XVI. CHEMICAL COMPOSITION OF MARINE ARGILLACEOUS SEDIMENTS AROUND THE IZU-OGASAWARA ISLANDS

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Introduction

Several core samples were collected during cruises GH79-2, 3 and 4 of the Geological Survey of Japan. The cruises covered a vast region including the Shichito Ridge, the Ogasawara Trench and the Pacific deep ocean floor of the Ogasawara Arc. This paper describes an investigation of the major chemical composition of argillaceous sediments selected from the cores.

Methods and Results

One hundred and one samples were selected for this study from cores collected during cruises GH79-2, 3 and 4. The locations and water depths of the cores are listed in Table XVI-1. These samples are all argillaceous or calcareous agrillaceous sediments.

The samples were dried at 110°C and subsequently ground. The detailed analytical procedure adopted in this study was described by SUGISAKI (1981).

Analytical results are summerized in Table XVI-2. Table XVI-3 lists the compositions of samples recalculated by excluding carbonates, salts, water and residual materials (organic matter, sulfides and others): These values are used in the following discussion.

Table XVI-1 List of cores

Core No.	Latitude	Longitude	Depth (m)	Length of cores (cm)
P142	24°44.6′ N	142°37.4′ E	2538	197
P143	23°37.4′ N	142°42.5′ E	3195	140
P145	22°48.5′ N	143°24.8′ E	4280	100
P148	26°30.2′ N	139°24.8′ E	4535	620
P149	26°45.0′ N	139°47.1′ E	3835	497
P150	27°30.2′ N	144°53.0′ E	5475	1139
P151	27°59.3′ N	143°17.5′ E	8665	759
P152	28°15.0′ N	141°25.1′ E	4150	408
P153	28°59.6′ N	142°55.5′ E	9410	415
P155	29°44.9′ N	144°11.4′ E	5800	750
P157	32°44.9′ N	142°33.6′ E	6320	489
RC45	23°32.7′ N	141°43.9′ E	1460	155
RC51	29°14.6′ N	139°35.3′ E	2420	202
RC53	30°44.1′ N	141°50.3′ E	5090	161
RC54	30°59.7′ N	141°04.8′ E	2915	66

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Discussion

The region surveyed during cruises GH79-2, 3 and 4 covered three areas. The first (the west part of the surveyed area) is an area of shallow water around the Izu-Ogasawara Islands. The second (the middle part) is the Ogasawara Trench area. The third (the east part) is the Pacific deep ocean floor on the east side of the trench. The average chemical composition of the sediments in each area differs from each other (Table XVI-4). For example, MnO content increases eastwards. The concentrations of TiO_2 and P_2O_5 in the sediments around the Ogasawara Ridge are higher than those in the other areas. These features can be attributed to the difference in sediment sources, sedimentation rates and other factors in the environment of sedimentation. The chemical features of each area are discussed below.

Fig. XVI-1 shows the relationship of TiO_2-SiO_2-Al_2O_3, which is useful for determining the sediment source (SUGISAKI, 1978). In the diagram, compositional

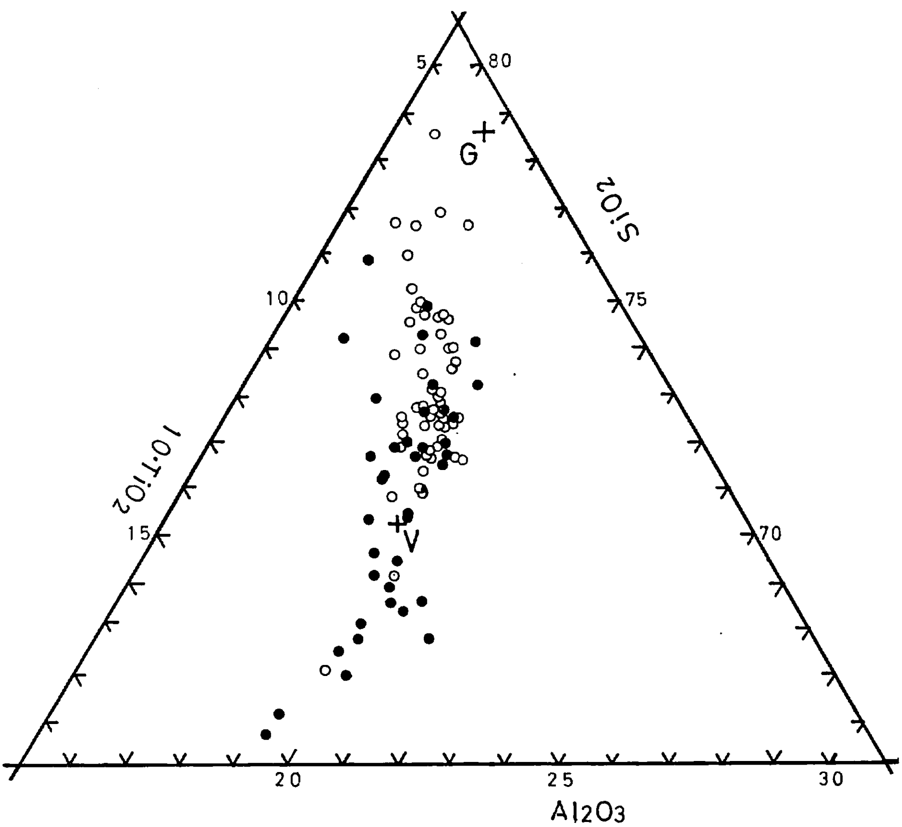

Fig. XVI-1 Relationship between SiO_2, Al_2O_3, and TiO_2. Closed circles represent sediments from the area around the Ogasawara Ridge. Open circles those from the Ogasawara Trench and deep ocean floor on the east side of the trench. Crosses represent averaged Japanese rocks. G : granites (Geological Survey of Japan 1960). V : Quaternary volcanic rocks (Sugisaki 1976).

