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85. *DATA REPORT*: PLIOCENE-PLEISTOCENE-HOLOCENE TRACE METAL DATA FROM HOLES 794A, 795A, 797A, AND 797B[1]

Adrian Cramp[2] and Colin Lewis[2]

BACKGROUND AND RATIONALE

Quaternary sedimentation within the Japan Sea was controlled by the configuration of peripheral sills, seasonal and long-term climatic variability, and the resultant fluctuations in sea level (Tamaki, 1988). Prior to drilling in the area, piston cores recovered from its basins contained Pleistocene sediments having distinctive color and fabric variation. Sedimentological and geochemical studies conducted on those facies indicated that the variability in fabric was the result of fluctuating marine and/or terrigenous influx to the deep-water basins of the Japan Sea (see, for example, Chough, 1984; Matoba, 1984).

The sequences recovered during Leg 127 at Sites 794, 795, and 797 contain long, virtually undisturbed sequences (92.3, 123, and 119.9 mbsf [Hole 797B], respectively) of upper Miocene, upper Pliocene, and Pleistocene/Holocene sediments. The majority of these sequences consists of dark-colored (dark brown, green, and black) silty-clays, many of which are enriched in biogenic components (majority silicious, some carbonate) and/or organic matter, some containing pyrite and/or ash. These facies alternate with light-colored silty-clays, some containing ash and some showing signs of bioturbation (for example, Tamaki, Pisciotto, Allan, et al., 1990, p. 425–433). The dark-to-light sequences are present throughout the section, although they are especially dominant throughout the Pleistocene (for a more detailed lithology of Quaternary sequences recovered at Sites 794, 795, and 797, see Follmi et al. and Tada et al., this volume).

This data report provides trace metal information on Pliocene-Pleistocene-Holocene samples at Sites 794, 795, and 797. These data can be used (1) to provide information related to the depositional environments of the Japan Sea during the Quaternary period, (2) to permit comparisons between the dark organic-rich sediments recovered from this semi-enclosed basin and those reported for other silled basins (for example, the Mediterranean and Black seas), and (3) to permit comparisons between these sediments and contemporary equivalents found, for instance, beneath areas of high biogenic productivity.

By providing such data, one should be able (1) to determine more precisely the processes governing the deposition of sediments with various levels of organic matter within enclosed basins, (2) to compare individual basin-wide processes, (3) to look for and compare the signatures present as a result of climatic fluctuation, and (4) to attempt to identify the presence and/or absence of cyclicity within such sequences.

MATERIALS AND METHODS

A total of 98 samples was analyzed for As, Ba, Cu, Mo, Ni, Pb, Rb, Sr, Y, Zn, and Zr using a pressed powder method similar to that of Harvey and Atkin (1982). Samples were run on a Philips PW 1400 X-ray spectrometer system. A marine sediment standard (NRCC BCSS-1) together with international silicate rock reference standards (USGS and CRPG) and duplicate samples were run at regular intervals (every batch of 10).

In most cases, the accuracy of the measurements was better than 2%. The precision of the measurements was better than 1%. All values tabulated have been expressed in parts per million.

Where possible, smear-slide analyses were used to identify the dominant lithology, which was defined as being the sediment type or types that make up approximately 60% of a sample.

Samples taken from the same unit as well as adjacent dark-light samples are grouped together in Tables 1 through 3.

GENERAL OBSERVATIONS

At all three sites, differences were noted in the trace element composition between the dark- and light-colored sediments. In general, the dark-colored sediments tend to be enriched in As, Ba, Cu, Mo, Ni, and Sr compared to the light-colored sediments. The light-colored sediments are enriched in Rb, Y, and Zr relative to the dark-colored sediments. Little variation can be seen in the levels of Zn and Pb between the two sediment colors.

Note that these are general observations and that considerable variation occurs between dark- and light-colored sequences at each site. This information should be integrated with detailed sedimentological, geochemical, and isotopic data to resolve depositional history throughout the Neogene-Pleistocene-Holocene period.

Comparisons with Other Areas.

For the purposes of this study, brief comparisons have been made between the trace metal content of the dark-colored Pliocene-Pleistocene organic-rich sediments from the Japan Sea and two other areas: (1) the Pleistocene sapropels recovered from the eastern Mediterranean during Leg 13 of the Deep Sea Drilling Project (DSDP Sites 125, 126, 127, 128, and 130). The geochemistry of these sapropels was reported by Calvert (1983) and (2) the organic-rich sediments recovered from the Black Sea during Leg 42B of the DSDP. This information appears in Calvert and Batchelor (1978).

