

APPENDIX II. X-RAY MINERALOGICAL ANALYSIS OF CRETACEOUS SEQUENCES, LEG 80 (GOBAN SPUR, SITES 548, 549, 550, 551)¹

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INTRODUCTION

At the request of the Leg 80 scientific party, selected samples of Cretaceous age were processed by X-ray diffraction at the mineralogy laboratories at the École des Mines (Albian to Late Cretaceous samples) and at the Institut de Géologie at Dijon (Barremian samples). The results of these mineralogical analyses are shown in Tables 1 and 2 and Figures 1 to 3. The results were used in developing the lithostratigraphy and sedimentology discussed in this volume by Rat et al. in their study of Barremian-Albian paleoenvironment, by Graciansky and Gillot in their study of Albian and Cenomanian limestones, and by Graciansky and Bourbon in their paleoenvironmental reconstructions for the Late Cretaceous chalks.

METHODS

The bulk sediment samples were dried and pulverized with a mortar of agate and then analyzed according to the powder diagram method. The contents of the various components were estimated from the diagrams by

¹ Graciansky, P. C. de, Poag, C. W., et al., *Init. Repts. DSDP*, 80: Washington (U.S. Govt. Printing Office).

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Table 1. X-ray analysis (%) of bulk samples.

Core-Section (interval or level in cm)	Clays	Quartz	Calcite	Dolomite	Plagio- clase	K-feld- spars	Opal-CT	Clinop- tilolite	Pyrite	Fluor- apatite	Barite	Gypsum	Halite	Not identified	Lithology	Age
Hole 548A																
29-1, 36-42		ε	100													
29-3, 0-7	ε	ε?	100							?		ε				
30-1, 103-104	ε	ε	100									ε				
31-2, 63-65	ε?	ε	100									ε				
32-1, 69-71	ε	ε	100									ε				
32-4, 69-71	ε	ε	100									ε				
33-2, 9-10	ε	ε	100									ε				
34-1, 29-31			100						ε?			ε				
34-3, 29-31	10	ε	90									ε				
34-5, 29-31	ε	ε	100									ε				
34-6, 29-31	ε	ε	100						ε?			ε				
Hole 549																
21-2, 7-9	25	ε	75			ε				?		ε				
22-1, 46-48	?	ε	100			ε					ε					
22-3, 105-109	10	ε	90			ε					ε					
22-5, 47-49	ε	ε	100			ε?					ε					
23-2, 52-54	ε	ε	100			ε?					ε					
23-4, 50-52	ε	ε	100			ε					ε					
23-5, 24-26	ε	ε	100			ε?					ε					
24-1, 50-52	ε	ε	100			ε					ε					
24-2, 13-15	ε	ε	100			ε					ε					
24-3, 31-34	ε	ε	100			ε					ε					
25-1, 32-35	ε	ε	100			ε					ε					
26-1,	5	ε	100			ε			?		ε					

comparing the intensity of the characteristic peaks, taking into account the differences between the intensities of diffraction of the various minerals. Estimates were related to a total of 100% to minimize the effects of the matrix and of the influence of the preparation of the powders. The estimates of the total amount of clay minerals and of cristobalite and tridymite is relatively uncertain because of the low crystallinity of these minerals.

To prepare the clay fraction, the bulk sediments were dispersed in pure water by mechanical agitation. Samples were first treated with HCl mixed 1:10 with water. After several washings in the water, the <2 μm fractions were separated by settling. The <2 μm fractions were then centrifuged, and the thick paste obtained was spread across slides bearing a narrow groove. The oriented paste was then dried, saturated with ethylene glycol and hydrazine hydrate, and later heated at 490°. Quantitative estimates of the relative proportions of the clay minerals and the mixed-layer clays were obtained from the areas beneath the peaks in the powder diagrams for the samples treated by ethylene glycol.

Operating conditions involved using copper K radiation and a beam of 1° of aperture for both the bulk sample and clay fraction analyses.

Date of Initial Receipt: November 18, 1983

Date of Acceptance: February 27, 1984

APPENDIX II

Table 1. (Continued).

