

XIII. CARBON AND NITROGEN CONTENTS OF SURFACE SEDIMENTS COLLECTED FROM OFF TOKAI AREA, JAPAN

Tatsuo Maekawa and Masatoshi Komiya

Introduction

Contents and stable isotopic compositions of carbon and nitrogen in sediments are useful parameters to assess and differentiate their depositional paleoenvironments or sources of organic matter or both. Here, we present contents of total carbon, organic carbon, and nitrogen in surface sediments collected from Northwest Pacific Ocean off Tokai area, Japan. Preliminary data of isotopic composition of organic carbon in several samples are also presented.

Sampling and Analysis

The surface sediments were collected with K-grab sampler from off Tokai area, Japan, in GH97 scientific cruise. The location map is shown in Fig. XIII-1. The samples were sealed in glass bottles and kept frozen during the cruise. They were freeze-dried in laboratory, and ground to powder with an agate mortar. For analysis of organic carbon, carbonate minerals were removed by two different methods: the wash-out method and the vapor method. In the first method, 3 to 4 g of samples were soaked in 1N HCl solution overnight, filtrated with a glass-fiber filter, washed out with distilled water, and dried at 50°C. The second method is that proposed by Yamamuro and Kayanne(1995) and uses HCl vapor. The samples were acidified in situ with HCl vapor in a desiccators overnight. After we confirmed that adding a drop of 1N HCl did not cause effervescence, the samples were dried at 50°C for at least 3 hours. A Yanaco MT-5 CHN analyzer was used to determine the carbon and nitrogen contents of the raw and carbonate-free samples. Hippuric acid ($C_6H_5CONHCH_2COOH$) was used as a standard for carbon and nitrogen measurements, and antipyrine and p-nitroaniline for organic carbon measurements.

Several carbonate-free samples obtained by the wash-out method were used for carbon isotope measurements. About 200 mg of samples were weighed, and placed into the quartz tube with about 1 g of powdered CuO and about 200 mg of Ag. The quartz tube was sealed under vacuum and heated at 950°C for 3 hours for complete combustion. The produced CO₂ was separated and purified cryogenically with a vacuum line described elsewhere (Sakata *et al.*, 1986; Omokawa, 1985). The purified CO₂ was introduced into a Finnigan MAT-252 mass spectrometer and its carbon isotopic composition was measured. NBS-21 graphite ($\delta^{13}C = -28.16\text{‰}$ vs. PDB) was used as a standard for carbon isotope measurements.

Keywords: organic matter, organic carbon, surface sediment, off Tokai, northwest Pacific

Results and Discussion

Total carbon, organic carbon and nitrogen contents were measured for twenty-four samples in this study. The results are listed in Table XIII-1, and illustrated at their sampling sites in Fig. XIII-1.

Organic carbon contents by the vapor methods are higher than those by the wash-out method. Nomura and Sakata(1992) reported similar results for recent sediments collected from Japan Sea, with interpretation that significant portion of organic carbon may have been decomposed and lost in the process of filtration and washing. Yamamuro and Kayanne(1995) verified that HCl vapor method eliminates loss of acid-soluble organic matter during carbonate removal. We therefore use the values obtained by the HCl vapor method for organic carbon contents in the following discussions.

Total carbon and nitrogen contents of samples analyzed in this study are between 1.15% and 3.07% , and between 0.10% and 0.32% , respectively. Organic carbon contents are between 0.76% and 2.61% . The total carbon/nitrogen ratio (TC/TN) and organic carbon/nitrogen ratio (TOC/TN) are in the ranges of 8.3 to 16.1, and 7.2 to 9.0, respectively.

The samples collected from the sites along the eastern coast of Izu Peninsula (Sites 4, 5, 6) have high carbon contents of 2.08 to 3.07% and high organic carbon contents of 1.46 to 2.61% . In general, the TOC/TN ratios increase as the contribution of organic matter of terrestrial origin increases. The relatively high TOC/TN ratios of 8.1-8.8 in this area may be due to the enhanced input of terrestrial organic carbon.

The samples collected from the eastern margin of Suruga Bay along the western coast of Izu Peninsula (Sites 20, 28, 29, 38) also have relatively high contents of total carbon (1.31 to 2.30%) and organic carbon (1.21 to 1.60%), but smaller than those of the samples from the sites along the eastern coast. The TOC/TN ratios in this area are in the range of 8.1 to 9.0. On the other hand, the samples collected from the western margin of Suruga Bay (Sites 63, 64, 102) have lower contents of total carbon and organic carbon, and are characterized by higher fractions of organic carbon to the total. The TOC/TN ratios in this area are in the range of 7.5 to 7.9. Preliminary results of carbon isotopic composition of organic carbon in the Suruga Bay are in the range of -22.5 to -23.5‰.

Site 149 is located near the mouth of the Tenryu River. Total carbon and organic carbon contents of the sample at this site are 1.42 and 1.21, respectively. It has the highest TOC/TN ratio of 9.0 in the analyzed samples, suggesting high contribution of terrestrial input to sediments in this area.