Eastern Mediterranean

The Ba, Cu, Mo, Y, and Zn levels found in Pliocene-Pleistocene sediments recovered from the Japan Sea are consistent with those of similar age recovered from the eastern Mediterranean. However, both Ni and Sr are significantly reduced in concentration, whereas Rb, Zr, As, and Pb show higher concentrations in the Japan Sea than those measured in the eastern Mediterranean.

Black Sea

Only Ni and Y have been found in similar concentrations in both the Japan and Black Sea basins. The Japan Sea sediments are enhanced with respect to Cu, Pb, Rb, Zn, Zr, and Ba and depleted in Mo and Sr with respect to the Black Sea. No As data were available for the Black Sea sediments.

[1]Tamaki, K., Suyehiro, K., Allan, J., McWilliams, M., et al., 1992. *Proc. ODP, Sci. Results,* 127/128, Pt. 2: College Station, TX (Ocean Drilling Program).
[2]Department of Geology, University of Wales, College of Cardiff, Cardiff, Wales, U.K.

Table 1. Content of trace metals in Pliocene–Pleistocene sediments from Site 794.

Site	Core	Section	Interval (cm)	As	Ba	Cu	Mo	Ni	Pb
794A	1H	1	72-74	58	766	163	52	76	35
794A	1H	1	118-120	221	843	99	51	66	21
794A	1H	3	22-24	500	1046	154	124	82	31
794A	1H	4	19-21	67	818	143	23	66	39
794A	1H	4	30-32	438	1064	177	57	99	34
794A	1H	5	32-34	106	740	141	71	58	28
794A	2H	1	106-109	267	885	129	23	81	29
794A	2H	3	16-18	239	1852	197	67	107	40
794A	2H	4	106-108	417	1740	138	201	72	31
794A	2H	5	85-87	9	565	79	2	55	34
794A	2H	5	112-114	123	866	121	81	71	25
794A	2H	6	29-31	130	493	69	29	44	16
794A	3H	1	9-11						
794A	3H	1	109-111	131	961	91	13	73	24
794A	3H	3	89-91	86	1142	88	84	58	25
794A	3H	3	109-112	64	1147	132	107	54	17
794A	3H	5	28-31	51	904	107	0	65	32
794A	3H	5	48-51	187	954	92	51	81	28
794A	4H	1	38-41	3	858	141	0	76	35
794A	4H	1	50-53	150	983	147	5	95	34
794A	4H	2	89-92	52	1158	135	90	57	22
797A	4H	4	118-121	27	2252	103	193	81	24
794A	4H	7	37-40	25	1894	141	119	96	26
794A	5H	1	19-21	80	1574	144	125	65	51
794A	5H	1	38-41	119	1766	160	52	94	41
794A	5H	2	40-42	315	1039	107	56	107	80
794A	5H	5	112-114	29	1449	173	0	82	50
794A	5H	6	19-21	28	1648	203	104	52	19
794A	6H	1	29-31	33	819	138	0	101	35
794A	6H	2	116-118	27	1516	217	19	138	41
794A	6H	3	49-51	75	2592	337	108	113	38
794A	6H	5	87-89	79	2404	192	19	75	43
794A	6H	5	140-143	0	1283	97	0	73	44
794A	6H	6	41-43	189	698	86	31	212	39
794A	7H	1	136-138	0	736	127	0	79	46
794A	7H	4	36-38	210	181	174	4	58	12
794A	7H	5	112-114	18	2706	120	0	75	24
794A	7H	7	53-55	0	1559	349	0	105	54
794A	8H	1	129-131	49	1866	238	0	136	34
794A	9H	1	109-111	13	1304	145	7	132	30
794A	9H	5	109-111	6	1262	377	4	131	32
794A	9H	6	115-117	0	1449	123	0	72	19
794A	10H	3	19-21	13	1063	128	0	104	38
794A	11H	3	111-113	0	2914	167	0	131	51
794A	11H	6	19-21	0	2118	176	0	156	42

Asterisk (*) denotes no information available.

Table 1 (continued).

