4. MINERAL AND CHEMICAL COMPOSITION OF SEDIMENTS OF THE VØRING PLATEAU, DSDP LEG 38

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INTRODUCTION

Samples from five sites, located in the northwest part of the Vøring Plateau (Figure 1), were investigated. The studies included:

1) grain size composition of six fractions (>0.1; 0.1-0.05; 0.05-0.01; 0.01-0.05; 0.005-0.001, and <0.001 mm);

2) mineral composition of light and heavy minerals (S.G. >2.9 of fractions 0.1-0.05 mm);

3) determination of calcite, aragonite, dolomite, siderite, quartz, plagioclase, and potassic feldspars; and

4) chemical composition and the content of $CaCO_3$, C_{org}, Fe, Mn, Ti, P, Cu, Zn, Ni, Co, Cr, Cd (by spectrophotometer), K_2O and Na_2O (by plasmatic photometer M-3).

In this paper, and accompanying figures and tables, the sediment terminology is that of the authors and may not correspond to shipboard designations. Sample numbers are those assigned by the authors for the investigations.

GRAIN SIZE

According to the preliminary core descriptions (ICD) and more exact descriptions by other investigators in shore-based laboratories, sediments of the Vøring Plateau are represented mainly by marine clays and silty clay muds; only in exceptional cases by sands and silts. This is confirmed by the grain-size analyses (Table 1).

The largest number of sandy interbeds and the >0.1 mm fraction is present in "glacial" deposits at Site 343. This may be a result of the accumulation of sediments, not only by glacial-marine processes, but by density currents moving downslope to the base of the Vøring Plateau. The clay fraction is abundant in Plio/Pleistocene and Eocene and Oligocene deposits of Sites 339 and 340. This is due to the location of the sites between the Vøring Plateau and Scandinavia, where quiet sedimentation conditions were present.

Genetically, on the basis of grain size, there are six sediment varieties: (1) glacial marine; (2) terrigenous, slightly calcareous terrigenous, and slightly calcareous with a $CaCO_3$ or SiO_2(amorph) content equal to 10%-30%; (3) diatomaceous (>30% SiO_2 [amorph]); (4) mixed siliceous/diatomaceous-spicules, spicules-radiolarian (>30% SiO_2[amorph]); (5) diatomites; and (6) calcareous-foraminiferal (>50% $CaCO_3$).

MINERAL COMPOSITION OF THE 0.1-0.05 MM FRACTION

The amount of the heavy subfraction is usually small, however, in some horizons it increases to 20%-30%. This is not a result of volcanic minerals, as it is normal, but is due to the presence of authigenic sulfides. Terrigenous minerals, which are abundant in the heavy subfractions, are represented mainly by ore minerals: magnetite, titanomagnetite, ilmenite, plus pyroxenes, hornblende, epidote, garnet, and rutile (Table 2, Figure 2).

Magnetite is present as angular to round formless grains, with a metallic luster, and well-developed magnetic properties. Ilmenite usually is strongly leucoxenizated, but has a table-like form. In contrast to magnetite, titanomagnetite is oxidized and has no magnetic properties.

Clinopyroxenes are colorless to light brown short prisms, with indented rims. Sometimes orthopyroxene (hypersthene) is present with a characteristic light green to light pink pleochroism. Hornblende is represented by green and brown varieties; alkaline varieties are rare. Clinozoisite represents the epidote group. Usually it forms angular, anhedral grains, pistachio-colored, with anomalous interference colors. Garnet is present as angular, isotropic grains with a high relief, colorless or pink. Anomalous garnet is present.

Terrigenous minerals of light fraction are mainly represented by quartz, feldspar, mica, and clay (minerals?) particles. The feldspars have various compositions; plagioclases (sodic), as well as potassic feldspar. The feldspar grains are usually rounded and clay minerals are mainly formed from feldspar alteration. Brown biotite and colorless muscovite are the abundant micas. Greenish chlorite is present as single grains.

Volcanic minerals are mainly represented by colorless volcanic glass and are acidic (N = 1.502 to 1.515). This is equal to an SiO_2 content of 64%-71%. Greenish-brown and brown glass is rare. The glass is present as sharp, angular fragments with a conchoidal fracture, and contains vesicles with ferrous sulfides. Volcanic ash is represented by cloudy, black, brown, formless grains.

Authigenic minerals consist of carbonates, glauconite, ferrous sulfides, and barite. There are two carbonate varieties: calcite and siderite. The brown ferruginous variety is restricted to the heavy fraction, calcite to the light. Their authigenic origin is confirmed by the grain form, which consists of rose-like crystals with the noticeable growth center. Glauconite is present as oval, green grains with a specific aggregate polarization. Fe-sulfides are abundant in some horizons, and comprise 20%-30% of the heavy fraction. They develop upon volcanic glass or ash fragments, or in diatom shells.

Figure 2 shows the content of biogenic carbonates and siliceous remains. The carbonates are mainly

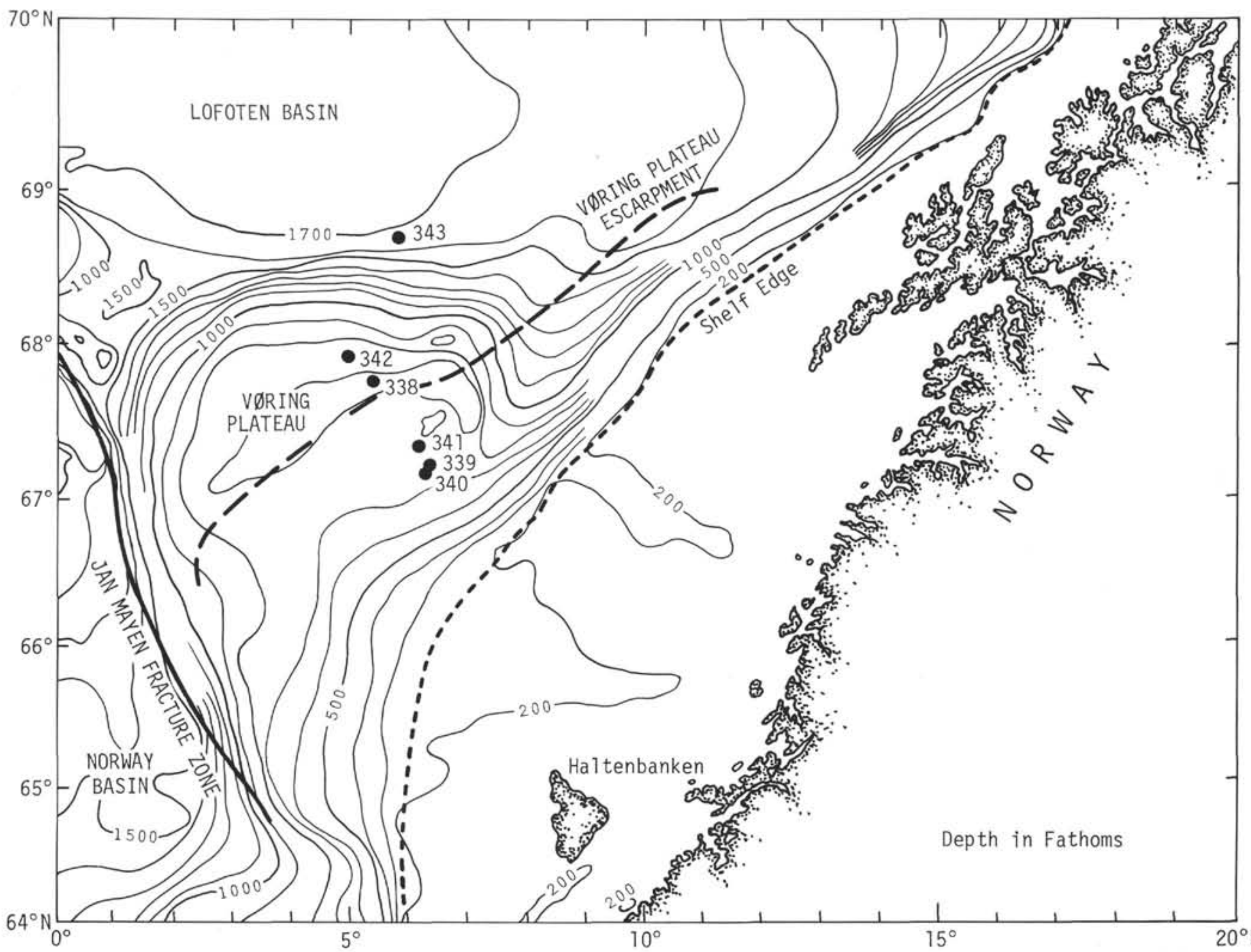

Figure 1. *Location of DSDP Leg 38 sites drilled on the Vøring Plateau.*

represented by fragments of foraminifera shells, the siliceous remains by fragments of diatoms, Radiolaria, and sponges.

DISTRIBUTION OF MINERALS IN COLUMN OF SEDIMENTARY STRATA

In Pleistocene/Pliocene deposits (Table 3, Figure 2) there is an increased content of hornblende, clinopyroxene, augite, epidote, garnet, quartz, feldspar, tourmaline, staurolite, and rutile. These represent minerals of mixed origin; sedimentary, metamorphic, and magmatic. This is expected because all Scandinavian continental rocks were subjected to glacial erosion. Only two glauconite peaks are noted (Sites 339 and 343, Figure 2) and are probably a result of diagenetic processes as indicated by the increased contents of foraminifera (Site 343), diatoms, Radiolaria, spicules (Site 339).

There is an increase in the content of volcanic glass, Fe-sulfides, clayey aggregates which define Pliocene, Miocene, and Oligocene deposits, cored at Sites 341 and 342. The contents of ilmenite, pyroxenes, hornblende, epidote, garnet, quartz, feldspar are sharply increased in comparison with the overlying Plio-Pleistocene sediments. These data may indicate that, in the formation of Miocene sediments on the Vøring Plateau, volcanism was more dominant than in the Plio-Pleistocene. An increased content of authigenic minerals is also characteristic of the Miocene. Besides the Fe-sulfides (Site 343, 147.5 m), an increase of glauconite (up to 11%) and biogenic siliceous particles is noted.

Generally, the regularities of mineral distribution in the Eocene are the same for the Neogene, i.e., the content of volcanic minerals, authigenic Fe-sulfides increase, and the amount of terrigenous minerals, especially of the heavy fraction, is lower. However, in some early Eocene horizons (Site 343) a high feldspar and ilmenite content is observed. This is indicative of an increased influx of terrigenous sediments during some phases of Eocene sedimentation.

