8. ORIGIN OF THE LATE CENOZOIC SEDIMENTS OF THE ICELANDIC BASIN, DSDP SITE 348, LEG 38

M.P. Nesterova, F.A. Scherbakov, A.Ja. Shevchenko, N.W. Turanskaja, W.P. Kazakova, A.G. Samosudova, T.G. Kuzmina, and A.N. Rudakova, Analytical Laboratory, P.P. Shirshov Institute of Oceanology, Academy of Sciences, USSR

INTRODUCTION

Site 348 attracted a great deal of interest because the hole was drilled within the Icelandic Basin, which represents a large depression in the Icelandic Plateau.

Laboratory studies consisted of a determination of: sediment grain sizes, the mineralogic composition of the coarse silt fraction (0.1 to 0.05 mm), and the chemical composition and the composition of clay minerals in the less than 0.001 mm size fraction.

Data Presentation

The data obtained are listed in Tables 1-9. The data in Table 1 are average values that characterize the sediments and rocks of each of the three stratigraphic units by the shipboard party (see Site Report, Chapter 8 , this volume). The tables also present data on the terrigenous, biogenic, volcanogenic, and authigenic sediment components. The data on chemical composition (Table 2) indicate the content of biogenic silica and $CaCO_3$ in the sediment. The iron content (Fe_2O_3) (Table 4) indicates the presence of both terrigenous and authigenic material. Components in the separate grain size fractions are grouped in such a manner so as to characterize most accurately the various components of the sediment. Table 3 also includes data on the quantity of particles with a size of less than 5 μm. It was assumed that these particles consist almost entirely of clay minerals.

The data presented on the content of separate minerals in the 0.1-0.05 mm fraction (Table 1) concentrate on a group of the most typical terrigenous minerals: quartz, potassium feldspars, hornblende, and weathered grains (chiefly rock debris, plagioclase feldspars). For the volcanogenic sediments, the data show the contents of varieties such as glass and various types of more or less altered particles of volcanic ash. The authigenic group included pyrite and marcasite, iron hydroxides, glauconite, and zeolites which have been formed in the process of devitrification and palagonitization of the primary volcanogenic ash material. However, some zeolites probably have a volcanic origin.

From analysis of the data, it is apparent that each of the three lithologic units distinguished differ both in composition and genesis. However, the interpretations on the composition and genesis of these sediments are somewhat different from those of the shipboard party (see Site Report, Chapter 8 , this volume).

DISCUSSION

Based on the data available, it is concluded that the sediments of all three units in Hole 348 are essentially clay sediments. The average percentage of the clay content calculated for the three units is over 70% (Table 3). The major bulk of these particles is represented by clay minerals, and a considerable portion of this clay material is authigenic. The material, which has been altered and converted into these clays, was probably of a volcanogenic origin and not terrigenous (see however, Site Report, Chapter 8 , this volume).

Biogenic Components (Carbonate and Silica)

Biogenic calcium carbonate has an extremely minor content in the Cenozoic sediments. Rarely, except in separate interlayers, does the $CaCO_3$ content reach 15%. However, biogenic amorphous silica is far more important, although the SiO_2 content in the samples studied hardly exceeds 8% (Table 2). A study of smear slides and thin sections of these sediments under the scanning electron microscope shows a high content of siliceous skeletons. It is believed that although the skeletal volume may be high, the mass contained in the skeletons is low. On the other hand, the mass of clay material in a similar volume is appreciably higher.

Volcanic Components

For the volcanic constituents, the predominant mass has been transported as ash particles to oceanic regions. The sediment contains particles of volcanic glass whose size corresponds chiefly to silt and (partially) coarse clay fractions.

Volcanic glass, under certain conditions, will comprise the major portion of such fractions; however, the main mass of volcanic glass appears to have been completely altered and converted to clay.

Studies of Volcanic Components

Volcanic material in the coarse fraction consists of heavy (specific weight 2.9 g/cc) and light (specific weight less than 2.9 g/cc) subfractions. The material includes volcanic glass that contained both the basic ($N>1.54$ [dominant type]) and acid varieties ($N<1.54$). Frequently, a significant portion of the volcanic material was represented by devitrified and more or less altered glass, particularly the palagonitized variety. These can be considered varieties of ash particles.

Also detected in the volcanogenic component of the coarse silt (heavy subfraction) were monoclinic pyrox-

TABLE 1
Composition of Sediments Cored at Site 348

Age		Grain Size Distribution (%)				Heavy Min. 0.1-0.05 (%)	Clastic Part 0.1-0.05 mm (%)									
							Terrigenous					Volcanogenic				
		>0.1 mm	1-0.1 mm	0.1-0.01 mm	<0005 mm		Quartz	K-Feldspar	Opaque	Hornblende Green	Weathered Fragments	Pyroxene	Volcanic ash heavy	Volcanic ash light	Volcanic glass	Pyrite-marcasite
Pleistocene	Q		1.5	3.3										9.0		
			4.3	6.4	70.2	6.0	35.8	13.1	7.4	6.9	16.7	19.8	46.7		3.3	0.5
	65 m															
Middle Miocene to Pliocene	N_2															4.9
	N_1mc_3		2.5	2.7	77.6	8.4	1.7	1.0	2.2	0.4		10.5	80.0	35.3	49.7	
	N_1mc_2															55.9
Oligocene to E. Miocene	N_1mc_1	15-79	55-117		57.4								tr		1.3	
		22-25	13-28													
		78	14.9													
			5.1	2.7	72.8	5.7	45.0	13.0	14.2	6.2	21.9	1.2	3.0	tr	tr	70.8
	527 m								28.0							30.6

enes (augite). However, some of the pyroxenes may have been transported (especially in Pleistocene times) as terrigenous components from Iceland.

Authigenic Components

Authigenic minerals formed by diagenesis include pyrite and marcasite (in the heavy subfraction of the coarse silt fraction). These are grouped in Table 1 as iron sulfides (FeS_2) and include iron hydroxides in the form of limonite and glauconite. These varieties, together with conspicuous zeolites, are commonly present in the thin bedded clay fractions. The zeolites were observed in the diffraction (X-ray) patterns of sediments of the less than 1 μm fraction, however, it is believed they are accessory minerals.

Clay Minerals

Important in the definition of sediment composition and genesis is determining the composition of clay minerals. The study utilized the data from X-ray diffraction and SEM microphotography. Detected were montmorillonite and hydromica, as well as chlorite, zeolites, and mixed-layer clays of varying compositions. Calculations of the quality of these minerals in the less than 1 μm fraction are based on the technique of Brindley (1965).

Montmorillonite is among the clays which comprise a major portion of the section. Moreover, montmorillonite, in pre-Pleistocene deposits, predominates and constitutes, locally, up to 100% in the less than 1 μm fraction. It is believed that the main portion of this montmorillonite is authigenic, formed as a result of transformation of basic volcanic glass.

Thus, analysis of the clay fraction of the sediment seems to provide substantial grounds that the major portion of the pre-Pleistocene sediments in the Icelandic Basin is primarily volcanogenic. These volcanogenic components have been subsequently transformed in varying degrees into authigenic components.

GENERAL CONCLUSIONS

Considerations of the data from the lithologic studies of the core samples of Hole 348 permit some general conclusions on the composition and genesis of the sedimentary material.

TABLE 1 – *Continued*

Authigenic			Organic		Chemical Composition (%)				Clay minerals <0.001 mm (%)					
Fe-hydro oxides	Glauco-nite	Zeolite	$CaCO_3$	Silic-eous	SiO_2 (Amorph)	Fe_2O_3	$CaCO_3$	Organic Carbon	Illite	Mont-mori-llonite	Chlorite	Kaoli-nite	Mixed Layer Minerals	Zeolite
1.7	0.5	tr	51.7 17.4		1.4	9.1	15.0	tr	50-60	10-40	5-10	5-10	5-10	
					3.8		30.40		30-60	25-60	10		5-10	
	tr	0.2- 1.4		tr	7.0	9.9	39 3.2 3.5 15-41	0.2	10-30	60-80	10-15		10	tr
		11.3 3.6 37.3 2.5-5.2	29-36 6-85			13.9	32		tr	∿100	tr	tr		tr
1.1	1.6	0.5- 2.2 0.2-			1.8	8.6	1.6	0.9 0.8	10-20	60-80	10-20	tr	tr	10-20
3.0		12.3							10	40	20			30

Despite the homogeneous composition of clay in the sedimentary section, there are very minor variations in the composition and content of accessory terrigenous, biogenic, volcanogenic, authigenic, and clay components. These variations support the division of the sediments into three stratigraphic units. There is also a general agreement of lithologic and stratigraphic boundaries.

Unit 3

The "accessory" components in the silt portion of the sediment section are almost exclusively "terrigenous" in the lower portion of Unit 3 (Oligocene and early Miocene). Volcanogenic constituents are practically absent in the silt fraction, however, there is a great deal of quartz, weathered plagioclase, or other minerals. The silt is also characterized by the highest content of heavy ore minerals (Table 1). Noteworthy is the low content of biogenic (SiO_2, $CaCO_3$) components. Interestingly, however, the sediments do have a high C_{org} content.

A direct correlation seems to exist with C_{org} and the percentage of authigenic pyrite and marcasite in Unit 3. Less common is glauconite. In all probability, the high C_{org} content present is the main factor that led to the origin (via diagenesis) of these authigenic components. Also of interest is the fact that all these deposits are the oldest of those cored.

Although all sediment sections are characterized by a generally low zeolite content in the silty sediments, Unit 3 has a high content (Table 1). The distribution of these zeolites in the coarse silts shows a tendency to increase in content from the top. An exception is the lowermost portion of Unit 3, where large zeolite crystals are abundant (Figures 1 and 2).

The clay component in Unit 3 has a quite different character. The less than 1 μm fraction is completely composed of montmorillonite, especially at the top of the unit (early-Miocene). X-ray diffraction fails to reveal but a trace of other minerals. An exception is the lowermost beds (late Oligocene) above basalts. Here, apart from the predominant montmorillonite, there is a considerable amount of chlorite, hydromica, and kaolinite. Zeolite is also conspicuous. The composition of these clays provides grounds to indicate that this clay has formed from ash material and basaltic lavas. The absence of the ash in larger size fractions indicates an

TABLE 2A
Results of Immersion Mineralogical Analysis of the 0.1-0.5 mm Fraction Samples (Heavy Minerals) From Hole 348 DSDP Leg 38

