Bulletin of the Geological Survey of Japan, vol. 33 (8), p. 369–379, 1982 543.4: 549: 546.22+546.26 (265)

Sulfur and Carbon Contents of Deep-sea Sediments from the Central Pacific, GH80–1 Cruise

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TERASHIMA, Shigeru, NAKAO, Seizo and MITA, Naoki (1982) Sulfur and carbon contents of deep-sea sediments from the central Pacific, GH80–1 cruise. *Bull. Geol. Surv. Japan*, vol. 33 (8), p. 369–379.

Abstract: One hundred and fifteen deep-sea sediments from the north and south Central Pacific were analyzed for total sulfur, total carbon, organic carbon, water soluble sodium and water soluble chlorine. These samples were collected along two tracks of 4,000 km long for each, running from east of the Wake island to west of Tahiti, in a Hakurei-maru cruise, GH80–1.

Total sulfur content ranges from 0.16% to 0.51%, and averages 0.33%. The total sulfur is positively correlated with sea salts content. For the occurrence of the sulfur, about 80% of the total sulfur is probably derived from the sea salts, and for the other part of the sulfur, barite is to be a main origin. Sulfide sulfur is not detected in the studied samples.

The content of organic carbon varies from 0.07% to 0.63%, and averages 0.20%. In most cases, organic carbon is more abundant in the deep-sea surface sediments than in the core samples. This may be related to the oxidation of organic carbon in the uppermost part of the sediments. The organic carbon contents of the survey area are clearly lower than those of coastal marine sediments from the sea-off of Northeast Japan or around Japan Trench.

Introduction

It is generally known that sulfide sulfur in the coastal marine sediments is produced from sulfate sulfur during the process of bacterial sulfate reduction (BERNER, 1970, JøRGENSEN, 1977, and GOLDHABER *et al.*, 1977). The bacterial sulfate reduction occurs only in the absence of oxygen, and the sulfur and organic matter contents are positively correlated in most cases. For the deep-sea sediments, however, there are few data, as to the contents of sulfur and carbon, and the details of geochemical characteristics of both elements have not been discussed.

In the present investigation, 115 deep-sea sediments have been collected from the north and south Central Pacific during the cruise GH80–1, Geological Survey of Japan. Total sulfur, total carbon, organic carbon, water soluble sodium and water soluble chlorine were analyzed for these samples. In order to know the chemical formation and occurrence of the sulfur, sulfate sulfur and barium were determined for some selected samples.

Localities of the analyzed samples are shown in Table 1. More details of the survey area and the comprehensive studies of the cruise have been reported by MIZUNO and NAKAO (1982), especially the chemistry of major and some minor elements for these sediments by SUGISAKI and KINOSHITA (1982) and MITA *et al.* (1982).

Sample Preparation and Analytical Methods

The 115 samples for this study were selected from 14 piston cores and 25 box cores, which were taken from 39 locations of the survey

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Table 1 Localities of the sampling stations.