BULK MINERAL DISTRIBUTION (X-RAY)

Carbonates

The carbonates generally are characteristic for Pleistocene sediments. Calcite is abundant, with other calcareous minerals found in trace concentrations in a small number of samples. However, at Site 342 (2-1) on

TABLE 1
Grain Size (%) of Sediments from the Vøring Plateau, DSDP Leg 38

Sample (Interval in cm)	Depth[a] (m)	Grain-Size Classification of Sediments[b]	Fractions, mm (%) >0.1	0.1-0.05	-0.05-0.01	0.01-0.005	0.005-0.001	<0.001	<0.01
Site 339									
2-1, 119-121	9.2	Pelitic mud	2.8	2.7	10.6	12.0	32.0	39.9	83.9
2-3, 129-131	12.4	Pelitic mud	3.1	2.2	9.6	24.3	24.4	36.5	85.2
3-4, 142-144	23.7	Pelitic mud	7.8	6.6	13.2	19.8	23.0	29.6	72.4
4-2, 121-123	33.0	Pelitic mud	6.9	5.4	11.9	19.8	33.0	23.0	75.8
5-1, 139-140	38.0	Aleuritic-pelitic mud	9.6	13.1	20.9	21.1	21.1	14.1	56.3
6-3, 102-104	49.9	Aleuritic-pelitic mud	6.6	11.9	24.6	18.2	22.7	15.9	56.8
7-1, 130-132	56.9	Aleuritic-pelitic mud	7.4	10.4	20.1	31.1	31.1	0.0	62.2
8-1, 100-102	66.0	Aleuritic-pelitic mud	7.3	8.1	15.5	29.6	22.2	17.3	69.1
10-3, 70-73	87.9	Pelitic mud	0.8	2.5	6.0	11.2	56.8	22.7	90.7
12-2, 70-72	104.2	Pelitic mud	0.3	0.3	3.0	12.2	36.2	48.1	96.5
Site 340									
1, CC	9.5	Pelitic mud	4.2	4.4	9.9	17.9	31.8	31.8	81.5
2-1, 38-40	9.9	Pelitic mud	4.1	4.5	14.5	32.9	33.0	11.0	76.9
2-3, 75-77	13.5	Pelitic mud	0.6	6.1	11.6	27.2	13.6	40.9	81.7
3-3, 75-77	23.0	Pelitic mud	0.8	0.5	6.3	34.6	34.8	23.0	92.4
4-4, 75-77	34.0	Pelitic mud	0.4	1.3	14.7	41.5	25.5	16.6	83.6
5-2, 70-72	40.3	Pelitic mud	7.4	4.5	13.5	44.9	29.8	0.0	74.7
6-3, 60-62	51.3	Pelitic mud	0.5	1.3	7.0	60.8	15.2	15.2	91.2
7-1, 95-97	58.0	Pelitic mud	0.6	2.4	8.8	35.1	35.4	17.7	88.2
7-6, 95-97	65.0	Pelitic mud	0.5	3.1	5.4	33.9	34.2	22.8	90.9
8-4, 72-74	72.0	Pelitic mud	4.2	2.0	10.1	37.2	28.0	18.5	83.7
9-3, 70-72	79.9	Pelitic mud	1.4	2.8	14.1	20.5	40.8	20.5	81.8
10-2, 50-52	87.6	Pelitic mud	2.1	5.6	15.4	38.5	19.1	19.4	77.0
11-4, 81-83	100.7	Pelitic mud	5.1	1.8	16.8	17.0	34.0	25.3	76.3
Site 341									
1-3, 75-77	3.4	Pelitic mud	2.1	4.9	17.5	25.2	32.4	18.0	75.6
2-2, 75-77	11.9	Pelitic mud	9.0	4.2	14.8	21.0	33.0	18.0	72.0
4-1, 75-77	29.3	Pelitic mud	5.2	4.5	11.7	19.7	34.4	24.6	78.7
6-3, 50	51.25	Fine-aleuritic mud	0.8	5.0	68.7	6.4	9.6	9.5	25.5
7-3, 50	60.8	Pelitic mud	2.8	4.5	14.8	15.6	46.7	15.6	77.9
8-3, 50	70.3	Aleuritic-pelitic mud	15.0	13.5	26.5	7.0	19.0	19.0	45.0
10-1, 109-111	86.7	Fine-aleuritic mud	11.2	9.6	34.9	11.6	18.7	13.9	44.2
13-1, 142-144	107.0	Aleuritic-pelitic mud	9.3	7.8	23.7	8.9	22.2	28.1	59.2
17-2, 129-131	183.5	Fine-aleuritic mud	16.2	10.7	33.7	6.1	21.2	12.1	39.4
20-2, 100-102	240.2	Pelitic mud	2.2	2.0	21.6	14.4	33.5	26.4	74.3
21-4, 90-92	262.3	Pelitic mud	2.1	3.6	16.6	8.6	41.0	28.1	77.7
28-3, 100-102	393.9	Aleuritic-pelitic mud	0.6	1.0	37.6	17.9	28.6	14.2	60.7
29-4, 118-120	405.1	Aleuritic-pelitic mud	0.2	0.9	32.2	15.9	25.4	25.4	66.7
30-4, 41-43	413.7	Aleuritic-pelitic mud	0.6	1.1	42.9	18.5	14.8	22.1	55.4
32-4, 50-52	432.9	Aleuritic-pelitic mud	0.4	0.6	29.7	15.1	21.1	33.1	69.3
Site 342									
1-2, 49-51	2.0	Aleuritic-pelitic mud	10.2	10.3	20.7	8.4	37.8	12.6	58.8
1-5, 69-71	6.7	Aleuritic-pelitic mud	7.2	7.3	16.9	8.6	37.2	22.9	68.7
2-2, 94-96	40.1	Aleuritic-pelitic mud	24.5	4.8	15.0	11.1	29.0	15.6	55.7
3-4, 100-102	90.9	Fine-aleuritic mud	2.9	8.1	41.8	7.8	27.6	11.8	47.2
4-2, 110-112	125.8	Aleuritic-pelitic mud	1.4	6.0	37.6	11.8	23.6	19.6	55.0
5-2, 100-102	135.2	Aleuritic-pelitic mud	1.0	4.9	28.1	16.6	22.0	27.5	66.1
5-6, 100-102	141.5	Aleuritic-pelitic mud	1.0	5.7	35.4	11.6	23.2	23.0	57.8
6-4, 61-62	147.5	Fine-aleuritic mud	21.7	5.5	34.1	16.1	9.6	12.9	38.6
Site 343									
1-1, 75-77	0.25	Aleuritic-pelitic mud	16.4	10.5	21.1	13.7	30.1	8.2	52.0
1-3, 75-77	1.25	Aleuritic-pelitic mud	20.6	13.0	24.3	5.0	24.8	12.4	42.2
2-2, 105-107	5.7	Aleuritic-pelitic mud	10.8	8.8	22.8	7.2	36.0	14.3	57.5
2, CC	12.5	Aleuritic-pelitic mud	12.0	9.1	21.1	9.4	23.5	25.0	57.9
2-4, 75-77	8.7	Aleuritic-pelitic mud	9.8	7.1	22.7	14.5	33.9	12.1	60.5
3-2, 129-131	53.5	Sand	47.8	31.0	13.8	1.5	2.9	2.9	7.3
3-4, 129-131	56.0	Fine-aleuritic mud	3.2	4.5	56.3	10.0	14.0	12.0	36.0
3-6, 119-121	59.7	Sand	45.8	27.2	15.7	4.3	2.8	4.2	11.3
4-3, 110-112	102.6	Aleuritic-pelitic mud	18.7	11.1	18.8	10.0	23.2	18.2	51.4
5-2, 19-21	147.3	Aleuritic-pelitic mud	4.0	6.4	25.0	28.6	24.7	11.4	64.7
7-0, 30-32	202.0	Aleuritic-pelitic mud	4.1	2.9	37.4	18.6	18.6	18.5	55.7
8-3, 100-103	216.3	Aleuritic-pelitic mud	1.6	0.5	46.4	–	–	–	51.6
11-2, 130-132	243.5	Aleuritic-pelitic mud	0.8	0.7	30.7	21.6	29.8	16.3	67.7
15-1, 99-101	270.1	Aleuritic-pelitic mud	0.1	0.3	48.7	22.8	12.7	15.3	50.8
16-3, 18-20	282.0	Aleuritic-pelitic mud	2.0	1.5	31.9	9.3	23.1	32.3	64.7

[a]From sea bed.

[b]According to Russian classification.

TABLE 2
Mineral Composition of Coarse-Silty Fraction (0.1-0.05 mm) of Sediments of the Vøring Plateau, DSDP Leg 38

