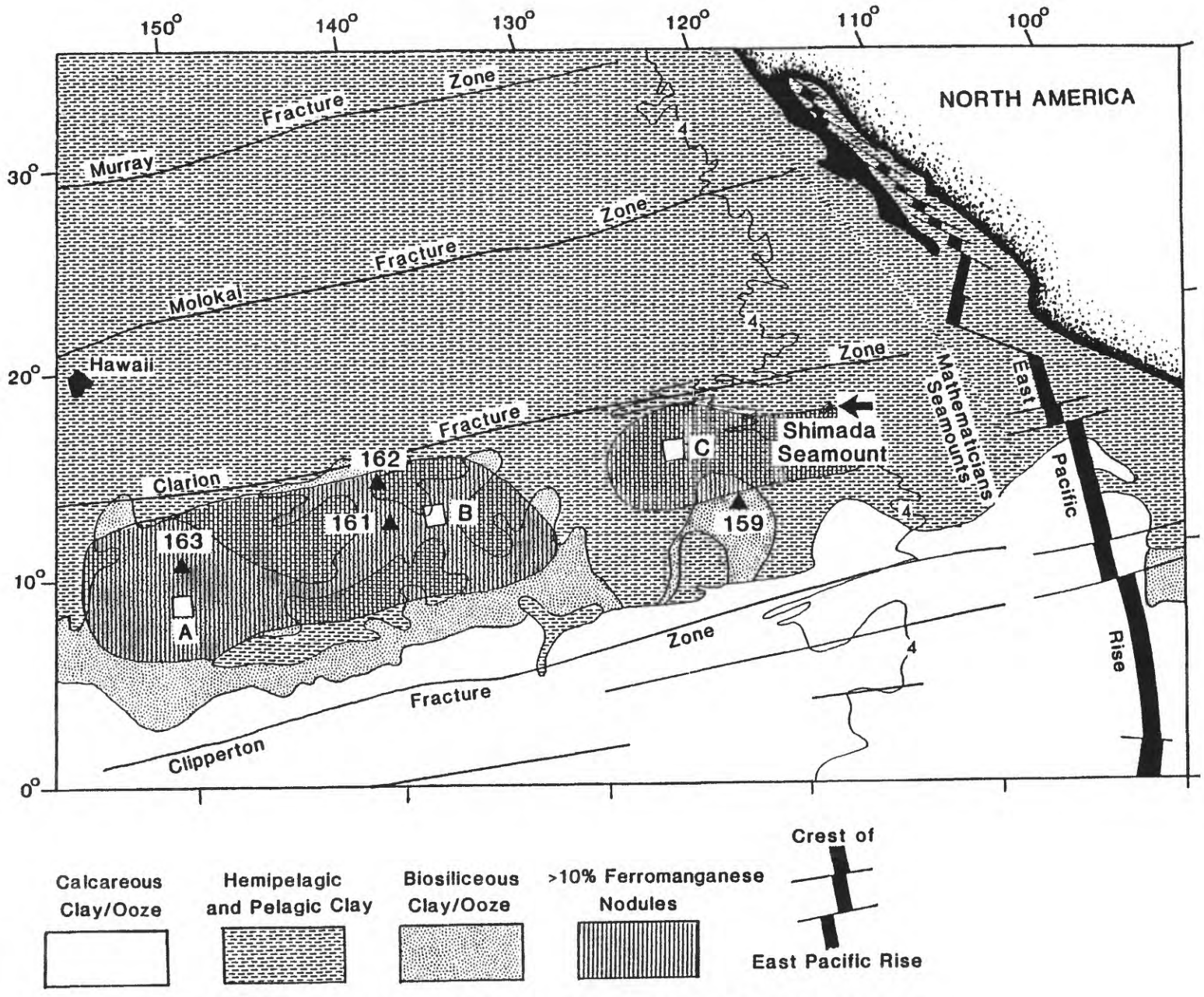


Figure 1. Map showing location of Shimada Seamount, sediment types, the extent of the eastern North Pacific nodule province, key structural and topographic features, the locations of Deep Ocean Environmental Mining Studies (DOMES) sites A, B, and C, Deep Sea Drilling Project (DSDP) sites 159, 161, 162, and 163, and the four kilometer isobath. Modified from Circum-Pacific Council for Energy and Mineral Resources (1985).