Table XVI-2 Analyses of samples

Location[1)]	No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO
P142, 40- 45	1.	38.49	0.56	10.65	5.73	0.69	0.19	0.69
P142, 60- 65	2.	34.83	0.56	9.66	4.19	1.82	0.25	0.64
P142, 120-125	3.	39.12	0.65	11.70	5.44	2.11	0.19	1.13
P142, 173-178	4.	37.59	0.62	10.64	4.88	2.71	0.18	0.77
P142, 213-218	5.	37.29	0.61	10.83	3.57	2.78	0.17	0.46
P143, 10- 15	6.	52.48	0.67	13.93	2.39	3.69	0.23	0.75
P143, 30- 35	7.	61.65	0.75	16.66	1.01	4.95	0.22	0.26
P143, 43- 48	8.	42.16	0.53	11.58	3.21	2.66	0.21	0.02
P143, 80- 85	9.	39.66	0.52	9.63	2.92	2.20	0.15	0.01
RC45, 60- 65	10.	53.97	1.04	15.80	2.23	7.36	0.26	1.91
RC45, 80- 85	11.	51.93	0.93	15.13	1.77	6.61	0.29	1.48
RC45, 100-105	12.	49.08	1.09	14.36	2.35	8.13	0.23	1.95
RC45, 120-125	13.	49.56	1.14	14.63	2.32	8.29	0.23	2.23
RC45, 140-145	14.	49.62	0.91	14.60	2.31	6.71	0.23	1.70
RC45, 160-165	15.	53.31	1.03	16.09	1.76	8.12	0.23	2.07
RC45, 180-185	16.	49.90	0.79	15.07	2.36	5.81	0.20	1.20
P157, 0- 5	17.	54.69	0.60	12.84	4.39	1.45	0.47	1.66
P157, 5- 10	18.	56.26	0.61	13.13	4.39	1.51	0.46	1.65
P157, 10- 15	19.	58.13	0.61	13.50	4.45	1.48	0.47	1.89
P157, 15- 20	20.	60.35	0.62	13.75	4.49	1.46	0.47	1.52
P157, 20- 25	21.	62.09	0.61	13.63	3.69	2.06	0.42	1.40
P157, 25- 30	22.	66.00	0.60	13.00	4.25	1.14	1.37	0.98
P157, 30- 35	23.	56.01	0.72	14.21	6.60	1.21	1.89	2.22
P157, 35- 40	24.	56.20	0.77	15.42	4.81	3.47	0.15	2.57
P157, 40- 45	25.	57.47	0.74	15.51	5.20	2.73	0.13	2.24
P157, 45- 50	26.	58.10	0.67	14.88	4.35	2.92	0.14	2.28
P157, 50- 55	27.	62.24	0.52	13.65	4.74	0.60	0.93	1.27
P157, 55- 60	28.	60.24	0.60	14.55	4.59	1.71	0.60	1.70
P157, 60- 65	29.	53.73	0.67	14.49	5.54	1.45	3.42	2.58
P157, 65- 70	30.	58.74	0.63	14.99	6.53	0.26	0.71	2.14
P157, 70- 75	31.	56.93	0.66	14.87	5.88	1.14	1.13	2.07
P157, 75- 80	32.	55.02	0.64	14.28	6.57	0.20	2.40	2.06
P157, 80- 85	33.	54.79	0.63	14.17	6.04	0.52	1.67	2.14
P157, 85- 90	34.	58.58	0.58	14.24	5.79	0.17	2.54	1.87
P157, 90- 95	35.	58.11	0.60	14.55	4.78	1.32	0.39	1.62
P157, 95-100	36.	66.23	0.54	12.43	1.99	2.26	0.15	0.52
P157, 112-117	37.	57.68	0.66	14.91	6.27	0.38	1.51	2.31
P157, 135-140	38.	56.54	0.67	14.71	5.22	1.34	0.25	2.12
P157, 155-160	39.	57.45	0.77	14.87	4.33	3.44	0.20	2.05
P157, 175-180	40.	62.52	0.69	14.85	2.94	3.08	0.19	1.49
P157, 202-207	41.	57.20	0.69	14.90	4.75	1.89	0.47	2.10
P157, 215-220	42.	59.54	0.66	14.44	6.00	0.69	1.38	1.71
P157, 242-247	43.	64.05	0.46	13.00	2.39	2.56	0.21	0.43
P157, 267-272	44.	57.38	0.69	14.71	4.87	2.32	0.20	2.39
P157, 287-292	45.	53.21	0.73	14.69	5.42	2.76	0.22	2.72
P157, 301-306	46.	52.31	1.05	15.35	6.83	6.11	0.23	4.29
P157, 327-332	47.	57.14	0.75	14.73	4.24	3.19	0.14	2.02
P157, 347-352	48.	59.29	0.68	14.80	5.44	1.59	0.53	2.02
P157, 372-377	49.	58.37	0.65	14.20	4.50	1.99	0.43	1.45
P157, 387-392	50.	57.31	0.66	14.58	4.04	2.31	0.17	1.60

(dried at 70C) in % weight.