Station No.	Latitude	Longitude	Depth (m)	Sediments
Mid-Pacific Mountains				
1647	16°10.14′N	179°19.82′W	5292	Zeolitic mud
1590	15°23.31′N	178°43.79′E	5287	Zeolitic-rich clay
1646	15°22.48′N	178°45.46′W	5537	ditto
1645	14°06.61′N	177°47.28′W	5068	ditto
1644	13°16.99′N	177°08.35′W	5027	Zeolitic mud
Central Pacific Basin, Northern Part				
1642	11°06.38′N	175°30.67′W	5441	Siliceous fossil-rich clay
1641	9°46.81′N	174°31.04′W	5829	ditto
1640	8°57.86′N	173°53.91′W	5915	Siliceous mud
1639	7°40.26′N	172°56.77′W	5926	ditto
1598	6°49.67′N	174°47.63′W	5962	Siliceous fossil-rich clay
1638	6°48.65′N	172°15.46′W	5791	Siliceous mud
Central Pacific Basin, Central Part				
1600	4°41.39′N	173°11.89′W	5584	Siliceous mud
1636	4°43.37′N	170°42.88′W	5747	ditto
1601	3°17.83′N	172°10.51′W	5350	ditto
1602	2°33.26′N	171°37.69′W	5389	ditto
1635	3°16.42′N	169°40.10′W	5351	Siliceous ooze
1635A	3°16.31′N	169°40.25′W	5350	ditto
1634	2°32.13′N	169°06.07′W	5087	Siliceous calcareous marly ooze
1603	1°17.22′N	170°42.28′W	5479	Siliceous mud
1633	1°16.04′N	168°09.97′W	5359	Siliceous ooze
1604	0°24.23′N	170°02.51′W	5457	Siliceous mud
1632	0°26.16′N	167°33.83′W	5255	Siliceous nanno mud
1605	0°57.91′S	169°01.69′W	5455	$CaCO_3$-rich siliceous mud
Central Pacific Basin, Southern Part and North Tokelau Basin				
1631	0°58.61′S	166°20.89′W	5342	Calcareous siliceous ooze
1630	1°30.45′S	165°52.52′W	5537	Siliceous mud
1629	2°53.00′S	164°57.31′W	5261	ditto
1607	3°02.12′S	167°29.91′W	5698	ditto
1628	3°30.50′S	164°09.94′W	4947	Siliceous fossil-rich clayey
Manihiki Western Plateau and Manihiki Northeastern Basin				
1627	5°27.32′S	163°64.01′W	4995	Siliceous calcareous fossil-rich mud
1625	7°06.72′S	161°56.68′W	4650	Clayey nanno ooze
1623	9°26.14′S	160°14.83′W	4561	Calcareous marly ooze
1613	9°29.32′S	162°41.40′W	2944	Foraminifera ooze
Penrhyn Basin				
1622	10°16.35′S	159°35.57′W	5235	Zeolite-rich mud
1621	11°35.38′S	158°34.91′W	5312	ditto
1616	12°20.07′S	160°30.89′W	5690	Pelagic clay
1620	12°26.44′S	157°57.20′W	5285	Zeolitic mud
1619	13°34.03′S	157°06.01′W	5131	ditto
1617	13°47.40′S	159°28.35′W	5162	Pelagic clay
1618	14°29.61′S	158°52.98′W	5453	ditto

area. After air-dried, samples were ground to under 150 mesh. The ground samples were dried at 110°C for 3 hours, and kept in a desiccator. These samples are the same as those reported by Mita *et al.* (1982).

The total sulfur, total carbon and organic carbon were analyzed by an infrared absorption photometry after combustion, and water soluble sodium and barium were determined by atomic absorption spectrometry. These methods were described in TERASHIMA *et al.* (1982). As for the other elements, water soluble chlorine were analyzed by titrimetry, and sulfate sulfur by gravimetry. Outlines of the analytical procedures for these two elements are given below.

Analysis of water soluble chlorine: Weigh 0.2 g of the sample into a test tube of 50 ml with a stopper. After adding water to the fixed volume, shake the mixture for about one minute. Allow to stand for more than 10 minutes, filter with a filter paper (5B), and titrate by N/20 silver nitrate solution.

Analysis of sulfate sulfur: Weigh 1.0 g of the sample into a beaker of 300 ml, and add 30 ml of HCl (1+2). After covering, heat the mixture for 20 minutes at about 100°C, then filter with a filter paper (5C). Determine sulfate sulfur in the filtrate by a conventional gravimetric method by adding barium chloride solution.

Results and Discussion

The analytical results for total sulfur, organic carbon, water soluble sodium and water soluble chlorine are listed in Table 2. The contents of sulfate sulfur, carbonate carbon and barium in selected 53 samples are given in Table 3. The calculated values of carbonate carbon are obtained by subtracting organic carbon from the total carbon.

General aspect

Sulfur: The value of total sulfur varies from 0.16 to 0.51%, and the average is 0.33%. It is generally known that sulfide sulfur in the coastal marine sediments is produced from sulfate sulfur by bacterial sulfate reduction. In order to know the presence of the sulfide sulfur in the samples studied, sulfate sulfur was analyzed for some samples. The results agree with the total sulfur contents within the experimental errors as shown in Fig. 1. It shows that sulfide sulfur is not present in the samples. Namely, there may be no bacterial sulfate reduction in the survey area.

Carbon: The content of organic carbon varies from 0.07 to 0.63%, and the average is 0.20%. The relationship between organic carbon contents and the depth below the ocean bottom are given in Fig. 2. It shows that the surface sediments are more abundant in organic carbon than the subsurface samples. This may be related to the oxidation of organic carbon in the uppermorst part of sediments. The organic carbon is found in all the samples, but the carbonate carbon is present in only 14 samples (Nos. 18, 52, 53, 59, 67, 75, 76, 80, 96, 97, 101, 102, 103, and 104). In general, carbonate carbon is present as the compounds of calcium carbonate in deep-sea sediments. Distribution of carbonate carbon calcurated agrees with the results by SUGISAKI and KINOSHITA (1982) who reported geochemical characteristics and geographical distribution of the calcium carbonate in the survey area.