The samples collected from off Tokai open sea are characterized by results that the organic carbon contribution to total carbon contents are relatively small, indicating that a large amount of inorganic carbon such as carbonate are included. The samples recovered from the west of Tenryu Canyon have carbon contents of 1.76 to 2.39% and organic carbon contents of 1.01 to 1.62% . The TOC/TN ratios in this area are in the range of 7.2 to 8.2.

Fig. XIII-2 shows the correlations between total carbon and nitrogen contents, and between organic carbon and nitrogen contents for all samples analyzed in this study. This figure indicates the correlation between organic carbon and nitrogen contents is

Table XIII-1 Analytical results of the samples.

Site	TC(%)	TOC(%) ^{*1}	TN(%)	TC/TN	TOC/TN	$\delta^{13}\text{C}(\text{‰})$ ^{*2}
4	3.07	2.61	0.32	9.7	8.3	
5	2.72	2.38 (2.16)	0.27	10.1	8.8	-21.0
6	2.08	1.46 (1.38)	0.18	11.6	8.1	-20.6
20	1.83	1.60 (1.52)	0.19	9.6	8.4	-22.5
28	1.50	1.35 (1.25)	0.17	9.1	8.2	-23.3
29	2.30	1.67	0.21	11.2	8.1	
38	1.31	1.21	0.14	9.7	9.0	
63	1.16	1.05 (1.01)	0.14	8.3	7.5	-23.4
64	1.17	1.06 (1.01)	0.14	8.6	7.9	-23.8
69	2.05	1.38	0.19	10.8	7.3	
92	1.83	1.40	0.19	9.6	7.4	
95	1.94	1.43	0.18	10.8	7.9	
102	1.15	1.01 (0.98)	0.13	8.8	7.8	-23.5
111	1.61	0.76	0.10	16.1	7.6	
147	1.48	1.13	0.15	9.8	7.5	
149	1.42	1.21	0.14	10.5	9.0	
165	2.04	1.30	0.17	12.0	7.6	
219	1.76	1.36	0.17	10.7	8.2	
228	1.80	1.02	0.14	13.3	7.6	
237	2.32	1.62	0.22	10.8	7.5	
238	2.39	1.48	0.21	11.6	7.2	
239	2.31	1.01	0.14	16.5	7.2	
257	2.25	1.35	0.19	12.2	7.3	
261	1.80	1.05	0.14	12.9	7.5	

* 1 TOC data in parentheses were obtained by the wash-out method, others by the HCl vapor method.

* 2 Carbon isotopic data are preliminary.