Sample (Interval in cm)	Opaque Minerals	Magnetite	Pyrite-Marcasite	Hydroxigeus Fe	Leucoxene	Weathering Fragments	Garnet	Schorlonite	Green Hornblende	Brown Hornblende	Basaltic Hornblende	Actinolite Tremolite	Glaucophane	Pyroxene (romb.)	Pyroxene (mono)	Aegirine	Epidote Group	Biotite	Chlorite Fragments
1-1, 70-72	26	9	8	4		3	4		23					2	12		4		
1-1, 70-72	6.6	2.4	2.1	10		1.6	1.0		6.1					0.5	3.1		1.0		
1-3, 100-104	77	8	5	40	6	28	40		49			5	1	6	34		58	2	
1-3, 100-104	19.1	2.0	1.2	10.0	1.5	7.0	10.0		12.3			1.2	0.2	1.5	8.5		14.3	0.5	
1-4, 100-102		5		2			1		6	3		2		4	37		8	1	
1-4, 100-102		0.7		0.3			0.1		0.8	0.4		0.3		0.5	5.1		1.1	0.1	
1-5, 90-92	12	30	1	4	4	20	7		21	18	5	2		1	94	1	61		1
1-5, 90-92	3.5	8.0	0.3	1.1	1.1	5.4	1.9		5.7	4.8	1.3	0.5		0.3	25.3	0.3	16.4		0.3
1, CC	53	22		24	4		11		61		2	2		18	68		51		
1, CC	13.9	5.8		6.3	1.0		2.9		16.3		0.5	0.5		4.7	17.8		13.4		
2-1, 98-100		35		5			1		34	11		6		4	72		42		1
2-1, 98-100		9.4		1.3			0.2		9.2	3.0		1.6		1.1	19.3		11.3		0.2
2-2, 50-52		29		11			2		17	5	1	1		1	64	2	23	2	2
2-2, 50-52		6.8		2.6			0.5		4.0	1.1	0.2	0.2		0.2	15.0	0.5	5.3	0.5	0.5
2-4, 99-101	14			5	1	3	1		9						14	1	20		
2-4, 99-101	–			–	–	–	–		–						–	–	–		
2, CC	49	19		37	5	44	37		89		2	3		16	80	1	61	1	
2, CC	10.2	3.9		7.7	1.0	9.1	7.7		18.2		0.4	0.6		33	16.5	0.2	12.6	0.2	
3-1, 99-101	53	6	1	12	5	31	13		13		2	2		1	48		18		
3-1, 99-101	24.4	2.8	0.5	5.5	2.3	14.3	6.0		6.0		0.9	0.9		0.5	21.0		8.3		
3-3, 99-101	33	45		13	5	19	18		68		5	6		5	77		33	1	
3-3, 99-101	98	13.2		3.8	1.5	5.6	5.3		20.0		1.5	1.2		1.5	22.8		9.8	0.3	
3-4, 99-101	78	15		15	3	22	35	2	87		1	4		9	45	1	71		
3-4, 99-101	18.4	3.5		3.5	0.7	5.2	8.2	0.5	20.6		0.2	0.9		2.1	10.6	0.2	16.7		
3-5, 89-91	43	14		6		18	7		69			7		8	94		36		
3-5, 89-91	13.5	4.4		1.9		5.7	2.2		21.8			2.2		2.5	29.7		11.4		
3, CC	38	34		9		141	10		71		1	9		10	52		44		
3, CC	87	78		2.0		32.1	2.3		16.2		0.2	2.0		23	11.8		10.0		
4-1, 119-121	17	30	3	13			7		37	17		3		4	95		12	2	2
4-1, 119-121	4.5	8.2	0.8	35			1.9		10.3	4.6		0.8		1.1	25.8		3.3	0.5	0.5
4-2, 99-104	5	10		7			4		31	1		2		3	123		14		1
4-2, 99-104	1.1	2.2		1.6			0.9		7.1	0.2		0.4		0.7	27.6		3.1		0.2
5-1, 99-100	6	6		8			1		3					1	11		3		
5-1, 99-100	1.3	1.3		1.7			0.2		0.6					0.2	2.3		0.6		
5-2, 139-141	2	10	9	7		5	5		29			3		1	6	1	15		
5-2, 193, 141	0.4	1.9	17	1.3		1.0	1.0		5.6			0.6		0.2	1.1	0.2	2.9		
5, CC	12	43	9	91			1		13						20		13		34
5, CC	2.8	10.1	2.1	21.2			0.2		3.0						4.7		3.0		7.9
6-1, 139-141	12	4							7	3				1	26		5		
6-1, 139-141	2.6	0.9							1.5	0.7				0.2	5.7		1.1		
6-2, 29-31	21	7		7					3					1	16		5		
6-2, 29-31	4.4	1.5		1.5					0.6					0.2	3.4		1.0		
6-4, 84-86	19	5	17	6		10			2						22		6		
6-4, 84-86	4.0	1.1	3.6	1.3		2.1			0.4						4.7		1.3		
6-5, 73-75	12		1	11		7	4		2.4			1		1	29		3		
6-5, 73-75	2.3		0.2	2.1		1.3	0.8		4.6			0.2		0.2	5.5		0.6		
6, CC	10			4			1		2					2	7		2		
6, CC	2.0			0.8			0.2		0.4					0.4	1.6		0.4		
7-1, 74-76		14	2	4			1		2			2			37		6		
7-1, 74-76		2.9	0.4	0.8			0.2		0.4			0.4			7.7		1.2		
7-3, 74-76		6	3	4					2						15				
7-3, 74-76		1.4	0.7	0.9					0.4						3.4				
7-4, 75-77		6	1	11					1						12		1		
7-4, 75-77		1.5	0.2	2.8					0.2						31		0.2		
7, CC	11	5	21	3					2						30		6		
7, CC	2.5	1.1	4.8	0.7					0.5						6.8		1.4		
8-2, 75-77		30	22	13			1		1			1			157		1		
8-2, 75-77		6.3	4.7	2.8			0.2		0.2			0.2			34.0		0.2		
8-3, 75-77		13	23	4											35		2		
8-3, 75-77		3.2	5.7	1.0											8.6		0.5		
9-1, 139-140		14		5					1	1					40		2		
9-1, 139-140		2.6		0.9					0.2	0.2					7.3		0.4		
9-2, 75-77		5	2	4											35		4		
9-2, 75-77		0.9	0.4	0.8											6.5		0.8		
9-5, 75-77		7	1	5					4						36				
9-5, 75-77		1.3	0.2	0.9					0.7						6.7				
9, CC	19.0	4		22											107				
9, CC	40	0.9		4.7											22.9				
11-1, 80-82		13	19	3											36				
11-1, 80-82		2.7	4.0	0.6											7.6				
11-2, 80-82		6	9	6											18		1		
11-2, 80-82		1.4	2.1	1.4											4.2		0.2		
11-4, 70-72		20	5	6										1	75				1
11-4, 70-72		3.8	0.9	1.1										0.2	14.4				0.2
12-2, 60-62		4	144							1					75				
12-2, 60-62		0.9	31.3							0.2					16.3				
12-4, 20-22		6	40											1	39				
12-4, 20-22		1.3	8.5											0.2	8.3				
13-1, 80-82	6	4		9										1	26		4		

TABLE 2A – *Continued*

Olivine	Chloritoids	Glauconite	Ortit (?)	Titanite	Staurolite	Tourmaline	Zircon	Apatite	Rutile	Kyanite	Corundum	Spinel	Cr-Spinel	Andalusite	Sillimanite	Celestite-Barite	Carbonates	Spinel	Volcanic Ash	Volcanic Glass	Anatase	Calculated Grains	Horizon
1						1	3	1		2									274			380	70-72
0.3						0.3	0.8	0.3		0.5									72.4				
				8		2	13	16	3								1					402	100-104
				2.0		0.5	3.2	4.0	0.7								0.2						
2				1			2	2											651			727	100-102
0.3				0.1			0.3	0.3											89.6				
1	2			8		2	2	4		3				3	1	2			61			372	90-92
0.3	0.5			2.1		0.5	0.5	1.1		0.8				0.8	0.3	0.5			16.3				
7	1			5			2	5	2			3							40			381	
18	0.3			1.4			0.5	1.4	0.5			0.8							10.5				
				4		1	2	3		2									149			372	98-100
				1.1		0.2	0.5	0.8				0.5							40.3				
2	1			5		1	1		1	2		1		2			2	1	250			429	50-52
0.5	0.2			1.1		0.2	0.2		0.2	0.5		0.2		0.5			0.5	0.2	58.3				
							1		1													70	99-100
							–		–														
3	9			7	1		7	9	1			1			1			1			1	485	
0.6	1.9			1.4	0.2		1.4	1.9	0.2			0.2			0.2			0.2			0.2		
				1			7	3								1						217	99-101
				0.5			3.2	1.4								0.5							
1						1	8	3														341	99-101
0.2						0.3	2.3	0.9															
3				5	1		12	14	2													425	99-101
0.7				1.2	0.2		2.8	3.3	0.5														
				4			8	2	1													317	89-91
				1.3			2.5	0.6	0.3														
2	2			3			8	5														439	
0.5	0.5			0.7			1.8	1.1															
				16			2	6						1	1		3		98			369	119-121
				4.3			0.5	1.6						0.2	0.2		0.8		26.6				
				1		1													243			446	99-104
				0.2		0.2	3.2															545	
							1												430			470	
							0.2												916				
1				1				3											422			522	
0.2				0.4		0.2		0.6											80.7				
1							1				1								188			427	
0.2							0.2				0.2								44.4				
1							1												399			459	
0.2							0.2												86.9				
1							1												415			477	
0.2							0.2												87.0				
																			385			472	
																			81.5				
3							1												426			523	
0.6							0.2												81.4				
							1												476			505	
							0.2												94.0				
							3	2											409			482	
							0.6	0.4											85.0				
																			405			435	
																			93.2				
																			356			388	
																			92.0				
1																			360			439	
0.2																			82.0				
							2												234			462	
							0.4												51.0				
																			328			405	
																			81.0				
											2								475			540	
											0.4								88.0				
1							2												469			522	
0.2							0.4												90.0				
							1												48.1	1		536	
							0.2												89.8	0.2			
1							1												315			469	
0.2							0.2												67.1				
								1											401			473	
								0.2											84.9				
								1											382			423	
								0.2											90.5				
																			413			521	
																			79.4				
																			237			461	
																			51.3				
1																			382			469	
0.2																			81.5				
1																							

TABLE 2A – *Continued*

Sample (Interval in cm)	Opaque Minerals	Magnetite	Pyrite-Marcasite	Hydroxigeus Fe	Leucoxene	Weathering Fragments	Garnet	Schorlonite	Green Hornblende	Brown Hornblende	Basaltic Hornblende	Actinolite Tremolite	Glaucophane	Pyroxene (romb.)	Pyroxene (mono)	Aegirine	Epidote Group	Biotite	Chlorite Fragments
13-1, 80-82	1.6	1.1		2.4										0.3	7.0		1.1		
13-2, 20-22	17	7		5			1		1					1	23		2		
13-2, 20-22	3.7	1.5		1.1			0.2		0.2					0.2	5.1		0.4		
13, CC	4			10					1					1	7		2		
13, CC	0.9			2.3					0.2					0.2	1.6		0.5		
14-1, 20-22	2	5	12	7											9		1		
14-1, 20-22	0.6	1.4	3.4	2.0											2.5		0.3		
14-2, 20-22	4	3	53	11											56		1		
14-2, 20-22	0.9	0.7	12.5	2.6											13.4		0.2		
14-4, 20-22	3	7	18	11		7	2		5						54		3		
14-4, 20-22	0.7	1.5	5.9	2.4		1.5	0.4		1.1						11.9		0.7		
14-5, 20-22	2	3	33	27			2		2						50		3		1
14-5, 20-22	0.4	0.6	6.4	5.2			0.4		0.4						9.7		0.6		0.2
14-6, 20-22	2	4	92	20											25		2		
14-6, 20-22	0.4	0.9	20.6	4.5											5.6		0.4		
14, CC	6	3	18	11			3								6		2		
14, CC	1.3	0.7	4.0	2.5			0.7								1.3		0.5		
15-1, 60-62	12	3	79	2			2		4						23		6		
15-1, 60-62	3.4	0.9	22.7	0.6			0.6		1.1						6.5		1.7		
15-2, 60-62	9		300	2			3		2		1				42		5		
15-2, 60-62	2.1		66.7	0.5			0.7		0.5		0.2				10.0		0.5		
15, CC		5	7	8					2						14		8		
15, CC		1.3	1.8	2.0					0.5						3.6		2.0		
16-1, 60-62	10	5	200	6			6		4			1			88		15		
16-1, 60-62	2.8	14	55.0	1.7			1.7		1.1			0.3			24.5		4.2		
16-3, 60-62	5		88	5			2		6					1	33		16		
16-3, 60-62	3.0		53.6	3.0			1.3		3.7					0.6	20.2		9.8		
16-5, 60-62			268	5			2		1			1			39		8		
16-5, 60-62			81.6	1.5			0.6		0.3			0.3			11.8		2.4		
16-6, 60-62	2		384	4			1		2						15				
15-6, 60-62	0.5		93.7	1.0			0.2		0.5						3.7				
16, CC	15	3	210	23			1		5						44		4		
16, CC	4.0	0.9	57.0	6.3			0.3		1.4						11.9		1.1		
19-1, 110-112	7		113	8			6		1						5		10		
19-1, 110-112	4.6		74.3	5.3			3.9		0.7						3.3		6.5		
19-3, 75-77	4	4	80	3		2	1					1			1		4		
19-3, 75-77																			
19-4, 10-12	1		45	10		2	1		1						2		1		
19-4, 10-12																			
19-6, 140-142	2		38	1		1	1		2						1		2		
19-6, 140-142																			
19, CC	4			2					3						1		3		
19, CC																			
20-1, 80-82		6	12	2			2		2						2		3		
20-1, 80-82																			
20-2, 80-82		1				2			1						6				
20-2, 80-82																			
20-4, 64-66	6	25	63	16			3		8		2	4			5		20		
20-4, 64-66	3.6	15.6	39.0	9.9			1.8		49		1.2	2.5			3.1		12.3		
20-6, 135-137	2		9	4		4	6		1			4							
20-6, 135-137																			
20, CC	1	34	34	21			1								2		1		
20, CC																			
21-1, 60-62	4	2	16						1						2	1	2		
21-1, 60-62																			
21-3, 100-104	17	13	180	9			6		12			5			3		26	5	
21-3, 100-104	5.9	4.5	62.8	3.1			2.1		4.2			1.7			1.0		9.0	1.7	
21-5, 60-62	5	4	10				3		4			4					3		
21-5, 60-62																			
21, CC	41	33	130	96			4		2			2			4		7		
21, CC	12.6	10.2	40.0	29.6			1.2		0.6			0.6			1.2		2.2		
22, CC	3	3	255	18			4		3						2		13		
22, CC	1.0	1.0	84.1	6.0			1.3		1.0						0.7		4.3		
23-1, 110-112	28	19	310	12			10		17						6	1	22		1
23-1, 110-112	6.2	4.3	69.8	2.7			2.2		3.8						1.3	0.2	4.9		0.2
23-3, 77-79	102	40	98	11	2	11	18		78			10			1		68	1	
23-3, 77-79	21.6	8.4	20.6	2.3	0.4	2.3	3.8		16.3			2.1			0.2		14.2	0.2	
23-5, 80-82	69	20	182	6	2	2	23		32			1				1	49		1
23-5, 80-82	16.3	4.7	43.3	1.4	0.4	0.4	5.4		7.5			0.2				0.2	11.5		0.2
23, CC	54	8	235	33	2	23	25		77			4			3		66		
23, CC	9.9	1.5	43.1	6.1	0.4	4.2	4.6		14.3			0.7			0.6		12.2		
24-1, 27-29	6		422	2			11		5			1			8		13		
24-1, 27-29	1.3		89.5	0.4			2.3		1.1			0.2			1.7		2.7		
24-2, 49-51	2		431	7			2		19						5		16		
24-2, 49-51	0.4		89.6	1.4			0.4		3.9						1.0		2.3		
24-4, 2-4	12	5	403		1		6		11			3					5	2	
24-4, 2-4	2.6	1.1	87.9		0.2		1.3		2.4			0.6					1.3	0.4	
24-6, 60-62	37	16	374		1		9		24			5					39	1	
24-6, 60-62	7.0	2.8	70.5		0.2		1.7		4.5			0.9					7.3	0.2	