CaO	Na_2O	K_2O	P_2O_5	H_2O	$CaCO_3$	Res.[2)]	Salts	Total
6.09	1.03	1.96	0.22	2.34	24.73	3.48	2.42	99.28
4.21	0.94	2.04	0.26	2.45	36.20	1.02	2.01	101.07
5.64	1.20	2.06	0.27	2.80	21.56	3.80	2.10	99.77
7.30	1.12	1.81	0.21	2.24	24.89	2.51	1.63	99.11
3.56	1.52	2.03	0.29	1.60	31.41	1.72	1.47	99.30
4.36	2.51	2.98	0.28	3.09	8.47	1.27	1.75	98.85
2.99	3.13	3.94	0.40	0.93	1.75	0.79	1.21	100.64
4.34	1.36	2.60	0.23	2.39	24.72	0.50	1.62	98.14
0.93	1.18	1.71	0.20	2.21	34.72	0.77	2.11	98.92
7.03	2.16	2.86	0.54	1.02	2.17	0.41	1.23	99.99
6.29	2.29	2.95	0.48	1.82	1.55	5.01	1.14	99.67
7.12	1.66	2.29	0.49	2.87	1.17	5.24	1.42	99.46
7.37	1.68	2.61	0.50	1.96	1.44	4.00	1.35	99.31
7.97	1.70	2.84	0.46	2.87	1.68	3.78	1.84	99.22
7.91	1.82	2.88	0.54	1.25	2.04	0.18	1.37	100.59
5.83	1.67	2.94	0.41	2.85	6.41	2.30	1.59	99.32
2.06	1.01	1.98	0.15	10.50	0.0	3.61	4.17	99.59
2.10	0.99	2.03	0.15	7.66	0.0	3.71	4.21	98.86
2.07	0.91	2.12	0.15	7.62	0.0	1.68	4.22	99.29
2.20	1.35	2.06	0.15	7.70	0.0	1.16	3.35	100.63
2.43	1.72	1.83	0.14	5.14	0.0	0.73	3.03	98.91
2.96	2.52	1.35	0.12	3.20	0.0	1.71	2.32	101.53
4.04	1.91	1.57	0.13	6.01	0.0	1.80	2.65	100.97
4.61	1.28	1.70	0.10	6.68	0.0	0.00	2.80	100.56
4.11	1.14	1.74	0.11	7.03	0.0	0.87	2.62	101.64
3.44	1.29	2.06	0.12	4.82	0.0	0.95	2.65	98.68
2.25	1.86	2.46	0.11	5.53	0.0	1.37	2.26	99.78
2.76	1.62	2.25	0.12	4.75	0.0	1.44	2.33	99.26
3.19	1.54	1.86	0.13	8.64	0.0	1.99	2.53	101.75
2.70	1.46	2.14	0.13	7.29	0.0	1.60	2.51	101.84
2.91	1.49	2.05	0.15	5.20	0.0	2.26	2.56	99.31
2.46	1.33	2.06	0.15	8.24	0.0	1.90	2.94	100.25
2.20	1.56	2.26	0.15	8.99	0.0	2.45	2.48	100.04
1.92	2.29	2.52	0.13	4.25	0.0	3.71	1.73	100.33
1.85	1.24	2.54	0.13	6.85	0.0	3.34	2.62	99.95
2.82	1.80	1.31	0.097	3.52	0.0	2.20	2.40	98.27
1.92	1.23	2.51	0.14	6.41	0.0	2.66	2.93	101.51
1.51	0.79	2.73	0.13	7.26	0.0	2.98	2.51	98.77
4.14	1.21	1.70	0.12	3.90	0.0	2.14	1.88	98.20
3.33	2.25	1.50	1.05	3.92	0.0	2.13	1.66	101.60
1.93	1.02	2.66	0.12	5.88	0.0	4.18	2.29	100.08
2.59	1.08	2.18	0.13	4.78	0.0	2.71	2.13	100.02
2.96	1.96	1.94	0.074	3.79	0.0	3.16	1.41	98.40
3.13	1.12	2.04	0.12	5.24	0.0	2.64	1.92	98.77
2.87	1.00	1.98	0.11	6.54	0.0	4.57	1.79	98.60
9.30	1.05	0.37	0.058	0.45	0.0	1.17	0.64	99.20
3.29	1.05	2.02	0.13	5.09	0.0	2.69	1.78	98.26
2.87	1.00	2.06	0.14	6.11	0.0	1.23	2.22	99.99
2.95	1.11	2.06	0.15	6.01	0.0	2.43	1.81	98.11
2.52	0.79	2.27	0.14	5.22	0.0	3.87	3.13	98.61