Core-Section (interval or level in cm)	Clays	Quartz	Calcite	Dolomite	Plagio- clase	K-feld- spars	Opal-CT	Clinop- tilolite	Pyrite	Fluor- apatite	Barite	Gypsum	Halite	Not identified	Lithology	Age
Hole 549 (Cont.)																
27-1, 17-19	5	€	95					20	€					€	Carbonaceous shale	Turon.
27-1, 17-19		€	80						€					€		
28-1, 71-73	10	€	90						€					€		
28-2, 23-25	5	€	90					5	€					€	Foraminifer-nannofossil chalk	Cenomanian
28-3, 4-6	5	€	90					5	€					€		
29-1, 17-19	5	€	90					5	€					€		
34-1, 11-14	30	15	35					15	5						Dark gray calc. muds	
34-1, 19-21	30	20	40						5	5						
37-2, 27-29	35	15	40					5	5							
38,CC	25	€	55					5	15						Dark gray calcareous mudstone	
39-1, 24-25	35	15	35					5	10							
40-1, 6-8	30	15	35					5	15							
42-1, 60-61	30	15	45					€	10							
43-1, 83-86	15	€	85					€	€?						Light gray calc. mudst.	
43-2, 68-69	15	€+	85						€						Dark gray calcareous mudstone	
43-3, 55-58	30	10	30					5	25						Light gray calc. mudst.	early to middle Albian
43-4, 40-41	35	20	35					5	5						Dark gray calcareous mudstone	
44-2, 110-116	15	€	85					€	€						Light gray calcareous mudstone	
45-1, 56-58	30	20	45					€	5						Dark gray calcareous mudstone	
45-3, 109-113	30	20	45						5							
45,CC	25	10	65						€							
46-1, 6-8	35	15	40					€	10						Dark gray calcareous mudstone	
46-1, 23-24	30	20	40					€	€	10						
47-2, 143-149	35	25	30					10	€							
52-1, 96-98	€	20	.	80												
53-1, 141-144	05	30												65		
53-2, 13-15	05	35												60		
53-2, 136-139	05	30												65		
54-1, 8-10	05	25												70		
55-1, 40-43	10	60												30	Calcareous mudstones	Barremian
55-3, 74-77	10	70												20		
55-5, 57-60	10	55												35		
56-2, 68-72	25	55												20		
56-4, 32-39	30	35												35		
57-2, 144-146	30	25												45		
57-5, 26-29	30	20												50	Marly calcareous mudstones	
58-3, 79-81	20	25												55		
58-4, 51-54	25	20												55		
58-5, 85-87	30	25												45		
58-6, 86-89	20	20												60		
59-2, 42-44	25	20												55		
59-3, 106-108	25	35												40	Calcareous mudstones	
60-1, 48-50	30	20												50		
60-3, 102-105	25	20												55		
61-2, 19-22	25	25												50		
61-4, 11-13	25	20												55		
72-1, 66-68		20												80	Bioclastic limestones	
72-2, 100-102		25												65		
73-1, 31-33	10	10												80	Calc. mudstone	Barremian
78-1, 28-30	50	05												45	Sandstone	
79-1, 88-91	25	10												65		
80-1, 30-34	40	15												45	Calcareous mudstones	
81-1, 27-29	30	05												65		
82-1, 8-10	50	15												35	Silty limestone	
82-1, 139-141	50	10												40		
82-2, 13-15	40	10												50	Calcareous mudstone	
82-2, 68-70	30	10												60		
84-1, 48-50	25	05												70	Siltstone	
86-1, 51-53	30	10												60		
86-1, 139-141	30	15												55	Calcareous mudstone	
86-2, 58-59	25	05												70		
86-2, 111-113	25	15												60	Calcareous mudstone	
86-3, 42-43	25	65												10	Silty limestone	
88-1, 1-3	10	10												80		
88-1, 112-115	10	25												65		
88-1, 121-123	40	05												55	Sandstone	
88-2, 3-6	15	€												85		
88-2, 43-45	15	05												80	Calcareous mudstone	
90-1, 25-28	50	05												45		
90-2, 108-110	40	05												55	Calcareous mudstone	
90-3, 1-3	30	05												65	Sandstone	
90,CC (17-19)	25	05												70	Siltstone	
91-2, 21-23	50	10												40	Calcareous mudstone	
91,CC	40	05												55	Sandstone	
Hole 550B																
1-1, 53-55	20	€	80											€		
1-1, 126-128	€	€	100													
1-3, 55	5	€	95	?												
1-3, 67-68	15	€	85													
1-4, 77-80	5	€	95	?												
1-6, 104-106	30	€	70													
2-3, 28-29	30	€	70		?											
2-3, 101-103																
3-1, 132-133	10	€	90											€		
3-2, 19-21	€	€	100													
4-1, 75-78	15	€	80											€		
5-1, 45-47																
5-2, 9-11	15	€	85													
5-2, 30-32	5	€	95													
5-2, 73-76	5	€	95													
5-3, 81-83	5	€	95													
5-4, 37-38	€	€	100													
7-1, 30-32	€	€	100											€		
7-1, 148-150	€	€	95													
7-2, 56-58	15	€	85													
7-3, 13-15	15	€	85													

Table 1. (Continued).