TABLE 2A – *Continued*

Olivine	Chloritoids	Glauconite	Ortit (?)	Titanite	Staurolite	Tourmaline	Zircon	Apatite	Rutile	Kyanite	Corundum	Spinel	Cr-Spinel	Andalusite	Sillimanite	Celestite-Barite	Carbonates	Spinel	Volcanic Ash	Volcanic Glass	Anatase	Calculated Grains	Horizon
0.3								0.3												85.9			
																				87.6			
																				406 94.3		431	
																				315 89.8		351	
																				297		425	
1 0.2	1 0.2						1 0.2													344 75.3		457	
1 0.2						1 0.2		1 0.2												392 75.5		518	
																				302 67.6		447	
							1 0.2													392 88.8		442	
							2 0.6		1 0.3										218 61.6			352	
							2 0.5												59 18.3			422	
																			348 88.8			392	
1 0.3	2 0.6			1 0.3			4 1.1												17 5.0			360	
	1 0.6			1 0.6			5 3.0	1 0.6														164	
	1 0.3	2 0.6					2 0.6															329	
	1 0.2						1 0.2															410	
2 0.5	1 0.3																		60 16.3			368	
							1 0.7	1 0.7														152	
	1						3															104	
							1									1						65	
							1															49	
																						13	
1							1	2									4					37	
																	3					13	
	1 0.6	2 1.2					3 1.8										4 2.5					162	
						1	8									5	5					49	
	1															3						98	
																	2					30	
	4 1.4			1 0.3			3 1.0	2 0.7		1 0.3				1 0.3								288	
						1	3		1													38	
							1 0.3	1 0.3	1 0.3							3 0.9						325	
	1 0.3		1 0.3																			303	
	5 1.1			3 0.6	2 0.4		4 0.9	2 0.4		2 0.4				1 0.2			1 0.2				1 0.2	447	
	16 3.4			3 0.6	2 0.4	2 0.4	4 0.8	7 1.4		3 0.6												477	
	16 3.7			3 0.7	1 0.2	2 0.4	6 1.4	2 0.4		4 0.9				1 0.2			1 0.2				2 0.4	426	
	4 0.7						4 0.7	2 0.4	3 0.6													543	
	1 0.2					1 0.2										2 0.4						472	
	3 0.6						2 0.4															487	
	2 0.4			1 0.2	1 0.2	1 0.2	1 0.2	1 0.2	1 0.2	1 0.2			1 0.2								1 0.2	459	
	7 1.3			3 0.5	1 0.2	1 0.2	5 0.9	1 0.2	1 0.2	3 0.6			1 0.2			2 0.4					1 0.2	532	

TABLE 2A – *Continued*

Sample (Interval in cm)	Opaque Minerals	Magnetite	Pyrite-Marcasite	Hydroxigeus Fe	Leucoxene	Weathering Fragments	Garnet	Schorlonite	Green Hornblende	Brown Hornblende	Basaltic Hornblende	Actinolite Tremolite	Glaucophane	Pyroxene (romb.)	Pyroxene (mono)	Aegirine	Epidote Group	Biotite	Chlorite Fragments
24, CC	14		344	21			9		35			3		1	4		32		
24, CC	2.9		71.5	4.3			1.9		7.2			0.6		0.2	0.8		6.6		
25-1, 64-66	19	10	397	7	2		9		18			4					21	1	1
25-1, 64-66	3.7	2.0	77.8	1.3	0.4		1.7		3.5			0.8					4.1	0.2	0.2
25-3, 44-46	23	15	371	2	1	4	10		2.6			1		1	1	1	30		2
25-3, 44-46	4.5	2.9	73.0	0.4	0.2	0.8	1.9		5.1			0.2		0.2	0.2	0.2	5.8		0.4
25-4, 75-77	16	8	314	6	1		11		15			2			2	1	19	1	2
25-4, 75-77	3.8	2.0	76.4	1.4	0.2		2.6		3.6			0.5			0.5	0.2	4.6	0.2	0.5
25-6, 71-73	31	12	399	6	1		6		21			3					23		
25-6, 71-73	6.0	2.3	76.5	1.1	0.2		1.1		4.0			0.6					4.4		
25, CC	35	6	363	10		14	32	1	58			4			5		40		
25, CC	5.9	1.0	61.1	1.7		2.3	5.4	0.2	9.8			0.7			0.8		6.7		
26-1, 58-60	35	2	316	2		7	6		11			2			1		26		
26-1, 58-60	84	0.5	75.5	0.5		1.7	1.4		2.6			0.5			0.2		6.1		
26-3, 68-70	61	7	320	3		10	8		16			1			1		31		
26-3, 68-70	13.0	1.5	68.5	0.6		2.1	1.7		3.4			0.2			0.2		6.7		
26-4, 39-41	40	8	297	3	2	8	24		26			3			2		30		
26-4, 39-41	8.9	1.8	66.2	0.7	0.4	1.8	5.3		5.7			0.7			0.4		6.7		
26, CC	50	6	286	4		17	25		55			4			6		47		5
26, CC	9.6	1.1	54.2	0.8		3.2	4.8		10.5			0.8			1.1		8.9		1.0
27-1, 92-96	93	4	217	2	4	25	15		54			2			3		72		
27-1, 92-96	18.1	0.8	42.8	0.4	0.8	4.9	2.9		10.6			0.4			0.6		14.3		
27-2, 103-105	52	5	244	3		18	6		36			3			5		51		
27-2, 103-105	11.2	1.1	52.9	0.7		3.9	1.3		7.8			0.7			1.1		11.0		
27-3, 21-23	78	5	257	5		16	26		24			4			3		39	1	
27-3, 21-23	16.1	1.0	53.1	1.0		3.3	5.3		5.0			0.8			0.6		8.1	0.2	
28-1, 75-77	54	5	311	5	3	10	14		28			1			5		48		
28-1, 75-77	10.7	1.0	61.9	1.0	0.6	2.0	2.8		5.5			0.2			1.0		9.5		
28-2, 129-131	85	1	219	4		17	28		16						4		42	1	
28-2, 129-131	19.7	0.2	50.4	0.9		3.9	6.5		3.7						0.9		9.7	0.2	
28, CC	56	15	181	10		20	32		49			4			9		66		
28, CC	11.8	3.2	38.6	2.1		4.2	6.8		10.5			0.8			1.9		14.0		
29-2, 124-126	39	8	340	5		14	15		12			5	1				40		
29-2, 124-126	7.6	1.6	66.6	1.0		2.7	2.9		2.3			1.0	0.2				7.8		
29-3, 27-29	44	2	378	4		14	14		5						1		36		
29-3, 27-29	8.5	0.4	72.8	0.8		2.7	2.7		1.0						0.2		7.0		
29-4, 24-26	60	6	274	5		5	21		36			2			4		63	1	
29-4, 24-26	12.1	1.2	55.0	1.0		1.0	4.2		7.2			0.4			0.8		12.7	0.2	
29-5, 89-91	81	5	189	10		9	13		32			3			7		83		
29-5, 89-91	17.6	1.1	42.0	2.2		2.0	28		7.0			0.7			1.5		18.3		
29, CC	65	11	237	16	2	23	23		42			5			7		59		
29, CC	12.5	2.1	45.5	3.1	0.4	4.4	4.4		8.1			1.0			1.4		11.4		
30-1, 76-78	40	2	432	5			5		4						3		31		
30-1, 76-68	7.4	0.4	81.0	0.9			0.9		0.7						0.6		5.8		
30-2, 25-27	122	4	106	8	2	31	28	2	41			1			5	1	50		1
30-2, 25-27	27.7	0.9	23.5	1.8	0.4	6.9	6.2	0.4	9.1			0.2			1.1	0.2	11.2		0.2
30-3, 62-64	107	8	305	4		12	18		31			5			5		37	1	
30-3, 62-64	19.3	1.4	54.9	0.7		2.1	3.2		5.6			1.0			1.0		6.7	0.2	
30-5, 52-54	70	2	165	12	2	20	29		84			2			14		75	1	
30-5, 52-54	14.1	0.4	33.2	2.4	0.4	4.0	5.8		17.0			0.4			2.8		15.1	0.2	
30-6, 18-20	117	5	165	10	3	17	25		55			4		1	8		65		
30-6, 18-20	23.7	1.0	33.5	2.0	0.6	3.4	5.1		11.2			0.8		0.2	1.6		13.2		
31-1, 71-73	60	7	251	11		16	27		45			3			3		53	1	
31-1, 71-73	11.9	1.4	49.8	2.3		5.2	5.3		9.0			0.6			0.6		10.5	0.2	
31-2, 72-74	241	15.0	54	18	2	20	28		45			4			19		72		
31-2, 72-74	45.0	2.8	10.1	3.3	0.3	3.7	5.2		8.4			0.8			3.5		13.5		
31-3, 62-64	269	44	72	16		18	26	1	15			2			10		30		
31-3, 62-64	51.6	8.4	13.8	3.0		3.6	5.0	0.2	2.8			0.3			1.9		5.7		
31-4, 48-50	53	4	169	10		23	11	1	42			5			7		64	5	
31-4, 48-50	12.8	1.0	40.6	2.3		5.5	2.6	0.2	10.2			1.2			1.7		15.4	1.2	
32-2, 82-85	107	15	72	24	2	31	15	1	78	1		4		2	19		49	1	1
32-2, 82-85	24.2	3.4	16.3	5.4	0.5	7.0	3.4	0.2	17.6	0.2		0.9		0.5	4.3		11.0	0.2	0.2

almost complete alteration of the glass into montmorillonite, and the absence of an admixture of acid volcanogenic material. This results in a partial enrichment of the large size fractions by terrigenous components.

Unit 2

The sediments of Unit 2 (middle Miocene-Pliocene) are distinct in composition and in the content of various genetic components. Biogenic components in these sediments show a remarkable increase in content. Individual thin interbeds are characterized by a sharp predominance of diatom skeletons. However, only in these interbeds are they considered as a major sediment component (Figures 3 and 4). There is also a large increase in the quantity of carbonate biogenic material, mainly foraminifera tests.

The silt fractions in Unit 2 have a higher content of volcanogenic material as compared to Unit 1. The main portion of this material is represented by devitrified volcanic glass. However, there is also a considerable

TABLE 2A – *Continued*

Olivine	Chloritoids	Glauconite	Ortit (?)	Titanite	Staurolite	Tourmaline	Zircon	Apatite	Rutile	Kyanite	Corundum	Spinel	Cr-Spinel	Andalusite	Sillimanite	Celestite-Barite	Carbonates	Spinel	Volcanic Ash	Volcanic Glass	Anatase	Calculated Grains	Horizon
	5 1.0				5 1.0	2 0.4	2 0.4	1 0.2	1 0.2	2 0.4						2 0.4						483	
9 1.7				2 0.4	1 0.2	2 0.4	2 0.4	3 0.6		1 0.2			1 0.2								1 0.2	511	
8 1.6				3 0.6		1 0.2	2 0.4	2 0.4	1 0.2	2 0.4			1 0.2								1 0.2	509	
4 0.9				2 0.5			4 0.9	1 0.2	1 0.2	1 0.2			1 0.2			1 0.2					1 0.2	414	
5 0.9				3 0.6	1 0.2	1 0.2	6 1.1	1 0.2		3 0.6												522	
3 0.5				5 0.8		2 0.3	4 0.7	5 0.8	5 0.8	3 0.5												595	
3 0.7					1 0.2		4 1.0	1 0.2	2 0.5													419	
7 1.5							2 0.4	1 0.2														468	
				1 0.2		1 0.2	1 0.2	2 0.4	2 0.4													450	
6 1.1				2 0.4		1 0.2	5 1.0	6 1.1	1 0.2													526	
4 0.8				2 0.4			5 1.0	3 0.6	2 0.4	1 0.2												508	
18 3.9		3 0.7		3 0.7			2 0.4	5 1.1		6 1.3						1 0.2						461	
17 3.5				2 0.4		1 0.2	3 0.6	2 0.4		2 0.4												485	
7 1.4				4 0.8	1 0.2		3 0.6	3 0.6	1 0.2													503	
12 2.8					2 0.5	1 0.2	1 0.2	1 0.2														434	
10 2.1				2 0.4		3 0.6	6 1.3	7 1.5		1 0.2												471	
18 35				2 0.4	1 0.2	1 0.2	3 0.6	2 0.4	1 0.2	4 0.8												511	
	13 2.5			1 0.2		2 0.4	2 0.4		1 0.2							1 0.2						518	
	2 0.4			2 0.4		2 0.4	4 0.8	8 1.6	1 0.2	2 0.4												498	
	13 2.8			2 0.4	1 0.2	1 0.2	1 0.2	2 0.4	1 0.2	2 0.4												455	
	12 2.3			4 0.8		1 0.2	6 1.2	4 0.8	2 0.4													519	
	1 0.2			1 0.2		1 0.2	8 1.5									1 0.2						534	
	12 2.7			1 0.2	4 10.9	1 0.2	21 4.7	5 1.1	1 0.2							1 0.2						448	
	10 1.8						10 1.8	2 0.3														555	
	5 1.0			1 0.2			11 2.2	3 0.6	1 0.2													497	
	4 0.8			1 0.2	2 0.4	1 0.2	5 1.0	4 0.8	1 0.2													493	
	7 1.4				3 0.5		15 2.9	2 0.3		1 0.2												505	
	3 0.5			5 1.0			5 1.0	3 0.5	1 0.2	1 0.2												536	
	2 0.3			2 0.3		3 0.6	7 1.3	3 0.6	2 0.3	2 0.3												524	
	6 1.4			1 0.2	2 0.5	1 0.2	6 1.4	5 1.2	1 0.2							1 0.2						417	
	4 0.9			1 0.2		1 0.2	7 1.6	5 1.1	2 0.5		1 0.2											443	

amount of unaltered glass present. It is predominantly basic, but also includes acid glasses. The amount of acid glass increases regularly upward in Unit 2. The maximum amount of the acid glass (up to a third of the total bulk of glass) is recorded in Pliocene sediments.