Table XVI-2

Location[1]	No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO
P157, 407-412	51.	60.34	0.71	14.36	3.61	3.36	0.19	1.67
P157, 427-432	52.	59.11	0.66	14.65	4.46	2.22	0.27	1.73
P157, 447-452	53.	61.46	0.64	14.50	3.80	2.26	0.15	1.61
P157, 467-472	54.	53.85	0.70	13.71	6.22	0.51	5.36	1.97
P145, 30- 35	55.	52.64	0.82	15.06	6.16	2.67	0.27	2.33
RC53, 20- 25	56.	57.73	0.65	14.68	5.01	1.85	0.22	1.99
RC53, 40- 45	57.	57.68	0.69	15.32	5.03	2.35	0.25	2.39
RC53, 60- 65	58.	57.81	0.67	15.33	4.41	2.30	0.008	2.13
RC53, 80- 85	59.	60.37	0.71	15.81	4.78	2.14	0.10	2.15
RC53, 100-105	60.	59.74	0.62	13.88	4.30	1.38	0.25	1.59
RC53, 105-110	61.	60.14	0.61	14.17	4.62	1.38	0.23	1.88
RC54, 63- 68	62.	58.90	0.64	12.43	2.20	3.83	0.14	0.94
RC54, 9- 14	63.	59.92	0.77	13.27	3.25	4.19	0.18	1.19
P148, 390-395	64.	47.79	0.69	13.26	4.75	3.08	0.23	2.43
P149, 60- 65	65.	43.82	0.63	11.43	4.72	2.39	0.31	1.77
P149, 120-125	66.	45.65	0.71	12.24	6.96	1.56	1.48	2.44
P149, 175-180	67.	51.79	0.85	16.26	2.53	7.42	0.21	3.23
P149, 255-260	68.	44.95	0.59	11.72	3.88	2.48	0.18	1.93
P149, 315-320	69.	37.98	0.54	9.68	4.46	1.91	0.21	1.56
P149, 440-445	71.	37.35	0.54	9.80	4.70	1.63	0.22	1.60
P149, 470-475	72.	50.40	0.84	14.83	6.24	4.07	0.27	3.20
P150, 10- 15	73.	53.40	0.62	13.94	6.15	0.57	0.68	2.49
P150, 45- 50	74.	52.76	0.65	13.78	6.54	0.15	0.86	2.58
P150, 100-105	75.	54.89	0.67	14.75	5.70	1.18	0.32	2.70
P150, 160-165	76.	52.06	0.64	14.08	6.07	0.64	0.59	2.30
P150, 260-265	77.	54.90	0.64	14.65	6.77	0.20	0.95	2.85
P150, 370-375	78.	55.96	0.66	14.75	6.75	0.03	2.11	2.47
P150, 470-475	79.	52.91	0.64	13.81	5.85	0.93	0.47	2.36
P150, 525-530	80.	67.76	0.41	12.95	3.10	0.96	0.39	1.38
P150, 600-605	81.	57.42	0.71	15.83	6.24	0.79	0.70	2.61
P150, 700-705	82.	54.41	0.79	14.62	6.98	0.68	0.72	2.61
P150, 800-805	83.	55.90	0.72	14.98	5.68	1.93	0.40	2.69
P150, 900-905	84.	57.61	0.69	15.31	6.26	0.70	0.85	2.78
P150, 1010-1015	85.	63.44	0.50	14.50	3.66	1.17	0.23	1.68
P150, 1110-1115	86.	57.26	0.70	15.85	7.02	0.33	1.24	2.77
P151, 365-370	87.	62.44	0.60	13.12	3.02	2.68	0.47	2.43
P152, 122-127	88.	52.70	0.83	14.12	1.62	7.77	0.27	2.89
P153, 198-203	89.	65.90	0.58	13.00	1.89	3.23	0.21	1.90
P155, 180-185	91.	56.32	0.71	15.66	5.84	1.20	0.52	2.71
P155, 295-300	92.	56.01	0.65	14.63	6.69	0.11	3.12	2.51
P155, 385-390	93.	57.21	0.70	15.63	4.86	1.77	0.14	2.69
P155, 465-470	94.	57.62	0.66	15.34	6.36	1.35	1.04	2.62
P155, 572-577	95.	59.85	0.57	15.24	3.71	1.67	0.19	1.93
P155, 615-620	96.	54.94	0.59	13.20	5.65	0.18	4.71	2.33
P155, 800-805	97.	57.65	0.66	14.63	4.66	1.64	0.13	2.61
RC51, 25- 30	98.	21.28	0.31	5.92	3.09	0.30	0.16	0.57
RC51, 60- 65	99.	36.56	0.48	9.71	3.73	1.20	0.036	1.12
RC51, 120-125	100.	36.57	0.44	9.43	3.50	1.41	0.041	0.78
RC51, 180-185	101.	29.62	0.40	7.63	2.75	0.93	0.049	0.31

1) The first term in sample location indicates core No., and the next example, "P51, 65-70" shows the sediment sample between 65 cm

2) Residual materials. This contains sulfur, organic materials and others.

(Continued)

CaO	Na_2O	K_2O	P_2O_5	H_2O	$CaCO_3$	Res.[2)]	Salts	Total
3.59	1.33	1.62	0.12	3.41	0.0	2.36	1.48	98.15
3.05	1.14	2.00	0.12	5.59	0.0	2.68	1.84	99.52
2.83	1.20	2.16	0.11	4.28	0.0	2.16	1.92	99.08
2.58	1.40	2.05	0.15	6.46	0.70	1.95	1.78	99.39
5.17	1.43	1.53	0.17	6.80	0.0	1.53	2.10	98.68
3.45	1.24	1.87	0.11	7.42	0.0	0.82	2.10	99.14
2.50	0.97	1.94	0.11	4.11	0.0	1.02	3.71	98.07
2.85	1.08	2.15	0.095	5.83	0.0	2.41	1.86	98.95
2.27	0.92	2.38	0.11	4.60	0.0	1.61	2.00	99.95
1.69	1.17	2.31	0.091	7.08	0.0	2.42	1.86	98.39
2.23	1.21	2.04	0.095	8.20	0.0	1.46	2.17	100.44
2.29	1.78	0.99	0.14	2.36	10.97	0.06	1.50	99.17
5.04	1.89	0.76	0.14	0.97	3.17	2.98	1.21	98.94
4.75	1.66	1.77	0.16	3.31	9.84	1.97	2.99	98.68
4.50	2.19	1.78	0.23	4.92	17.40	1.91	1.28	99.28
4.59	2.36	1.32	0.16	3.81	16.34	0.15	1.56	101.31
8.77	2.25	0.64	0.14	0.87	1.01	1.24	1.15	98.36
4.26	1.48	1.98	0.13	3.23	17.07	1.27	2.91	98.06
2.37	1.29	1.65	0.15	3.43	30.30	0.53	2.68	98.74
4.98	1.39	1.65	0.14	3.22	27.00	3.19	2.24	99.64
6.67	2.00	1.16	0.20	2.95	1.50	2.68	1.41	98.42
2.18	1.04	2.28	0.20	7.88	0.0	3.27	3.97	98.67
1.98	1.04	2.61	0.16	6.22	4.10	1.73	3.67	98.83
2.82	1.13	2.66	0.16	5.01	2.05	2.22	3.27	99.54
2.84	0.47	2.62	0.18	7.04	3.71	2.39	3.96	99.59
2.49	1.68	2.45	0.18	3.74	2.32	3.90	2.78	100.50
2.13	1.31	2.73	0.15	6.66	0.0	1.16	2.67	99.55
1.93	1.21	2.43	0.17	10.17	0.0	2.71	2.92	98.49
2.16	2.42	1.79	0.078	4.41	0.0	1.77	2.02	101.60
1.43	1.15	2.93	0.15	4.96	0.0	3.99	2.46	101.37
2.15	1.26	2.55	0.31	6.38	0.0	2.12	2.78	98.37
2.41	1.24	2.41	0.18	4.90	0.0	2.48	2.77	98.69
1.41	1.42	2.93	0.16	5.53	0.0	1.98	2.05	99.68
1.65	1.59	3.25	0.14	3.79	0.0	3.89	1.81	101.30
2.19	1.52	2.62	0.19	5.33	0.0	0.99	1.79	99.79
3.41	2.27	1.51	0.15	3.31	0.0	2.37	2.27	100.05
9.42	2.67	1.12	0.19	1.00	0.0	2.22	1.29	98.12
2.25	2.45	1.11	0.13	2.18	3.96	0.48	1.15	100.41
1.62	0.93	2.82	0.13	5.36	0.0	2.17	2.53	98.51
1.93	1.52	2.40	0.15	4.31	0.0	2.56	2.43	99.01
1.31	0.71	2.97	0.12	5.48	0.0	6.06	1.86	101.52
3.74	1.23	2.05	0.11	4.60	0.0	0.75	2.34	99.81
1.98	1.54	2.37	0.12	4.82	0.0	2.71	2.00	98.71
1.50	0.91	2.54	0.12	5.86	0.0	3.66	1.85	98.04
1.41	1.50	2.75	0.11	5.20	0.0	3.61	1.85	98.41
3.16	0.08	1.18	0.12	3.22	54.37	2.36	1.90	98.02
2.44	0.91	2.16	0.087	3.18	33.22	2.37	0.89	98.10
4.05	0.56	2.20	0.092	2.45	28.26	6.93	1.59	98.30
5.83	0.55	1.66	0.12	1.66	41.13	4.48	1.35	98.46