Occurrence of sulfur

A large amount of sulfate sulfur from sea salt is contained in the deep-sea sediments.

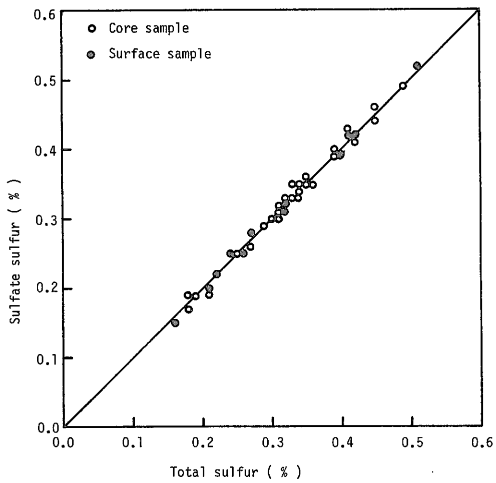

Fig. 1 Comparison of sulfur contents determined by infrared absorption photometry (total sulfur) and gravimetry (sulfate sulfur).

Table 2 Analytical results of total sulfur, organic carbon, water soluble sodium and water soluble chlorine for deep-sea sediments from the GH80-1 cruise in weight percent.

No.	Station No.	Observ. No.	Location (cm)	Total sulfur	Organic carbon	Water soluble sodium	Water soluble chlorine
1	1647	B 32 (c)		0.26	0.34	2.40	3.70
2	1590	B 2 (s)	Surface	0.23	0.27	2.33	3.11
3	1646	B 31 (c)		0.22	0.31	2.42	3.52
4	1645	B 30 (c)		0.24	0.37	3.05	4.47
5	1644	P 179	5–17	0.18	0.16	1.43	1.89
6			148–158	0.20	0.11	1.92	2.54
7			192–202	0.25	0.13	1.68	2.39
8			302–312	0.31	0.14	2.53	3.11
9	1642	P 178	20–30	0.35	0.17	3.63	5.17
10			90–100	0.33	0.17	3.22	5.25
11			220–230	0.29	0.15	3.24	4.70
12			320–330	0.35	0.14	3.61	5.07
13			420–430	0.34	0.14	3.65	5.26
14			520–530	0.30	0.14	2.97	4.35
15			620–630	0.26	0.13	3.22	4.44
16			680–690	0.22	0.12	2.39	3.31
17			730–740	0.19	0.10	2.03	2.37
18	1641	B 29		0.27	0.38	3.85	5.66
19	1640	P 177	5–20	0.27	0.24	3.59	5.27
20			127–137	0.35	0.15	4.74	7.47
21			227–237	0.37	0.16	4.76	7.44
22			287–297	0.35	0.17	4.97	7.12
23			347–357	0.33	0.16	4.67	6.68
24			427–437	0.27	0.15	3.76	5.52
25			525–535	0.32	0.13	4.71	6.92
26			625–635	0.36	0.15	4.40	6.25
27			725–735	0.35	0.16	4.61	7.13
28	1639	B 28		0.32	0.48	4.72	6.84
29	1598	B 4	Surface	0.35	0.43	4.87	7.62
30	1638	P 176	10–20	0.34	0.17	4.41	6.56
31			124–134	0.36	0.17	4.78	6.85
32			224–234	0.39	0.14	4.90	7.45
33			324–334	0.31	0.13	4.52	6.33
34			424–434	0.38	0.10	4.33	6.60
35			522–532	0.35	0.09	4.00	6.39
36			602–612	0.33	0.11	4.48	6.28
37			697–707	0.33	0.09	4.29	6.33
38	1600	B 5	Surface	0.40	0.47	5.62	7.96
39	1636	P 175	5–20	0.35	0.29	4.64	6.92
40			116–126	0.33	0.17	4.82	6.90
41			225–235	0.37	0.17	5.05	7.13
42			315–325	0.32	0.16	4.55	6.84
43			416–426	0.38	0.16	4.75	7.12
44			514–524	0.37	0.15	5.00	7.06
45			624–634	0.38	0.13	5.17	7.63
46			714–724	0.39	0.14	5.10	7.53
47	1601	B 6	Surface	0.41	0.61	5.30	8.05
48	1602	B 7	Surface	0.41	0.52	5.54	8.68

Table 2 (continued)