Distribution of authigenic components in the silt fraction of Unit 2 is very irregular. At its lower portion (at the boundary with early Miocene), the unit is characterized by a high content of iron sulfides and zeolites. The quantity of these components decreases sharply towards the upper boundary of Unit 2.

A common mineral in the clay fraction (less than 1 μm) is montmorillonite. The content tends to generally decrease in the upper layers of the unit. This can be explained by the fact that in the younger sediments, a part of the volcanogenic ash material has not yet decomposed, although it is nearly devitrified. Also, the acid glasses are not strongly altered. There is also a considerable decrease of finely dispersed zeolites in the sediments of Unit 2.

Apart from the clay composition, Unit 2 differs from Unit 3 by a gradual increase of hydromica and probable

TABLE 2B
Results of Immersion Mineralogical Analysis of the 0.1-0.5 mm Fraction Samples (Light Minerals) From Hole 348 DSDP Leg 38

Sample (Interval in cm)	Quartz	Feldspar (N<1.54)	Plagioclase (acid)	Plagioclase (mean)	Microcline	Biotite	Muscovite	Glauconite	Zeolites	Analcime	Chloritized Fragments	Organic Carbonate Fragments	Organic Siliceous Fragments	Cristallized Radiolarian Fragments	Volcanic Ash	Volcanic Glass (acid)	Volcanic Glass (N<1.54)	Volcanic Glass (Basic)	Chalcedonic Fragments	Carbonates	Palagonitized Glass	Weathering Fragments	Microconcretions	Clay Fragments	Calculated Grains
1-1, 70-72	61	26	10	2							1	89			12	12		2				41			256
1-1, 70-72	23.8	10.2	3.9	0.8							0.4	34.8			4.7	4.7		0.8				15.9			
1-3, 100-104	75	56	20		1						5	10				1						51			219
1-3, 100-104	34.3	25.5	9.1		0.5						2.3	4.5				0.5						23.3			
1-4, 100-102	80	31	15	1	2	1						227			69	10	1	2		4					443
1-4, 100-102	18.1	7.0	3.4	0.2	0.4	0.2						51.3			15.6	2.3	0.2	0.4		0.9					
1-5, 90-92	220	85	11	4	4		1	2			1	19			12	1		1		6		36			404
1-5, 90-92	54.5	21.5	2.7	0.9	0.9		0.2	0.4			0.2	4.7			3.0	0.2		0.2		15	0.2	8.9			
1, CC	76	27	19	3							1	53				1						42		38	260
1, CC	29.2	10.4	7.3	1.2							0.4	20.4				0.4						16.1		14.6	
2-1, 98-100	175	48	13	3	1				1		1	69			16	7		2	1	12		53			402
2-1, 98-100	43.5	12.0	3.2	0.7	0.2				0.2		0.2	17.4			4.0	1.7		0.5	0.2	3.0		13.2			
2-2, 50-52	134	49	15	1	1			2	1		1	19			20	20	1	2	2	7	1	88	1		366
2-2, 50-52	36.5	13.4	4.1	0.3	0.3			0.5	0.3		0.3	5.2			5.5	5.5	0.3	0.5	0.5	1.9	0.3	24.0	0.3		
2-4, 99-101	71	52	12	1	1			2			4	7						3	5			53			211
2-4, 99-101	33.6	24.6	5.7	0.5	0.5			1.0			1.9	3.3						1.4	2.4			25.1			
2, CC	58	25	9	1	1			4				24										18		71	211
2, CC	27.4	11.8	4.3	0.5	0.5			1.9				11.3										8.5		33.8	
3-1, 99-101	73	57	21	2	1			7				3						1	1			78			244
3-1, 99-101	30.0	23.3	8.6	0.8	0.4			2.9				1.2						0.4	0.4			32.0			
3-3, 99-101	66	42	19	6				4				5										76			218
3-3, 99-101	30.2	19.3	8.7	2.7				1.8				2.3										35.0			
3-4, 99-101	78	42	18	4	3			3														53			201
3-4, 99-101	38.8	20.8	9.0	2.0	1.5			1.5														26.4			
3-5, 89-91	94	48	20	5	1			1				4										51			224
3-5, 89-91	42.2	21.4	8.8	2.2	0.4			0.4				1.8										22.8			
3, CC	66	48	15	2				1			2					2						75		44	255
3, CC	25.9	18.7	5.8	0.8				0.4			0.8					0.8						29.5		17.3	
4-1, 119-121	167	55	35	2	3			3				1			10	15		4				75			370
4-1, 119-121	45.2	14.8	9.5	0.5	0.8			0.8				0.2			2.7	4.1		1.1				20.3			
4-2, 99-104	133	47	37	19	3		1	1	1		1	1			5	2		4		1		106			362
4-2, 99-104	36.8	13.0	10.2	5.2	0.8		0.3	0.3	0.3		0.3	0.3			1.5	0.5		1.1		0.3		29.1			
5-1, 99-100	19	19	2	8				1							107	9		88							253
5-1, 99-100	7.5	7.5	0.8	3.2				0.4							42.3	3.5		34.8							
5-2, 139-141	57	30		4				1				1			85	11		27							216
5-2, 139-141	26.5	13.8		1.8				0.5				0.5			39.4	51		12.4							
5, CC	36	32	7	2	1						2				25	24	1	29				46			205
5, CC	17.5	15.6	3.4	1.0	0.5						1.0				12.3	11.7	0.5	14.1				22.4			
6-1, 139-141	51	26	9	5							1	7			78	2		73							252
6-1, 139-141	20.3	10.6	3.6	2.0							0.4	2.8			30.4	0.8		29.1							
6-2, 29-31	9	3	2	4					2						115	21		77							233
6-2, 29-31	3.9	1.3	0.9	1.7					0.9						48.8	9.1		33.4							
6-4, 84-86	12	12	1	11				1				3			110	39		86							275
6-4, 84-86	4.3	4.3	0.4	4.0				0.4				1.1			40.3	14.2		31.0							
6-5, 73-75	14	4	2	3											105	19		74							221
6-5, 73-75	6.3	1.8	0.9	1.4											47.8	8.6		33.2							
6, CC	5	4		3								1			98			116						2	229
6, CC	2.2	1.7		1.3								0.4			43.0			50.5						0.9	

7-1, 74-76	75	22	13	8			2		4				145	46	4	100			2	39		460
7-1, 74-76	16.3	4.8	2.8	1.7			0.4		0.9				31.3	10.0	0.9	22.0			0.4	8.5		
7-3, 74-76	6	4	5	6			1		2				152	28	4	140			1	5		354
7-3, 74-76	1.7	1.4	1.4	1.7			0.2		0.5				43.0	7.9	1.1	39.5			0.2	1.4		
7-4, 75-77	5	3	5	12	1		3		23				160	86	3	43				7		351
7-4, 75-77	1.4	0.8	1.4	3.4	0.2		0.8		6.6				45.7	24.7	0.8	12.2				2.0		
7, CC	9	4	3	3						2			59	80		48					13	221
7, CC	4.1	1.8	1.4	1.4						0.9			26.8	36.0		21.8					5.8	
8-2, 75-77	6	2	2	13									108	176	1	58			1			367
8-2, 75-77	1.6	0.5	0.5	3.6									29.5	48.1	0.2	15.8			0.2			
8-3, 75-77	13	4	2	15			4		1				177	106	1	64	1		6			394
8-3, 75-77	3.3	1.0	0.5	3.8			1.0		0.2				45.0	27.0	0.2	16.3	0.2		1.5			
9-1, 139-140	1	1	6	19			1		2				238	99	2	113						482
9-1, 139-140	0.2	0.2	1.2	3.9			0.2		0.4				49.4	20.6	0.4	23.5						
9-2, 75-77	2	1	5	13			2		1				165	122		54			1			366
9-2, 75-77	0.5	0.2	1.4	3.5			0.5		0.2				45.2	33.6		14.7			0.2			
9-5, 75-77	1		2	22			3		3				179	80	12	64			7			376
9-5, 75-77	0.3		0.5	5.8			0.8		0.8				47.6	21.4	3.2	17.0			1.8			
9, CC	1	2		4						1	1		45	96	1	50				3	24	228
9, CC	0.4	0.9		1.7						0.4	0.4		19.7	42.3	0.4	29.0				1.3	10.5	
11-1, 80-82	1		2	3			3		5		1		153	32	1	155						356
11-1, 80-82	0.3		0.6	0.8			0.8		1.4		0.3		43.0	9.0	0.3	43.						
11-2, 80-82	1		3	5			1		2				152	44	2	137						347
11-2, 80-82	0.3		0.9	1.4			0.3		0.6				44.0	12.7	0.6	39.2						
11-4, 70-72	1		1	6			1						228	12	1	306			1			557
11-4, 70-72	0.2		0.2	1.0			0.2						41.0	2.0	0.2	55.0			0.2			
12-2, 60-62				3			1						198	27		249						478
12-2, 60-62				0.6			0.2						41.4	5.6		52.2						
12-4, 20-22	2		1	2									195	17	1	208						426
12-4, 20-22	0.5		0.2	0.5									46.0	4.0	0.2	48.6						
13-1, 80-82	2	2		5									90	31		94						224
13-1, 80-82	0.9	0.9		2.2									40.2	13.8		42.0						
13-2, 20-22		1		6					2				112	26		90						237
13-2, 20-22		0.4		2.5					0.8				47.3	11.0		38.0						
13, CC	2			12									99	43	1	81					1	239
13, CC	0.8			5.0									41.5	17.9	0.4	34.0					0.4	
14-1, 20-22	2			2			3						61	33		110		1				212
14-1, 20-22	0.9			0.9			1.4						28.7	15.6		52.0		0.5				
14-2, 20-22	1	2		2				1			1		90	18		103						218
14-2, 20-22	0.5	0.9		0.9				0.5			0.5		413	8.2		47.2						
14-4, 20-22	3	1	1	5			1				1		79	32		150						273
14-4, 20-22	10	0.4	0.4	1.8			0.4				0.4		29.0	11.6		55.0						
14-5, 20-22	3	1		5									124	41		112						286
14-5, 20-22	1.0	0.4		1.7									43.6	14.4		38.9						
14-6, 20-22	1			5									115	14		109				4		248
14-6, 20-22	0.4			2.0									46.0	5.5		44.5				1.6		
14, CC	3					1							63	12		127						253
14, CC	1.2					0.4							25.0	4.8		50.0						
15-1, 60-62	6	5		5					2				105	11		153				5		292
15-1, 60-62	2.0	1.7		1.7					0.7				36.0	38		52.4				1.7		
15-2, 60-62	8	2		1		1	2		3		2	2	107	13		97						241
15-2, 60-62	3.3	0.8		1.7		0.4	0.8		1.2		0.8	0.8	44.6	5.4		40.2						
15, CC	1	1		3									87	3		167					13	275
15, CC	0.4	0.4		1.1									31.3	1.1		61.0					4.7	
16-1, 60-62	9			4			2	1	2				80	44	3	93						238
16-1, 60-62	3.8			1.7			0.8	0.4	0.8				33.7	18.5	1.3	39.0						
16-3, 60-62	8	1		3					2		1		58	54	4	88			1			220
16-3, 60-62	3.6	0.5		1.4					0.9		0.5		26.3	24.5	1.8	40.0			0.5			
16-5, 60-62	1	1		8					2		1		111	20		99						243
16-5, 60-62	0.4	0.4		3.3					0.8		0.4		45.7	8.2		40.8						
16-6, 60-62	2	1		3			1				1		64	9		131				3		215