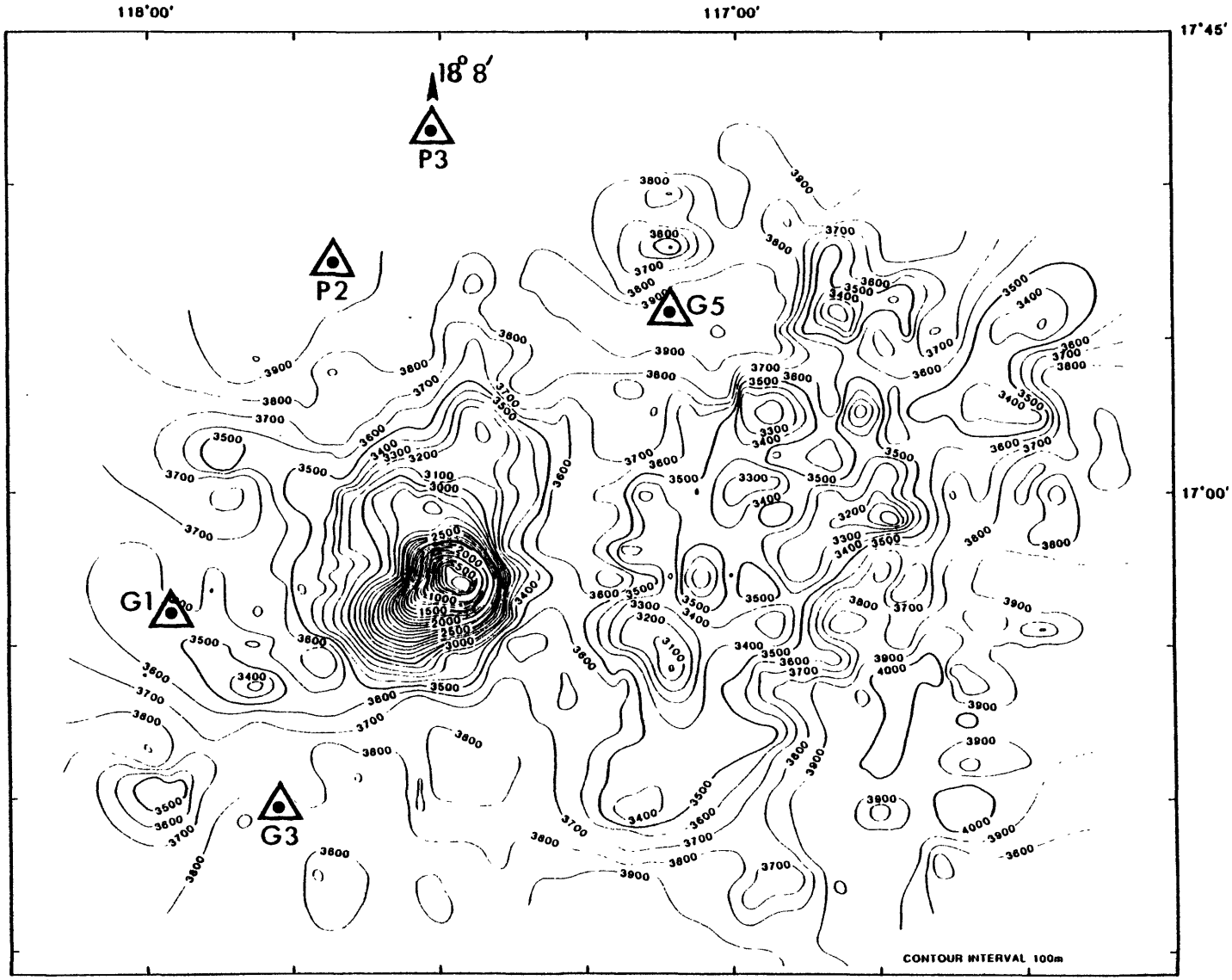


Figure 2. Map showing bathymetry of Shimada Seamount (Gardner and others, 1984) and locations of cores used in this study.

## METHODS

Five cores of pelagic clay were collected from five different stations around Shimada Seamount (Fig. 2; Table 1). The recovered sections range in thickness from 240 to 790 cm (Table 1). The five cores (G1, G3, G5, P2, and P3) were sampled at 50-cm intervals for chemical analyses.

Samples were air dried and ground in a ceramic mill to pass a 100-mesh (149μm) sieve. From a total of 46 samples, four were chosen at random for duplicate analyses. All 50 analytical samples (46 samples plus 4 duplicates) were submitted in a random sequence to the analytical laboratories of the U.S Geological Survey, Denver. Total carbon (TC) and total sulfur (TS) were measured using the LECO induction-furnace gasometric method. Concentrations of ten major and minor elements (Si, Al, Fe, Mg, Ca, Na, K, Ti, P, and Mn) were measured by X-ray fluorescence spectrometry (Taggert and others, 1981). Concentrations of 19 trace elements (B, Ba, Be, Co, Cr, Cu, Ga, La, Mo, Nb, Ni, Pb, Sc, Sn, Sr, V, Y, Zn, and Zr) were determined by semiquantitive optical emission spectrometry (Miesch, 1976).

Because the samples were air dried, concentrations of Na, Mg, and S as measured in the bulk sample are too high owing to Na, Mg, and $SO_4$ dissolved in interstitial water and left as a residue on evaporation. To correct these values, Cl was measured by specific ion electrode. We assumed that all of the Cl was due to Cl dissolved in the interstitial seawater, and that this interstitial seawater contained the same proportions of Na, Mg, S, and Cl as average seawater. Contributions of Na, Mg, and S from interstitial seawater were subtracted from the analytical values determined on the bulk sample.

## RESULTS

Results of analyses for major, minor, and trace elements are presented in Table 2. Average values of major- and minor-element oxides, loss on ignition (LOI) at 900°C, and trace elements are given in Table 3 along with values for Pacific pelagic clay, sediments from the DOMES manganese-nodule areas in the east central Pacific (Fig. 1), metalliferous sediment from Bauer Basin, and average basaltic glass dredged from Shimada Seamount.