		Heavy Fraction (%)[a]																	
		Volcano-terrigenous																	
Sample (Interval in cm)	Depth (m)	Content Heavy Fraction (%)	Titano-magnetite	Magnetite	Ilmenite	Hydro-goethite	Leucoxene	Hornblende	Actinolite Tremolite	Alkali Amphibole	Basaltic Hornblende	Epidote Group	Garnet	Zircon	Apatite	Sphene	Rutile	Biotite	Chlorite
Site 339																			
2-1, 119-121	9.2	1.2	–	1.4	13.0	1.4	0.3	23.0	0.3	–	–	29.8	5.3	2.4	2.7	0.3	0.8	1.0	0.3
2-3, 129-131	12.4	2.9	–	–	4.3	0.4	0.7	21.7	0.4	–	–	10.9	1.1	1.4	1.4	–	–	0.7	0.4
3-4, 142-144	23.7	1.3	–	0.7	24.8	0.4	–	4.0	–	–	0.4	11.0	12.0	3.5	1.8	0.4	1.1	–	–
4-2, 139-140	38.0	1.9	–	0.7	24.8	3.8	1.4	19.6	–	–	–	23.8	8.0	2.8	1.4	–	0.7	1.0	0.4
5-1, 139-140	38.0	1.9	–	0.4	8.9	–	0.4	32.1	0.4	–	–	21.4	7.9	2.1	1.1	1.4	0.7	0.4	0.4
6-3, 102-104	49.9	1.2	–	0.7	13.6	–	–	26.0	0.4	0.3	–	21.6	13.2	1.8	0.4	–	0.3	0.4	–
7-1, 130-132	56.9	0.9	–	3.9	9.4	–	3.5	23.0	0.7	–	0.4	23.0	7.0	2.3	1.6	–	1.6	0.4	–
8-1, 100-102	66.0	2.6	–	–	8.0	0.3	0.3	40.5	–	0.7	–	17.9	12.3	2.7	2.7	0.3	0.7	2.0	0.3
10-3, 70-73	87.9	0.2	–	1.3	10.5	2.6	–	1.3	–	–	–	7.9	7.9	14.5	–	–	2.6	–	–
12-2, 70-72	104.2	2.3	–	1.9	0.9	–	0.9	2.8	–	–	–	19.4	11.1	7.4	–	1.9	2.8	–	1.9
Site 340																			
1, CC	9.5	1.9	0.7	0.3	16.3	5.2	0.7	19.4	1.1	1.4	0.7	19.4	6.9	4.5	1.7	–	0.7	0.4	–
2-1, 38-40	9.9	1.5	0.3	2.0	11.6	2.1	3.8	16.4	0.7	0.3	0.7	34.8	6.1	3.1	2.4	1.0	0.3	1.0	0.6
2-3, 75-77	13.5	0.2	–	1.5	1.5	1.5	1.5	3.1	–	1.5	–	9.2	4.6	3.1	–	–	–	–	–
3-3, 75-77	23.0	1.8	–	+	+[b]	++[c]	–	+	–	–	–	+	+	+	–	–	–	–	–
4-4, 70-72	40.3	0.1	–	–	–	–	–	4.0	–	–	–	–	5.9	–	–	–	–	7.8	2.0
5-2, 70-72	40.3	0.1	–	–	+	+	–	+	–	–	–	+	+	++	–	–	–	–	–
6-3, 60-62	51.3	0.9	–	–	2.6	78.2	–	–	–	–	–	–	1.3	5.1	–	–	–	–	–
7-1, 95-97	58.0	0.5	–	5.3	1.1	20.2	1.1	3.2	–	–	–	6.4	4.2	3.2	–	–	1.1	1.1	1.1
7-6, 60-62	65.0	0.3	–	–	4.5	–	–	7.6	–	–	–	9.1	3.0	6.1	–	–	1.5	–	–
8-4, 72-74	72.0	0.9	–	1.1	3.2	–	–	19.1	–	–	2.1	3.2	–	39.3	7.4	–	1.1	–	1.1
9-3, 70-72	79.9	0.2	–	1.9	5.7	–	1.9	3.8	–	–	–	1.9	–	5.8	–	–	1.9	–	1.9
10-2, 50-52	87.6	0.1	–	–	1.7	3.4	–	–	–	–	–	–	3.4	5.2	1.7	–	–	3.4	5.2
11-4, 81-83	100.7	0.3	–	–	–	1.6	–	4.7	–	–	–	–	–	–	–	–	–	3.2	4.7
Site 341																			
1-3, 75-77	3.4	1.2	0.7	–	11.6	0.7	1.8	28.8	2.0	–	0.7	22.1	13.3	3.2	1.4	1.0	0.7	1.4	1.8
2-2, 75-77	11.9	2.0	–	–	8.7	1.4	0.7	26.5	2.4	0.7	–	26.9	7.4	2.4	2.1	0.4	0.4	12.9	–
4-1, 75-77	29.3	3.4	–	–	4.2	2.5	3.0	29.8	0.8	0.4	–	27.2	4.9	1.1	1.9	1.5	0.8	5.6	0.8
6-3, 50	51.25	0.2	–	–	–	–	–	4.9	–	–	–	2.8	2.1	2.1	–	–	–	–	3.5
7-3, 50	60.8	1.6	–	–	1.0	0.7	0.7	17.7	–	–	–	9.4	5.9	2.4	0.4	–	1.0	0.4	–
8-3, 50	70.3	5.6	–	–	3.3	0.7	0.4	33.5	2.2	–	–	30.1	13.4	1.5	1.1	0.4	1.9	2.6	–
10-1, 109-111	86.7	6.3	–	–	4.4	–	0.7	41.4	1.3	0.4	0.4	28.4	11.6	1.7	0.4	0.4	0.7	0.4	–
13-1, 142-144	107.0	6.4	0.7	–	1.5	2.6	–	43.4	1.2	–	–	20.8	6.2	0.4	1.5	–	–	4.4	–
17-2, 129-131	183.5	8.7	–	–	3.0	–	0.8	34.2	–	–	–	17.3	9.0	2.6	1.9	–	0.8	9.4	3.8
20-2, 100-102	240.2	1.3	–	–	0.3	–	–	5.5	–	0.3	–	3.7	1.4	1.1	0.7	–	0.3	0.7	1.1
21-4, 90-92	262.3	3.2	0.7	–	1.4	1.0	0.8	28.3	0.3	0.3	0.3	15.5	3.1	0.3	1.7	0.3	–	0.7	0.7
28-3, 100-103	393.9	19.0	–	–	–	–	–	0.3	–	–	–	–	0.3	–	–	–	–	0.3	0.3
29-4, 118-120	405.1	19.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
30-4, 41-43	413.7	9.1	–	–	–	–	–	–	–	–	–	0.4	0.7	–	–	–	–	–	–
32 4, 50-52	432.9	9.8	–	–	–	–	–	0.6	–	–	–	0.3	0.3	–	0.3	–	–	–	–
Site 342																			
1-2, 49-51	2.0	1.4	1.0	–	12.5	0.3	2.8	25.6	–	–	0.3	27.0	13.8	2.1	3.8	–	0.7	0.7	–
1-5, 69-71	6.7	1.6	–	–	12.8	2.4	2.7	23.2	1.0	0.3	–	26.8	9.7	3.7	1.7	–	0.7	0.3	–
2-2, 94-96	40.1	1.6	–	–	5.0	2.0	1.0	18.1	0.6	0.7	0.3	23.7	9.4	1.0	1.3	–	–	0.3	0.3
3-4, 100-102	90.9	1.7	–	–	–	–	–	0.7	–	–	–	0.3	0.3	–	–	–	–	–	1.0
4-2, 110-112	125.8	0.3	–	–	–	–	–	0.8	–	–	–	0.8	–	–	–	–	–	1.5	0.8
5-2, 100-102	135.2	0.1	–	0.9	–	2.7	–	0.9	–	–	–	0.9	–	–	–	–	–	–	0.9
5-6, 100-102	141.5	0.2	–	0.8	–	1.6	–	–	–	–	–	–	0.8	–	–	–	–	–	2.4
6-4, 61-62	147.5	2.5	–	–	–	–	–	0.7	–	–	–	1.1	–	0.4	–	–	–	–	0.4
Site 343																			
1-1, 75-77	0.2	1.1	0.7	–	8.6	2.1	3.8	30.7	0.7	0.3	–	23.1	11.7	2.8	3.4	–	0.7	0.7	0.3
1-3, 75-77	1.2	1.3	0.7	0.3	7.5	4.1	3.4	29.4	0.7	–	–	22.2	11.9	3.8	1.7	–	0.6	1.4	0.3
2-2, 105-107	5.7	1.1	–	0.7	12.4	2.7	2.7	17.8	–	–	–	16.8	16.9	3.0	1.7	–	1.0	1.3	3.0
2-4, 75-77	8.7	1.4	1.4	1.1	10.6	1.8	2.1	17.3	0.4	0.7	–	15.5	18.8	2.8	1.8	–	0.4	–	0.4
2, CC	12.5	2.2	–	–	13.9	4.1	3.7	15.6	0.3	–	–	23.8	16.0	2.4	1.4	0.3	0.3	1.4	0.3
3-2, 129-131	53.5	2.8	–	1.4	5.1	0.3	3.0	24.0	–	1.0	1.0	19.9	16.9	3.0	2.0	0.7	0.3	–	0.7
3-4, 129-131	56.0	1.7	–	–	5.4	–	–	7.0	–	–	–	4.7	5.7	1.0	0.3	–	0.3	17.4	17.8
3-6, 119-121	59.7	4.4	1.0	0.3	8.5	1.4	0.5	25.8	0.7	0.3	0.3	25.8	15.6	0.3	1.4	0.7	0.7	0.3	–
4-3, 110-112	102.6	1.6	–	0.4	14.2	2.1	1.4	33.0	1.8	–	0.3	18.1	15.2	1.4	1.8	–	0.7	0.4	0.7
5-2, 19-21	147.3	0.9	1.5	0.4	23.0	10.9	2.6	8.0	–	0.4	–	19.7	16.0	10.9	2.6	–	0.4	–	–
7-0, 30-32	202.0	0.7	–	3.1	0.3	1.0	0.3	–	–	–	–	–	0.3	0.3	0.3	–	–	1.0	1.3
8-3, 100-103	216.3	30.3	–	–	–	–	–	–	–	–	–	0.4	–	–	–	–	–	2.9	0.7
11-2, 130-132	243.5	1.2	–	0.7	–	0.3	–	–	–	–	–	0.3	–	–	–	–	–	–	4.7
15-1, 99-101	270.1	3.2	–	2.2	–	–	–	0.4	–	–	–	0.4	0.5	0.4	–	–	–	–	8.0
16-1, 18-20	282.0	0.9	–	1.1	–	1.1	–	1.8	0.4	–	–	1.1	–	–	–	–	–	–	7.2

[a]Also single rounded carbonate grains.
[b]Single grains.
[c]Abundant.