Core-Section (interval or level in cm)	Clays	Quartz	Calcite	Dolomite	Plagio- clase	K-feld- spars	Opal-CT	Clinop- tilolite	Pyrite	Fluor- apatite	Barite	Gypsum	Halite	Not identified	Lithology	Age
Hole 550B (Cont.)																
7, CC (3-5)	20	ε	80													
8-2, 148-150	5	ε	95													
8-5, 32-35	5	ε	95													
8-5, 137-139	ε	ε+	100													
8-5, 143-145	25	ε	75													
9-1, 148-150	20	ε	80													
9-2, 125-127		ε	100													
9-3, 44-46	30	5	65													
9-3, 63-65	ε	ε	100													
9-3, 148-150	30	ε	70		?	?		ε								Maestrichtian
10-1, 40-44	ε	ε	100													
10-1, 110-112	20	ε	80		ε			ε								
10-4, 76-78	ε	ε	100													
11-1, 6-8	35	5	60													
12-1, 148-150	20	ε	80													
12-2, 75-78	ε	ε	100													
12-2, 115-117	30	ε	70		?	?										Campanian
12-4, 64-65	30	ε	70													
13-2, 25-27	30	ε	70													
13-3, 29-31	25	ε	75													
13-3, 134-136	75	25			ε											
13-4, 52-54	80	20			ε	?										
13-5, 68-70	80	20			ε											
13-6, 57-59	80	20			ε											
14-1, 67	15	ε							?							
14-1, 138-140	75	20			ε?	ε?				80		5				Coniacian-Santonian
14-2, 124-126	80	20			ε?	ε?										
15-2, 25-26	80	20			ε											
15-2, 64	15	ε								85						
15-2, 140-142	75	25	ε?													
15-4, 56-58	80	20			ε											
15-5, 88-90	15	ε	80													
16-2, 76-79	20	ε+	80													
17-1, 59-63	10	ε	90					ε								
18-1, 87-89	25	ε	75													
18-1, 102-104	15	ε	85					?								
20-1, 0-2	30	ε	70													
20-5, 38-40	10	ε	90					?								
21-1, 47-49	25	5	70													
21-4, 47-50	25	5	70													
22-1, 124-126	20	5	75													Cenomanian
22-3, 63-66	20	15	65													
22-6, 4-6	25	5	70													
23-2, 69-72	25	5	70													
23-3, 84-87	15	5	80													
23-3, 148-150	30	20	50													
24-1, 148-150	25	15	70													
24-3, 52-54	15	5	< 80							ε?						
24-3, 62-64	20	15	65													
24-3, 80-82	25	5	70													
25-2, 133-136	20	ε	80					ε				ε				Vraconian
Hole 551																
2-2, 90-95	ε	ε	100								ε					
3-1, 90-92	ε	ε	100								ε					early Maestrichtian
3-1, 130-135	ε	ε	100								ε					
3-2, 80-85	5	ε	95								ε					
4-1, 97-102	5	ε	95								ε					late Camp.
5-1, 101-106	5	ε	95					?			ε					
5-1, 144-145	5	ε	95				ε		x		ε					
5-2, 23-25	5	ε	95						x		ε					
5-2, 33-35	5	ε	95						x		ε					
6-1, 7-9	5	ε	95								ε					
6-1, 79-81	ε	ε	95				5	ε			ε					late Cenomanian
6-2, 70-72	10	ε	90								ε					

Note: ε = trace, x = present.

APPENDIX II

Table 2. X-ray analysis of <2 μm fraction.