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Table 2. Geochemical analyses of sediments on the abyssal plain surrounding Shimada Seamount.

| Sample | % $SiO_2$ | % $Al_2O_3$ | % $Fe_2O_3$ | % MgO | % CaO | % $Na_2O$ |
|---|---|---|---|---|---|---|
| P2-000cm | 47.89 | 12.8 | 7.61 | 3.2 | 1.41 | 4.2 |
| P2-050cm | 47.29 | 12.4 | 7.69 | 3.2 | 1.41 | 4.5 |
| P2-100cm | 50.19 | 13.3 | 7.73 | 3.4 | 1.46 | 4.4 |
| P2-150cm | 49.69 | 13.1 | 8.11 | 3.3 | 1.63 | 4.4 |
| P2-200cm | 48.59 | 12.8 | 8.37 | 3.2 | 1.55 | 4.2 |
| P2-250cm | 48.79 | 13.2 | 7.55 | 3.5 | 1.38 | 4.8 |
| P2-300cm | 49.39 | 13.1 | 8.64 | 3.2 | 1.86 | 4.3 |
| P2-350cm | 48.69 | 13.2 | 8.02 | 3.2 | 1.60 | 4.0 |
| P2-400cm | 49.59 | 13.4 | 8.41 | 3.3 | 1.50 | 4.2 |
| P2-450cm | 49.59 | 13.6 | 8.38 | 4.1 | 1.42 | 4.2 |
| P2-500cm | 48.49 | 13.0 | 8.72 | 3.3 | 1.41 | 4.5 |
| P2-550cm | 47.99 | 12.5 | 8.84 | 3.3 | 1.43 | 4.4 |
| P2-550cm | 48.19 | 12.5 | 8.88 | 3.3 | 1.46 | 4.4 |
| P2-600cm | 47.49 | 12.2 | 9.13 | 3.4 | 1.61 | 4.4 |
| P2-650cm | 47.59 | 12.5 | 8.75 | 3.4 | 1.45 | 4.4 |
| P2-700cm | 46.69 | 11.7 | 9.42 | 3.6 | 1.82 | 4.8 |
| P2-750cm | 46.79 | 11.5 | 9.77 | 3.7 | 1.79 | 4.5 |
| P3-000cm | 50.39 | 14.4 | 7.33 | 3.2 | 1.50 | 3.7 |
| P3-100cm | 50.69 | 14.9 | 7.09 | 3.3 | 1.66 | 3.6 |
| P3-150cm | 51.69 | 15.1 | 7.30 | 3.3 | 1.67 | 3.3 |
| P3-200cm | 49.19 | 14.0 | 7.56 | 3.3 | 1.46 | 3.7 |
| P3-250cm | 48.39 | 13.8 | 7.73 | 3.3 | 1.46 | 3.7 |
| P3-300cm | 49.19 | 13.9 | 7.67 | 3.3 | 1.49 | 3.7 |
| P3-300cm | 49.09 | 13.9 | 7.83 | 3.3 | 1.47 | 3.7 |
| P3-347cm | 49.59 | 14.1 | 7.53 | 3.3 | 1.53 | 3.8 |
| P3-400cm | 49.19 | 14.0 | 7.37 | 3.3 | 1.51 | 3.9 |
| G1-035cm | 46.99 | 11.2 | 10.40 | 3.3 | 1.37 | 4.8 |
| G1-085cm | 43.49 | 10.8 | 12.10 | 3.4 | 1.50 | 5.1 |
| G1-135cm | 47.39 | 12.7 | 10.20 | 3.4 | 1.47 | 4.9 |
| G1-185cm | 49.09 | 13.6 | 8.31 | 3.2 | 1.91 | 3.8 |
| G1-235cm | 50.49 | 13.7 | 8.26 | 3.3 | 1.66 | 3.7 |
| G1-236cm | 50.19 | 13.6 | 8.23 | 3.2 | 1.65 | 3.8 |
| G1-285cm | 49.39 | 12.9 | 8.35 | 3.3 | 1.49 | 4.1 |
| G1-335cm | 49.49 | 13.2 | 8.52 | 3.4 | 1.34 | 4.2 |
| G3-000cm | 46.69 | 11.9 | 9.07 | 3.3 | 1.70 | 4.5 |
| G3-000cm | 46.89 | 12.0 | 9.20 | 3.3 | 1.71 | 4.5 |
| G3-065cm | 48.49 | 12.9 | 8.85 | 3.4 | 1.67 | 4.3 |
| G3-115cm | 46.99 | 12.0 | 9.41 | 3.3 | 1.63 | 4.3 |
| G3-165cm | 45.39 | 11.3 | 9.74 | 3.4 | 2.20 | 4.6 |
| G3-215cm | 44.19 | 10.3 | 9.95 | 3.5 | 2.12 | 5.2 |
| G5-000cm | 47.79 | 11.9 | 9.61 | 3.4 | 1.56 | 5.2 |
| G5-050cm | 42.69 | 10.9 | 9.26 | 3.2 | 1.58 | 4.5 |
| G5-100cm | 47.09 | 11.4 | 8.99 | 3.4 | 1.57 | 5.6 |
| G5-100cm | 46.99 | 11.4 | 9.14 | 3.5 | 1.52 | 5.9 |
| G5-147cm | 46.19 | 12.2 | 10.40 | 3.4 | 1.63 | 4.8 |
| G5-200cm | 47.49 | 12.0 | 9.73 | 3.4 | 1.57 | 5.0 |
| G5-250cm | 46.89 | 12.5 | 10.20 | 3.4 | 1.47 | 4.5 |
| G5-297cm | 46.99 | 11.9 | 9.78 | 3.5 | 1.58 | 5.4 |
| G5-350cm | 47.19 | 12.1 | 9.91 | 3.5 | 1.63 | 5.1 |