No.	Station No.	Observ. No.	Location (cm)	Total sulfur	Organic carbon	Water soluble sodium	Water soluble chlorine
49	1635	B 26		0.41	0.47	5.38	7.95
50	1635A	P 174	50–60	0.33	0.09	3.84	5.50
51			731–741	0.37	0.07	3.88	6.00
52	1634	P 173	50–60	0.34	0.11	4.19	6.00
53			138–148	0.33	0.13	4.37	6.33
54			238–248	0.35	0.14	4.40	6.34
55			318–328	0.38	0.13	4.75	6.84
56			438–448	0.37	0.07	3.30	5.23
57			535–545	0.49	0.11	3.16	4.91
58			635–645	0.41	0.08	4.18	6.56
59			735–745	0.30	0.13	2.76	4.24
60	1603	P 159	0–15	0.42	0.29	5.02	7.07
61			57–67	0.48	0.12	5.75	8.35
62			237–247	0.40	0.09	5.24	7.80
63			437–447	0.32	0.09	4.33	6.50
64			637–647	0.36	0.08	4.56	7.02
65	1633	B 25 (c)		0.44	0.58	5.83	9.14
66	1604	B 8		0.40	0.63	5.70	7.80
67	1632	P 172	20–30	0.32	0.14	3.96	5.75
68			122–132	0.39	0.19	4.95	7.20
69			202–212	0.45	0.17	5.07	7.44
70			312–322	0.37	0.15	4.76	7.10
71			422–432	0.35	0.15	4.68	6.78
72			522–532	0.38	0.15	5.07	7.53
73			602–612	0.40	0.13	5.15	7.57
74			722–732	0.41	0.13	5.18	7.25
75	1605	P 160	6–16	0.29	0.24	3.44	5.22
76			162–172	0.34	0.16	4.06	6.13
77			362–372	0.37	0.16	4.32	6.16
78			562–572	0.34	0.13	4.10	6.22
79			741–752	0.41	0.19	4.95	7.00
80	1631	B 24 (c)	Surface	0.42	0.54	5.15	7.42
81	1630	P 171	15–34	0.29	0.30	3.48	5.14
82			36–46	0.31	0.17	3.92	5.82
83			136–146	0.32	0.15	4.14	5.92
84			231–241	0.32	0.14	4.03	5.98
85			338–348	0.32	0.13	4.13	5.82
86			423–433	0.31	0.11	3.91	5.25
87			523–533	0.32	0.08	4.22	6.18
88			613–623	0.31	0.11	4.11	5.93
89			723–733	0.30	0.11	3.88	5.50
90	1629	B 23 (c)	Surface	0.43	0.44	5.32	8.25
91	1607	P 161	15–30	0.28	0.14	3.52	5.07
92			26–36	0.27	0.19	3.39	4.90
93			226–236	0.34	0.09	4.07	5.98
94			516–526	0.22	0.10	1.85	2.22
95			716–726	0.31	0.20	1.94	2.51
96	1628	P 170	10–25	0.25	0.28	2.64	3.74

Table 2 (continued)

No.	Station No.	Observ. No.	Location (cm)	Total sulfur	Organic carbon	Water soluble sodium	Water soluble chlorine
97			59–69	0.34	0.16	4.29	6.14
98			152–162	0.38	0.15	5.06	7.69
99			243–253	0.38	0.17	4.79	7.32
100			343–353	0.45	0.14	5.29	7.82
101	1627	B 22 (c)		0.51	0.44	6.25	9.45
102	1625	B 21 (c)	Surface	0.32	0.31	3.41	5.28
103	1623	B 20 (c)		0.21	0.20	1.58	2.10
104	1613	B 12	Surface	0.16	0.07	1.12	1.84
105	1622	P 167	5–20	0.18	0.17	1.82	2.50
106			33–43	0.21	0.13	1.94	2.62
107			178–188	0.29	0.09	2.97	4.45
108			375–385	0.27	0.07	2.82	4.11
109			575–585	0.27	0.08	2.62	3.65
110	1621	B 19 (c)		0.26	0.41	2.83	4.07
111	1616	B 14	Surface	0.33	0.45	3.03	4.37
112	1620	B 18 (c)		0.31	0.35	3.28	5.34
113	1619	B 17 (c)	Surface	0.34	0.36	3.81	5.71
114	1617	B 15 (c)	Surface	0.41	0.44	4.29	6.73
115	1618	B 16 (c)	Surface	0.35	0.37	4.48	7.05