term does the collected interval in cm from the top of the core. For
and 70 cm from the top of core No. P51.

Table XVI-3 Analyses for major constituents on a carbonate, water, salts and residual materials free basis (% weight)

No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Fe_3/Fe_2*	Tot Fe**
1.	58.05	0.84	16.06	8.65	1.04	0.29	1.04	9.19	1.56	2.96	0.33	8.31	9.80
2.	58.64	0.94	16.26	7.05	3.06	0.42	1.07	7.09	1.58	3.43	0.44	2.30	10.46
3.	56.28	0.94	16.83	7.83	3.04	0.27	1.63	8.11	1.72	2.96	0.39	2.58	11.21
4.	55.41	0.91	15.68	7.19	3.99	0.27	1.14	10.76	1.66	2.67	0.31	1.80	11.63
5.	59.09	0.97	17.16	5.66	4.41	0.27	0.72	5.63	2.41	3.22	0.46	1.28	10.55
6.	62.28	0.80	16.53	2.83	4.38	0.27	0.89	5.17	2.98	3.54	0.33	0.65	7.70
7.	64.25	0.78	17.36	1.05	5.16	0.23	0.27	3.11	3.26	4.11	0.42	0.20	6.78
8.	61.19	0.77	16.81	4.66	3.86	0.31	0.03	6.29	1.98	3.77	0.33	1.21	8.95
9.	67.09	0.88	16.29	4.95	3.72	0.25	0.02	1.57	2.00	2.89	0.34	1.33	9.08
10.	56.71	1.09	16.60	2.34	7.73	0.27	2.01	7.39	2.27	3.01	0.57	0.30	10.94
11.	57.60	1.03	16.78	1.97	7.33	0.32	1.64	6.98	2.54	3.27	0.53	0.27	10.12
12.	55.29	1.23	16.18	2.65	9.16	0.26	2.20	8.03	1.87	2.58	0.55	0.29	12.83
13.	54.73	1.26	16.16	2.56	9.15	0.25	2.46	8.14	1.85	2.88	0.55	0.28	12.73
14.	55.72	1.02	16.40	2.60	7.54	0.26	1.91	8.95	1.90	3.19	0.52	0.34	10.97
15.	55.68	1.08	16.80	1.83	8.48	0.24	2.16	8.26	1.90	3.01	0.56	0.22	11.26
16.	57.91	0.92	17.49	2.74	6.74	0.23	1.39	6.76	1.93	3.41	0.48	0.41	10.24
17.	67.27	0.74	15.79	5.40	1.78	0.58	2.05	2.53	1.25	2.44	0.18	3.03	7.38
18.	67.55	0.73	15.77	5.27	1.81	0.55	1.98	2.52	1.19	2.44	0.18	2.91	7.29
19.	67.77	0.71	15.74	5.18	1.73	0.55	2.20	2.41	1.06	2.47	0.18	3.00	7.10
20.	68.25	0.70	15.55	5.08	1.65	0.53	1.72	2.49	1.53	2.33	0.17	3.07	6.91
21.	68.98	0.68	15.14	4.10	2.29	0.47	1.55	2.70	1.91	2.03	0.16	1.79	6.64
22.	69.99	0.64	13.79	4.51	1.21	1.45	1.04	3.14	2.68	1.43	0.13	3.73	5.85
23.	61.88	0.80	15.70	7.29	1.34	2.09	2.45	4.46	2.11	1.73	0.14	5.45	8.77
24.	61.70	0.85	16.93	5.28	3.81	0.17	2.82	5.06	1.41	1.87	0.11	1.39	9.52
25.	63.07	0.81	17.02	5.70	3.00	0.14	2.46	4.51	1.25	1.91	0.12	1.90	9.03
26.	64.37	0.74	16.49	4.82	3.24	0.16	2.53	3.81	1.43	2.28	0.13	1.49	8.42
27.	68.67	0.57	15.06	5.23	0.66	1.03	1.40	2.48	2.05	2.71	0.12	7.91	5.97
28.	66.39	0.66	16.04	5.06	1.88	0.66	1.87	3.04	1.78	2.48	0.13	2.68	7.15

Table XVI-3 (Continued)