Table 2. (Continued)

| Sample | % $K_2O$ | % $TiO_2$ | % $P_2O_5$ | % MnO | % Total C | LOI-900 |
|---|---|---|---|---|---|---|
| P2-000cm | 2.69 | 0.60 | 0.30 | 1.21 | 0.17 | 13.30 |
| P2-050cm | 2.61 | 0.58 | 0.30 | 1.19 | 0.15 | 14.45 |
| P2-100cm | 2.78 | 0.64 | 0.30 | 1.02 | 0.18 | 11.50 |
| P2-150cm | 2.78 | 0.64 | 0.40 | 1.30 | 0.14 | 11.70 |
| P2-200cm | 2.75 | 0.61 | 0.40 | 1.44 | 0.19 | 11.80 |
| P2-250cm | 2.59 | 0.57 | 0.30 | 1.19 | 0.16 | 12.58 |
| P2-300cm | 2.78 | 0.61 | 0.58 | 1.20 | 0.17 | 11.30 |
| P2-350cm | 2.58 | 0.58 | 0.40 | 0.95 | 0.14 | 12.50 |
| P2-400cm | 2.59 | 0.59 | 0.40 | 1.32 | 0.15 | 12.05 |
| P2-450cm | 2.49 | 0.57 | 0.30 | 1.27 | 0.17 | 12.25 |
| P2-500cm | 2.46 | 0.56 | 0.30 | 1.28 | 0.17 | 12.46 |
| P2-550cm | 2.44 | 0.55 | 0.40 | 1.30 | 0.15 | 12.90 |
| P2-550cm | 2.45 | 0.55 | 0.40 | 1.28 | 0.11 | 12.40 |
| P2-600cm | 2.47 | 0.54 | 0.50 | 1.28 | 0.15 | 12.80 |
| P2-650cm | 2.43 | 0.55 | 0.40 | 1.21 | 0.13 | 13.60 |
| P2-700cm | 2.35 | 0.53 | 0.62 | 1.43 | 0.18 | 12.80 |
| P2-750cm | 2.32 | 0.52 | 0.61 | 1.76 | 0.15 | 12.80 |
| P3-000cm | 2.95 | 0.69 | 0.40 | 0.89 | 0.44 | 11.20 |
| P3-100cm | 2.93 | 0.71 | 0.59 | 0.87 | 0.26 | 10.90 |
| P3-150cm | 3.07 | 0.74 | 0.61 | 1.00 | 0.20 | 10.80 |
| P3-200cm | 2.87 | 0.68 | 0.50 | 1.89 | 0.20 | 11.26 |
| P3-250cm | 2.83 | 0.67 | 0.40 | 1.75 | 0.19 | 12.04 |
| P3-300cm | 2.88 | 0.69 | 0.50 | 1.74 | 0.20 | 10.90 |
| P3-300cm | 2.88 | 0.69 | 0.50 | 1.73 | 0.16 | 11.40 |
| P3-347cm | 2.90 | 0.71 | 0.51 | 1.49 | 0.21 | 11.10 |
| P3-400cm | 2.87 | 0.68 | 0.51 | 1.45 | 0.22 | 12.30 |
| G1-035cm | 2.43 | 0.68 | 0.40 | 0.89 | 0.62 | 14.35 |
| G1-085cm | 2.26 | 0.74 | 0.40 | 1.58 | 0.42 | 15.00 |
| G1-135cm | 2.66 | 0.79 | 0.50 | 0.94 | 0.32 | 13.20 |
| G1-185cm | 2.82 | 0.67 | 0.40 | 1.93 | 0.19 | 10.90 |
| G1-235cm | 2.88 | 0.68 | 0.40 | 1.62 | 0.19 | 11.00 |
| G1-236cm | 2.85 | 0.68 | 0.40 | 1.58 | 0.16 | 11.00 |
| G1-285cm | 2.77 | 0.62 | 0.30 | 1.48 | 0.31 | 11.20 |
| G1-335cm | 2.53 | 0.55 | 0.30 | 1.45 | 0.17 | 12.10 |
| G3-000cm | 2.48 | 0.54 | 0.56 | 1.90 | 0.23 | 12.85 |
| G3-000cm | 2.51 | 0.55 | 0.56 | 1.92 | 0.15 | 12.50 |
| G3-065cm | 2.44 | 0.54 | 0.52 | 1.23 | 0.19 | 12.70 |
| G3-115cm | 2.38 | 0.53 | 0.50 | 1.18 | 0.14 | 13.60 |
| G3-165cm | 2.38 | 0.51 | 0.87 | 1.45 | 0.20 | 13.40 |
| G3-215cm | 2.39 | 0.45 | 0.83 | 1.66 | 0.21 | 14.20 |
| G5-000cm | 2.44 | 0.78 | 0.40 | 1.16 | 0.42 | 13.45 |
| G5-050cm | 2.27 | 0.74 | 0.40 | 0.97 | 0.29 | 20.20 |
| G5-100cm | 2.34 | 0.75 | 0.30 | 0.85 | 0.41 | 14.82 |
| G5-100cm | 2.41 | 0.74 | 0.30 | 0.84 | 0.49 | 13.75 |
| G5-147cm | 2.49 | 0.75 | 0.40 | 0.90 | 0.37 | 13.06 |
| G5-200cm | 2.49 | 0.80 | 0.40 | 1.07 | 0.38 | 12.90 |
| G5-250cm | 2.60 | 0.69 | 0.40 | 1.26 | 0.36 | 12.41 |
| G5-297cm | 2.45 | 0.77 | 0.40 | 1.03 | 0.49 | 12.80 |
| G5-350cm | 2.51 | 0.80 | 0.40 | 1.12 | 0.38 | 13.10 |
| G5-400cm | 2.56 | 0.78 | 0.40 | 1.17 | 0.35 | 13.40 |