TABLE 2B – *Continued*

Sample (Interval in cm)	Quartz	Feldspar (N<1.54)	Plagioclase (acid)	Plagioclase (mean)	Microciine	Biotite	Muscovite	Glauconite	Zeolites	Analcime	Chloritized Fragments	Organic Carbonate Fragments	Organic Siliceous Fragments	Cristallized Radiolarian Fragments	Volcanic Ash	Volcanic Glass (acid)	Volcanic Glass (N<1.54)	Volcanic Glass (Basic)	Chalcedonic Fragments	Carbonates	Palagonitized Glass	Weathering Fragments	Microconcretions	Clay Fragments	Calculated Grains
15-6, 60-62	0.9	0.5		1.4					0.5				0.5		29.7	4.2		60.9				1.4			
16, CC	27	3		13					99		7		3			6		2.8				45		47	278
16, CC	9.7	1.1		4.7					35.7		2.5		11			2.1		10.1				16.2		16.8	
19-1, 110-112	35	3	1	18					2	1	58					2		27				59			206
19-1, 110-112	17.0	1.5	0.5	8.8					1.0	0.5	28.1					1.0		13.0				28.6			
19-3, 75-77	23	2	1	22					26	2	53					6		10				83			228
19-3, 75-77	10.2	0.9	0.4	9.6					11.3	0.9	23.2					2.6		4.4				30.4			
19-4, 10-12	10			6					19		14		1			1		7		85		72		18	233
19-4, 10-12	4.3			2.6					8.1		6.0		0.4			0.4		3.0		36.5		31.0		7.7	
19-6, 140-142	3	1	1	1				1	9			23				3		2				27		128	249
19-6, 140-142	1.2	0.4	0.4	0.4				0.4	3.6			29.4				1.2		0.8				10.8		51.4	
19, CC	20	4		18				5	5			7				2		27				132			220
19, CC	9.1	1.8		8.2				2.3	2.3			32				0.9		12.3				59.9			
20-1, 80-82	15	6	10	23	1			2	114		50					1		9		1		58		18	308
20-1, 80-82	4.9	1.9	32	7.5	0.3			0.6	37.3		16.2					0.3		2.9		0.3		13.8		5.8	
20-2, 80-82	13	2	5	6				1	3		6					3		4		14		19		14	90
20-2, 80-82																									
20-4, 64-66	150	29	23	14		1		2	25		17	1				2	1	4	2	8		8		242	529
20-4, 64-66	28.5	5.5	4.3	26		0.2		0.3	4.7		3.2	0.2				0.3	0.2	0.7	0.3	1.5		1.5		460	
20-6, 135-137	83	9	10	10	1		1	3	17		54	38				3		4						92	325
20-6, 135-137	25.5	2.8	3.1	3.1	0.3		0.3	0.9	5.2		16.6	11.7				0.9		1.2						28.4	
20, CC	2			3					8			58						8				276			355
20, CC	0.6			0.8					2.2			16.2						2.2				78.0			
21-1, 60-62	9	3	2	5				3	10								1	4		291		13			341
21-1, 60-62	2.6	0.9	0.6	1.5				0.9	2.9								0.3	1.2		85.3		3.8			
21-3, 100-104	218	41	10	8	1			4	8		18					2	1	1		32		53			397
21-3, 100-104	55.2	10.3	2.5	2.0	0.2			1.0	2.0		4.5					0.5	0.2	0.2		8.1		13.3			
21-5, 60-62	156	33	15	4	1			7	1		23					1		8		9				98	356
21-5, 60-62	44.0	9.3	4.2	1.1	0.3			1.9	0.3		6.5					0.3		2.2		2.5				27.4	
21, CC	40	15	5	1					1			39				3		7	28			28		95	262
21, CC	15.3	5.8	1.9	0.4					0.4			14.8				1.1		2.4	10.8			10.8		36.3	
22, CC	18	3	3	2							1	13	2			7		13						197	259
22, CC	6.9	1.2	1.2	0.8							0.4	5.0	0.8			2.7		5.0						76.0	
23-1, 110-112	215	37	10	3	1			53	2		5							2	2	1		25			356
23-1, 110-112	60.8	10.4	2.8	0.8	0.2			14.9	0.5		1.4							0.5	0.5	0.2		7.0			
23-3, 77-79	233	47	10		2			9			5								2	1		54			363
23-3, 77-79	64.3	13.0	2.8		0.5			2.5			1.4								0.5	0.2		14.8			
23-5, 80-82	216	65	16	2	3			9			9							1	1			55			377
23-5, 80-82	57.5	17.2	4.2	0.5	0.8			2.4			2.4							0.2	0.2			14.6			
23, CC	98	32	2								26	5	1						5			79			248
23, CC	39.9	12.8	0.8								10.4	2.0	0.4						2.0			31.7			
24-1, 27-29	97	36	4				1				10			2								5.3			203
24-1, 27-29	47.8	17.7	2.0				0.5				4.9			1.0								26.1			
24-2, 49-51	86	36	8	2							17			2						4		75			230
24-2,·49-51	37.2	15.7	3.5	0.9							7.4			0.9						1.7		327			
24-4, 2-4	243	53	18	1		2	1	3			2							1	1			65			390
24-4, 2-4	62.5	13.7	4.6	0.2		0.5	0.2	0.7			0.5							0.2	0.2			16.7			
24-6, 60-62	196	38	15	1	3			7			1								6			42			309
24-6, 60-62	63.5	12.5	4.8	0.3	0.9			2.2			0.3								1.9			13.6			
24, CC	103	34	3	1	1						5	4	1									80			232

24, CC	44.3	14.6	1.3	0.4	0.4						2.2	1.7	0.4						34.7	
25-1, 64-66	320	79	23	1	3	2	1	3	1		35					1	3		171	643
25-1, 64-66	49.9	12.3	3.6	0.1	0.5	0.3	0.1	0.5	0.1		5.4					0.1	0.5		26.6	
25-3, 44-46	222	63	15	1	1	2	1	4			23						3	2	62	399
25-3, 44-46	56.0	15.8	3.8	0.2	0.2	0.5	0.2	1.0			5.7						0.7	0.5	15.4	
25-4, 75-77	264	43	20		2	3	1	4	2		8						4		47	398
25-4, 75-77	66.5	10.8	5.0		0.5	0.7	0.2	1.0	0.5		2.0						1.0		11.8	
25-6, 71-73	178	47	29	1	2	1		4			17					1	7		82	369
25-6, 71-73	48.4	12.8	7.9	0.2	0.5	0.2		1.1			4.6					0.2	1.9		222	
25, CC	81	29	12			1			2		8			5	1				53	192
25, CC	42.2	15.2	6.3			0.5			1.0		4.2			2.6	0.5				27.5	
26-1, 58-60	90	53	14					5			12						5		63	242
26-1, 58-60	37.0	21.8	5.8					2.4			5.0						2.4		25.6	
26-3, 68-70	85	50	14	1				5			14								59	228
26-3, 68-70	37.3	21.9	6.1	0.4				2.2			6.1								26.0	
26-4, 39-41	98	42	13								14								63	230
26-4, 39-41	42.7	18.2	5.6								6.1								27.4	
26, CC	97	46	22								14								49	228
26, CC	42.4	20.1	9.6								6.2								21.7	
27-1, 92-96	109	51	19	1		3		7			13								59	262
27-1, 92-96	41.7	19.3	7.2	0.4		1.1		2.7			5.0								22.6	
27-2, 103-105	128	53	18	4	1			2			8							2	44	260
27-2, 103-105	49.1	20.4	6.9	1.5	0.4			0.8			3.1							0.8	17.0	
27-3, 21-23	114	48	18	8							5								75	268
27-3, 21-23	42.6	17.8	6.7	3.0							1.9								28.0	
28-1, 75-77	77	34	18	4				2			4								57	196
28-1, 75-77	39.3	17.3	9.2	2.0				1.0			2.0								29.2	
28-2, 129-131	85	40	14	2	1	1		1	6		6			2					58	210
28-2, 129-131	40.2	19.0	6.7	1.0	0.5	0.5		0.5			2.9			1.0					27.7	
28, CC	60	13									8						4		59	220
28, CC	27.3	5.9									3.6						1.8		26.7	
29-2, 124-126	53	18		1							8								63	244
29-2, 124-126	41.2	21.8	7.4		0.4						3.3								25.9	
29-3, 27-29	104	61	16								6							3	46	236
29-3, 27-29	44.2	25.8	6.8								2.5							1.3	19.4	
29-4, 24-26	112	30	12	1							7			1					69	232
29-4, 24-26	48.5	12.8	5.2	0.4							3.0			0.4					29.7	
29-5, 89-91	96	46	15	1	1	1	1	2			6								48	217
29-5, 89-91	44.2	21.2	6.9	0.5	0.5	0.5	0.5	0.9			2.7								22.1	
29, CC	95	54	16								7							7	60	239
29, CC	39.8	22.5	6.7								2.9							2.9	25.2	
30-1, 76-78	92	40	16	2	1		1				11							1	57	221
30-1, 76-78	11.5	18.0	7.2	0.9	0.5		0.5				5.0							0.5	259	
30-2, 25-27	99	51	18	2	1			3			2								52	228
30-2, 25-27	43.6	22.4	7.9	0.8	0.4			1.3			0.8								22.8	
30-3, 62-64	114	30	15	1	1			4			4			2					63	234
30-3, 62-64	48.7	12.8	6.4	0.4	0.4			1.7			1.7			0.9					27.0	
30-5, 52-54	94	32	11	2							7						5		62	213
30-5, 52-54	44.2	15.0	5.2	0.9							3.3						2.3		29.1	
30-6, 18-20	93	32	11	1							7								65	209
30-6, 18-20	44.5	15.3	5.3	0.5							3.3								31.3	
31-1, 71-73	93	34	8			1		1			6								51	204
31-1, 71-73	45.6	16.7	3.9			0.5		0.5			2.9								29.9	
31-2, 72-74	105	45	15	4	2	3	1	2	3	4	14								34	232
31-2, 72-74	45.4	19.5	6.5	1.7	0.8	1.3	0.4	0.8	1.2	1.7	6.0								147	
31-3, 62-64	108	33	6		1		2				4				1			2	57	216
31-3, 62-64	50.0	15.3	2.8		0.5		0.9				1.8				0.5			0.9	26.4	
31-4, 48-50	111	38	6			1	1	1			9			3					30	200
31-4, 48-50	55.5	19.0	3.0			0.5	0.5	0.5			4.5			1.5					15.0	
32-2, 82-85	98	30	13	3	1	2	1	2	31		7								64	252
35-2, 82-85	39.0	11.9	5.2	1.2	0.4	0.8	0.4	0.8	12.3		2.8								25.2	

TABLE 3
Chemical Composition of Sediments from Site 348 DSDP Leg 38
from X-Ray Fluorescent Analysis