Sample (interval or level in cm)	Chlorite	Kaolinite	Illite	Smectite	Mixed-layer clays		Zeolites	Lithology	Age
					Ill-sm	Cl-sm			
Hole 548A									
29-1, 36-42		ϵ^+	0.5	9.5					
30-1, 103-104	0.5	1.5	1.5	6.5					
31-2, 63-65	0.5	1.5	2	5	0.5	0.5			
32-1, 69-71		1.5	1.5	7					
32-4, 69-71		ϵ	0.5	9.5	ϵ				
33-2, 9-10		1	1.5	8	0.5	ϵ			
34-1, 29-31	0.5	1.5	1.5	6	0.5	ϵ			
34-5, 29-31		0.5	0.5	8.5	0.5				
34-6, 29-31	0.5	2.5	2	5					
35-1, 135-138		2	2	6					
Hole 549									
21-2, 7-9		1	9			x			
22-1, 46-48		1	8	1		x			
22-3, 105-109		0.5	9	0.5		x			
23-2, 52-54		0.5	9.5			x			
23-4, 50-52		1.5	8.5			x			
23-5, 24-26		1	9			x			
24-1, 50-52		0.5	9.5						
24-2, 13-15		1.5	8.5			x			
24-3, 37-39		1.5	8	0.5		x			
25-1, 32-35		1.5	8.5			x			
26-1		2	8			x			
27-1, 17-19		1.5	8	0.5					
28-1, 71-73		1	8	1					
28-2, 23-25		1	8	1					
28-3, 4-6		1	8	1					
29-1, 17-19		1	8	1					
34-1, 8-10	ϵ	1	7.5		1.5				
34-1, 19-21	1	2	5.5		1.5				
37-2, 27-29	0.5	1	8.0		0.5				
38,CC	0.5	1	8.0		0.5				
39-1, 24-25		1	8.0	1					
40-1, 6-8	2	3	5						
42-1, 60-61	1		2	7					
43-1, 83-86	1		1	7		1			
43-2, 68-69	1		1	6		2			
43-3, 55-58			1	7	1	1			
43-4, 40-41			1	8		1			
44-2, 110-116			1	8		1			
45-1, 56-58	1		2	6		1			
45-3, 109-113			0.5	8	0.5				
45,CC			0.5	8	0.5				
46-1, 6-8	0.5		1	5	0.5	0.5			
46-1, 23-24	0.5		1	5	0.5	0.5			
47-2, 143-149	ϵ	0	0.5	9.5	ϵ				
52-1, 96-98	ϵ	0	3	7	ϵ				
53-1, 50-52	2		7			1			
53-1, 141-144	4		5			1			
53-2, 13-15	1		6			3			
53-2, 136-139	1		6.5			2.5			
54-1, 8-10	1		6			3			
55-1, 40-43			5			5			
55-3, 74-77			5			5			
55-5, 60			4			6			
56-1, 39-42			6			4			
56-2, 68-72			5			5			
56-4, 32-39			4	5		1			
57-2, 144-146			4	5		1			
57-5, 26-29	1.5		5			3.5			
58-1, 29-31			5			5			
58-2, 37-40	1.5		4.5			4			
58-3, 79-81			6			4			
58-4, 51-54	1		3	5		1			
58-5, 85-87			4	5		1			
58-6, 86-89			5			5			
59-2, 42-44			4			6			
59-3, 106-108			4	5		1			
60-1, 48-50			5	4		1			
60-3, 102-105			4	5		1			
60-5, 84-86			7			3			
60-5, 100-102			5			5			
61-2, 19-22			4	5		1			
Calcareous mudstones									
Marly calcareous mudstone									
Calcareous sandstones									
Calcareous mudstones									

Table 2. (Continued).

Sample (interval or level in cm)	Chlorite	Kaolinite	Illite	Smectite	Mixed-layer clays			Lithology	Age
					Ill-sm	Cl-sm	Zeolites		
Hole 549 (Cont.)									
61-2, 129-131	0.5		3.5	6					
61-4, 11-13			4	5		1		Calcareous mudstones	
72-1, 66-68			4	6				Bioclastic limestones	
72-2, 100-102			5			5			
73-1, 31-33			4.5	1.5		1		Calcareous mudstone	
74-3, 44-46		0.5	5.5			4		Siltstone	
75,CC, 24-26	1.5	2.5	5		1			Limestone	
78-1, 28-30	3.5	1	5.5					Sandstone	
79-1, 88-91	2.5		2.5	4		1			
80-1, 30-34	1		3	4		2		Calcareous mudstones	
81-1, 27-29	1		2.5	5.5		1			
82-1, 8-10	1		3	5		1		Silty limestone	
82-1, 47-49			4	6					
82-1, 139-141			3.5	4.5		2		Calcareous mudstones	
82-2, 13-15			2	6		2			
82-2, 68-70			4	4		2			
84-1, 48-50			2	6		2		Siltstone	
85-3, 28-30	4	1	4			1		Sandstone	
86-1, 51-53	1	3	4.5		1.5				
86-1, 139-141	2	3	4		1				
86-2, 58-59	3	3	4					Calcareous mudstones	
86-2, 111-113	1	3	4		2				
86-3, 42-43	1	3	4		2			Silty limestone	
88-1, 1-3	1	2	4		3				
88-1, 112-115	2.5		1.5	5		1			
88-1, 121-123	1	2.5	4.5		2			Sandstones	
88-2, 3-6			2.5	5		2.5			
88-2, 43-45			2.5	6.5		1		Calcareous mudstone	
88,CC	3	2.5	2.5					Silty limestone	
89-2, 9-11	2	2.5	5.5						
90-1, 25-28	1	3	5		1			Calcareous mudstones	
90-2, 107-110			2.5	4.5		3		Sandstones	
90-3, 0-3	1	3	4		2				
90,CC, 17-19			2	5		3		Siltstone	
91-1, 44-45	2	2	5		1			Sandstone	
91-2, 21-23	1	2	6		1			Calcareous mudstone	
91,CC	1	2	6.5			2.5		Sandstone	
92-1, 8-10	2	2.5	4.5		1				
92-1, 106-108	1	1	8					Calcareous mudstone	
93-1, 72-75	1	1	7			1		Sandstones	
Hole 550B									
1-1, 53-55	1	3 +	2	3		1			
1-1, 126-128		€ +	0.5	9.5		€			
1-3, 55		3	1.5	4		1.5			
1-3, 67-68		3	2	4		1			
1-4, 77-80		€	0.5	9.5			x		
1-6, 104-106		1	0.5	8.5		€			
2-1, 57-59									
2-3, 28-29		2	1	7		€			
2-3, 101-103		2	1	7		€			
3-1, 132-133	2	2	2	1		3			
3-2, 19-21		2.5	1.5	5		1			
4-1, 75-78	2	2	2	2		2			
5-1, 45-47	2		2	4		2			
5-2, 9-11		2	2	5		1			
5-2, 30-32		1	1	8		€			
5-2, 40-43	€	1.5	1.5	7					
5-3, 81-83		€	€	10					
5-4, 37-38		1	1	7.5		0.5			
7-1, 30-32		1	0.5	8.5		€			
7-1, 148-150		1.5	1	7.5		€			
7-2, 56-58		2	2	4	2	€			
7-3, 13-15	€	2	1	6.5		0.5			
7,CC (4-5)	1	2	2	4	1				
8-2, 148-150	1	1	1	5		2			
8-3, 49-50									
8-5, 32-35	1	1	1	5		2			
8-5, 137-139	0.5	0.5	1	7		1			
8-5, 143-145	0.5	0.5	1	7		1			
9-1, 148-150		2	2	4		2			
9-2, 125-127		1	1	5	3				
9-3, 44-46	1	3	1	2	1	2			
9-3, 63-65		1.5	1.5	6		1			