Table 2. (Continued)

| Sample | % Total S | ppm B | ppm Ba | ppm Be | ppm Ce | ppm Co |
|---|---|---|---|---|---|---|
| P2-000cm | 0.39 | 57 | 5100 | 2.0 | 98 | 65 |
| P2-050cm | 0.39 | 57 | 6500 | 2.0 | 84 | 80 |
| P2-100cm | 0.46 | 49 | 6300 | 2.0 | 110 | 86 |
| P2-150cm | 0.38 | 60 | 6300 | 1.8 | 100 | 81 |
| P2-200cm | 0.35 | 49 | 5700 | 2.4 | 85 | 100 |
| P2-250cm | 0.37 | 54 | 5100 | 1.8 | 94 | 72 |
| P2-300cm | 0.34 | 120 | 6300 | 2.4 | 130 | 72 |
| P2-350cm | 0.38 | 140 | 5700 | 2.1 | 99 | 81 |
| P2-400cm | 0.36 | 54 | 5700 | 2.0 | 110 | 45 |
| P2-450cm | 0.28 | 31 | 7900 | 3.1 | 140 | 99 |
| P2-500cm | 0.36 | 60 | 6500 | 2.4 | 110 | 52 |
| P2-550cm | 0.46 | 130 | 7600 | 2.7 | 96 | 62 |
| P2-550cm | 0.39 | 120 | 6500 | 2.3 | 91 | 0 |
| P2-600cm | 0.42 | 120 | 6500 | 2.2 | 130 | 61 |
| P2-650cm | 0.38 | 120 | 6300 | 2.6 | 120 | 88 |
| P2-700cm | 0.45 | 56 | 6500 | 2.4 | 120 | 53 |
| P2-750cm | 0.46 | 49 | 6100 | 2.1 | 40 | 53 |
| P3-000cm | 0.27 | 150 | 5600 | 2.2 | 120 | 65 |
| P3-100cm | 0.19 | 140 | 6000 | 1.8 | 130 | 72 |
| P3-150cm | 0.31 | 120 | 6400 | 2.2 | 150 | 77 |
| P3-200cm | 0.42 | 130 | 7600 | 2.0 | 150 | 130 |
| P3-250cm | 0.34 | 120 | 7000 | 2.1 | 150 | 110 |
| P3-300cm | 0.31 | 140 | 7600 | 2.4 | 130 | 120 |
| P3-300cm | 0.42 | 60 | 4900 | 2.1 | 110 | 86 |
| P3-347cm | 0.36 | 57 | 5700 | 1.8 | 140 | 87 |
| P3-400cm | 0.27 | 130 | 7300 | 1.7 | 100 | 91 |
| G1-035cm | 0.35 | 120 | 4000 | 2.3 | 120 | 58 |
| G1-085cm | 0.46 | 150 | 5100 | 2.1 | 40 | 86 |
| G1-135cm | 0.33 | 140 | 5300 | 1.9 | 130 | 83 |
| G1-185cm | 0.37 | 120 | 7600 | 2.1 | 140 | 120 |
| G1-235cm | 0.35 | 47 | 4900 | 1.7 | 120 | 76 |
| G1-236cm | 0.28 | 130 | 9000 | 2.5 | 130 | 100 |
| G1-285cm | 0.33 | 49 | 6500 | 2.3 | 99 | 79 |
| G1-335cm | 0.38 | 140 | 5700 | 2.3 | 110 | 81 |
| G3-000cm | 0.40 | 140 | 9300 | 2.5 | 84 | 56 |
| G3-000cm | 0.45 | 160 | 7900 | 3.2 | 150 | 81 |
| G3-065cm | 0.32 | 57 | 5100 | 2.1 | 120 | 51 |
| G3-115cm | 0.42 | 49 | 5100 | 1.7 | 82 | 37 |
| G3-165cm | 0.41 | 120 | 6500 | 2.2 | 110 | 61 |
| G3-215cm | 0.45 | 120 | 7300 | 2.1 | 100 | 60 |
| G5-000cm | 0.29 | 60 | 4400 | 1.5 | 110 | 52 |
| G5-050cm | 0.27 | 54 | 4300 | 1.7 | 95 | 49 |
| G5-100cm | 0.41 | 100 | 4400 | 1.5 | 96 | 51 |
| G5-100cm | 0.40 | 130 | 5000 | 1.7 | 120 | 88 |
| G5-147cm | 0.29 | 60 | 5000 | 1.7 | 110 | 45 |
| G5-200cm | 0.33 | 57 | 4500 | 1.6 | 120 | 68 |
| G5-250cm | 0.27 | 45 | 3900 | 1.5 | 98 | 61 |
| G5-297cm | 0.34 | 130 | 4900 | 1.9 | 40 | 95 |
| G5-350cm | 0.33 | 120 | 4400 | 1.5 | 100 | 81 |
| G5-400cm | 0.25 | 130 | 4900 | 1.9 | 110 | 60 |