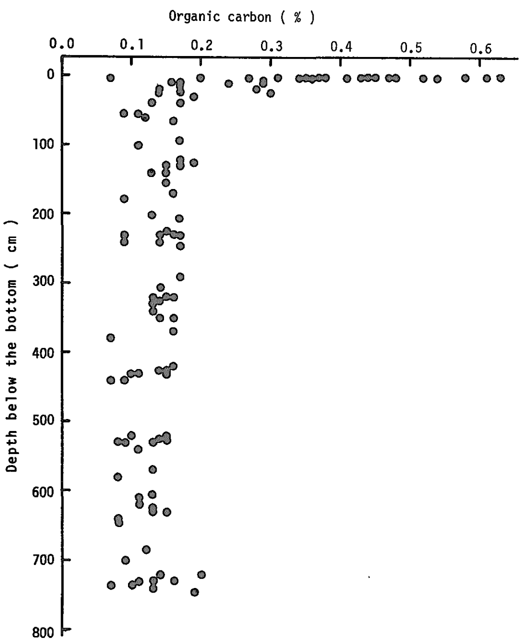

Fig. 2 Plot of organic carbon contents to depth below the bottom of the sample.

In order to estimate the sulfate sulfur of the sea salt origin, water soluble sodium and chlorine are analyzed. The relationship between the water soluble sodium and chlorine are illustrated in Fig. 3. There are clear positive correlation. Concentration ratios of sodium to chlorine are calculated for both sea water and sodium chloride, and the results are also illustrated in the figure. The concentrations of water soluble sodium to chlorine of the deep-sea sediments exist in the sodium-rich area of the sea water ratio. This means that water soluble sodium in the sediments are not only from the pore water, but from the minerals in the sediments. So, the sulfur from the sea salt should be better estimated from the water soluble chlorine contents.

The relationship between total sulfur contents and water soluble chlorine contents are presented in Fig. 4. There are clear positive correlation, but the plots exist in the sulfur-rich area of the sea water ratio. This implies

Table 3 Analytical results of sulfate sulfur, carbonate carbon and barium for ocean-floor sediments from the GH80–1 cruise in weight percent.

No.	Sulfate sulfur	Carbonate carbon*	Barium	No.	Sulfate sulfur	Carbonate carbon*	Barium
1	0.25	0.00	0.27	67	0.33	2.96	0.28
3	0.22	0.00	0.08	68	0.39	0.00	0.25
4	0.25	0.00	0.22	69	0.44	0.00	0.27
5	0.17	0.00	0.18	71	0.36	0.00	0.29
8	0.30	0.00	0.05	74	0.42	0.00	0.38
9	0.35	0.00	0.47	75	0.29	2.31	0.12
11	0.29	0.00	0.25	76	0.33	0.34	0.21
17	0.19	0.00	0.06	79	0.43	0.00	0.36
18	0.28	0.03	0.07	80	0.42	0.33	0.16
19	0.26	0.00	0.11	84	0.31	0.00	0.21
26	0.35	0.00	0.23	93	0.34	0.00	0.09
27	0.35	0.00	0.18	94	0.22	0.00	0.05
28	0.32	0.00	0.12	95	0.31	0.00	n.d.
31	0.35	0.00	0.21	96	0.25	5.19	0.18
33	0.32	0.00	0.16	97	0.35	0.30	0.22
35	0.35	0.00	0.16	100	0.46	0.00	0.51
37	0.33	0.00	0.18	101	0.52	0.32	0.33
38	0.39	0.00	0.15	102	0.31	4.81	0.18
40	0.35	0.00	0.15	103	0.20	8.22	0.16
46	0.40	0.00	0.37	104	0.15	10.23	0.05
49	0.42	0.00	0.21	105	0.19	0.00	0.04
52	0.33	1.45	0.27	106	0.19	0.00	0.05
53	0.33	0.04	0.30	107	0.29	0.00	0.04
57	0.49	0.00	0.87	109	0.26	0.00	0.05
59	0.30	2.37	0.32	114	0.42	0.00	0.38
60	0.41	0.00	0.27				
63	0.33	0.00	0.16				
66	0.39	0.00	0.16	$\overline{X}$ (n=53)	0.33	0.73	0.21 (n=52)

Nos. same as the Table 2. n.d.: Not determined.

* Carbonate carbon was detected only in 14 samples (Nos. 18, 52, 53, 59, 67, 75, 76, 80, 96, 97, 101, 102, 103, and 104).

that there are other types of sulfate sulfur, beside the sulfate sulfur contained in sea salt. Goldberg and Arrhenius (1958) have described that barite is the most common sulfur-bearing mineral in deep-sea sediments. In this study, barium was analyzed in some selected samples, and the results are given in Fig. 5 and are compared with corrected sulfate sulfur contents. Most of the samples show a positive correlation, though weakly, between the barium and corrected sulfate sulfur. It appears that the sea salt origin sulfur and barite sulfur are the main portion of sulfur occurring in the deep-sea sediments.