TABLE 2 – *Continued*

Heavy Fraction (%)[a]																				
Volcano-terrigenous														Bio-genic						
Muscosite	Tourmaline	Staurolite	Chloritoids	Kyanite	Topaz	Weathered Grains	Clino-pyroxene	Ortho-pyroxene	Olivine, Iddingsite	Volcanic Ash	Brown Glass	Colorless Glass	Palagonite	Fish Teeth, Bone	Carbonates	Barite	Galuconite	Fe-Mn Concretion	Sulfide	Total (%)
–	0.3	–	–	0.3	1.1	0.3	4.0	1.0	–	4.7	–	–	–	–	0.3[a]	–	–	0.3	4.7	99.9
0.4	–	–	–	–	1.5	–	5.4	–	–	1.8	–	–	–	–	0.4	–	–	–	47.1	100.0
0.4	0.4	0.4	–	–	–	–	15.2	0.7	–	–	–	–	–	–	1.4	–	–	–	21.3	99.9
–	2.1	–	–	–	–	–	1.0	1.1	0.4	1.1	–	–	–	–	3.5	–	–	–	2.4	100.0
–	1.4	–	–	0.4	–	–	7.5	2.5	0.4	1.1	–	–	–	–	7.1	–	–	–	2.1	100.1
0.4	0.3	0.3	–	0.4	0.9	–	1.1	0.4	–	1.1	–	–	–	–	9.9	–	–	–	6.2	99.7
–	–	0.4	0.4	0.4	–	–	2.3	0.4	–	2.3	0.4	–	–	0.4	0.8	–	–	–	15.6	100.2
1.0	–	0.3	–	0.3	–	–	4.0	1.0	–	0.7	–	–	–	–	1.0	–	–	–	3.0	100.0
–	–	–	–	–	–	–	1.3	–	–	–	–	–	–	–	5.3	–	–	–	44.7	99.9
–	–	–	–	–	–	1.9	1.9	–	–	–	5.5	2.8	–	–	–	–	–	–	37.0	100.1
–	0.7	–	–	–	–	–	4.2	0.7	0.4	2.1	–	–	–	–	1.7	10.1	–	–	0.7	100.0
1.0	–	0.3	–	–	1.7	–	2.0	–	–	1.0	–	–	–	–	2.0	0.7	–	–	3.8	99.7
49.2	–	–	–	–	1.5	–	1.5	–	–	1.5	–	1.5	–	4.6	–	1.5	–	–	10.8	99.6
+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	–	++	–
3.9	–	–	–	–	2.0	–	3.9	–	–	3.9	–	2.0	–	2.0	–	–	–	–	62.7	100.1
+	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	–	–	–	++	–
–	–	–	–	–	–	–	–	–	–	–	1.3	1.3	–	2.6	–	–	–	–	7.7	100.1
2.2	–	–	–	1.1	–	23.4	1.1	–	–	6.3	4.2	2.1	–	4.3	–	1.1	–	–	6.4	100.2
6.1	–	–	–	–	–	–	4.5	–	–	–	–	1.5	–	–	–	–	–	–	56.1	100.0
–	–	–	–	–	–	–	1.1	–	–	10.6	2.1	1.1	–	2.2	–	–	–	–	5.3	100.0
1.9	–	–	–	–	–	5.8	5.8	–	–	–	–	1.9	–	1.9	–	–	–	–	57.7	99.8
1.7	–	–	–	–	–	5.2	–	1.7	–	3.4	3.4	3.4	–	5.2	–	–	–	–	51.7	99.7
–	–	–	–	–	1.7	–	–	–	3.1	3.1	1.6	–	–	1.6	–	–	–	–	70.3	100.2
1.0	1.4	–	–	–	0.4	–	0.7	1.4	–	2.8	–	–	–	–	1.0	–	–	–	–	99.9
–	–	–	–	–	–	–	2.1	1.4	–	–	–	–	–	–	0.4	–	–	–	3.5	100.3
0.4	0.4	–	0.4	0.4	–	–	3.8	0.7	–	5.7	–	–	–	–	3.0	0.4	0.4	–	0.4	100.3
0.7	0.7	–	–	–	–	–	0.7	0.7	–	–	–	2.1	–	–	–	–	–	–	79.9	100.2
–	–	–	–	–	–	–	0.7	0.4	–	0.4	0.4	0.4	–	–	1.4	–	–	–	56.9	100.2
0.7	0.7	–	–	0.4	–	–	–	–	0.4	0.4	–	–	–	–	3.0	–	–	–	3.3	100.0
–	0.7	0.4	–	–	0.4	–	1.7	0.7	–	1.0	–	–	–	–	2.0	–	–	–	1.0	100.1
–	0.7	0.4	–	–	–	–	–	0.7	–	1.9	–	–	–	–	3.9	–	–	–	5.1	100.1
0.8	0.8	0.4	–	–	–	–	8.6	–	–	1.1	–	–	–	–	1.5	–	–	–	3.8	99.8
0.3	0.3	–	–	–	0.3	–	0.7	0.3	–	–	–	–	–	–	0.3	–	–	–	83.0	100.3
0.8	–	0.3	0.3	–	0.3	–	1.0	–	–	–	–	–	–	–	0.9	–	–	–	40.7	99.6
0.7	–	–	–	–	–	–	–	–	–	–	2.7	0.3	–	–	–	–	–	–	94.9	99.8
–	–	–	–	–	–	–	–	–	–	–	1.0	–	–	–	0.3	–	–	–	98.6	99.9
–	–	–	–	–	–	–	–	–	–	–	1.1	0.7	–	–	–	–	–	–	97.1	100.0
–	–	–	–	–	–	–	–	–	–	–	4.1	0.3	–	–	–	–	–	–	93.6	100.0
–	1.7	0.7	–	–	0.6	0.3	3.4	0.3	0.3	1.4	–	–	–	–	–	–	–	0.3	–	99.6
–	0.7	0.3	–	–	0.7	–	4.7	0.3	–	6.4	–	–	–	–	1.7	–	–	–	–	100.1
–	0.7	–	–	–	2.1	0.3	2.3	–	–	0.7	–	–	–	–	0.3	–	–	–	30.0	100.1
1.3	–	–	–	–	–	–	–	–	–	–	1.0	1.0	–	0.7	–	–	–	–	93.7	100.0
1.5	–	–	–	–	–	–	–	–	–	–	6.0	0.4	–	–	–	–	–	–	88.3	100.1
5.4	–	–	–	–	–	–	–	–	–	0.9	6.2	0.9	–	0.9	–	–	–	–	79.5	100.1
–	–	–	–	–	–	–	–	0.8	–	–	4.1	0.8	–	–	0.8	–	–	–	87.8	99.9
0.4	–	–	–	–	–	–	0.4	–	–	–	0.4	–	–	1 1	0.4	–	–	–	94.9	100.2
–	1.0	–	0.3	–	–	–	4.1	0.3	–	3.8	–	–	–	0.3	0.3	–	–	–	–	99.7
0.7	1.0	0.3	-	–	–	–	2.0	–	–	5.5	–	–	–	0.3	1.0	–	–	1.0	–	99.8
1.3	0.3	–	–	0.3	–	2.7	3.4	–	–	1.4	–	–	–	–	2.7	–	–	–	0.3	99.7
–	1.4	–	–	–	1.6	10.4	2.4	–	–	0.7	–	–	–	–	4.3	–	–	–	9.5	100.3
0.7	0.7	–	–	–	1.1	2.8	3.2	1.1	–	1.8	–	–	–	–	4.1	–	–	–	3.1	99.9
–	0.7	0.3	–	0.3	–	1.0	3.4	1.4	–	0.7	–	–	–	–	8.1	–	–	–	4.7	99.9
29.2	0.3	–	–	–	–	–	0.7	0.7	–	–	–	–	–	–	5.7	–	–	–	3.7	99.9
–	1.4	0.3	–	–	–	–	2.4	1.0	–	–	–	–	–	–	8.9	–	–	–	3.0	100.0
0.7	1.4	0.4	–	0.3	0.7	–	3.2	0.4	–	–	–	–	–	–	0.3	–	–	–	0.7	99.6
–	0.4	–	0.4	–	–	–	2.2	–	–	0.7	–	–	–	–	–	–	–	–	–	100.1
77.2	–	–	–	–	–	–	0.3	–	–	–	–	–	–	0.3	–	–	–	0.7	13.3	99.7
0.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	63.9	–	–	–	31.4	100.0
1.4	–	–	–	–	–	4.4	–	–	–	–	–	–	–	–	–	–	–	–	88.1	99.9
16.8	–	–	–	–	–	2.2	–	–	–	–	–	–	–	–	–	–	–	–	69.0	99.9
12.3	–	–	0.7	–	–	–	–	–	–	–	–	–	–	1.8	–	–	–	–	72.4	99.9