No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Fe_3/Fe_2*	Tot Fe**
29.	60.65	0.76	16.35	6.25	1.64	3.86	2.91	3.60	1.73	2.10	0.15	3.82	8.07
30.	64.95	0.70	16.57	7.22	0.29	0.79	2.37	2.99	1.62	2.37	0.14	25.12	7.54
31.	63.76	0.74	16.65	6.59	1.28	1.27	2.32	3.26	1.67	2.30	0.17	5.16	8.01
32.	63.12	0.73	16.38	7.53	0.23	2.75	2.37	2.82	1.53	2.36	0.17	32.84	7.79
33.	63.62	0.73	16.45	7.02	0.60	1.94	2.48	2.55	1.81	2.62	0.17	11.62	7.69
34.	64.63	0.64	15.71	6.39	0.19	2.80	2.07	2.12	2.53	2.78	0.14	34.07	6.60
35.	66.69	0.69	16.70	5.49	1.51	0.45	1.86	2.12	1.42	2.92	0.15	3.62	7.17
36.	73.47	0.60	13.79	2.21	2.51	0.17	0.58	3.13	2.00	1.45	0.11	0.88	4.99
37.	64.44	0.74	16.66	7.00	0.42	1.69	2.58	2.14	1.37	2.80	0.16	16.49	7.47
38.	65.73	0.78	17.10	6.07	1.56	0.29	2.47	1.76	0.92	3.17	0.15	3.90	7.80
39.	63.63	0.85	16.47	4.79	3.81	0.22	2.27	4.59	1.34	1.88	0.13	1.26	9.03
40.	66.59	0.73	15.82	3.13	3.28	0.20	1.59	3.55	2.40	1.60	1.12	0.95	6.77
41.	65.20	0.79	16.98	5.41	2.15	0.54	2.40	2.20	1.16	3.03	0.14	2.51	7.81
42.	65.87	0.73	15.97	6.64	0.76	1.53	1.89	2.87	1.19	2.41	0.14	8.70	7.49
43.	71.14	0.51	14.44	2.66	2.84	0.23	0.48	3.29	2.18	2.15	0.082	0.94	5.82
44.	64.49	0.78	16.53	5.48	2.61	0.23	2.68	3.52	1.26	2.29	0.14	2.10	8.37
45.	62.08	0.85	17.14	6.33	3.22	0.26	3.17	3.35	1.16	2.31	0.13	1.96	9.91
46.	53.96	1.08	15.83	7.04	6.30	0.24	4.43	9.59	1.08	0.38	0.060	1.12	14.05
47.	64.41	0.85	16.61	4.78	3.60	0.16	2.28	3.71	1.19	2.28	0.15	1.33	8.78
48.	65.57	0.75	16.37	6.02	1.76	0.59	2.23	3.17	1.11	2.28	0.16	3.42	7.97
49.	66.44	0.74	16.16	5.12	2.27	0.49	1.65	3.36	1.26	2.34	0.17	2.26	7.64
50.	56.34	0.76	16.88	4.68	2.67	0.20	1.85	2.92	0.91	2.63	0.16	1.75	7.65
51.	66.38	0.78	15.80	3.97	3.70	0.21	1.83	3.95	1.47	1.78	0.13	1.07	8.08
52.	66.11	0.74	16.38	4.99	2.48	0.30	1.94	3.41	1.27	2.24	0.13	2.01	7.75
53.	67.75	0.71	15.98	4.19	2.49	0.17	1.77	3.12	1.33	2.38	0.12	1.68	6.96
54.	60.84	0.79	15.49	7.03	0.58	6.06	2.23	2.91	1.59	2.32	0.17	12.20	7.67
55.	59.65	0.93	17.06	6.98	3.03	0.31	2.64	5.86	1.62	1.73	0.19	2.31	10.35
56.	65.01	0.73	16.53	5.65	2.08	0.25	2.24	3.88	1.40	2.11	0.12	2.71	7.96

Table XVI-3 (Continued)

No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Fe_3/Fe_2*	Tot Fe**
57.	64.64	0.77	17.17	5.63	2.63	0.28	2.68	2.80	1.09	2.17	0.12	2.14	8.56
58.	65.07	0.75	17.26	4.97	2.59	0.010	2.40	3.21	1.22	2.42	0.11	1.92	7.85
59.	65.81	0.77	17.23	5.21	2.33	0.11	2.34	2.47	1.00	2.59	0.12	2.23	7.80
60.	68.65	0.71	15.95	4.94	1.59	0.29	1.83	1.94	1.35	2.65	0.11	3.11	6.70
61.	67.87	0.69	15.99	5.21	1.56	0.26	2.13	2.52	1.37	2.30	0.11	3.35	6.94
62.	69.88	0.76	14.75	2.61	4.54	0.17	1.12	2.71	2.11	1.17	0.17	0.58	7.66
63.	66.12	0.85	14.65	3.59	4.62	0.20	1.31	5.57	2.08	0.84	0.16	0.78	8.73
64.	59.31	0.86	16.46	5.89	3.82	0.29	3.02	5.90	2.06	2.20	0.20	1.54	10.14
65.	59.39	0.85	15.49	6.40	3.24	0.42	2.41	6.10	2.97	2.41	0.31	1.98	10.00
66.	57.45	0.89	15.40	8.75	1.96	1.86	3.07	5.77	2.97	1.66	0.20	4.46	10.94
67.	55.04	0.90	17.28	2.69	7.89	0.22	3.43	9.32	2.39	0.68	0.15	0.34	11.46
68.	61.09	0.80	15.93	5.28	3.37	0.25	2.62	5.79	2.02	2.69	0.18	1.57	9.02
69.	61.46	0.87	15.67	7.21	3.09	0.34	2.52	3.83	2.09	2.67	0.24	2.33	10.65
71.	58.37	0.84	15.31	7.34	2.55	0.34	2.50	7.78	2.17	2.58	0.22	2.88	10.17
72.	56.08	0.93	16.50	6.94	4.53	0.30	3.56	7.42	2.22	1.29	0.22	1.53	11.97
73.	63.91	0.74	16.68	7.36	0.68	0.81	2.98	2.61	1.25	2.73	0.24	10.78	8.11
74.	63.48	0.78	16.58	7.87	0.18	1.04	3.10	2.38	1.25	3.14	0.19	43.62	8.07
75.	63.10	0.77	16.96	6.55	1.36	0.37	3.11	3.24	1.30	3.06	0.18	4.83	8.06
76.	63.11	0.78	17.07	7.36	0.78	0.72	2.79	3.44	0.57	3.18	0.22	9.48	8.22
77.	62.56	0.73	16.69	7.71	0.23	1.08	3.25	2.84	1.91	2.79	0.21	33.84	7.97
78.	62.84	0.74	16.56	7.58	0.04	2.37	2.77	2.39	1.47	3.07	0.17	198.59	7.62
79.	63.98	0.77	16.70	7.07	1.12	0.57	2.85	2.33	1.46	2.94	0.21	6.29	8.32
80.	72.55	0.44	13.86	3.32	1.03	0.42	1.47	2.31	2.60	1.92	0.084	3.23	4.46
81.	63.83	0.79	17.60	6.94	0.88	0.78	2.90	1.59	1.28	3.26	0.17	7.90	7.91
82.	62.48	0.91	16.79	8.02	0.78	0.83	3.00	2.47	1.45	2.93	0.36	10.27	8.89
83.	63.13	0.81	16.92	6.42	2.18	0.45	3.04	2.72	1.40	2.72	0.20	2.95	8.84
84.	63.92	0.77	16.99	6.95	0.78	0.94	3.09	1.56	1.57	3.25	0.18	8.95	7.81
85.	69.10	0.54	15.79	3.99	1.27	0.25	1.83	1.80	1.73	3.54	0.15	3.13	5.40