APPENDIX II

Table 2. (Continued).

Sample (interval or level in cm)	Chlorite	Kaolinite	Illite	Smectite	Mixed-layer clays			Lithology	Age
					Ill-sm	Cl-sm	Zeolites		
Hole 550B (Cont.)									
9-3, 148-150		3	2	3		2			
10-1, 40-44	1	1	1	7					Maestrichtian
10-1, 110-112	1	2	2	3		2			
10-4, 76-78		1	1	7		1			
11-1, 6-8		1	1	7	0.5	0.5			
11-2, 63-65	0.5	0.5	8	1				Marly nannofossil chalks and foraminifer-nannofossil chalks	
12-1, 148-150	0.5	0.5	10						
12-2, 75-77		ε	10						
12-2, 115-117		ε	10						Campanian
12-4, 64-65	0.5	1	8.5						
13-2, 25-27	1	1	7	1	ε				
13-3, 29-31	0.5	0.5	9						
13-3, 134-136	1	1	8						
13-4, 52-54	ε	1	9						
13-5, 68-70		0.5	9.5						
13-6, 57-59	ε	ε	10		ε				Coniac.- Santonian
15-2, 25-26	ε	0.5	9.5	ε					
15-2, 64			10						
15-2, 140-142	ε		0.5	9.5	ε	ε			
15-4, 56-58	ε		0.5	9.5	ε				
15-5, 88-90			0.5	9.5	ε				
16-2, 76-79			0.5	9	0.5			Light-gray calc. mudst.	
17-1, 59-63			0.5	9.5					
18-1, 87-89			0.5	9.5	ε				
18-1, 102-104			0.5	9.5	ε				
20-1, 0-2		ε+	10					Light gray calc. mudst.	
20-5, 38-40		ε	0.5	9.5	ε				
21-1, 47-49	ε?	ε?	0.5	9.5	ε				
21-4, 47-50	ε	ε	0.5	9.5	ε				
22-1, 124-126	ε	ε	0.5	9	0.5			Dark gray calc. mudst.	
22-3, 63-66				No analysis available					
22-6, 4-6	ε	ε?	1	7.5	1	0.5		Dark gray calc. mudst.	
22-6, 63-66									
23-2, 69-72	ε	ε?	1.5	6	1.5	1		Light gray calc. mudst.	
23-3, 84-87	ε	ε	1	1	1	1			
23-3, 148-150	ε	ε?	1	8	1			Light gray calc. mudst.	
24-1, 148-150	ε	ε	1	7.5	1.5	ε			
24-3, 52-54	1	ε?	2	7				Dark gray calc. mudst.	
24-3, 62-64	ε	?	1	7.5	1.5	ε+			
24-3, 80-82	1	?	1.5	6	1.5			Dark gray calc. mudst.	
25-2, 133-136	0.5	?	1.5	6.5	1.5				Vraconian
Hole 551									
2-2, 90-95		ε	10						
3-1, 90-92		0.5	9		0.5				early Maestrichtian
3-1, 130-135		0.5	9.5	ε					
3-2, 80-85		ε+	9.5	0.5					late Camp.
4-1, 97-102		0.5	8	1.5					
5-1, 101-106		1.5	8.5		x				
5-1, 144-145		0.5	9	0.5				Foraminifer-nannofossil chalks	
5-2, 23-25		1.5	8.5		x				
5-2, 33-35		1.5	8.5		x				early Turonian
6-1, 7-9		3	4	3					
6-1, 79-81		2	2	6					late Cenomanian
6-2, 70-72		1	8	1	x				

Note: Quantities are totaled to 10. ε = trace, x = present. Ill-sm = illite-smectite mixed-layer clay; Cl-sm = chlorite-smectite mixed-layer clay.