TABLE 2 – *Continued*

		Light Fraction (%)																				
		Terrigenous							Volcanogenic			Biogenic							Authigenic			
Sample (Interval in cm)	Depth (m)	Quartz	Pelitized Grains	Muscovite	Mica (green, yellow)	Feldspar	Carbonates	Lithics	Brown Glass	Colorless Glass	Pelitized Volc. Ash	Biogenous Carbonate	Foraminifera	Si-Spicules	Diatoms	Radiolarians	Plant Remains	Fish Teeth Bone	Carbonates	Glauconite	Phosphate	Total (%)
Site 339																						
2-1, 119-121	9.2	69.4	12.0	–	1.4	7.0	1.8	–	–	–	–	0.7	4.2	–	–	–	–	0.4	2.5	0.7	–	100.1
2-3, 129-131	12.4	76.4	8.5	–	0.3	7.2	–	–	–	0.3	–	–	3.8	–	0.3	–	–	–	2.7	0.3	–	99.8
3-4, 142-144	23.7	64.1	12.3	–	0.4	19.5	0.7	–	–	–	–	–	1.8	–	–	–	–	–	0.4	0.7	–	99.9
4-2, 121-123	33.0	78.9	2.1	–	1.8	12.3	–	–	–	0.7	–	–	1.8	0.4	–	–	0.4	–	0.7	1.1	–	100.2
5-1, 139-140	38.0	64.3	6.7	1.0	2.4	17.8	–	–	–	–	–	–	0.7	–	1.0	1.0	–	–	1.0	3.7	0.3	99.9
6-3, 102-104	49.9	64.8	9.2	0.4	0.7	17.0	–	–	–	0.4	–	–	0.4	–	0.7	0.7	–	–	0.7	4.8	–	99.8
7-1 130-132	56.9	6.0	9.0	–	0.3	5.7	0.7	–	–	17.7	–	–	0.3	–	42.8	17.4	–	–	–	–	–	99.9
8-1, 100-102	66.0	68.6	3.4	0.3	0.7	20.7	0.3	–	–	–	–	–	1.0	0.3	1.7	0.7	–	–	0.7	1.4	0.3	100.1
10-3. 70-73	87.9	–	–	–	0.3	–	–	–	–	4.0	–	–	–	2.7	84.8	8.2	–	–	–	–	–	100.0
12-2, 70-72	104.2	2.7	2.1	–	–	1.7	–	–	1.7	9.2	–	–	–	2.7	41.4	38.4	–	–	–	–	–	99.9
Site 340																						
1, CC	9.5	66.6	5.2	–	0.3	10.3	2.1	–	–	1.0	–	–	3.8	–	6.2	2.4	–	–	1.4	0.7	–	100.0
2-1, 38-40	9.9	29.2	6.5	–	0.4	1.8	0.7	–	–	2.5	–	–	–	0.7	40.4	17.0	–	–	–	0.7	–	99.9
2-3, 75-77	13.5	0.3	–	–	–	–	–	–	–	4.2	11.0	–	–	–	71.9	12.8	–	–	–	–	–	100.2
3-3, 75-77	23.0	1.5	–	–	–	0.4	–	–	0.3	8.0	17.3	–	–	1.1	13.2	58.2	–	–	–	–	–	100.0
4-4, 75-77	34.0	0.7	–	–	0.8	–	–	–	0.4	17.1	7.8	–	–	2.8	8.9	61.6	–	–	–	–	–	100.1
5-2, 70-72	40.3	–	–	–	0.4	1.5	–	–	–	11.1	21.5	–	–	3.0	8.9	53.7	–	–	–	–	–	100.1
6-3, 60-62	51.3	–	0.3	–	–	–	–	–	–	5.6	3.6	–	–	–	75.7	14.6	–	–	–	–	–	99.8
7-1, 95-97	58.0	–	–	–	0.3	0.3	–	–	–	5.8	50.0	–	–	–	21.4	19.3	–	–	–	–	–	100.1
7-6, 95-97	65.0	0.4	–	–	–	–	–	–	–	1.5	6.3	–	–	0.7	74.6	16.5	–	–	–	–	–	100.0
8-4, 72-74	72.0	0.4	–	–	0.4	0.4	–	–	2.1	16.0	10.7	–	–	3.9	14.2	52.0	–	–	–	–	–	100.1
9-3, 70-72	79.9	–	–	–	–	0.4	–	–	0.7	3.3	–	–	–	–	17.8	77.8	–	–	–	–	–	100.0
10-2, 50-52	81.6	–	–	–	–	0.4	–	–	–	5.5	2.6	–	–	–	11.3	80.3	–	–	–	–	–	100.1
11-4, 81-83	100.7	–	–	–	0.4	–	–	–	0.7	3.0	–	–	–	–	–	95.9	–	–	–	–	–	100.0
Site 341																						
1-3, 75-77	3.4	74.6	–	–	0.6	18.8	–	–	–	–	–	–	1.4	–	0.3	–	–	–	3.1	1.0	–	99.8
2-2, 75-77	11.9	41.9	2.3	0.9	2.3	26.0	–	–	–	–	–	–	17.9	–	–	–	–	–	7.8	1.0	–	100.1
4-1, 75-77	29.3	73.1	–	1.0	1.7	16.9	–	–	–	–	–	–	4.0	–	–	–	–	–	3.0	0.3	–	100.0
6-3, 50	51.25	–	–	–	–	0.6	–	–	–	87.1	5.2	–	–	1.0	4.8	1.3	–	–	–	–	–	100.0
7-3, 50	60.80	8.5	–	–	0.4	1.1	0.4	–	–	11.3	14.8	–	–	0.4	53.7	9.5	–	–	–	–	–	100.1
8-3, 50	70.3	65.6	1.7	1.0	3.8	23.1	–	–	–	–	–	–	0.3	0.3	–	0.3	–	–	2.4	1.4	–	99.9
10-1, 109-111	86.7	70.0	2.4	1.7	1.4	19.2	0.3	–	–	–	–	–	1.4	–	0.7	–	–	–	1.0	1.5	–	99.6
13-1, 142-144	107.0	66.4	0.7	2.0	2.0	26.5	–	–	–	–	–	–	0.7	–	0.3	–	–	–	1.3	–	–	99.9
17-2, 129-131	183.5	74.9	1.4	1.4	0.4	14.8	–	–	–	–	–	–	0.7	–	–	–	–	–	5.8	0.4	–	99.8
20-2, 100-102	240.2	11.3	28.6	3.0	2.0	3.6	–	–	–	–	–	0.3	45.8	2.6	0.7	1.0	–	–	0.7	0.3	–	99.9
21-4, 90-92	262.3	63.8	1.8	2.1	2.1	19.5	–	0.4	–	–	–	–	2.5	–	2.1	–	–	–	5.3	0.4	–	100.0
28-3, 100-102	393.9	2.5	–	–	0.4	1.8	–	–	14.4	3.2	33.8	6.5	1.8	1.4	24.1	9.5	–	–	–	0.7	–	100.1
29-4, 118-120	405.1	–	–	0.7	0.7	–	–	–	1.0	0.3	56.5	4.1	7.5	0.3	19.0	9.5	–	–	–	0.3	–	99.8
30-4, 41-43	413.7	2.6	–	–	0.6	0.3	–	–	0.3	6.1	80.5	–	–	0.6	2.2	6.1	–	–	–	0.6	–	99.9
32-4, 50-52	432.9	–	–	–	0.3	0.6	–	–	1.0	7.5	28.4	–	–	1.3	1.3	59.5	–	–	–	–	–	99.9
Site 342																						
1-2, 49-51	2.0	72.0	2.1	0.4	0.4	15.4	–	–	0.4	–	–	–	5.9	–	0.4	–	–	–	2.1	1.0	–	100.1
1-5, 69-71	6.7	58.2	3.7	1.4	1.0	25.6	–	–	–	–	–	0.7	5.0	–	–	–	–	–	4.0	0.3	–	99.9
2-2, 94-96	40.1	66.3	7.0	1.0	1.1	23.5	–	–	–	–	–	–	–	–	0.7	–	–	–	–	0.4	–	100.0
3-4, 100-102	90.9	–	27.0	–	0.3	–	–	–	1.7	64.7	–	–	–	1.4	0.7	4.2	–	–	–	–	–	100.0
4-2, 110-112	125.8	0.4	15.5	–	0.4	0.7	–	–	0.7	10.8	–	–	–	1.1	64.4	6.1	–	–	–	–	–	100.1
5-2, 100-102	135.2	–	29.2	–	–	–	–	–	–	1.1	–	–	–	1.1	66.5	2.1	–	–	–	–	–	100.0
5-6, 100-102	141.5	–	9.6	–	–	–	–	–	–	1.4	–	–	–	0.7	80.8	7.4	–	–	–	–	–	99.9
6-4, 61-62	147.5	–	44.3	–	0.4	0.8	–	–	–	31.1	–	–	–	0.4	4.5	8.0	–	–	–	10.7	–	100.2
Site 343																						
1-1, 75-77	0.2	48.4	–	0.4	0.7	13.8	–	–	–	2.2	–	–	32.0	0.4	0.4	–	–	–	0.7	1.1	–	100.1
1-3, 75-77	1.2	50.0	7.1	0.7	0.3	11.8	1.4	–	–	0.3	–	–	25.3	0.6	–	–	–	–	1.4	1.1	–	100.0
2-2, 105-107	5.7	58.2	6.6	–	0.4	25.6	–	–	–	–	–	–	1.1	–	0.4	–	–	–	1.1	6.7	–	100.2
2-4, 75-77	8.7	53.3	10.1	–	–	24.3	–	–	–	–	–	0.4	9.8	–	–	–	–	–	0.4	1.8	–	100.2
2, CC	12.5	63.3	10.2	–	–	17.8	0.4	–	–	–	–	–	6.9	–	0.4	–	–	–	0.4	0.7	–	100.1
3-2, 129-131	53.5	72.7	7.5	–	0.6	15.9	–	–	–	–	–	0.3	–	–	–	–	–	–	2.6	0.3	–	99.9
3-4, 129-131	56.0	38.6	20.8	14.0	14.7	10.9	–	–	–	–	–	–	0.3	–	–	–	–	–	0.7	–	–	100.0
3-6, 119-121	59.7	83.9	0.3	–	–	12.3	–	–	–	–	0.3	–	–	–	–	–	–	–	2.3	0.7	–	99.8
4-3, 110-112	102.6	55.2	0.7	0.3	–	11.7	–	–	–	–	–	0.3	26.9	–	0.3	–	–	–	3.4	1.0	–	99.8
5-2, 19-21	147.3	51.6	17.0	–	0.4	28.9	–	–	–	–	–	–	–	–	–	–	–	–	–	2.1	–	100.0
7-0, 30-32	202.0	1.0	–	–	0.3	1.3	–	97.0	–	–	–	–	–	–	0.3	–	–	–	–	–	–	99.9
8-3, 100-103	216.3	3.9	–	0.3	2.1	1.0	–	22.8	–	–	–	–	0.7	–	0.3	1.0	–	0.3	67.4	–	–	99.8
11-2, 130-132	243.5	1.0	–	0.6	0.6	7.3	–	90.1	–	0.3	–	–	–	–	–	–	–	–	–	–	–	99.9
15-1, 99-101	270.1	5.0	–	13.8	12.8	14.2	–	52.5	–	–	–	–	0.4	–	1.1	–	–	0.4	–	–	–	100.2
16-3, 18-20	282.0	4.3	–	–	8.5	13.9	–	73.1	–	–	–	–	–	–	–	–	–	–	–	0.2	–	100.0

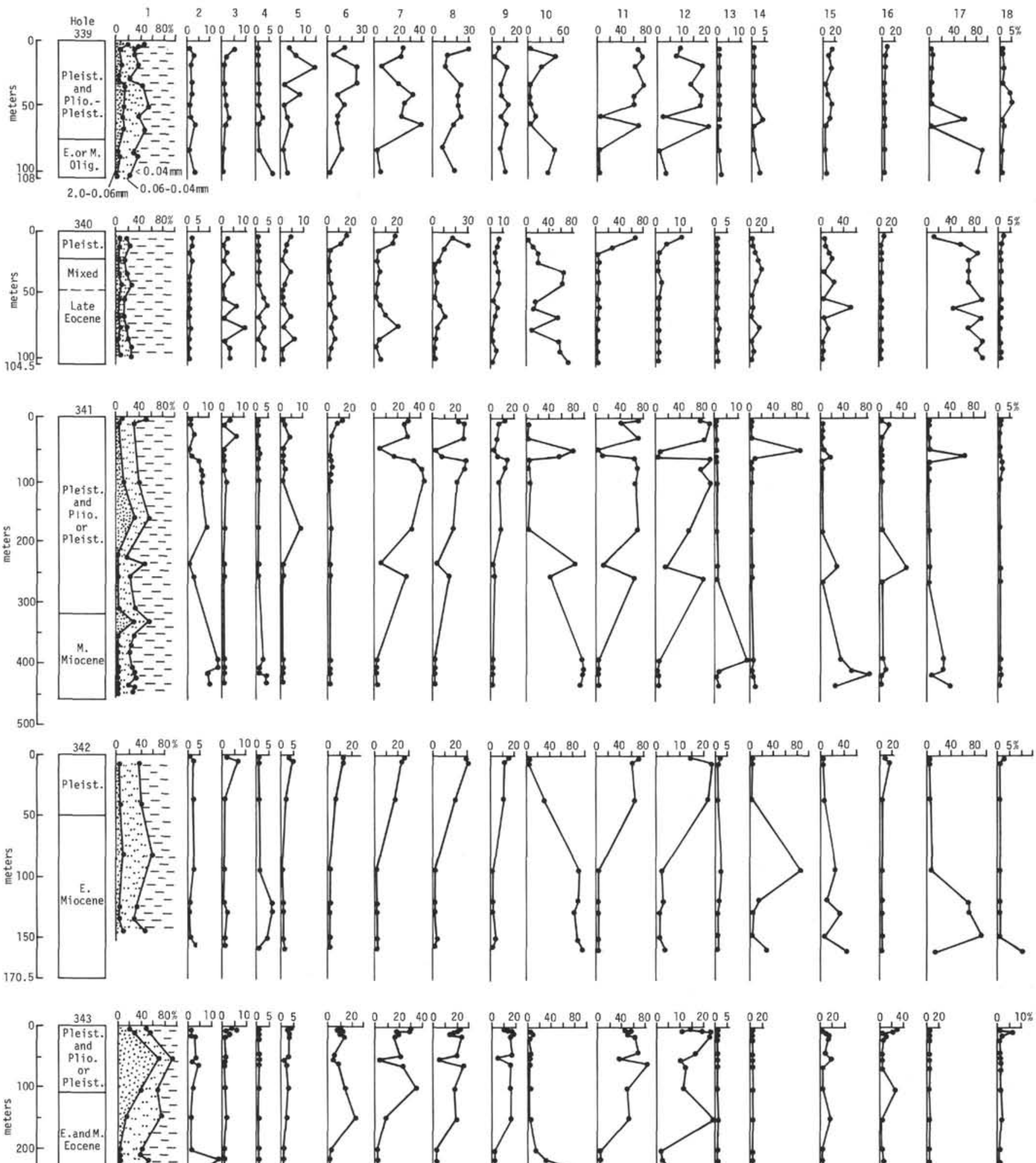

Figure 2. *Lithologic diagrams of the sites. Legend: 1 = grain size composition of sediments (%), 2 = content of heavy mineral fraction 0.1-0.5mm (%);* 3-18 *= distribution of minerals, volcanic ash, biogenic material: 3 = volcanic ash; 4 = brown glass (basaltic); 5 = clinopyroxene; 6 = ilmenite; 7 = hornblende; 8 = epidote; 9 = garnet; 10 = Fe-sulfide; 11 = quartz; 12 = feldspar; 13 = light brown glass; 14 = colorless glass; 15 = clayey aggregate; 16 = biogenic carbonate; 17 = biogenic siliceous; and 18 = glauconite.*