The sulfur content of the sea salt origin in the survey area ranges from 0.09 to 0.44%, averaging 0.27%, whereas that of the corrected sulfur ranges from 0.00 to 0.26% with an average of 0.058%. It means that about 80% of sulfur in the sediment comes from the sea salts.

Relationship between regional variations and type of sediments

The regional variations of the average contents of total sulfur (uncorrected and corrected), organic carbon, carbonate carbon,

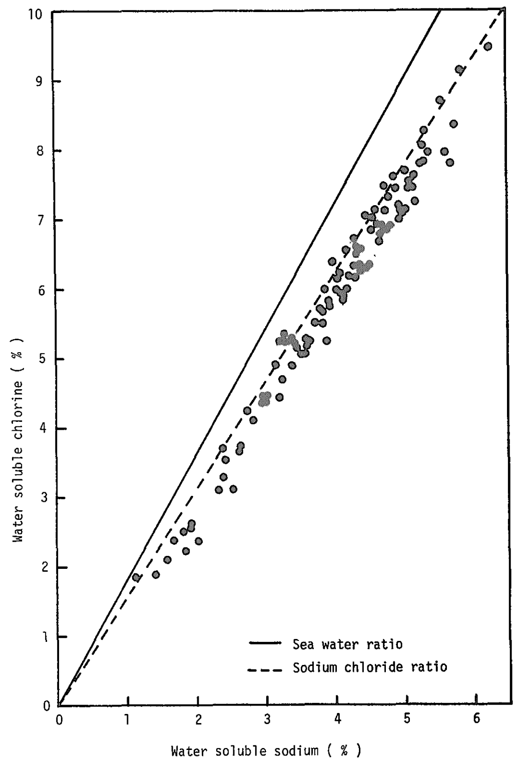

Fig. 3 Relationship between water soluble sodium and water soluble chlorine.

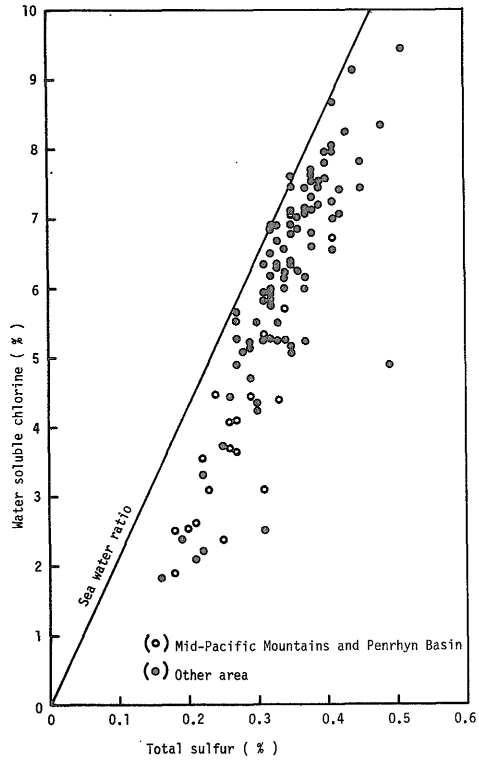

Fig. 4 Relationship between total sulfur and water soluble chlorine.

water soluble sodium and water soluble chlorine are listed in Table 4. The uncorrected total sulfur, water soluble sodium and water soluble chlorine in the samples from central part of the survey area, Central Pacific Basin and North Tokelau Basin, are slightly higher than those of both northern part as the Mid-Pacific Mountains and southern part as the Manihiki Western Plateau, Manihiki North-eastern Basin and Penryn Basin. Whereas the corrected total sulfur and organic carbon in the samples from central part of the survey area are lower than those of other areas. This may be related to type of sediments and bathymetric or geographical situations of deep-sea sedimentation. Table 5 gives the average contents of some elements on various types of sediments. The contents of uncorrected total sulfur, water soluble sodium and water soluble chlorine in the zeolitic sediments are

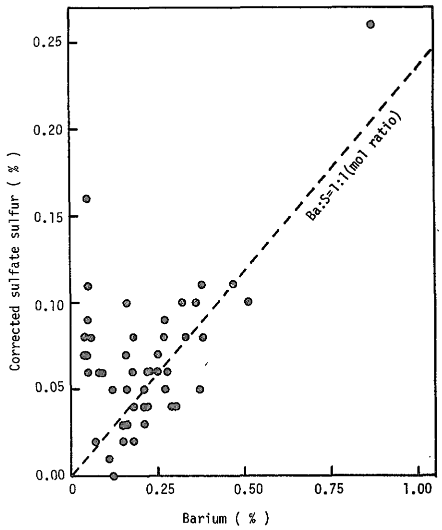

Fig. 5 Relationship between barium and corrected sulfate sulfur.