Sample (Interval in cm)	Percentage									
	SiO_2	TiO_2	Al_2O_3	Fe	MnO	MgO	CaO	K_2O	Na_2O	L.O.I.
1-3, 100-104	58.8	0.91	15.1	6.37	0.22	2.69	0.64	2.55	2.32	7.48
1-5, 90-92	54.2	0.78	14.7	5.18	0.14	3.52	5.59	3.20	1.79	9.05
1, CC	50.7	1.06	13.6	6.19	0.15	3.95	5.30	2.69	2.96	10.75
2-1, 98-100	52.2	0.82	13.5	5.64	0.19	3.15	5.64	3.12	2.35	10.05
2-2, 50-52	45.4	0.99	12.0	5.76	0.13	2.76	10.0	2.78	2.60	14.10
2, CC	54.5	0.91	14.7	6.96	0.14	2.75	3.11	3.00	2.06	9.00
3-1, 99-101	54.7	1.21	15.1	7.14	0.10	2.87	1.02	3.24	2.23	8.83
3-4, 99-101	56.2	1.08	13.9	6.17	0.53	2.90	1.60	3.26	2.12	8.55
3, CC	56.5	1.20	14.8	7.63	0.12	2.97	1.14	3.07	2.12	8.20
4-1, 119-121	57.1	1.05	14.8	6.73	0.13	2.56	1.02	3.05	2.90	8.09
5-1, 99-100	54.4	1.14	15.1	6.51	0.11	1.90	1.10	3.09	5.50	7.75
6-5, 73-75	37.4	0.52	8.45	3.04	0.28	2.28	20.3	0.67	3.05	21.68
6, CC	47.6	1.60	10.0	7.45	0.16	3.00	10.6	1.43	3.34	11.94
8-2, 77-79	53.5	1.06	13.7	6.67	0.08	2.97	1.91	2.68	3.17	11.16
8-3, 75-77	53.7	1.25	12.5	7.53	0.08	2.22	2.02	2.62	3.43	11.34
9-1, 138-140	48.4	1.25	12.0	8.76	0.10	3.40	2.01	2.27	3.09	13.84
11-1, 80-81	52.2	1.70	11.5	7.90	0.11	2.48	3.68	1.52	3.63	12.01
12-2, 60-62	54.5	1.80	9.55	7.95	0.11	3.02	4.05	1.33	3.50	10.85
12-4, 20-22	52.6	1.78	10.7	8.79	0.11	2.38	3.87	1.48		12.25
14-2, 20-22	52.6	1.48	10.7	8.19	0.12	2.62	3.86	1.62	3.50	11.70
14-6, 20-22	51.7	1.23	10.3	8.40	0.12	4.18	4.36	1.44	3.32	11.17
14, CC	53.2	1.33	10.4	10.8	0.15	3.10	6.30	0.93	2.99	6.33
15-1, 60-62	54.4	1.15	11.7	6.41	0.07	1.97	2.78	1.89	3.54	13.17
15-2, 60-62	54.8	1.08	11.1	5.13	0.05	3.89	2.54	1.87	3.64	13.45
15, CC	55.5	1.36	11.6	8.78	0.10	2.23	5.07	1.59	3.22	6.29
16-1, 60-62	56.9	1.06	11.8	6.03	0.01	1.31	3.0	2.20	3.28	11.34
16-6, 60-62	56.6	1.36	10.3	7.56	0.13	2.38	4.38	1.18	3.05	10.02
16, CC	55.2	1.20	11.4	7.10	0.03	3.41	1.90	1.98	2.50	12.28
19-1, 110-112	53.5	1.56	11.0	7.70	0.06	5.35	2.06	1.91	2.54	11.41
19-3, 75-77	48.7	1.81	10.6	9.10	0.07	5.63	2.48	1.22	2.89	13.70
19-4, 10-12	51.0	1.39	10.7	8.06	0.08	5.04	2.13	1.67	2.80	13.40
19-6, 140-142	46.0	1.64	9.67	8.54	0.25	7.72	4.87	0.88	2.46	14.15
19, CC	47.0	1.48	10.4	12.4	0.09	5.13	2.98	0.92	2.46	11.25
20-1, 80-82	46.0	1.77	9.40	10.1	0.20	6.27	4.05	0.72	2.79	14.36
20-2, 80-82	47.6	1.69	10.2	9.80	0.08	6.75	2.33	1.15	2.62	13.91
20-6, 135-137	40.4	1.62	7.80	8.40	0.38	5.76	11.3	0.83	2.33	17.20
20, CC	46.7	2.26	9.17	11.5	0.17	4.92	4.68	0.84	2.37	12.76
21-1, 60-62	50.9	1.42	10.6	8.95	0.06	4.55	2.00	1.41	2.47	13.58
21-3, 100-104	51.8	0.98	12.4	7.53	0.05	5.20	1.64	2.21		13.14
21-5, 60-62	54.4	1.07	11.7	6.23	0.03	5.27	1.44	2.62	2.03	12.40
22, CC	51.8	1.36	12.9	8.74	0.07	3.64	1.71	2.25	1.71	12.29
23-1, 110-112	52.7	1.53	13.3	7.40	0.06	3.64	1.11	2.38	2.13	12.20
23-3, 77-79	55.2	1.02	13.7	6.46	0.04	4.60	1.52	2.24	1.88	11.26
23-5, 80-82	54.6	1.56	14.0	6.72	0.04	2.38	1.54	2.49	2.64	11.03
23, CC	58.3	1.37	14.0	6.60	0.04	2.72	1.38	2.35	1.36	9.13
24-1, 27-29	56.0	1.68	14.2	4.73	0.05	3.20	1.36	2.21	2.01	12.63
24-2, 49-51	54.9	1.33	14.1	6.83	0.05	2.17	1.22	2.26	1.84	12.34
24-4, 2-4	56.0	1.43	13.4	6.55	0.04	2.06	1.25	2.18	1.83	12.38
24-6, 60-62	54.2	1.49	14.95	6.23	0.04	3.71	1.24	2.26	1.47	11.83
24, CC	55.0	1.55	14.8	7.48	0.05	2.66	1.47	2.62	1.35	9.53
25-1, 64-66	55.6	1.42	14.8	6.42	0.05	2.82	1.19	2.48	1.46	10.87
25-3, 44-46	55.2	1.41	14.0	6.87	0.04	2.85	1.56	2.20	1.38	11.59
25-4, 75-77	54.6	1.43	14.4	7.27	0.04	2.68	1.25	2.50	1.38	11.46
25-6, 71-78	56.5	1.50	14.5	5.26	0.06	2.78	1.43	2.34	1.75	11.31
25, CC	56.1	1.45	13.9	7.59	0.02	2.87	1.55	2.47	1.33	9.29
26-1, 58-60	55.6	1.36	13.9	6.88	0.05	2.66	1.42	2.11	2.23	10.84
26-3, 68-70	56.8	1.44	14.4	6.67	0.05	2.13	1.56	2.14	1.75	9.66
26-4, 39-41	56.8	1.52	14.2	7.20	0.04	1.80	1.53	2.47	1.32	10.18
26, CC	58.5	1.39	13.5	7.20	0.02	2.26	1.83	2.42	1.40	8.04
27-1, 92-96	57.5	1.20	14.4	6.08	0.04	2.07	1.45	2.39	1.39	10.53
27-2, 103-105	56.4	1.35	15.1	6.52	0.04	2.54	1.49	2.45	1.04	10.50
27-3, 21-23	58.2	1.32	14.9	6.17	0.04	2.34	1.42	2.15	1.48	10.20
28-1, 75-77	56.5	1.49	14.5	6.71	0.05	1.55	1.40	2.47	1.52	10.44
28-2, 129-131	54.6	1.27	14.3	7.90	0.04	2.13	1.62	2.25	1.73	10.76
28, CC	59.8	1.34	14.8	6.99	0.02	1.34	1.43	2.42	1.29	7.81

TABLE 3 – *Continued*

Sample (Interval in cm)	SiO_2	TiO_2	Al_2O_3	Fe	MnO	MgO	CaO	K_2O	Na_2O	L.O.I.
	Percentage									
29-2	57.9	1.33	14.85	5.73	0.04	2.77	1.39	2.37		10.41
29-4, 24-26	60.5	1.54	13.8	6.64	0.04	0.70	1.47	2.23	1.57	9.29
29, CC	61.6	1.28	13.7	6.18	0.04	2.00	1.27	2.13	1.23	7.16
30-1, 76-78	52.6	1.56	15.7	7.48	0.02	2.31	1.55	2.17	1.56	12.18
30-2, 25-27	64.8	1.46	13.3	3.27	0.05	2.49	1.44	1.96	1.51	8.22
30-3, 62-64	57.2	1.32	13.1	7.33	0.04	2.39	1.42	2.12	1.57	10.12
30-5, 52-54	57.2	1.51	15.0	6.47	0.05	2.00	1.82	2.22		9.71
30-6, 18-20	62.3	1.38	13.8	3.94	0.05	2.86	1.46	2.10	1.52	9.02
31-1, 71-73	58.0	1.38	14.9	6.30	0.04	2.67	1.30	2.45	1.38	8.97
31-2, 72-74	57.1	1.55	15.8	6.12	0.05	2.71	1.42	2.72	1.41	8.88
31-3, 61-64	46.6	2.24	19.1	7.90	0.07	2.76	1.65	1.92	2.54	12.06
31-4, 48-50	55.7	1.62	17.0	5.54	0.03	3.54	1.42	2.68	0.77	8.86
32-2, 82-85	59.5	1.61	15.2	6.06	0.04	2.94	1.32	2.58	1.21	7.00

mixed-layered clays, mainly of the hydromica-montmorillonitic composition. These components are probably terrigenous, an indication of a gradual increase in the supply of erosional material in the Pliocene.

Unit 1

A comparison of the Unit 1 (Pleistocene) deposits with the sediments of Unit 2 indicates many differences. There is a considerable decrease of biogenic material expressed chiefly by a sharp decrease in the content of amorphous silica and calcium carbonate. The content of these components is more characteristic for that indicated in Unit 3.

Analysis of the composition of the coarse silt fraction of Unit 1 shows a mixing of terrigenous and volcanogenic components with some predominance of the volcanogenic. The terrigenous composition of this fraction (quartz, potassium feldspars, hornblende, weathered minerals) is very similar to the composition of the silts of lower units (Table 1). Volcanogenic material (devitrified glass and palagonitized glass) is more significant in the silts of Unit 1 than in Unit 3. This is probably caused by a smaller degree of alteration by diagenesis.

An analysis of the silt composition also indicates a sharp decrease in iron sulfide as compared with lower units. There is also an extremely low content of glauconite and iron hydroxides. Only individual grains of zeolite are present, which indicates a low degree of diagenesis of the Pleistocene sediments; this also correlates with the lower content of organic material (less than 0.1%) in these sediments.

A similar composition is characteristic for the (less than 1 μm) fraction of Unit 1. The mineral assemblage is very rich, and many of the minerals are well crystallized. The predominance of hydromica and the presence of considerable amounts of kaolinite and mixed-layered varieties of the hydromica-chlorite and montmorillonite points to a significant contribution by terrigenous components. However, montmorillonite, which is considered to be authigenic and formed from volcanogenic material, is also abundant. This is the second major component after hydromica in the clay fraction.

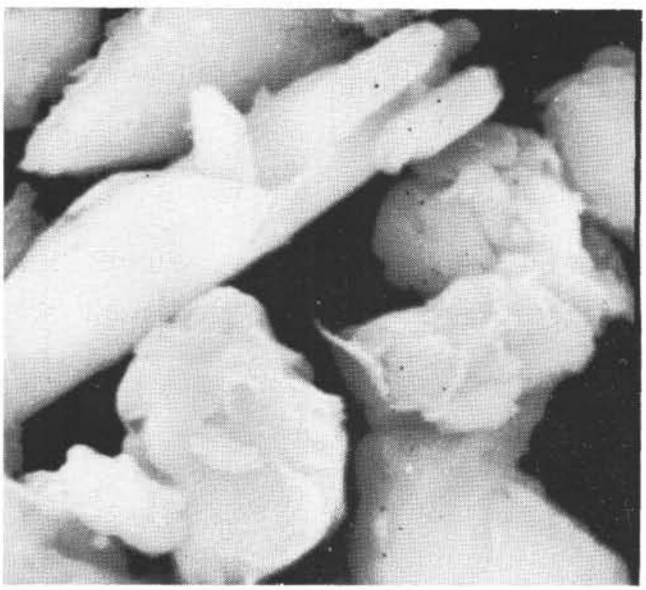

Figure 1. *Less than 5 μm fraction of the sediments from a depth of 525-526.5 meters. Core 32. ×9500 magnification.*

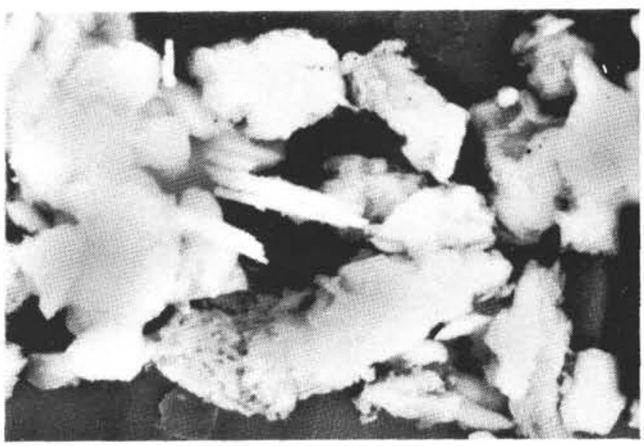

Figure 2. *Less than 5 μm fraction of sediments from a depth of 278-279.5 meters. Core 20. ×2490 magnification.*