TABLE 3
Mineral Composition (%) of Sediments Voring Plateau, DSDP Leg 38 X-ray Data[a]

Sample (Interval in cm)	Depth (m)	$CaCO_3$	Carbonates				Total	Quartz	Plagioclase	Alkali Feldspar	Quartz/ Feldspar
			Calcite	Aragonite	Dolomite	Siderite					
Site 339											
2-2, 140-142	10.9	12.51	8	0	0	0	8	13	3	1	3.3
2-4, 138-141	14.4	8.00	6	+	+	0	–	14	2	1	4.7
3-1, 129-131	18.8	6.00	3	+	+	0	–	12	2	2	3.0
3-3, 138-140	21.9	8.75	7	+	+	0	–	15	3	1	3.8
3, CC	27.0	2.50	1	0	0	0	1	19	10	4	1.4
4-1, 142-144	28.45	12.85	10	0	+	0	–	11	3	1	2.8
4-3, 89-91	31.0	12.76	12	0	+	0	–	19	3	3	3.2
4, CC	36.5	–	0	0	0	0	0	14	3	1	3.5
5-2, 138-140	39.5	2.50	0	0	0	0	0	8	2	+	–
5, CC	46.0	–	2	0	0	0	2	19	2	1	6.3
6-1, 140-142	47.4	10.01	7	0	0	0	7	24	2	4	4.0
6-4, 85-87	51.6	2.50	0	0	+	0	–	15	3	+	–
6, CC	55.5	9.76	8	0	+	0	–	12	3	1	3.0
7-2, 50-52	57.7	3.76	0	0	0	0	0	10	2	1	3.3
8-5, 60-62	72.0	0.0	0	0	0	0	0	12	3	2	2.4
8, CC	74.5	0.0	0	0	0	0	0	20	4	1	4.0
10, CC	93.5	0.0	0	0	0	0	0	0	0	0	–
12-1, 120-122	103.0	0.0	0	0	0	0	0	0	0	0	–
Site 340											
1-1, 75-77	0.8	–	3	0	0	0	3	10	2	+	–
1-2, 148-150	3.2	–	7	0	+	0	–	14	4	3	2.0
1-5, 75-77	7.2	–	4	0	0	0	4	8	3	+	–
1, CC	9.5	–	7	0	0	0	7	16	4	2	2.7
2-2, 75-77	11.9	–	0	0	0	0	0	2	+	0	–
2-3, 80-82	13.5	–	4	0	0	0	4	12	5	1	2.0
2, CC	19.0	0.0	2	0	0	0	2	22	8	2	2.2
3-1, 75-77	19.8	–	2	0	0	0	2	7	6	2	0.9
3-2, 75-77	21.4	–	0	0	0	0	0	1	0	0	–
3-4, 75-77	24.6	1.50	8	0	0	0	8	7	6	2	0.9
3, CC	28.5	2.0	1	0	0	0	1	3	2	+	–
4-3, 75-77	33.5	0.0	0	0	0	0	0	1	0	0	–
4, CC	38.0	0.0	1	0	0	0	1	4	2	+	–
6, CC	57.0	0.0	0	0	0	0	0	3	4	1	0.6
7-4, 95-97	62.8	0.0	0	0	0	0	0	2	2	0	1.0
8-1, 72-74	67.2	0.0	0	0	0	0	0	1	+	0	–
8-5, 72-74	73.6	–	0	0	0	0	0	1	+	0	–
9-1, 70-72	76.7	–	0	0	0	0	0	1	+	0	–
9, CC	85.5	0.0	0	0	0	0	0	1	1	+	–
10-3, 50-52	89.2	0.0	0	0	0	0	0	2	+	0	–
10-5, 50-52	92.4	0.0	0	0	0	0	0	1	1	0	1.0
11-3, 81-83	99.0	0.0	0	0	0	0	0	1	2	0	0.5
11, CC	104.5	3.0	0	0	0	0	0	2	2	0	1.0
Site 341											
7, CC	66.5	5.50	2	0	0	0	2	11	6	2	1.4
8, CC	76.0	4.00	4	0	0	0	4	18	7	2	2.0
9, CC	85.5	8.26	8	0	0	0	8	13	7	2	1.4
10-3, 109-111	90.4	8.50	7	0	0	0	7	12	7	2	1.3
10, CC	95.0	–	6	0	0	0	6	16	6	2	2.0
11-3, 141-143	99.7	–	4	0	0	0	4	16	7	+	–
11, CC	104.5	9.00	6	0	0	0	6	17	6	2	2.0
12-3, 135-137	105.0	–	10	0	0	0	10	19	7	2	2.1
12, CC	105.5	9.51	6	0	0	0	6	14	5	2	2.0
13, CC	114.0	10.76	8	0	0	0	8	22	6	2	2.8
14, CC	123.5	15.76	14	0	0	0	14	17	5	1	2.8
15, CC	161.0	–	8	0	0	0	8	25	11	4	1.7
16, CC	171.0	8.00	6	0	0	0	6	17	7	2	1.9
17, CC	190.0	–	5	0	0	0	5	17	6	2	2.1
18, CC	209.0	8.76	7	0	0	0	7	13	5	1	2.2
19, CC	228.0	9.00	10	0	0	0	10	20	6	2	2.5
20, CC	247.0	10.51	7	0	0	0	7	14	6	2	1.8

TABLE 3 – *Continued*

Sample (Interval in cm)	Depth (m)	$CaCO_3$	Carbonates: Calcite	Aragonite	Dolomite	Siderite	Total	Quartz	Plagioclase	Alkali Feldspar	Quartz/ Feldspar
21-2, 120-122	259.4	–	3	0	0	0	3	13	5	2	1.9
21, CC	266.0	0.25	0	0	0	0	0	22	6	2	2.8
23, CC	313.5	–	0	0	0	0	0	14	5	2	2.0
23-3, 10-12	304.1	3.00	2	0	0	0	2	12	5	+	–
24-3, 75-77	317.5	–	4	0	0	0	4	8	4	1	1.6
24, CC	323.0	2.50	0	0	0	0	0	14	4	1	2.8
25-3, 75-77	339.0	–	0	0	0	0	0	4	+	+	–
25, CC	342.0	0.25	0	0	0	0	0	10	+	+	–
26-5, 137-139	359.2	–	6	0	0	0	6	3	+	+	–
26, CC	361.0	10.0	8	0	0	0	8	4	1	0	4.0
27-4, 120-122	376.6	–	7	0	0	0	7	3	0	0	–
28, CC	399.0	0.50	0	0	0	0	0	4	0	0	–
31-4, 28-30	423.1	–	0	0	0	0	0	7	+	+	–
33-4, 60-62	442.4	–	0	0	0	0	0	3	0	0	–
34, CC	456.0	0.25	0	0	0	0	0	3	0	0	–
Site 342											
1-1, 49-51	0.5	11.26	6	0	+	0	–	18	2	1	6.0
1-4, 49-51	5.0	–	7	0	+	0	–	10	2	1	3.3
1-6, 69-71	8.2	–	+	0	0	0	+	40	6	2	5.0
1, CC	9.0	6.50	4	0	0	0	4	17	5	2	2.4
2-1, 99-101	38.6	–	4	3	0	0	7	11	4	1	2.2
2-4, 80-82	43.1	–	0	6	0	0	6	16	5	2	2.3
2, CC	47.60	14.76	10	0	0	0	10	12	4	1	4.0
3-2, 110-112	87.8	–	0	0	0	0	0	6	1	0	6.0
3-3, 119-121	89.6	–	0	0	0	0	0	5	1	0	5.0
4-1, 110-112	124.2	–	0	0	0	0	0	3	+	+	–
5, CC	142.0	–	0	0	0	0	0	2	0	0	–
6-3, 90-92	146.2	–	0	0	0	0	0	3	0	0	–
6, CC	151.5	–	0	0	0	0	0	2	+	0	–
Site 343											
2-1, 75-77	3.9	–	2	0	0	0	2	16	6	2	2.0
3-1, 129-131	51.8	–	3	0	0	0	3	27	10	4	1.9
3-5, 120-122	57.4	–	2	0	0	0	2	20	7	3	2.0
3, CC	60.0	–	2	0	0	0	2	40	6	2	5.0
4-1, 119-121	99.3	–	0	0	+	0	+	12	5	2	1.7
4-4, 119-121	104.0	–	0	0	0	0	0	16	4	2	2.0
4, CC	107.5	–	2	0	0	0	2	18	5	2	2.5
5-4, 114-116	151.5	–	0	0	0	0	0	+	+	+	–
6, CC	202.5	–	0	0	0	0	0	12	+	+	–
7-2, 90-92	205.6	–	0	0	0	0	0	5	0	+	–
7-3, 89-91	206.6	–	0	0	0	0	0	11	+	+	–
7, CC	212.0	–	0	0	0	+	+	11	0	+	–
8-1, 100-102	213.1	–	0	0	0	0	0	12	+	+	–
8-2, 50-52	214.1	–	0	0	0	0	0	8	+	+	–
8, CC	221.5	–	0	0	0	0	0	8	+	+	–
9-2, 110-112	224.2	–	0	0	0	0	0	14	2	1	4.6
10-1, 80-82	231.9	–	0	0	0	0	0	7	+	+	–
11-1, 118-120	241.8	–	0	0	0	0	0	11	+	+	–
16-1, 119-121	279.7	–	4	0	0	0	4	9	+	1	–
16-2, 110-112	281.0	–	0	0	0	0	0	3	+	+	–

[a] Analytical procedure of L.N. Yorbunova (1969) and Eltzina (1973); 0 = absent, + = present, – = not determined.

the basement of glacial strata, aragonite is present (3%-6%), and may represent relicts of pteropod fauna. Petrographic data indicate the calcite consists of coccoliths, sometimes foraminifera. It is possible that the peaks of increased calcite content in the Pleistocene deposits correspond to interglacial periods, where the conditions for nannoplankton development were improved and the influx of terrigenous material was decreased.