Table 2. (Continued)

| Sample | ppm Cr | ppm Cu | ppm Ga | ppm La | ppm Mo | ppm Nb |
|---|---|---|---|---|---|---|
| P2-000cm | 29 | 410 | 24 | 66 | 14 | 11 |
| P2-050cm | 27 | 360 | 35 | 59 | 33 | 10 |
| P2-100cm | 40 | 400 | 28 | 62 | 20 | 13 |
| P2-150cm | 24 | 350 | 35 | 71 | 32 | 11 |
| P2-200cm | 34 | 360 | 29 | 69 | 33 | 11 |
| P2-250cm | 32 | 370 | 23 | 65 | 36 | 9 |
| P2-300cm | 31 | 340 | 25 | 110 | 44 | 11 |
| P2-350cm | 28 | 360 | 29 | 77 | 37 | 11 |
| P2-400cm | 28 | 320 | 18 | 78 | 63 | 8 |
| P2-450cm | 37 | 420 | 33 | 95 | 66 | 19 |
| P2-500cm | 39 | 350 | 25 | 79 | 33 | 13 |
| P2-550cm | 29 | 360 | 26 | 73 | 38 | 12 |
| P2-550cm | 28 | 400 | 26 | 73 | 39 | 12 |
| P2-600cm | 33 | 350 | 26 | 99 | 53 | 12 |
| P2-650cm | 34 | 350 | 27 | 73 | 91 | 18 |
| P2-700cm | 22 | 360 | 24 | 98 | 61 | 14 |
| P2-750cm | 19 | 320 | 21 | 99 | 43 | 9 |
| P3-000cm | 54 | 220 | 27 | 64 | 5 | 12 |
| P3-100cm | 52 | 250 | 26 | 92 | 13 | 15 |
| P3-150cm | 55 | 280 | 26 | 100 | 16 | 15 |
| P3-200cm | 40 | 480 | 28 | 110 | 36 | 15 |
| P3-250cm | 40 | 440 | 24 | 100 | 28 | 14 |
| P3-300cm | 40 | 410 | 27 | 99 | 36 | 19 |
| P3-300cm | 44 | 400 | 26 | 70 | 34 | 11 |
| P3-347cm | 44 | 400 | 23 | 97 | 16 | 13 |
| P3-400cm | 45 | 360 | 27 | 80 | 22 | 14 |
| G1-035cm | 40 | 250 | 19 | 64 | 2 | 14 |
| G1-085cm | 45 | 320 | 19 | 68 | 2 | 13 |
| G1-135cm | 48 | 320 | 20 | 75 | 5 | 13 |
| G1-185cm | 48 | 450 | 29 | 120 | 24 | 18 |
| G1-235cm | 33 | 360 | 22 | 89 | 28 | 11 |
| G1-236cm | 37 | 450 | 25 | 99 | 36 | 13 |
| G1-285cm | 36 | 400 | 23 | 66 | 26 | 11 |
| G1-335cm | 27 | 410 | 23 | 63 | 31 | 10 |
| G3-000cm | 26 | 420 | 26 | 83 | 43 | 12 |
| G3-000cm | 37 | 520 | 35 | 120 | 46 | 15 |
| G3-065cm | 31 | 360 | 20 | 90 | 34 | 15 |
| G3-115cm | 19 | 320 | 18 | 74 | 21 | 8 |
| G3-165cm | 23 | 350 | 21 | 120 | 35 | 13 |
| G3-215cm | 20 | 360 | 22 | 120 | 46 | 9 |
| G5-000cm | 41 | 250 | 19 | 57 | 2 | 10 |
| G5-050cm | 43 | 220 | 21 | 50 | 6 | 7 |
| G5-100cm | 34 | 200 | 18 | 53 | 1 | 9 |
| G5-100cm | 52 | 250 | 23 | 62 | 7 | 13 |
| G5-147cm | 40 | 250 | 22 | 58 | 5 | 10 |
| G5-200cm | 44 | 250 | 19 | 57 | 4 | 9 |
| G5-250cm | 41 | 290 | 19 | 55 | 3 | 12 |
| G5-297cm | 43 | 280 | 25 | 61 | 4 | 14 |
| G5-350cm | 43 | 250 | 23 | 60 | 6 | 10 |
| G5-400cm | 47 | 250 | 22 | 64 | 3 | 12 |

Table 2. (Continued)