TABLE 4
Grain-Size Distribution of the Sediments from Site 348 Leg 38

Sample (Interval in cm)	Weight of Samples	Wetness (%)	Fractions (%)											
			7-5	5-3	3-2	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001
1-1, 70-72	4.57	60.2					1.97	2.19	24.07	3.28	0.88	0.88	20.79	37.20
1-3, 100-104	13.25	62.4					0.45	0.68	4.15	6.04	3.77	16.08	21.13	47.70
1-4, 100-102	4.81	55.4					0.62	0.62	1.56	3.12	2.08	19.86	27.44	44.70
1-5, 90-92	7.58	35.2							4.62	9.76	3.56	6.47	24.93	50.66
1, CC	18.55	57.2					0.49	0.32	2.43	2.10	0.81	35.69	31.37	26.79
2-1, 98-100	5.10	39.1						0.59	5.69	2.94	1.76	12.55	14.90	61.57
2-2, 50-52	6.33	51.1						0.79	6.16	4.58	3.63	7.59	23.85	53.40
2-4, 99-101	6.15	42.7							2.28	0.65	0.65	24.55	24.88	46.99
2, CC	11.60	40.2					1.03	0.86	4.66	4.74	2.07	15.78	19.57	51.29
3-1, 99-101	8.03	42.6							1.74	1.87	0.50	23.04	24.66	48.19
3-3, 99-101	9.93	49.8							1.21	1.41	0.72	22.55	24.97	49.14
3-4, 99-101	8.43	39.4						0.47	3.44	13.00	0.59	13.57	15.07	53.86
3-5, 89-91	11.25	55.4							0.44	10.44	0.44	24.36	25.96	48.36
3, CC	11.00	47.6						0.36	3.18	5.91	3.09	19.65	22.36	45.45
4-1, 119-121	11.43	51.8							1.22	1.22	1.31	18.56	33.07	44.62
4-2, 99-101	8.26	60.0							1.09	1.21	1.21	29.06	27.60	39.83
5-1, 99-101	12.26	44.0							0.33	2.37	0.82	21.69	30.83	43.96
5-2, 130-144	13.58	69.4							0.74	1.25	0.59	52.70	32.18	32.54
5, CC	6.93	56.8					5.34	0.58	3.61	5.34	2.02	2.23	24.82	49.06
6-1, 139-141	6.61	67.6							0.61	0.76	0.45	28.59	28.74	40.85
6-2, 29-31	12.12	66.0							0.41	0.74	0.41	26.49	31.19	40.76
6-4, 84-86	13.57	60.1							0.37	0.37	0.29	22.25	38.03	38.69
6-5, 73-75	10.67	50.6							0.37	0.48	0.48	19.10	35.43	44.14
6, CC	19.02	55.2						0.05	1.26	4.10	2.37	37.28	29.81	25.13
7-1, 74-76	13.11	66.8							0.84	0.38	0.31	30.73	33.87	33.87
7-3, 74-76	8.20	62.3							0.49	0.98	0.49	25.00	27.68	44.76
7-4, 75-77	8.95	67.0							0.22	0.44	0.22	30.61	27.62	40.89
7, CC	18.46	52.7							1.30	1.63	0.54	17.93	38.89	30.71
8-2, 75-77	9.37	57.6							0.43	0.53	0.43	17.59	36.29	44.93
8-3, 75-77	8.81	46.4							0.23	0.34	0.46	23.06	34.26	41.65
9-1, 138-140	7.36	68.3							0.41	0.68	0.41	27.72	35.19	35.59
9-2, 75-77	9.53	65.6							0.52	0.73	0.31	20.77	38.51	39.16
9-5, 75-77	12.18	62.9							0.82	1.31	0.41	23.41	31.03	43.02
9, CC	11.24	42.5							1.33	1.96	0.44	28.30	25.27	42.70
11-1, 80-82	6.06	64.3							0.99	1.65	1.49	15.67	24.92	55.28
11-2, 80-81	11.43	62.7							1.75	2.01	1.31	26.42	25.03	43.48
11-4, 70-72	9.15	56.2							3.28	4.92	2.62	22.73	33.01	33.44
12-1, 85-86	6.38	60.5							0.78	1.88	2.35	19.44	23.67	51.88
12-2, 60-62	9.76	60.3							2.97	2.56	3.48	17.83	36.58	36.58
12-4, 20-22	8.00	65.0							2.88	1.88	0.88	22.50	35.87	35.99
13-1, 80-82	5.71	21.5							5.60	1.75	1.75	19.45	26.44	45.01
13-2, 20-22	8.35	66.9							0.60	1.80	0.36	24.54	31.74	40.96
13, CC	8.78	56.4						0.57	11.96	15.48	5.81	9.35	19.36	37.47
14-1, 20-22	7.36	62.1							3.67	1.63	0.41	15.22	30.84	48.29
14-2, 20-22	7.08	37.4							2.82	2.68	0.56	21.06	29.38	43.50
14-4, 20-22	9.17	55.8							0.98	0.76	0.22	35.00	32.93	30.11
14-5, 20-22	8.53	61.3							0.59	0.59	0.23	23.09	31.89	43.61
14-6, 20-22	8.19	58.0							2.93	1.71	0.49	20.51	27.72	46.64
14, CC	10.46	47.4					6.02	8.03	18.55	10.61	3.35	6.21	9.08	38.15
15-1, 60-62	6.75	61.1							0.74	0.59	0.59	21.93	37.78	38.37
15-2, 60-62	6.93	61.8							0.58	0.58	0.58	18.32	27.27	52.67
15, CC	7.87	54.5					0.25	0.89	13.34	10.17	2.03	9.03	16.77	47.52
16-1, 60-62	7.19	55.0							2.64	0.97	0.70	21.56	26.29	47.84
16-3, 60-62	7.89	62.2							1.40	0.64	0.38	18.80	36.27	41.51
16-5, 60-62	7.81	59.6							3.07	1.41	0.64	23.84	31.50	39.44
16-6, 60-62	7.42	53.6							4.45	1.21	1.35	13.48	35.71	43.80
16, CC	10.38	48.1							1.16	1.45	0.48	36.42	29.76	30.73
19-1, 110-112	8.40	50.4							1.19	0.24	0.24	24.76	31.55	42.02
19-3, 75-77	5.73	55.9							0.87	0.35	0.17	21.47	23.04	54.10
19-4, 10-12	7.80	53.3							2.44	0.26	0.26	19.23	29.10	48.71
19-6, 140-142	8.20	44.3		9.02	2.93	2.93	1.83	1.71	1.95	0.12	0.12	15.49	27.68	36.22
19, CC	11.87	43.2	40.49	18.01	14.23	6.31	3.79	3.79	4.12	0.17	0.42	1.68	2.36	4.63
20-1, 80-82	6.97	50.0					2.15	1.72	3.44	0.29	0.15	16.07	24.39	51.79
20-2, 80-82	6.85	47.1							3.65	0.15	0.58	26.42	27.59	41.61
20-4, 64-6		58.3							0.21	0.21	0.11	22.01	38.41	39.05
20-6, 135-137	6.95	46.4	4.60	7.19	5.04	5.18	3.45	4.75	5.04	0.29	0.29	6.47	13.67	44.03
20, CC	11.05	42.4		9.14	7.42	9.23	7.15	9.86	10.77	3.62	0.45	2.45	8.60	31.31
21-1, 60-62	6.37	55.6							0.78	0.16	0.32	32.65	32.97	33.12
21-3, 100-104	9.09	54.0							0.44	0.10	0.10	23.46	31.24	44.66
21-5, 60-62	7.03	52.9							0.71	0.14	0.14	26.47	26.88	45.66
21, CC	8.75	54.6	56.03	8.80	6.29	6.97	4.46	4.34	5.49	1.14	0.57	0.66	1.14	4.11
22, CC	8.34	56.9							0.24	0.24	0.24	20.87	34.05	44.36
23-1, 110-112	7.03	52.4							1.56	0.28	0.28	31.72	33.00	33.16
23-3, 77-79	6.37	41.3							2.20	1.57	0.16	21.35	37.36	37.36
23-5, 80-82	5.29	37.0							1.13	1.51	0.57	17.20	39.70	39.89
23, CC	13.57	34.1						1.77	3.32	5.53	0.37	17.67	27.86	43.48
24-1, 27-29	10.29	37.9						0.24	1.85	0.87	0.19	27.22	25.75	44.12
24-2, 49-51	4.34	34.8							1.61	2.30	0.41	17.80	26.04	51.84
24-4, 204	12.59	34.2							3.57	1.91	0.40	12.94	27.01	54.17
24-6, 60-62	11.33	30.5							5.47	2.21	0.62	25.86	22.50	43.34
24, CC	13.51	31.4						0.15	2.74	1.11	0.37	35.68	30.63	29.32
25-1, 64-66	11.26	33.9							2.84	2.58	0.18	13.41	26.82	54.17
25-3, 44-46	13.52	32.6							2.51	1.11	0.15	19.90	25.15	51.18
25-4, 75-77	7.85	33.2							1.15	1.78	0.51	13.24	24.08	59.24
25-6, 71-73	11.11	32.9							0.81	0.90	0.45	27.18	24.76	45.90
25, CC	14.88	27.3						0.34	3.02	2.35	0.34	16.47	25.40	52.08

TABLE 4 – *Continued*

Sample (Interval in cm)	Weight of samples	Wetness (%)	Fractions (%) 7-5	5-3	3-2	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001
26-1, 58-60	5.84	18.0							2.57	3.25	0.86	12.15	25.86	55.31
26-3, 68-70	6.03	28.2							2.99	1.99	0.83	18.74	25.04	50.41
26-4, 39-41	11.11	28.5							3.15	1.71	0.36	21.34	24.48	48.96
26, CC	14.93	28.9						1.00	5.69	4.02	0.33	26.53	25.32	37.11
27-1, 92-96	14.29	34.2							5.87	4.48	0.28	17.29	23.79	48.29
27-2, 103-105	12.17	29.7							0.41	3.04	0.16	19.97	31.06	45.36
27-3, 21-23	9.32	33.5							2.04	2.04	0.54	19.31	20.28	55.79
28-1, 75-77	12.11	27.6							2.06	1.57	0.74	27.33	23.38	44.92
28-2, 129-131	10.41	31.2							6.15	2.69	1.63	10.47	25.46	53.60
28, CC	16.28	18.8					5.90	3.81	11.36	6.39	0.84	10.78	24.92	36.00
29-2, 124-126	11.29	31.6							3.72	2.75	0.80	21.25	23.47	48.01
29-3, 25-27	10.69	28.2							4.77	4.12	0.47	18.05	21.23	51.36
29-4, 24-26	8.97	30.4							6.02	2.45	1.11	18.40	23.97	48.05
29-5, 89-91	11.08	63.4							2.26	1.90	0.45	22.82	23.92	48.65
29, CC	15.69	21.9	18.93	3.82	0.64	0.64	0.32	3.12	8.86	5.42	0.32	10.19	15.81	31.93
30-1, 76-68	9.68	31.2					2.48	4.65	11.47	2.38	0.41	23.35	17.56	37.70
30-2, 25-27	10.15	23.5							7.00	5.52	0.89	13.98	18.62	53.99
30-3, 62-64	6.29	24.5							1.10	4.78	0.79	22.74	24.01	46.58
30-5, 52-54	7.44	13.4							5.38	6.05	1.34	19.62	22.85	44.76
30-6, 18-20	12.05	35.1							6.14	2.49	0.83	23.22	23.57	43.75
31-1, 71-73	9.81	21.5							7.54	3.36	0.92	7.65	27.01	53.52
31-2, 72-74	10.22	24.4					0.88	1.86	5.28	3.91	1.96	17.91	23.09	45.11
31-3, 62-64	14.50	24.2							1.10	0.55	0.34	31.25	26.07	40.69
31-4, 48-50	12.68	19.0							6.62	4.26	0.79	12.46	29.81	46.06
32-2, 82-85	10.92	20.3				2.20	0.55	3.11	8.79	10.53	0.64	11.54	19.05	43.59

TABLE 5
Fe_2O_3, TiO_2, and MnO Content in Sediments from Site 348, DSDP, Leg 38

Core	Section	Interval (cm)	Fe_2O_3 (%)	TiO_2 (%)	MnO (%)
5	2	139-141	7.87	0.96	0.06
7	3	74-76	9.60	1.56	0.09
7	4	75-77	9.71	1.38	0.09
7	CC		8.59	1.18	0.06
11	4	70-72	11.04	1.86	0.10
13	1	80-82	9.31	1.36	0.09
13	CC		11.36	1.52	0.11
14	5	20-27	7.26	0.86	0.07
16	5	60-62	7.05	0.96	0.06
20	4	64-66	8.88	1.10	0.04
21	CC		12.26	1.34	0.05
29	3	25-27	7.32	1.16	0.06

CONCLUSIONS

The origin of the late Cenozoic sediments in the Icelandic Basin represents a series of sedimentation stages characteristic for the North Atlantic. The contact between the sediments and underlying basalts is sedimentary. The approximately 20-meter-thick layer of Oligocene(?) sediments, which overlies the basalts, has been formed, to a considerable degree, as a result of submarine weathering of these variolitic basalts, and/or erosion from adjacent uplifted sections of the oceanic floor. This is further supported by the presence of basaltic gravels in the lowermost layers. The high degree of zeolitization indicates the importance of the alteration products from the basalts. Zeolites of the analcite group may also be present.

The accumulation of the late Oligocene-early Miocene deposits occurred concurrently with effusive surface and submarine volcanism. The supply of the volcanogenic ash material increases upward in the section, attaining a maximum at the end of early Miocene, particularly at the boundary with middle Miocene. Probably, the ash material consisted almost entirely of basic glass. Subsequently, this glass was altered to montmorillonite and zeolite.

The supply of the terrigenous material was very low, probably, lower than in the Pleistocene and Holocene. The factor affecting the supply of terrigenous material was probably glaciation, but may have been less operative at this time. The similarity of the Oligocene-early Miocene deposits with contemporary sediments is displayed by the low content of biogenic components which may be indicative of a severe climate similar to the present.

The latter comment seems contradictory because the sediments of the lower stratigraphic horizon are largely enriched in organic matter. However, the level of this "enrichment" is significantly low, and it can be detected only by comparison with the "poorer" organic carbon content in the sediments of the overlying units (1 and 2). The relatively higher content of organic matter in the sediments of Unit 3, as well as the evidence of iron sulfidization, evidently points to a somewhat higher content of hydrogen sulfide in benthonic depths of the basin at that time. If this is the case, there are reasons to suggest the existence of a relatively low content of free oxygen in bottom waters. These would be associated with a slow circulation of water masses in the basin and existence of a chalistatic zone in this water. Another factor leading to stagnant water masses of the basin in the Oligocene-early Miocene times may be the steep topography of the peripheres (i.e., the Jan-Mayen Ridge system).

These conditions were favorable for the preservation of the organic matter which appeared to change its composition mainly by diagenesis. At the same time, it should be added that these conditions stimulated the dissolution of carbonate skeletons, and to some degree, the silica varieties, both of which are unstable in an alkaline environment.