Generally, carbonates are absent in Pliocene-Oligocene sediments. The small concentrations increase only in late Miocene sediments (up to 8%, Site 342). Eocene sediments are also noncalcareous. Only in the basement, Eocene sediments at Site 348 are carbonates present (4%).

Quartz

High (20%-25%, up to 40%) contents of quartz are characteristic for Plio-Pleistocene deposits. The maximum content corresponds to periods of maximum ice-rafting. This is indicated by a reversed correlation between the quartz and calcite distributions in the majority of samples (Figure 3). The lower parts of Plio-Pleistocene strata, with the interbeds of underlying diatom ooze, are appreciably impoverished in quartz. The quartz content in Pliocene and Miocene sediments is not very large, up to 5%-10% in Pliocene and late Miocene, and only up to 1%-3% in older strata. Diatom ooze of Oligocene and late and middle Eocene age contains very little quartz; however, in early Eocene (Site 343) the terrigenous component increases, and the quartz component reaches up to 10%-14%.

Feldspars

Almost without exception, plagioclases are abundant among the feldspars. In Plio-Pleistocene sediments, their content is up to 10%-11%; orthoclases—not more than 3%-4%. The correlation between quartz and feldspars (Figure 3) in the Pleistocene is evidence of their similar derivation.

The feldspar content decreases in Pliocene-Eocene sediments. This is also characteristic for quartz; however, a correlation between these two minerals is not present. Plagioclase in Tertiary diatom oozes are of

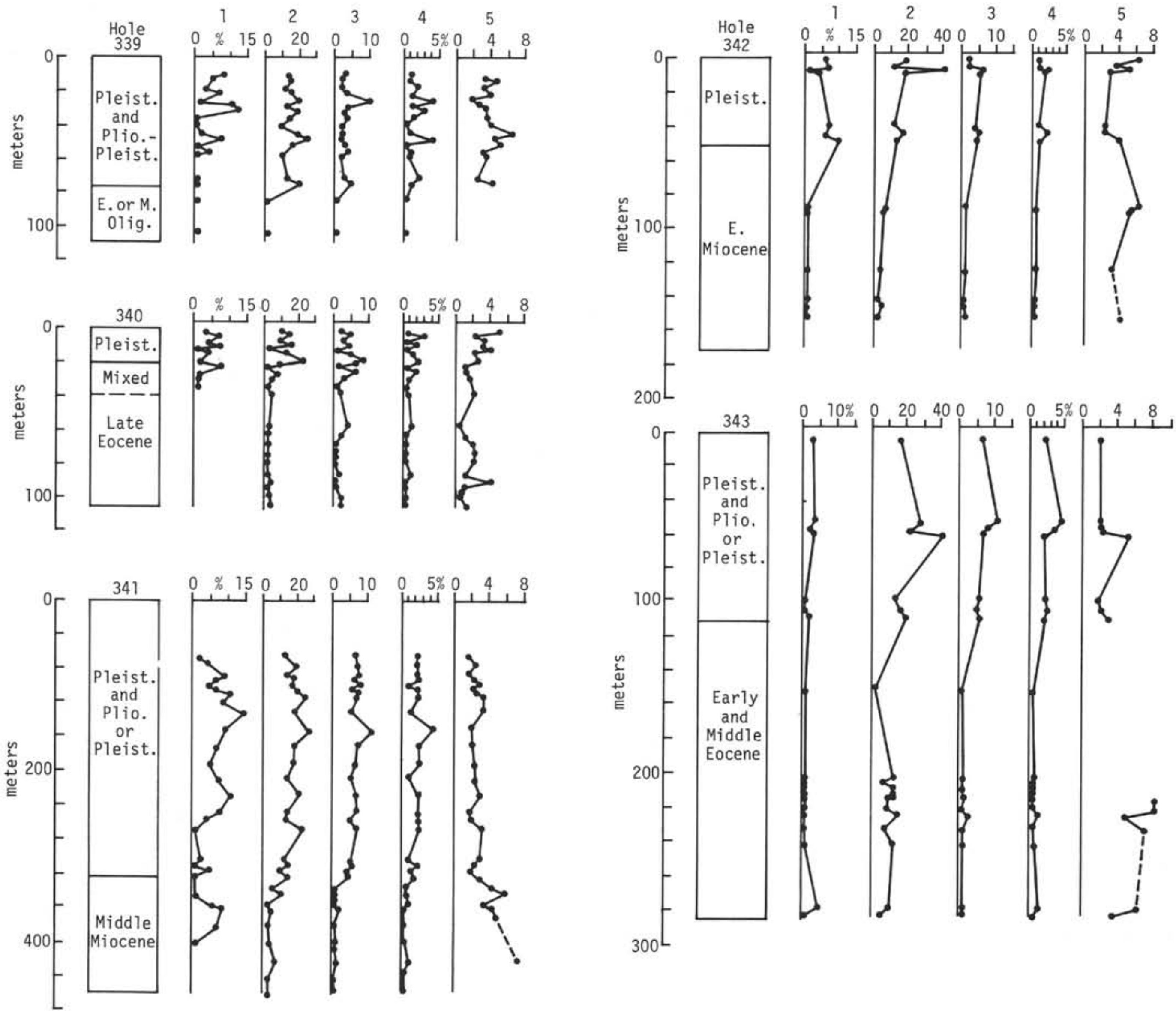

Figure 3. *Distribution of minerals in sediment samples of the Vøring Plateau (%). Legend: 1 = carbonates; 2 = quartz; 3 = plagioclase; 4 = K-feldspar; 5 = quartz-feldspar (Q/F) ratio.*

volcanic origin, as shown by the presence of volcanic ash and glass in silty fractions (Figure 2). In the early Eocene terrigenous strata where turbidite interbeds are also present, feldspars have a direct correlation with quartz.

Quartz to Feldspar Ratios (Q/F)

High ratios (up to 6-8) are characteristic of Plio-Pleistocene deposits. This may be a result of the prevalence of erosional products from quartzites and sandstones, as well as an influx of weathering products from ancient preglacial rocks. In the Pliocene (Site 342) and the late and middle Miocene, the Q/F ratio is also high.

In Eocene siliceous sediments, the Q/F ratio is often equal to 1 or <1, an indication of a volcanogenic source for the plagioclases (Site 340). In early Eocene terrigenous sediments (Site 343), the ratio increases.

CHEMICAL COMPOSITION OF SEDIMENTS

Sediments from Sites 339, 340, 341, 342 differ considerably in their chemical composition (Table 4). The Pleistocene terrigenous glacial-marine sediments contain increased amounts of $CaCO_3$ and K_2O. C_{org} content is less than in Recent terrigenous sediments of the Norwegian Sea (Emelyanov et al., 1975). For other elements, the glacial-marine sediments are similar to the composition of granitoids of the Baltic shield and Quaternary moraines (Table 5). There is no doubt that the sediments, as well as moraines, were formed mainly by the products of erosion of the Baltic crystalline shield.

Pleistocene terrigenous muds from Site 342 have a similar composition with the exception of a higher content of Fe, Mn, and Ti. This indicates a similarity with the typical deep-sea terrigenous muds of the Atlantic Ocean (Emelyanov et al., 1975).

Late Miocene diatomites differ from the diatom oozes of Site 340 by the following: (1) higher contents of $CaCO_3$ and CO_{org}; (2) higher contents of Fe, Ti, Ni, Cr, and K_2O, and (3) a low content of Na_2O. Miocene diatom mudstones from Site 341 and the early Pleistocene of Site 342 are characterized by similar chemical compositions. However, in contrast to the diatomites, high C_{org} contents (up to 2.52%) are present. This is the maximum value for the sediments from all sites of the Vøring Plateau. The contents of Fe (up to 6.00%), Ti (up to 0.63%), Cr (up to $10.30.10^{-4}$%) are noticeable.

Volcanogenic sediments of the Norwegian Sea are characterized by high amounts of Fe, Ti, Ni, Cr, and K_2O. This is indicative of the close relationship of the diatomites and diatom sediments of Sites 341 and 342 with volcanic processes (Emelyanov and Kharin, 1974; Emelyanov et al., 1975). Also noted is the presence of volcanic glass in the Eocene sediments (Figure 2).

Eocene oozes (Site 340) are contrasted to glacial-marine and terrigenous sediments by the following features: (1) low $CaCO_3$ content, (2) low C_{org}, Fe, Mn, Ti, P, Cr, and K_2O content, and (3) a high Na_2O content. These chemical characteristics make the diatom oozes of the Vøring Plateau similar to the Recent diatom oozes of the deep-sea Antarctic zone of the Atlantic Ocean (Emelyanov et al., 1975). Radiolaria and diatom-spicule oozes have a chemical composition similar to the diatom oozes.

DISCUSSION AND CONCLUSIONS

Based on the mineral and chemical data, the origin and depositional conditions of the sedimentary deposits can be considered.

Thick deposits of glacial-marine sediments accumulated during the Pleistocene on the Vøring Plateau, especially in the region of Sites 341 and 343. The most active sedimentation probably took place during early periods of glaciation, when the weathered materials of ancient rocks were glaciated. These materials, represented mainly by quartz and clay minerals, formed the glacial-marine sediments of the Vøring Plateau. Upper horizons of glacial-marine sediments contain appreciable quantities of biogenous carbonates.

Terrigenous material represents glaciated crystalline rocks. Since feldspars are slightly destroyed under such conditions, the Q/F ratio in the upper deposits of glacial sediments is lower in comparison with the underlying strata. Thus, mineralogical data indicate the relationship of the glacial sediments with the rocks of the contiguous land with crystalline rocks (granites), and Cambrian-Silurian calcareous rocks (northern Norway) which contributed sediments. The latter source is indicated by the admixture of dolomite in the sediments of Site 339. The mineral compositions of Quaternary and Recent sediments of the eastern region of the Norwegian Sea are nearly identical (Holtedahl, 1955; Emelyanov et al., 1975).

The chemical composition of the terrigenous sediments has a close relationship with the average composition of glacially eroded acid rocks, granitoids of the Baltic shield, and Quaternary moraines. The transportation of minerals by floating ice and icebergs did not provide a thick accumulation of Pleistocene sediments on the Vøring Plateau. It is a safe assumption that the main part of products of glacial origin was provided during the time of glacial erosion. Glaciers, during the maximum of glaciation, sank to the 200-meter isobath (Holtedahl, 1957, 1958). After deglaciation, the shelf moraines were submerged and subjected to marine erosion. The transportation of minerals was provided by ice, icebergs, currents, and on the slopes of the Vøring Plateau, by suspension currents.

Marine sedimentation prevailed in the development of the Vøring Plateau. The sediments are characterized by the presence of glaciated rocks, admixtures of the products of moraines, and fragments from underlying deposits. Greenland, Iceland, and Jan-Mayen volcanic contributions were minor, as shown by the absence of volcanic ash and the chemical composition of the sediments.