Table XVI-3 (Continued)

No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Fe_3/Fe_2*	Tot Fe**
86.	62.45	0.76	17.29	7.66	0.36	1.35	3.02	2.39	1.65	2.86	0.21	21.28	8.06
87.	67.80	0.65	14.25	3.28	2.91	0.51	2.63	3.70	2.47	1.64	0.16	1.13	6.51
88.	56.30	0.59	15.08	1.74	8.30	0.29	3.09	10.06	2.86	1.20	0.20	0.21	10.96
89.	71.13	0.63	14.03	2.04	3.49	0.23	2.05	2.43	2.64	1.20	0.14	0.59	5.92
91.	63.67	0.80	17.70	6.60	1.36	0.59	3.07	1.83	1.05	3.19	0.15	4.86	8.11
92.	62.43	0.72	16.31	7.45	0.12	3.48	2.80	2.15	1.69	2.68	0.17	60.80	7.59
93.	64.93	0.79	17.74	5.52	2.01	0.16	3.05	1.49	0.81	3.37	0.14	2.75	7.75
94.	62.55	0.72	16.65	6.90	1.47	1.13	2.84	4.06	1.33	2.23	0.12	4.71	8.53
95.	67.12	0.64	17.09	4.16	1.87	0.21	2.16	2.22	1.73	2.66	0.14	2.22	6.25
96.	63.39	0.68	15.23	6.52	0.21	5.43	2.69	1.73	1.05	2.93	0.14	31.39	6.75
97.	65.70	0.75	16.67	5.31	1.87	0.15	2.98	1.61	1.71	3.13	0.13	2.84	7.38
98.	58.84	0.86	16.37	8.54	0.83	0.44	1.57	8.74	0.22	3.26	0.33	10.29	9.46
99.	62.57	0.82	16.62	6.38	2.05	0.062	1.92	4.18	1.56	3.70	0.15	3.11	8.66
100.	61.91	0.74	15.96	5.93	2.39	0.069	1.31	6.86	0.94	3.72	0.16	2.48	8.58
101.	59.43	0.80	15.31	5.51	1.87	0.098	0.62	11.71	1.10	3.33	0.24	2.95	7.58

* Fe_2O_3/FeO. ** Total Fe as Fe_2O_3.

Table XVI-4 Average and their standard deviation of major constituents of sediments in three areas.

	West area (around the Izu-Ogasawara ridge)	Middle area (the Izu-Ogasawara trench)	East area (Pacific ocean floor on the east of the trench)
SiO_2	59.60 ± 3.93	65.60 ± 3.24	64.30 ± 2.52
TiO_2	0.90 ± 0.13	0.74 ± 0.09	0.74 ± 0.10
Al_2O_3	16.22 ± 0.73	16.06 ± 0.91	16.66 ± 0.86
Fe_2O_3	4.96 ± 2.33	5.30 ± 1.31	6.54 ± 1.34
FeO	4.50 ± 2.46	2.15 ± 1.20	0.98 ± 0.66
MnO	0.31 ± 0.29	0.84 ± 1.15	1.10 ± 1.26
MgO	1.80 ± 0.95	2.15 ± 0.64	2.80 ± 0.44
CaO	6.71 ± 2.38	3.24 ± 1.22	2.34 ± 0.67
Na_2O	2.01 ± 0.62	1.54 ± 0.47	1.44 ± 0.42
K_2O	2.68 ± 0.89	2.22 ± 0.51	2.93 ± 0.37
P_2O_5	0.32 ± 0.15	0.16 ± 0.15	0.18 ± 0.06
Fe_2O_3/FeO	1.95 ± 2.22	5.22 ± 7.57	22.61 ± 43.30
Tot · Fe_2O_3	9.96 ± 1.55	7.69 ± 1.39	7.63 ± 1.09

Table XVI-5 Correlation coefficient between SiO_2 and Al_2O_3

West area	−0.672
Middle area	−0.836
East area	−0.841

points from the Ogasawara Trench and the Pacific deep ocean floor are mostly distributed between the averaged granites and Quaternary volcanics of Japan, suggesting that most sediments in these areas are derived from the Japanese Islands. On the other hand, points from the area around the Ogasawara Islands deviate downwards; some of them are situated below the point of average volcanics of Japan.

