Short Note

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Uranium and Other Heavy Elements in Deep Sea Sediments Coexisting with Manganese Nodules

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Mn, Fe, Cu, Ni, Co, and U contents were analyzed for deep sea sediments in which two manganese nodules had been contained. These nodules were discussed in the previous paper about their heavy elements.(1) Dredge sampling was carried out by Chiyoda-Maru II at the station given in TABLE I. The sediments seem to be a kind of foraminiferous ooze which consists of mainly calcium carbonate. FIG. 1 shows a microphotograph of CM-17 sediments. CM-9 is rather more white in color but almost similar to CM-17. "Manganese nodule CM-9" was tightly enveloped by those sediments.

The analysis of the elements except U was performed using atomic absorption spectrometry. The sediments were air dried, passed through a 200 mesh seave and observed under a binocular microscope. Micronodules were rarely found in them. U was determined by the induced fission track method by applying the internal standard addition. Details of these analytical methods were described in the previous paper.(2) The relation between the etch pit density and added uranium is shown in FIG. 2. The extrapolation of the curve to zero track density gives the natural uranium contents of the samples.

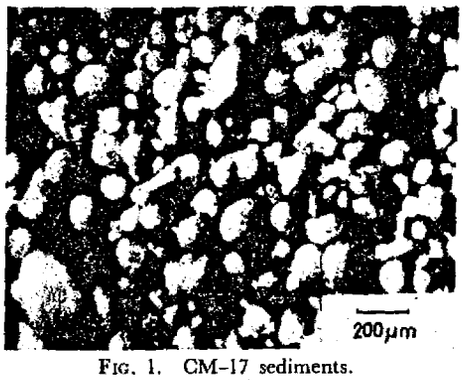

FIG. 1. CM-17 sediments.

The heavy element contents of the samples are summarized in TABLE II with those of manganese nodules included in the sediments.

TABLE I. *Discription of samples*

Sample No.	Locality	Depth (m)	Date of collection
CM-9	150°33′ W, 13°50′ S	?	9/2 (1970)
CM-17	170°50′ W, 10°18′ S	4550	9/23

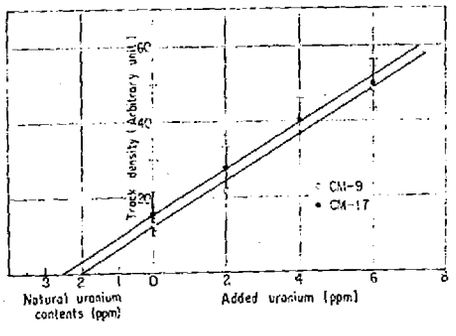

FIG. 2. The picture of track density vis uranium content.

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(1) H. YABUKI: *Sci. Papers I.P.C.R.*, 65, 100 (1971).

(2) H. YABUKI and M. SHIMA: *Reports I.P.C.R.*, 47, 27 (1971).

TABLE II. *The comparison of heavy elements between sea sediments and included manganese nodules*

	Sample No.	Heavy elements (in wt. %)						Acid insoluble residue (wt. %)
		Mn	Fe	Cu	Ni	Co	U	
Manganese Nodules	CM-9	16.5	13.7	0.30	0.60	0.47	0.0012	10.17
	CM-17	16.7	12.1	0.32	0.69	0.40	0.0011	14.20
Sediments	CM-9	0.060	0.125	0.0034	0.0022	0.0017	0.00020	2.96
	CM-17	0.075	0.110	0.0065	0.0042	0.0024	0.00025	10.70

TABLE III. *Ratios of heavy elements*

	Sample No.	Mn/Fe	Co/Ni	Co/Fe (×1000)	Ni/Mn (×1000)	Cu/Fe (×1000)
Manganese Nodules	CM-9	1.20	0.78	34.3	36.4	21.9
	CM-17	1.38	0.58	33.1	41.3	26.4
Sediments	CM-9	0.48	0.77	13.6	36.7	27.2
	CM-17	0.68	0.58	21.8	56.0	59.1

Nodules are richer in those element, when comparing with associated sediments, by a factor of about 5 for U and by a factor of more than 100 for other elements. This tendensy of U is also seen in the relation between sea water and nodules or sediments. This may be represented that UO^{2+} ion in sea water scarcely co-precipitates with Mn or Fe by scavenging effect such as Cu^{2+}, Ni^{2+} or Co^{2+}, and formes complex ion with carbonate ion and is absorbed on the surface of sediment or nodules.

The comparison of Mn/Fe, Co/Ni, Co/Fe, Ni/Mn, and Cu/Fe ratios is presented in TABLE III. It is noticed that Co/Ni and Ni/Mn ratios of nodules fairly coincide with those of coexisting sediments. This agreement suggests that Mn, Ni, and Co are accumulated in both nodules and sediments at about the same rates. According to the calculation of Somayajulu *et al.*[3] similar consideration is also applicable to Cu. Results in TABLE III are, however, implying that Cu co-precipitates with Fe, rather than Mn.

It is nesessary to investigate more samples so as to make clear the growth mechanism of the elements in nodules and sediments.

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(3) B. L. K. SOMAYAJULU, G. R. HEATH, T. C. MOORE, and D. S. CRONAN: *Geochim. Cosmochim. Acta*: 35, 621 (1971).