Table 4 Average contents based on their localities in weight percent.

Area	(n)	Total sulfur		Organic carbon	Carbonate carbon	Water soluble sodium	Water soluble chlorine
		uncorrected	corrected*				
Midlle Pacific Mountains	8	0.24	0.08	0.23	0.00	2.22	3.09
Central Pacific Basin, Northern Part	29	0.32	0.04	0.17	0.00	4.05	5.95
Central Pacific Basin, Central part	42	0.38	0.06	0.20	0.23	4.66	6.88
Central Pacific Basin, Southern part, and North Tokelau Basin	21	0.33	0.06	0.19	0.28	3.96	5.74
Manihiki Western Plateau, and Manihiki Northeastern Basin	4	0.30	0.08	0.26	5.90	3.09	4.67
Penrhyn Basin	11	0.29	0.08	0.27	0.00	3.08	4.60
Average	115	0.33	0.058	0.20	0.34	4.00	5.88

* Values obtained by subtracting salt origin sulfur from the analyzed value.

Table 5 Average contents based on the type of sediments in weight percent.

Sediment	(n)	Total sulfur		Organic carbon	Carbonate carbon	Water soluble sodium	Water soluble chlorine
		uncorrected	corrected*				
Zeolitic mud, Zeolite-rich mud and Zeolite-rich clay	16	0.25	0.08	0.22	0.00	2.49	3.57
Siliceous mud	50	0.34	0.04	0.19	0.00	4.45	6.52
Siliceous fossil-rich clay	16	0.32	0.07	0.19	0.35	3.67	5.37
Siliceous calcareous marly ooze	8	0.37	0.10	0.11	0.48	3.89	5.81
$CaCO_3$-rich siliceous mud	5	0.35	0.06	0.18	0.53	4.17	6.15

* Same as in Table 4.

clearly lower than those of siliceous mud, siliceous fossil rich clay, siliceous calcareous marly ooze and calcium carbonate rich siliceous mud. The relationship between water soluble sodium and total sulfur for zeolitic sediments and siliceous muds are given in Fig. 6. There are clear close correlation. And the siliceous muds are much dominated by both water soluble sodium and total sulfur than the zeolitic sediments. This fact implies that the sea salts are abundant in the siliceous muds.

Organic carbon and water soluble chlorine are correlated positively on the surface samples. However, those of the subsurface samples appear to have no correlation, as shown in Fig. 7. It follows that the organic carbon in the sediment is supplied from the sea water, and the half or more of them is lost by intensive oxidation. But this oxidation may be limited only to the uppermorst part of the sediments,

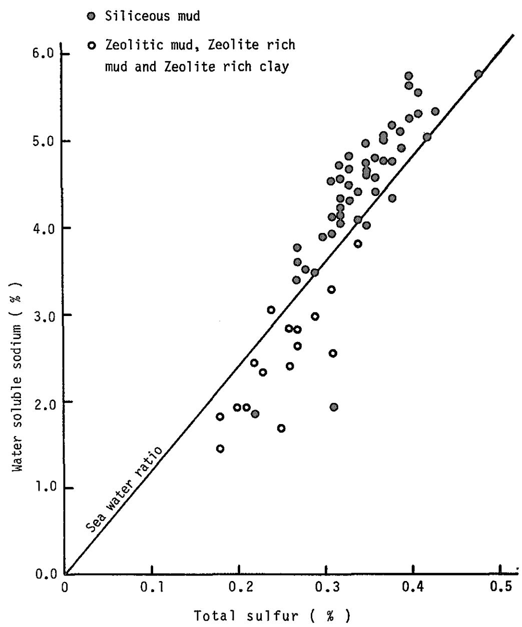

Fig. 6 Relationship between total sulfur and water soluble sodium.

because more than 0.07%of organic carbon are remained in the subsurface samples.