Table XVI-4 and Fig. XVI-1 show that the silica content of sediments in the Ogasawara Trench and on the Pacific deep ocean floor is higher than in sediments around the Ogasawara Ridge. The correlation coefficient between SiO_2 and Al_2O_3 in the first two areas is large enough (Table XVI-5) to indicate a close relationship between these components. SUGISAKI (1980) found a similar correlation in the sediments of the Japan Trench during DSDP Legs 56 and 57. For example, sediments at Site 438 have a relationship expressed by a formula, $SiO_2 = 100.1 - 2.12Al_2O_3$, which was calculated by the least square method. This formula gives 100.1% of SiO_2 when Al_2O_3 is null, showing a pure silica precipitates against Al_2O_3. Since the sediments contain many siliceous organisms such as radiolaria, diatoms and sponges, and the amount of these organisms is positively correlated with the SiO_2 content, the high silica of the sediments in the Japan Trench can be attributed to biogenic silica (SUGISAKI, 1980). Piston cores P150, P151, P153, P155 and P157 taken during cruises GH79-3 and 4 were collected from a strip which connects with the Japan Trench to the north, and hence some proportion of

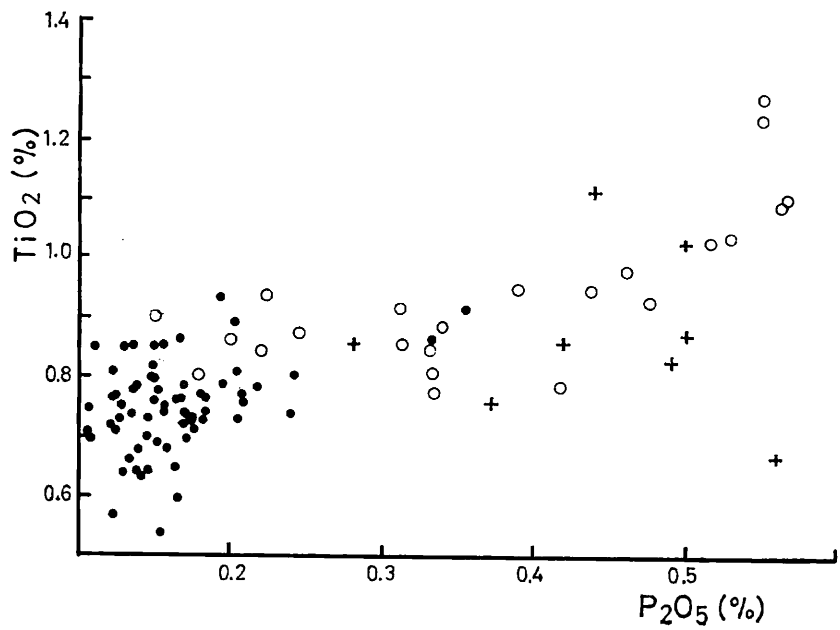

Fig. XVI-2 Relation of TiO_2 versus P_2O_5. Open circles represent samples collected within 300 km of Iwojima Island. Closed ones represent all others. Crosses do the volcanics from Iwojima Island (KUNO, 1962).

the silica might be also derived from biogenic silica. The relationship of SiO_2 to Al_2O_3 in these cores, however, is expressed by $SiO_2 = 118.8 - 3.31Al_2O_3$. This fact does not indicate the precipitation of pure silica. Furthermore, even in samples with a lot of silica, few siliceous organisms are observed, if any, under the microscope; instead, a lot of volcanic glass is contained. The glass is certainly responsible for the high concentration of silica in the sediments. The regression lines of $SiO_2 = 126.6 - 3.79Al_2O_3$ and $SiO_2 = 114.5 - 3.30Al_2O_3$ are calculated for average granites and volcanics in Japan* respectively. These formulae are similar to those for the sediments in the Ogasawara Trench and on the east of the trench. This suggests a contribution of volcanic glass to these sediments. The sediments of lower silica content around the Izu-Ogasawara Islands (Fig. XVI-1) may be partly derived from volcanics on these Islands, which are intermediate or basic.

The sediments around the Izu-Ogasawara Islands are rich in TiO_2 and P_2O_5, whereas those from other areas show normal concentrations of these components (Table XVI-4). Fig. XVI-2 shows the relation of TiO_2 to P_2O_5 in the present samples and in volcanics from Iwojima Island. The volcanics belong to the alkaline rock series characterized by high concentrations of TiO_2 and P_2O_5. In Fig. XVI-2, points of core samples obtained within 300 km of Iwojima Island fall in almost the same areas as points of the Iwojima volcanics. This also shows a local contribution

*The regression lines were calculated from the data for averaged granites and volcanics, which were published by ARAMAKI *et al.* (1972) and SUGISAKI (1976), respectively.

to the area from the islands.

A lateral variation trend of MnO content and Fe_2O_3/FeO ratio emerges in Table XVI-4. The average MnO content in sediments from the Nankai Trough and its vicinity amounts to 0.083% (SUGISAKI, 1978), whereas the MnO contents of sediments around the Ogasawara Ridge, from the Ogasawara Trench and the east side of the trench are 0.31%, 0.84% and 1.10%, respectively. The MnO content increases with increasing distance from lands. This can be ascribed to a decline in sedimentation rates to the east. Furthermore, Fe_2O_3/FeO rapidly increases to the east (Table XVI-4), indicating that the environment becomes oxidizing eastwards, probably because of a lack of organic material derived from lands. This oxidizing environment, as well as the lower sedimentation rate in pelagic regions, will promote precipitation of manganese.

On the basis of the chemical compositions of sediments from the Nankai Trough and its environs, SUGISAKI (1978) inferred that the sediments on the continental margin characterized by low Mn, high Si and high ferrous are gradually reorganized into usual pelagic sediments of high Mn, low Si and low ferrous. The data obtained in the present study provide information on the transition of the chemical composition of the sediments from the continental margin to the pelagic region.

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