Sedimentation in the middle and upper Miocene and in Pliocene (Unit 2) shows an increase in the supply of

TABLE 6
P_2O_5 Content in Sediments
from Site 348 DSDP Leg 38

Core	Section	Interval (cm)	P_2O_5 (%)
1	3	100-104	0.24
1	3	100-104	0.23
1	5	90-92	0.12
1	CC		0.17
2	1	98-100	0.18
2	2	50-52	0.22
2	CC		0.18
3	1	99-101	0.16
3	1	99-101	0.18
3	2	75-77	0.08
3	4	99-101	0.16
3	CC		0.11
3	CC		0.13
4	1	119-121	0.16
5	1	99-100	0.12
5	2	134-141	0.10
6	5	73-75	0.20
6	CC		0.19
6	CC		0.18
7	CC		0.13
8	3	75-77	0.11
9	1	138-140	0.10
11	1	80-86	0.15
12	2	60-62	0.17
13	CC		0.13
14	2	20-22	0.14
14	6	20-22	0.13
14	CC		0.12
14	CC		0.11
15	1	60-62	0.14
15	2	60-62	0.18
15	CC		0.08
16	1	60-62	0.14
16	6	60-62	0.13
16	6	60-62	0.10
19	1	110-112	0.11
19	3	75-77	0.09
19	4	10-12	0.08
19	6	140-142	0.38
19	CC		0.05
20	1	80-82	0.14
20	1	80-82	0.11
20	4	64-66	0.09
20	6	135-137	0.24
20	CC		0.16
21	1	60-62	0.09
21	3	108-109	0.08
21	CC		0.03
22	CC		0.27
23	1	110-112	0.22
23	CC		0.13
23	CC		0.13
24	CC		0.09
25	4	75-77	0.10
25	6	71-73	0.11
25	6	71-73	0.10
25	CC		0.10
26	1	58-60	0.16
26	3	68-70	0.13
26	CC		0.14
27	1	92-96	0.14
27	2	103-105	0.20
28	1	75-77	0.13
28	CC		0.18
29	3	25-27	0.11
29	CC		0.09
30	1	76-78	0.16
30	2	25-27	0.12
30	3	62-64	0.10
30	5	52-54	0.14
30	6	18-20	0.12
31	1	71-73	0.10

Figure 3. *Less than 1 μm fraction of sediments from a depth of 400-401.5 meters. Core 26. ×4900 magnification.*

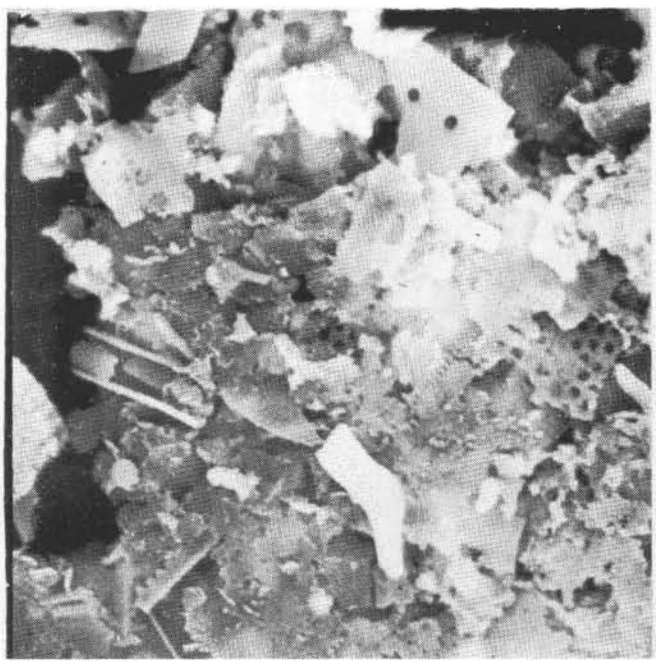

Figure 4. *Less than 1 μm fraction of sediments from a depth of 160.5-161 meters. Core 11, CC. ×4900 magnification.*

TABLE 7
SiO_2 Content from Soda Extraction in Sediments at Site 348 DSDP Leg 38

Core	Section	Interval (cm)	SiO_2 (%)
1	3	100-101	1.10
1	CC		1.44
2	1	98-100	1.20
3	1	99-101	1.28
3	CC		1.24
5	2	139-141	1.70
6	CC		4.56
7	3	74-76	5.00
7	4	75-77	2.56
7	CC		3.26
8	2	75-77	3.28
8	3	75-77	3.50
9	CC		3.50
11	4	70-72	7.04
13	1	80-82	6.14
13	CC		5.26
14	1	20-22	7.86
14	2	20-22	7.76
14	4	20-22	6.00
14	5	20-22	5.94
14	6	20-22	7.26
14	CC		5.30
15	1	60-62	8.14
15	2	60-62	7.84
16	1	60-62	6.30
16	3	60-62	8.04
16	5	60-62	8.60
16	6	60-62	8.06
16	CC		2.02
19	4	10-12	2.20
19	6	140-142	1.30
19	CC		0.76
20	1	80-82	1.56
20	2	80-82	1.35
20	4	64-66	1.98
20	6	135-137	1.30
20	CC		1.20
21	1	60-62	1.66
21	3	100-104	1.72
21	5	60-62	1.70
21	CC		1.28
22	CC		1.20
23	1	110-112	2.68
23	3	77-79	1.36
23	CC		1.46
24	CC		1.18
25	4	75-77	1.44
25	6	71-73	1.18
25	CC		0.70
26	1	58-60	1.32
26	3	68-70	1.10
26	CC		1.10
27	1	92-96	1.36
27	2	103-105	1.50
28	1	75-77	1.42
28	CC		0.86
29	3	25-27	1.34
29	CC		2.00
30	1	96-98	1.14
30	2	25-29	1.28
30	3	62-64	1.24
30	5	52-54	1.34
30	6	18-20	1.32
31	1	71-73	1.32

ash. A substantially high amount of this material is present in the lower portions of Unit 2, particularly at the boundary with the early Miocene. The highest contents

TABLE 8
CO_2 and C Organic Content (by Knopp's Method) in Sediments at Hole 348 DSDP Leg 38

Core	Section	Interval (cm)	Contents in Dry Sample CO_2	C_{org}
1	3	100-104	1.04	0.27
1	CC		2.86	0.31
3	CC		0.16	0.32
6	CC		4.20	0.33
7	CC		0.05	0.36
9	CC		1.88	0.23
13	CC		0.10	0.10
13	CC		0.11	0.11
14	CC		0.06	0.31
16	1	67-69	0.13	1.47
16	CC		0.10	0.57
19	CC		0.23	0.11
20	CC		1.25	0.10
21	CC		0.13	0.22
22	CC		5.80	0.05
23	CC		0.14	0.42
24	CC		0.06	0.65
25	CC		0.05	0.84
26	CC		0.18	0.95
28	CC		0.13	0.91
29	CC		4.44	0.62

of montmorillonite in the clay and zeolite in the silt fraction are present in the lower portions of the middle Miocene. Thus, the early/middle Miocene in the Icelandic Basin was a time of accumulation of essentially volcanogenic sediments.

Upward within Unit 2, the volcanogenic constituents decrease, giving way to an increase in terrigenous components. This is especially noticeable in the composition of the clay fraction where hydromicas and montmorillonites are sediment components. These changes are clearly seen in sediments of Unit 2, of late Pliocene age. This may indicate active glaciation with ice rafting being the main source of terrigenous material by late Pliocene times.

A distinctive feature of the volcanogenic sediment of Unit 2, when compared with the sediment of Unit 3, is the high degree of preservation of silt-sized ash material. A considerable portion of the glass is not yet devitrified. They may be explained by the relative young age of the sediments and the low content of organic matter. This, together with a sharp decrease of iron sulfidization, may indicate that in the middle, especially, upper Miocene a reconstruction of the water mass characteristics was occurring in the Icelandic Basin. This reconstruction may be a result of an increased influence of North Atlantic waters in the Norwegian-Greenland Sea due to a subsidence of barriers (Iceland-Faeroe Ridge).

Possibly, during the accumulation of Unit 2 there was a change in volcanic activity. This seems indicated by an increase of acid products upwards in Unit 2, with a maximum supply in the Pliocene.

Sedimentation in the Icelandic Basin during the middle-upper Miocene and Pliocene was taking place under climatic conditions that differed from those during the deposition of Units 3 and 1. In all probability, the climate was "mild" which resulted in a minimal effect by glaciation and/or ice-rafting. The temperature regime of the water masses became favorable, which, in

TABLE 9
Ca and Mg Content in Carbonates in Sediments at Site 348 DSDP Leg 38

Core	Section	Interval (cm)	CaO (%)	MgO (%)
1	3	100-104	2.00	1.47
1	CC		4.34	1.41
2	1	98-100	8.34	1.48
3	1	99-101	0.72	1.37
3	CC		0.72	1.04
5	2	134-142	1.42	2.32
6	CC		7.20	1.37
7	3	74-76	2.58	1.19
7	4	75-77	1.68	1.12
7	CC		1.08	1.02
8	2	75-77	1.08	0.89
8	3	75-77	1.52	1.12
11	4	70-72	2.18	1.21
13	1	80-82	1.18	0.75
13	CC		1.72	1.19
14	1	20-22	1.84	1.15
14	2	20-22	1.92	1.02
14	4	20-22	1.82	0.98
14	6	20-22	2.24	1.21
14	CC		1.96	1.06
15	1	60-62	1.92	0.95
15	2	60-62	2.28	1.05
16	1	60-62	1.92	1.09
16	3	60-62	1.24	0.78
16	5	60-62	1.96	0.88
16	6	60-62	2.24	0.96
16	CC		1.56	1.28
19	4	10-12	1.76	3.15
19	6	140-142	7.10	6.03
19	CC		1.64	6.02
20	1	80-82	3.24	5.41
20	2	80-82	2.00	4.92
20	4	64-66	1.08	1.28
20	6	135-137	17.16	4.18
20	CC		3.20	5.33
21	1	60-62	1.88	3.40
21	3	100-104	1.36	1.28
21	5	60-62	2.20	1.44
21	CC		1.80	4.87
22	CC		8.76	2.86
23	1	110-112	0.74	0.45
23	3	77-79	1.36	0.95
23	CC		1.16	0.89
24	CC		1.28	1.27
25	4	75-77	1.02	0.83
25	6	71-73	1.40	0.96
25	CC		3.48	1.37
26	1	58-60	0.84	0.94
26	3	68-70	1.16	0.97
26	CC		1.52	0.98
27	1	92-96	1.14	0.79
27	2	103-105	1.12	0.81
28	2	75-77	0.88	0.96
28	CC		1.36	0.75
29	3	25-27	0.96	0.78
29	CC		7.48	0.81
30	1	76-78	1.02	0.80
30	2	25-27	0.78	0.61
30	3	62-64	0.94	0.76
30	5	52-54	1.04	0.97
30	6	18-20	1.06	0.89
31	1	71-73	1.04	0.70

combination with an active circulation, led to increased productivity. This is reflected by the increase of biogenic components in the sediments of Unit 2. The predominance of diatoms indicates the increase of temperature was not sufficient to exclude this area from the subtropical climatic zone.

The Pleistocene stage (Unit 1) of sedimentation in the Icelandic Basin is characterized by a sharp increase in the supply of terrigenous material. This material became the predominant sediment component in the Unit 1 sediments. Thus, the sediments can be considered to be volcanogenic-terrigenous.

The increase in the terrigenous components is associated with increased glaciation resulting from Pleistocene on Greenland and the Scandinavian Peninsula. The transport of ice-rafted terrigenous material had already been recorded in the upper Pliocene (Laughton, Berggren, et al., 1972). This cooling was responsible for a decrease in water mass temperatures in the North Atlantic, for a change of climatic conditions to "Arctic" types for the Norwegian-Greenland Sea, and for a certain reduction of primary productivity. The Pleistocene was notable only for rare local increases in productivity, expressed by a sharp increase of biogenic calcium carbonate and foraminiferal fragments in separate interlayers. Most of these maxima are most likely confined to the Holocene.

Since the change of the composition of the Pleistocene sediments was brought about by the increase in the supply of terrigenous material, it is difficult to establish whether there was a change in the rates of supply of volcanogenic material to the area. A decrease in the percentage of volcanogenic components in the Pleistocene sediments is caused primarily from dilution by terrigenous material. However, some indirect data indicate that during the Pleistocene, there was a decrease in the rate of supply of volcanogenic (mainly ash) material. This is testified by a sharp drop of the percentage of (fresh) volcanic glass in the silty fractions of these sediments.

Devitrificated glass (its quantity remains always high) is not a sufficiently exact indicator, inasmuch as part of this glass, in the form of terrigenous material, is supplied from the continental extrusive sources.

SUMMARY

1. Dominant volcanogenic sources were active during almost the entire period of late Oligocene, Miocene, and Pliocene. The main component is explosive material of a basic composition. The maximum influx corresponds to the boundary between early and middle Miocene. At the base of this primarily volcanogenic sequence, a basal sediment sequence exists whose composition indicates derivation by weathering of underlying basalts.

2. The major portion of the volcanogenic material has been subjected to reworking and alteration to montmorillonite clay. These changes are most vividly manifested in older late Oligocene and early Miocene sediments.

3. Pleistocene sediments represent mixed volcanogenic-terrigenous sources. This can be explained by climatic change (cooling) and by a decrease of volcanic activity.

4. Biogenic component (silica, calcium carbonate) in the late Cenozoic sediments is subordinate. The maximum accumulation was during the middle and late Miocene and in early Pliocene.

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