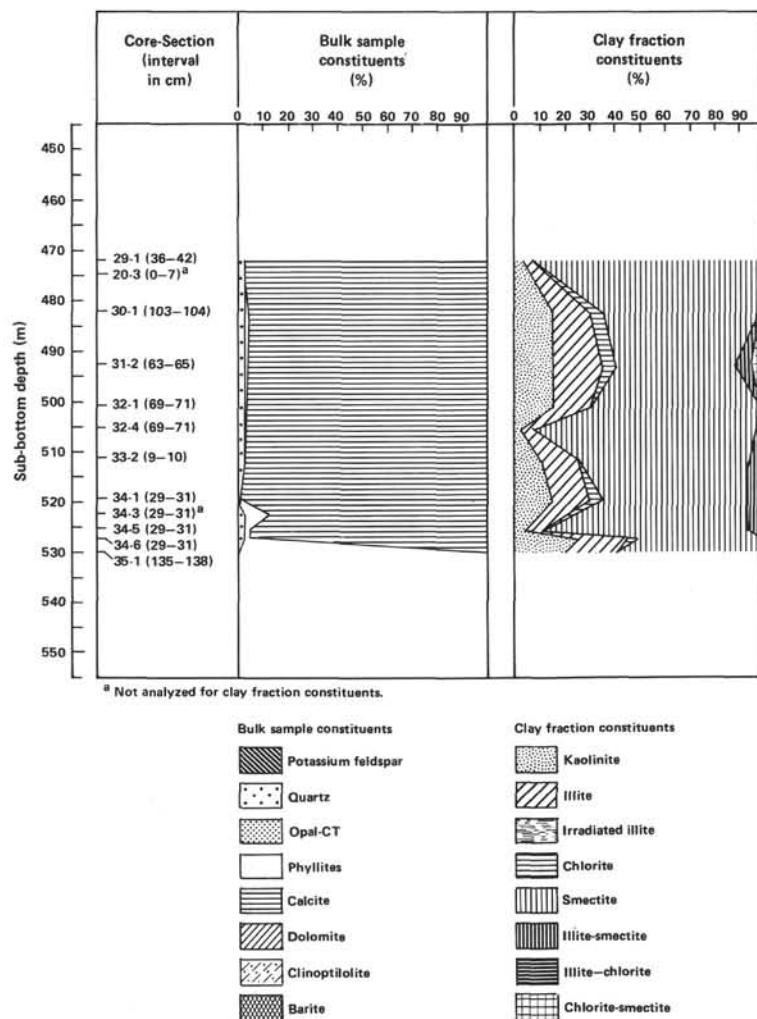


Figure 1. Bulk sample and clay fraction constituents of sediments from Hole 548A (Cores 29-34).