| Sample | ppm Nd | ppm Ni | ppm Pb | ppm Sc | ppm Sn | ppm Sr |
|---|---|---|---|---|---|---|
| P2-000cm | 70 | 150 | 35 | 16 | 7.1 | 330 |
| P2-050cm | 40 | 130 | 34 | 16 | 4.5 | 340 |
| P2-100cm | 71 | 110 | 40 | 18 | 8.7 | 430 |
| P2-150cm | 75 | 120 | 39 | 16 | 6.1 | 280 |
| P2-200cm | 57 | 320 | 35 | 18 | 7.8 | 420 |
| P2-250cm | 56 | 120 | 26 | 15 | 5.9 | 350 |
| P2-300cm | 130 | 120 | 36 | 20 | 4.5 | 330 |
| P2-350cm | 95 | 120 | 32 | 16 | 5.9 | 330 |
| P2-400cm | 79 | 82 | 29 | 16 | 4.7 | 340 |
| P2-450cm | 95 | 110 | 59 | 19 | 9.4 | 410 |
| P2-500cm | 89 | 77 | 39 | 16 | 8.1 | 400 |
| P2-550cm | 61 | 89 | 41 | 15 | 6.4 | 420 |
| P2-550cm | 84 | 82 | 40 | 15 | 7.0 | 420 |
| P2-600cm | 120 | 97 | 37 | 20 | 8.2 | 420 |
| P2-650cm | 90 | 110 | 41 | 16 | 6.4 | 380 |
| P2-700cm | 110 | 85 | 57 | 16 | 7.0 | 440 |
| P2-750cm | 140 | 87 | 44 | 16 | 7.2 | 440 |
| P3-000cm | 64 | 110 | 40 | 19 | 4.4 | 290 |
| P3-100cm | 100 | 120 | 35 | 21 | 4.9 | 340 |
| P3-150cm | 110 | 130 | 37 | 22 | 6.8 | 350 |
| P3-200cm | 100 | 740 | 70 | 22 | 7.9 | 500 |
| P3-250cm | 160 | 560 | 55 | 21 | 8.5 | 480 |
| P3-300cm | 96 | 590 | 63 | 18 | 5.3 | 400 |
| P3-300cm | 72 | 480 | 67 | 15 | 9.5 | 330 |
| P3-347cm | 120 | 460 | 41 | 20 | 7.1 | 410 |
| P3-400cm | 83 | 490 | 46 | 17 | 5.2 | 330 |
| G1-035cm | 60 | 75 | 44 | 15 | 8.0 | 310 |
| G1-085cm | 52 | 110 | 59 | 14 | 6.6 | 360 |
| G1-135cm | 63 | 75 | 52 | 15 | 7.2 | 330 |
| G1-185cm | 170 | 570 | 54 | 19 | 7.8 | 370 |
| G1-235cm | 120 | 380 | 37 | 18 | 6.5 | 320 |
| G1-236cm | 100 | 540 | 40 | 21 | 5.8 | 390 |
| G1-285cm | 70 | 340 | 41 | 16 | 6.7 | 440 |
| G1-335cm | 56 | 110 | 52 | 15 | 7.0 | 350 |
| G3-000cm | 76 | 600 | 62 | 13 | 2.5 | 380 |
| G3-000cm | 130 | 750 | 59 | 22 | 6.5 | 580 |
| G3-065cm | 120 | 96 | 35 | 17 | 7.3 | 400 |
| G3-115cm | 90 | 70 | 30 | 14 | 5.7 | 350 |
| G3-165cm | 150 | 100 | 53 | 18 | 6.7 | 490 |
| G3-215cm | 130 | 120 | 56 | 13 | 6.7 | 510 |
| G5-000cm | 48 | 83 | 44 | 14 | 5.6 | 270 |
| G5-050cm | 58 | 77 | 50 | 13 | 6.5 | 280 |
| G5-100cm | 47 | 86 | 36 | 13 | 4.3 | 260 |
| G5-100cm | 61 | 100 | 45 | 16 | 6.6 | 330 |
| G5-147cm | 40 | 75 | 57 | 13 | 5.2 | 340 |
| G5-200cm | 40 | 73 | 46 | 13 | 6.8 | 300 |
| G5-250cm | 56 | 82 | 48 | 13 | 7.7 | 300 |
| G5-297cm | 40 | 100 | 51 | 13 | 5.7 | 340 |
| G5-350cm | 63 | 90 | 53 | 13 | 5.9 | 300 |
| G5-400cm | 58 | 100 | 51 | 16 | 3.5 | 280 |

Table 2. (Continued)

| Sample | ppm V | ppm Y | ppm Yb | ppm Zn | ppm Zr |
|---|---|---|---|---|---|
| P2-000cm | 86 | 80 | 6.7 | 160 | 200 |
| P2-050cm | 91 | 82 | 8.4 | 160 | 260 |
| P2-100cm | 85 | 77 | 6.7 | 150 | 270 |
| P2-150cm | 85 | 100 | 7.5 | 120 | 350 |
| P2-200cm | 95 | 95 | 10.0 | 140 | 210 |
| P2-250cm | 82 | 81 | 12.0 | 120 | 210 |
| P2-300cm | 110 | 150 | 12.0 | 140 | 360 |
| P2-350cm | 91 | 98 | 8.1 | 150 | 220 |
| P2-400cm | 88 | 90 | 7.4 | 120 | 240 |
| P2-450cm | 110 | 130 | 12.0 | 220 | 340 |
| P2-500cm | 87 | 91 | 9.3 | 120 | 250 |
| P2-550cm | 95 | 93 | 10.0 | 170 | 210 |
| P2-550cm | 90 | 82 | 8.8 | 130 | 260 |
| P2-600cm | 110 | 120 | 11.0 | 150 | 340 |
| P2-650cm | 110 | 92 | 9.4 | 180 | 370 |
| P2-700cm | 95 | 110 | 9.8 | 170 | 260 |
| P2-750cm | 89 | 120 | 9.0 | 160 | 250 |
| P3-000cm | 97 | 100 | 8.9 | 110 | 370 |
| P3-100cm | 100 | 140 | 9.9 | 150 | 290 |
| P3-150cm | 100 | 130 | 10.0 | 140 | 300 |
| P3-200cm | 120 | 150 | 11.0 | 190 | 300 |
| P3-250cm | 89 | 130 | 9.9 | 180 | 250 |
| P3-300cm | 120 | 150 | 14.0 | 190 | 380 |
| P3-300cm | 90 | 110 | 8.7 | 150 | 220 |
| P3-347cm | 98 | 130 | 9.8 | 150 | 230 |
| P3-400cm | 98 | 130 | 11.0 | 190 | 320 |
| G1-035cm | 86 | 82 | 6.1 | 140 | 220 |
| G1-085cm | 110 | 87 | 6.2 | 150 | 180 |
| G1-135cm | 95 | 91 | 6.6 | 150 | 230 |
| G1-185cm | 110 | 180 | 15.0 | 190 | 360 |
| G1-235cm | 92 | 110 | 7.2 | 140 | 220 |
| G1-236cm | 120 | 140 | 13.0 | 150 | 370 |
| G1-285cm | 78 | 77 | 8.4 | 150 | 210 |
| G1-335cm | 93 | 79 | 7.2 | 160 | 210 |
| G3-000cm | 110 | 120 | 13.0 | 210 | 170 |
| G3-000cm | 140 | 160 | 17.0 | 210 | 410 |
| G3-065cm | 86 | 110 | 9.5 | 140 | 240 |
| G3-115cm | 73 | 83 | 7.7 | 150 | 180 |
| G3-165cm | 110 | 150 | 15.0 | 150 | 220 |
| G3-215cm | 98 | 140 | 15.0 | 200 | 250 |
| G5-000cm | 81 | 73 | 4.6 | 130 | 180 |
| G5-050cm | 81 | 67 | 6.0 | 150 | 190 |
| G5-100cm | 83 | 71 | 4.3 | 120 | 170 |
| G5-100cm | 100 | 84 | 7.0 | 140 | 230 |
| G5-147cm | 79 | 70 | 6.2 | 140 | 190 |
| G5-200cm | 78 | 69 | 5.0 | 130 | 140 |
| G5-250cm | 81 | 75 | 5.6 | 120 | 180 |
| G5-297cm | 99 | 84 | 6.8 | 160 | 190 |
| G5-350cm | 92 | 77 | 6.2 | 150 | 160 |
| G5-400cm | 96 | 94 | 8.1 | 140 | 220 |