Site	Core	Rb	S	Sr	Y	Zn	Zr	Light/Dark	Sediment type
794A	1H	99	9540	182	34	160	149	Dark	Ash/clay
794A	1H	108	25433	155	30	126	149	Dark	Ash
794A	1H	99	24344	140	27	141	152	Dark	Ash
794A	1H	122	617	148	33	124	169	Light	Clay
794A	1H	84	10120	264	23	129	113	Dark	Ash
794A	1H	120	18999	139	33	122	177	Dark	Clay/diatoms
794A	2H	128	9714	151	30	165	186	Dark	Ash/clay
794A	2H	98	12966	159	31	184	148	Dark	Ash/clay
794A	2H	94	26895	149	26	125	143	Dark	Ash
794A	2H	135	2542	158	33	134	189	Light	Clay
794A	2H	116	25005	126	33	119	173	Dark	Ash
794A	2H	49	16048	703	20	59	51	Dark	Clay/ash
794A	3H								
794A	3H	66	17734	442	32	98	89	Dark	Ash
794A	3H	100	31076	131	29	133	146	Dark	Ash
794A	3H	63	10144	108	18	108	90	Dark	Diatoms
794A	3H	135	4160	145	33	127	188	Grey	-
794A	3H	116	26388	139	31	113	190	Dark	Clay/ash
794A	4H	126	2113	171	35	134	173	Light	Clay
794A	4H	134	5784	145	41	148	249	Dark	Ash
794A	4H	69	18256	472	30	90	93	Dark	Clay/ash
797A	4H	67	35327	119	20	109	99	Dark	Clay/diatoms
794A	4H	75	31011	290	27	151	104	Dark	Clay
794A	5H	45	2680	95	10	145	55	Grey	Clay/ash
794A	5H	102	7108	139	29	171	148	Dark	Clay
794A	5H	48	46155	65	8	81	69	Dark	Diatoms
794A	5H	130	3519	164	34	157	157	Light	Ash/clay
794A	5H	130	11221	102	10	95	85	Dark	Diatoms
794A	6H	127	2528	142	31	148	136	Light	-
794A	6H	116	10194	152	35	147	157	Dark	-
794A	6H	100	31301	130	29	150	137	Dark	Ash
794A	6H	121	5081	168	42	209	186	Dark	Ash/cl/dia
794A	6H	138	2295	158	37	146	181	Light	-
794A	6H	112	5777	107	30	105	169	Dark	Ash/clay
794A	7H	136	2299	149	32	155	167	Light	Ash
794A	7H	18	4865	14	18	89	30	Dark	Ash
794A	7H	128	2236	198	34	142	175	Gray	-
794A	7H	116	2757	159	25	181	156	Gray	-
794A	8H	130	4638	161	33	253	177	Grey	-
794A	9H	104	3732	172	26	183	153	Grey	-
794A	9H	95	4557	116	24	208	142	Grey	-
794A	9H	81	1434	129	19	111	99	Light	-
794A	10H	116	4633	144	27	176	149	Light	-
794A	11H	103	2490	173	23	139	127	-	-
794A	11H	107	3879	150	31	227	142	-	-

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Table 2. Contents of trace metals in Pliocene–Pleistocene sediments from Site 795.

		As	Ba	Cu	Mo	Ni	Pb	Rb	Sr	Y	Zn	Zr	Sediment Color	Sediment Type
795A	1H-1-20-22	50	465	129	7	57	35	85	184	25	115	117	Dark	Clay
795A	1H-2-19-21	113	786	109	66	71	23	108	169	31	128	154	Dark	Ash
795A	2H-1-140-142	340	812	185	211	57	32	82	118	23	110	141	Dark	Pyrite/clay
795A	2H-3-30-32	223	937	134	4	71	22	58	108	20	102	85	Dark	Diatoms
795A	2H-4-125-127	103	706	112	0	115	29	94	164	32	147	145	Dark	*
795A	3H-2-69-71	211	755	111	96	68	23	102	117	24	117	146	Dark	*
795A	3H-3-89-91	244	1069	188	125	82	44	98	159	32	173	163	Dark	Ash/pyrite
795A	3H-5-81-83	301	1266	131	96	86	35	94	147	31	147	160	Dark	Clay
795A	4H-2-42-44	319	1009	134	37	66	20	79	257	24	109	116	Dark	Clay
795A	4H-2-50-52	14	692	127	0	72	39	133	159	38	139	190	Light	Ash/clay
795A	5H-4-13-15	0	724	119	59	73	25	101	132	33	169	146	Light	*
795A	5H-4-21-23	426	1073	97	123	59	14	62	159	30	80	89	Dark	Clay/pyrite
795A	5H-4-34-36	114	1474	158	120	76	19	86	310	35	112	131	Dark	Clay/pyrite
795A	5H-4-46-48	272	1101	310	133	72	17	74	258	26	96	106	Dark	Clay/pyrite
795A	5H-7-32-34	136	1974	163	130	71	18	46	94	110	81	68	Dark	Clay/pyrite
795A	6H-2-43-45	217	2085	124	14	77	25	75	160	41	137	120	Dark	Clay/pyrite
795A	6H-2-57-59	2	830	115	0	61	37	126	166	34	132	177	Light	*
795A	6H-3-51-53	*	967	113	*	61	24	*	*	*	119	*	Light	*
795A	6H-5-8-10	81	1403	168	126	54	20	58	113	17	114	86	Dark	Diatoms
795A	7H-4-37-39	178	1168	167	29	55	21	62	92	20	91	95	Dark	Diatoms
795A	7H-4-53-55	65	628	109	2	30	14	41	84	16	63	60	Dark	Diatoms
795A	7H-4-61-63	171	2157	446	16	72	25	64	96	20	86	93	Dark	Diatoms
795A	7H-5-72-74	511	1998	159	104	99	15	34	94	12	79	53	Dark	Diatoms
795A	7H-5-92-94	64	2115	280	102	59	14	36	76	7	51	52	Dark	Diatoms
795A	7H-5-112-114	164	1886	168	118	70	16	35	76	13	64	56	Dark	Clay/diatoms
795A	8H-4-17-19	24	2203	249	8	77	37	100	166	49	175	153	Dark	Clay
795A	9H-2-125-127	255	1800	140	4	98	31	86	153	30	131	139	Dark	Clay/diatoms
795A	9H-3-17-19	38	7950	158	0	63	26	80	159	33	135	122	Dark	Clay/diatoms
795A	9H-3-30-32	37	4592	120	6	69	28	83	164	35	125	129	Dark	Clay
795A	11H-CC-3-5	21	765	292	0	83	31	104	146	32	149	149	Dark	Clay/diatoms
795A	13H-4-82-84	33	1056	180	0	60	32	93	138	31	137	136	Dark	Diatoms
795A	13H-4-89-91	14	851	120	0	63	32	94	136	28	137	136	Dark	Clay/diatoms