APPENDIX II

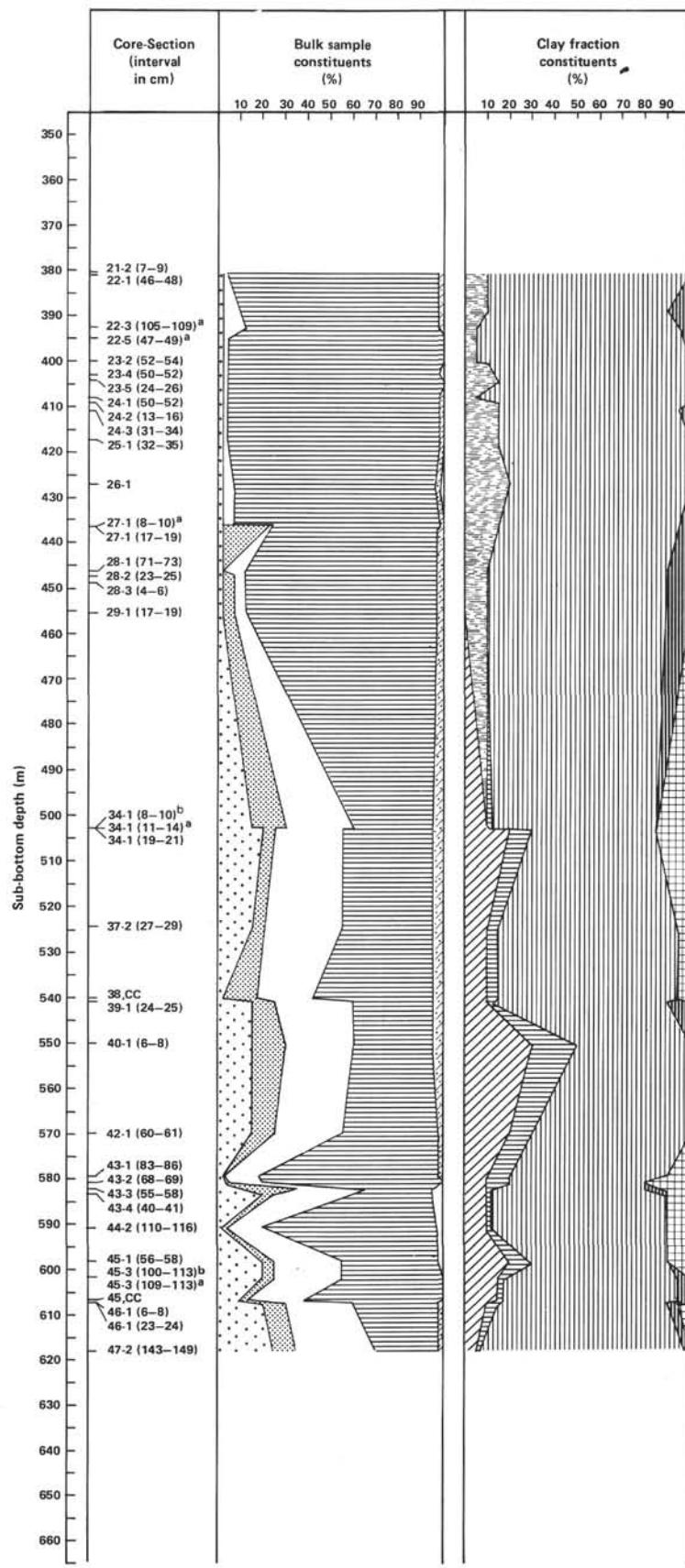


Figure 2. Bulk sample and clay fraction constituents of sediments from Hole 549 (Cores 21–91). Legend as in Fig. 1.