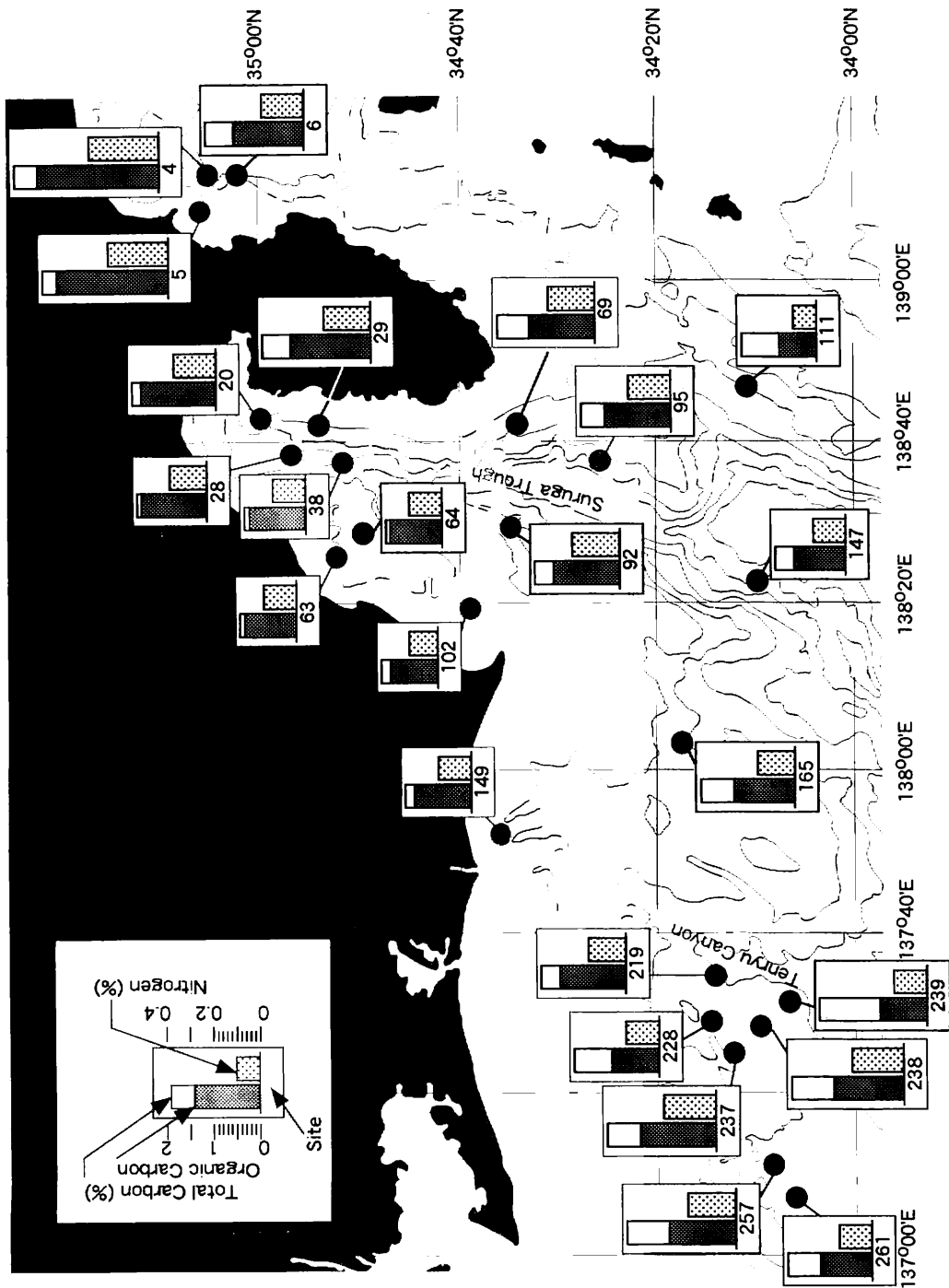


Fig. XIII-1 Location map and analytical results of the samples.

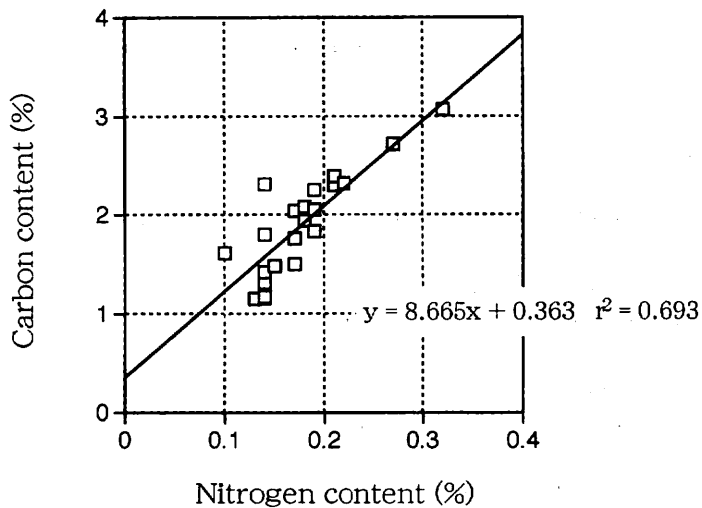
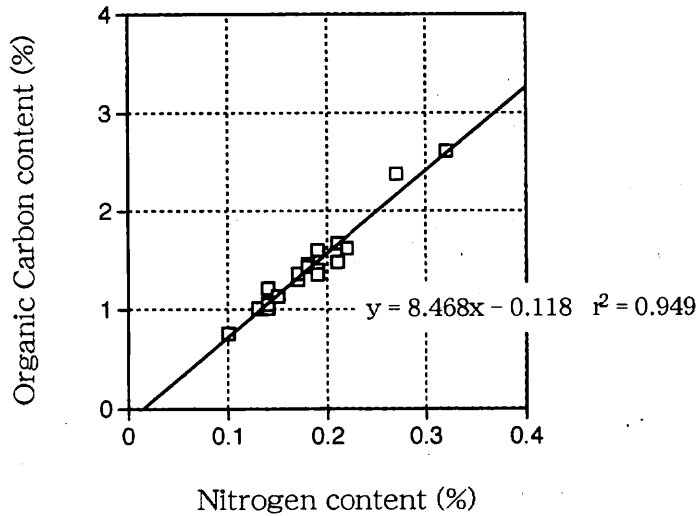


Fig. XIII-2 Correlations between total carbon and nitrogen contents, and between organic carbon and nitrogen contents.

very strong, whereas the correlation between total carbon and nitrogen content is not as strong. The former correlation has also been reported for samples from Japan Sea (Terashima and Komiya, 1995). Although it has been observed that slopes of the regression lines vary with depositional environments (Martens *et al.*, 1992), causes of the variation have not yet been well understood. It is therefore difficult to specify the depositional environments of the samples based on our data.

Summary

In this study, total carbon, organic carbon and nitrogen contents were measured for

twenty-four samples collected from off Tokai area during GH97 scientific cruise. The samples collected from the sites along the eastern coast of Izu Peninsula are characterized by contents of high total carbon and organic carbon, and by relatively high TOC/TN ratios. On the other hand, the samples collected from the western margin of Suruga Bay have smaller contents of total carbon and organic carbon, and characterized by the large contribution of organic carbon to total carbon. The samples recovered from off Tokai open sea are characterized by the small contribution of organic carbon to total carbon, indicating that a large amount of inorganic carbon such as carbonate are included in these samples.

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