Areal variation

Average contents of sulfide sulfur, sulfate sulfur, organic carbon and carbonate carbon in recent marine sediments from two different areas are listed in Table 6 for comparison. There are clear differences in the sulfide sulfur contents among the samples from the area to the east of Northeast Japan (0.54%), around the Japan Trench (0.27%) and in the Central Pacific (0.00%). There also exists similar tendency in the organic carbon contents. Thus both sulfide sulfur and organic carbon are more abundant in the coastal side than in the oceanic side. This fact implies that the sulfide sulfur in the marine sediments are provided by bacterial sulfate reduction through sedimentary processes involving abundant organic carbon. Absence of sulfide sulfur in the Central Pacific may be related to the low organic carbon contents, and, in lesser degree, to very slow rate of sedimentation and other bathymetric situations.

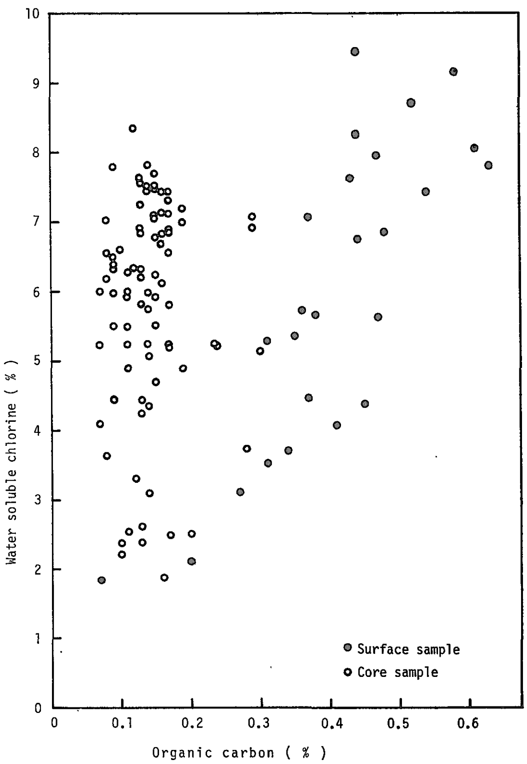

Fig. 7 Relationship between organic carbon and water soluble chlorine.

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Table 6 Comparison of the average contents for sulfide sulfur, sulfate sulfur, organic carbon and carbonate carbon in recent marine sediments.

Area	Water depth (m)	Sulfide sulfur (%)	Sulfate sulfur (%)		Organic carbon (%)	Carbonate carbon (%)
			Total	Salt origin		
Sea off of Northeast Japan*	750–4770	0.54	0.29	0.12	1.52	0.30
Around Japan Trench*	5180–8805	0.27	0.18	0.11	0.90	0.04
Central Pacific Basin	2944–5962	0.00	0.33	0.27	0.20	0.34

* Data from TERASHIMA *et al.* (in prep.)

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中央太平洋海底堆積物中の硫黄と炭素含有量

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要　旨

中央太平洋海盆から得られた深海底堆積物 115 試料について全硫黄，全炭素，有機炭素，水溶性ナトリウム及び水溶性塩素を定量した．そして硫黄の存在形態と地球化学的性質を知る目的で一部については硫酸塩硫黄，バリウムも定量した．用いた分析方法は燃焼-赤外吸収法（全硫黄，全炭素，有機炭素），原子吸光法（水溶性ナトリウム，バリウム），滴定法（水溶性塩素），重量法（硫酸塩硫黄）である．

全硫黄の含有量は 0.16-0.51% で，平均値は0.33%であった．全硫黄と水溶性ナトリウム，水溶性塩素，バリウム含有量との関係を検討した結果，全硫黄の約80%は海水中の硫酸イオンに由来し，残りは主として重晶石として存在すると考えられた．そして，硫化物硫黄は全く検出されなかった．

有機炭素の含有量は 0.07-0.63% であり，平均値は0.20%であった．そして表層堆積物に多く，コアー堆積物で低い傾向があり，大半の有機炭素は海底面で酸化分解されると推定された．全炭素から有機炭素を差し引くことによって求められた炭酸塩炭素は，115 試料のうちわずか 14 試料（そのほとんどは表層堆積物）に存在する．

堆積物の種類との関係では，沸石質堆積物中の全硫黄，水溶性ナトリウム，水溶性塩素の含有量は珪質軟泥その他の堆積物に比べて低かった．本研究で得られたいくつかのデータを日本海溝周辺海域の試料についての結果と比較したところ，硫化物硫黄及び有機炭素の含有量に顕著な差があり，この両者は陸側海域で高く，陸から遠くなるに従って減少する傾向を示した．これは海域の酸化還元環境や堆積速度，有機物の供給量等に関係すると思われる．

（受付：1982年 1 月18日；受理：1982年 2 月22日）