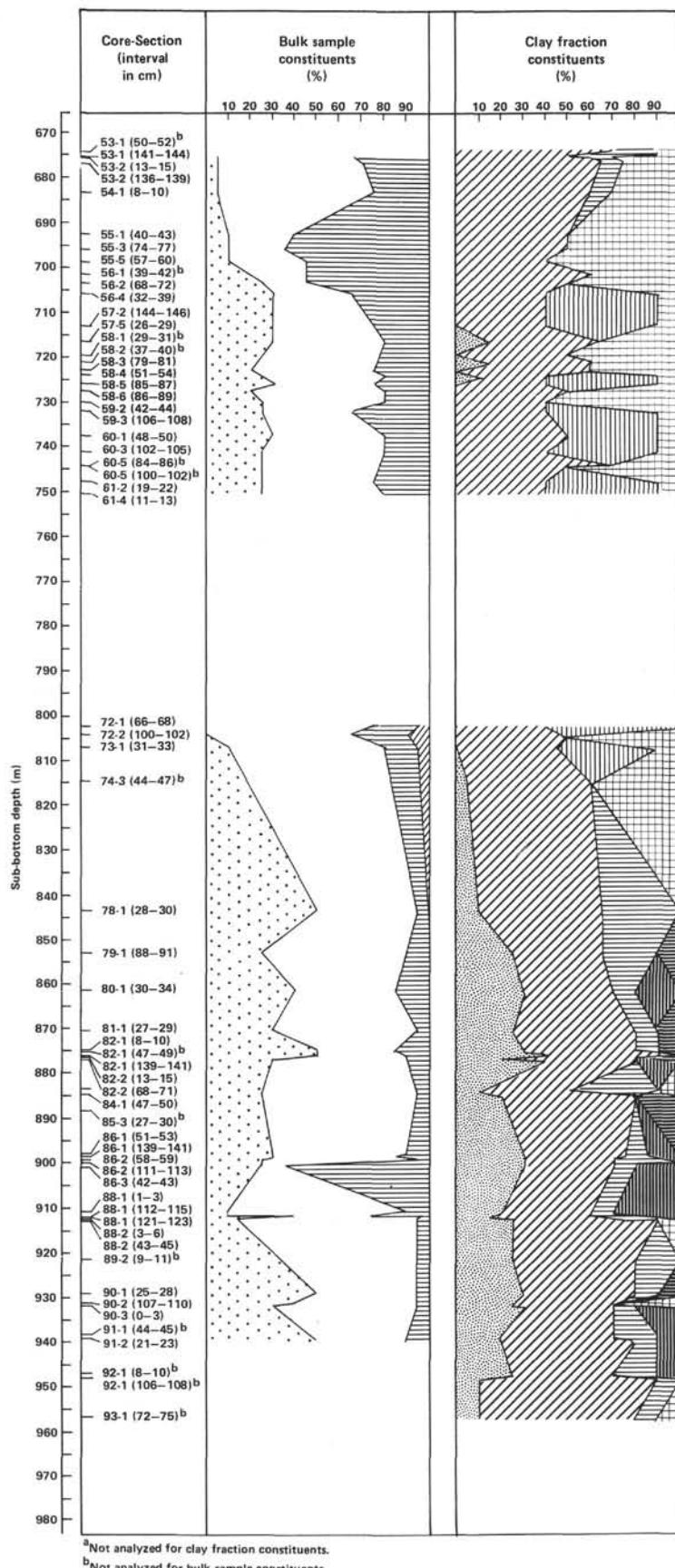


Figure 2. (Continued).

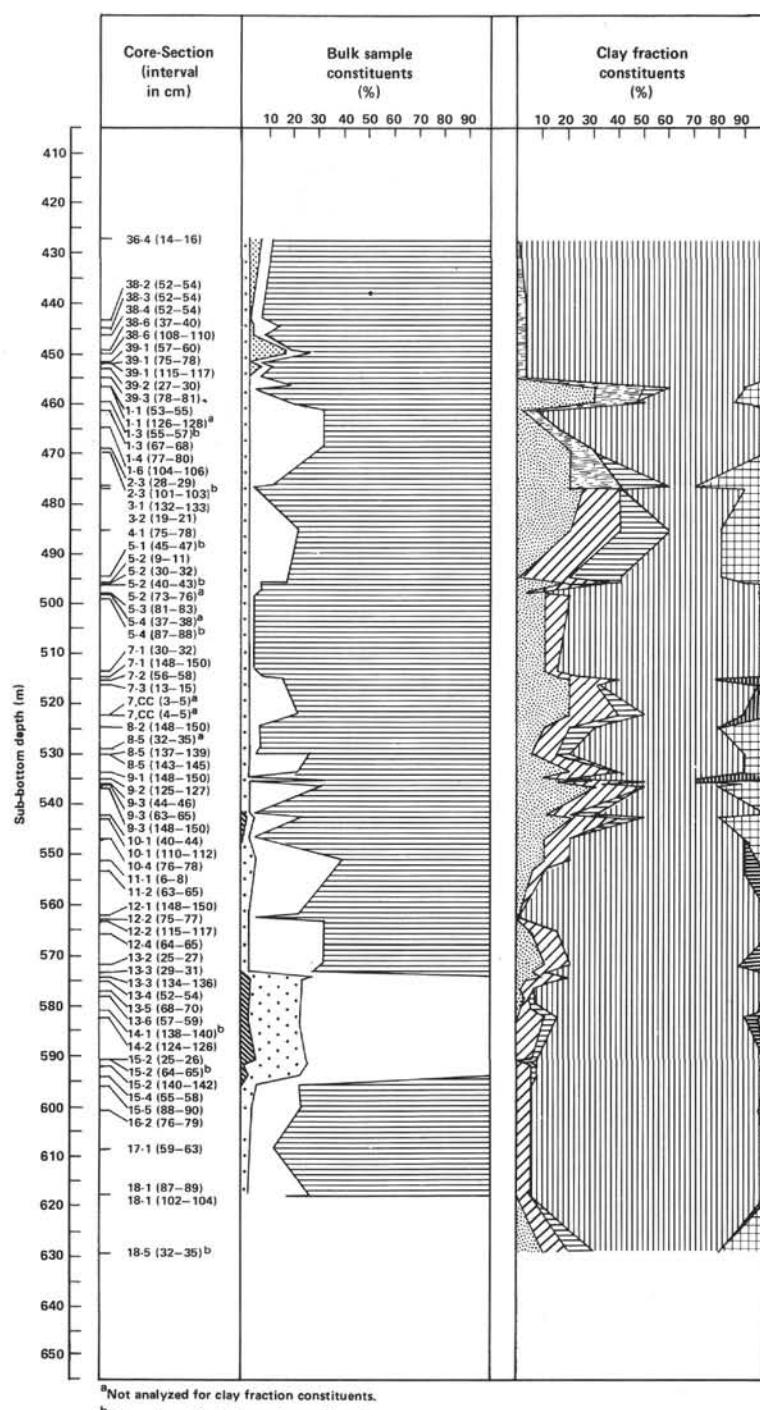
^aNot analyzed for clay fraction constituents.^bNot analyzed for bulk sample constituents.

Figure 3. Bulk sample and clay fraction constituents of sediments from Holes 550 (Cores 36-39) and 550B (Cores 1-18). Legend as in Fig. 1.