Asterisk(*) denotes no information available.

Table 3. Contents of trace metals in Pliocene–Pleistocene sediments from Site 797.

		As	Ba	Cu	Mo	Ni	Pb	Rb	Sr	Y	Zn	Zr	Sediment Color	Sediment Type
797A	1H-1-38-40	41	792	115	29	99	35	111	166	28	155	163	Dark	Clay
797A	1H-1-139-141	175	660	87	48	77	26	105	187	32	119	143	Dark	Clay/ash
797A	2H-5-32-34	192	734	168	10	94	42	123	186	56	197	165	Light	Clay
797A	2H-6-102-104	221	764	138	123	81	34	111	139	29	207	170	Dark	Clay
797B	2H-6-113-116	2	552	111	0	60	31	135	177	34	120	190	Dark	Ash
797B	2H-6-127-129	249	738	131	102	93	33	117	149	28	162	165	Grey	Clay
797B	3H-4-83-85	0	1000	103	0	57	37	126	158	34	133	168	Dark	Ash
797B	3H-4-86-88	67	1220	172	8	60	39	116	165	32	152	160	Dark	Clay
797B	3H-4-94-96	103	937	103	47	59	33	117	152	32	133	175	Dark	Clay
797B	4H-4-132-134	22	793	75	38	50	11	42	730	18	63	46	Dark	Clay
797B	4H-6-69-71	96	855	159	41	65	24	124	128	32	113	183	Dark	Ash
797B	4H-6-106-108	99	1182	105	86	82	24	110	191	37	145	158	Light	Clay/ash
797B	4H-6-142-144	92	812	102	45	71	27	115	191	30	120	154	Dark	Ash
797B	5H-2-127-129	0	500	88	0	56	37	131	182	30	129	173	Dark	Clay/ash
797B	5H-2-135-137	510	1141	126	117	82	36	77	364	29	151	104	Dark	Clay
797B	5H-3-53-55	61	971	177	8	103	45	117	156	31	207	152	Dark	Clay
797B	5H-4-17-19	38	957	129	43	110	21	98	137	28	129	153	Dark	Clay
797B	6H-2-138-140	*	1303	191	*	91	38	*	*	*	215	*	Dark	Clay
797B	6H-5-57-59	*	1656	221	*	110	45	*	*	*	216	*	Dark	Clay
797B	7H-4-3-5	47	1548	160	0	84	40	123	144	31	143	132	Light	Clay/diatoms
797B	7H-4-18-20	33	3020	200	72	95	37	95	126	24	181	122	Dark	Clay/diatoms
797B	9H-1-69-71	24	2142	193	9	110	32	102	131	33	209	152	Dark	Clay

Note: First four samples are from Hole 797A, others from Hole 797B. Asterisk (*) denotes no information available.