Table 3. Average concentrations of major-element oxides and trace elements for Pacific pelagic clay, sediments from DOMES sites A, B, C, DOMES site C, all sediment samples from this study, sediments from core P2, and surface sediments from five stations on abyssal plain surrounding Shimada Seamount, sediments from Bauer Basin, and basaltic glass from Shimada Seamount.

| Oxide or Element | Pacific Pelagic Clay[1] | DOMES Sites A+B+C[1] | DOMES Site C[1] | Shimada all Samples | Shimada Core P2 | Shimada Surface Samples | Bauer Basin[2] | Shimada glass[3] |
|---|---|---|---|---|---|---|---|---|
| | | | | Percent | | | | |
| $SiO_2$ | 54.9 | 50.4 | 50.7 | 48.1 | 48.4 | 48.0 | 44.1 | 52.4 |
| $Al_2O_3$ | 16.6 | 11.5 | 14.5 | 12.7 | 12.7 | 12.4 | 8.8 | 14.5 |
| $Fe_2O_3$ | 7.7 | 6.9 | 7.6 | 8.8 | 8.5 | 8.8 | 13.0 | 11.2 |
| MgO | 3.4 | 3.1 | 3.2 | 3.4 | 3.4 | 3.3 | 4.3 | 5.89 |
| CaO | .7 | 2.6 | 2.3 | 1.6 | 1.5 | 1.5 | 2.3 | 9.78 |
| $Na_2O$ | 1.3 | 3.8 | 2.9 | 4.4 | 4.4 | 4.5 | .74 | 2.65 |
| $K_2O$ | 2.7 | 3.2 | 3.2 | 2.6 | 2.6 | 2.6 | 2.3 | .80 |
| $TiO_2$ | .78 | .67 | .72 | .64 | .58 | .66 | .50 | 2.00 |
| $P_2O_5$ | .25 | .46 | .42 | .44 | .41 | .41 | -- | .22 |
| MnO | .56 | .97 | 1.20 | 1.30 | 1.30 | 1.20 | 5.60 | -- |
| LOI | -- | 12.6 | 12.4 | 12.7 | 12.6 | 13.0 | -- | -- |
| Sum | | 96.2 | 99.1 | 96.7 | 96.4 | 96.4 | | 99.85 |
| $T\text{-}CO_2$ | 1.00 | 2.1 | 1.04 | .89 | .59 | 1.41 | -- | -- |
| T-S | -- | -- | -- | .36 | .39 | .34 | -- | -- |
| | | | | Parts per million | | | | |
| ppm B | 100 | 154 | 145 | 96 | 78 | 105 | -- | |
| ppm Ba | 3900 | 3300 | 3900 | 6000 | 6300 | 5700 | 3300 | |
| ppm Be | -- | 3.3 | 3.5 | 2.1 | 2.3 | 2.1 | -- | |
| ppm Co | 113 | 101 | 116 | 73 | 67 | 59 | -- | |
| ppm Cr | 64 | 53 | 53 | 37 | 30 | 38 | -- | |
| ppm Cu | 230 | 510 | 600 | 340 | 360 | 310 | 960 | |
| ppm Mo | 10 | 19 | 24 | 27 | 43 | 13 | -- | |
| ppm Ni | 210 | 280 | 340 | 210 | 120 | 200 | 750 | |
| ppm Pb | 34 | 50 | 61 | 45 | 39 | 45 | -- | |
| ppm Sc | 25 | 25 | 21 | 17 | 17 | 15 | -- | |
| ppm Sr | 710 | 300 | 320 | 370 | 380 | 320 | -- | |
| ppm V | 120 | 99 | 100 | 96 | 94 | 92 | -- | |
| ppm Y | 150 | 110 | 97 | 100 | 99 | 91 | -- | |
| ppm Zn | 165 | 163 | 160 | 150 | 150 | 150 | 410 | |

Sources of data:

[1] Bischoff and others, 1979
[2] Sayles and Bischoff, 1973; Heath and Dymond, 1977
[3] Average of 4 basaltic glass samples dredged from Shimada Seamount (Gardner and others, 1983).