Other types of sedimentation took place before the Quaternary and early Pleistocene (Sites 339 and 340). Biogenic siliceous oozes became prevalent. Therefore, before the Quaternary a different hydrochemical and tectonic regime existed in the Norwegian Sea. This

TABLE 4
Chemical Composition of Sediments from Vøring Plateau, DSDP Leg 38

Sample (Interval in cm)	Depth (m)	Content (%)						Content ($\%\text{-}10^{-4}$)						Content (%)		Sediment Type[a]
		$CaCO_3$	C_{org}	Fe	Mn	Ti	P	Cu	Ln	Ni	Co	Cr	Cd	K_2O	Na_2O	
Site 339																
2-2, 119-121	10.8	13.01	0.60	4.40	0.05	0.54	0.07	32	85	44	10	84	<4	3.07	2.43	M-gl.m.
2-2, 140-142	10.9	12.51	0.45	3.96	0.05	0.56	0.06	23	79	38	10	84	<4	3.15	2.00	M-gl.m.
2-4, 138-141	14.4	8.00	0.30	3.62	0.05	0.52	0.06	32	79	49	15	79	<4	3.06	1.98	M-gl.m.
3-2, 110-112	20.2	6.00	0.45	3.86	0.04	0.52	0.07	25	87	44	12	74	<4	2.96	2.18	M-gl.m.
3-3, 138-140	21.9	8.75	0.39	4.34	0.05	0.54	0.07	35	92	46	18	86	<4	2.90	2.21	M-gl.m.
3, CC	27.0	2.50	0.34	3.80	0.03	0.54	0.06	33	87	27	27	87	<6	2.72	2.04	M-gl.m.
4-1, 142-144	28.4	12.85	0.60	4.27	0.08	0.56	0.06	35	100	49	22	101	<6	2.87	2.10	M-gl.m.
4-3, 89-91	31.0	12.76	0.63	4.27	0.06	0.50	0.06	32	86	50	21	105	<6	3.11	1.72	M-gl.m.
4-4, 17-19	32.0	13.51	0.81	4.05	0.06	0.50	0.06	25	80	45	22	105	<6	3.82	1.67	M-gl.m.
5-2, 138-140	39.5	2.50	0.60	3.70	0.05	0.47	0.04	24	67	22	18	78	<6	2.40	1.92	M-gl.m.
6-2, 23-25	47.9	10.01	0.42	3.55	0.02	0.43	0.04	27	85	30	15	80	<6	2.30	1.77	M-gl.m.
6-4, 85-87	51.6	2.50	0.54	3.86	0.06	0.48	0.05	27	78	27	17	83	<6	2.28	1.85	M-gl.m.
6, CC	55.5	9.76	0.75	3.80	0.05	0.47	0.05	23	89	42	19	97	<6	2.49	1.93	M-gl.m.
7-2, 50-52	57.5	3.76	0.45	3.10	0.03	0.30	0.03	40	83	40	15	47	<6	1.81	3.67	T-si.
7-3, 50-52	59.2	6.25	0.39	3.19	0.04	0.30	0.03	40	82	30	15	49	<6	1.84	3.50	T-si.
7, CC	65.0	2.50	0.54	2.08	0.03	0.22	0.02	26	54	29	17	41	<6	1.64	2.72	D.
8-4, 10-12	69.9	0.00	0.51	3.80	0.06	0.50	0.05	25	85	36	22	83	<6	2.65	1.78	T.m.
8-5, 60-62	72.0	0.00	5.21	3.62	0.04	0.43	0.05	41	88	27	17	66	<6	2.91	2.02	T-si.
10-2, 89-91	86.6	0.00	0.48	1.22	0.01	0.13	0.01	26	50	10	8	26	<6	0.56	3.48	D
11-1, 100-110	94.7	0.00	0.78	0.86	0.004	0.08	0.01	28	38	26	8	16	<6	0.49	3.17	D
11, CC	103.0	0.00	0.57	0.85	0.01	0.08	0.01	27	40	10	8	18	<6	0.54	3.11	D
12-3, 90-92	105.5	0.00	0.60	0.90	0.009	0.10	0.03	27	34	12	16	18	<6	0.49	2.55	D
12, CC	108.0	0.00	0.81	0.53	0.007	0.05	0.02	25	30	10	11	15	<6	0.39	2.70	D
Site 340																
2-1, 35-37	9.9	7.23	0.45	3.42	0.04	0.46	0.05	32	84	42	22	84	<6	3.35	2.63	D
2-1, 42-44	10.0	0.00	0.27	1.60	0.02	0.13	0.02	38	44	38	21	27	<6	1.05	4.80	D
2-1, 148-150	11.1	10.01	0.45	3.69	0.07	0.46	0.06	27	82	44	22	84	<6	3.33	2.04	D
2, CC	19.0	0.00	0.24	2.36	0.04	0.30	0.01	30	106	89	30	23	<6	1.60	5.07	D
3-4, 75-77	24.6	1.50	0.15	1.54	0.02	0.19	0.01	37	59	45	22	28	<6	1.13	5.23	D
3-5, 75-77	26.2	2.50	0.12	1.85	0.02	0.19	0.02	39	63	27	15	28	<6	1.23	4.85	D
3, CC	28.5	2.00	0.24	2.69	0.02	0.35	0.01	61	101	44	19	40	<6	1.26	4.92	D
4-2, 75-77	31.0	0.00	0.18	1.91	0.02	0.13	0.01	32	68	35	22	25	<6	1.21	4.20	D
4, CC	38.0	0.00	0.18	1.83	0.02	0.21	0.01	31	68	32	19	28	<6	1.12	4.21	D
5-1, 70-72	38.8	0.00	0.21	2.13	0.01	0.22	0.02	36	72	35	24	28	<6	1.22	4.07	D
5, CC	47.5	2.50	0.21	1.85	0.02	0.21	0.01	36	71	32	24	25	<6	1.06	4.40	D
6-1, 60-62	48.1	0.00	0.27	1.06	0.01	0.08	0.004	30	47	35	21	16	<6	0.65	4.25	D
6-2, 60-62	49.9	0.00	0.24	2.14	0.01	0.13	0.004	30	48	35	22	18	<6	0.62	3.65	D
6, CC	67.0	0.00	0.24	2.10	0.03	0.29	0.009	57	87	38	24	28	<6	1.27	4.12	D
7-0, 10-12	67.1	0.00	0.27	2.44	0.02	0.32	0.02	43	81	40	22	33	<6	1.44	4.02	D
7-2, 95-97	59.7	0.00	0.27	2.27	0.03	0.24	0.01	53	90	50	18	28	<6	1.02	5.10	D
7-5, 95-97	64.4	0.00	0.12	1.67	0.02	0.14	0.009	43	72	38	18	24	<6	1.02	3.59	D
7, CC	66.5	0.00	0.15	0.95	0.01	0.05	0.004	34	52	22	18	14	<6	0.87	0.87	D
8-2, 72-74	67.2	0.00	0.15	1.58	0.01	0.16	0.009	37	51	34	15	24	<6	0.91	3.53	D
8-3, 72-74	70.5	1.75	0.15	1.76	0.01	0.16	0.009	39	55	34	20	23	<6	1.07	4.16	D
8, CC	76.0	2.50	0.24	2.91	0.02	0.28	0.01	57	141	44	20	35	<6	1.43	4.38	D
9-2, 70-72	78.4	3.00	0.27	2.16	0.01	0.14	0.01	48	108	–	26	28	<6	1.09	4.33	D
9-4, 70-72	81.5	0.00	0.27	2.55	0.01	0.22	0.01	45	73	32	21	34	<6	1.29	3.81	D
9-5, 70-72	83.1	0.00	0.33	2.16	0.01	0.19	0.01	45	71	32	17	26	<6	1.13	3.52	D
9, CC	85.5	0.00	0.30	2.79	0.01	0.24	0.01	52	73	60	17	34	<6	1.16	3.59	D-R-S
10-1, 195-197	86.4	0.00	0.24	2.88	0.01	0.29	0.009	52	80	44	19	33	<6	1.31	3.90	D
10-4, 50-52	90.8	0.00	0.33	2.80	0.02	0.29	0.01	48	104	40	20	35	<6	1.37	3.78	D
10-5, 50-52	92.4	0.00	0.27	2.82	0.01	0.22	0.01	53	89	26	13	34	<6	1.50	3.65	D
10, CC	95.0	0.00	0.15	2.15	0.05	0.22	0.01	32	93	40	23	19	<6	1.38	3.36	D
11-2, 81-83	97.4	0.00	0.30	2.91	0.01	0.24	0.01	60	100	54	22	38	<6	0.99	2.81	D
11-5, 81-83	102.2	0.00	0.18	3.40	0.02	0.26	0.01	60	90	61	24	38	<6	1.14	2.87	D
11-6, 81-83	103.8	1.50	0.24	2.94	0.01	0.26	0.01	62	101	50	24	34	<6	1.08	2.92	D
11, CC	104.5	3.00	0.39	3.24	0.03	0.24	0.01	56	136	58	30	33	<6	1.34	2.84	D-R-S
Site 341																
4, CC	38.0	1.75	0.45	3.08	0.03	0.40	0.05	31	80	49	18	57	<6	1.96	2.85	M-gl.m.
5-2, 50	41.0	0.00	0.96	3.02	0.02	0.37	–	31	86	50	18	64	<6	1.89	3.06	R
5, CC	47.5	0.00	0.66	3.11	0.02	0.41	–	33	86	53	21	64	<6	1.89	2.90	D
6, CC	57.0	2.75	0.90	2.95	0.02	0.32	–	33	77	50	19	53	<6	1.51	2.78	D
7, CC	66.5	5.50	0.78	3.94	0.05	0.48	–	27	82	49	23	79	<6	2.74	2.99	M-gl.m.
8, CC	76.0	4.00	0.84	3.82	0.05	0.50	–	21	83	49	23	81	<6	2.81	2.04	M-gl.m.
9, CC	85.5	8.26	0.36	3.97	0.06	0.43	–	25	88	49	20	86	<6	2.96	2.29	M-gl.m.

TABLE 4 – *Continued*

Sample (Interval in cm)	Depth (m)	Content (%)						Content (%–10^{-4})						Content (%)		Sediment Type[a]
		$CaCo_3$	C_{org}	Fe	Mn	Ti	P	Cu	Zn	Ni	Co	Cr	Cd	K_2O	Na_2O	
Site 341 – *Continued*																
10-3, 109-111	90.4	8.50	0.54	3.89	0.06	0.43	–	21	86	53	24	89	<6	2.92	2.18	M-gl.m.
11, CC	99.7	9.00	0.45	3.97	0.06	0.38	–	21	86	54	24	86	<6	3.00	2.15	M-gl.m.
12, CC	105.5	9.51	0.36	3.99	0.05	0.47	–	20	85	53	26	84	<6	2.96	2.17	M-gl.m.
13, CC	114.0	10.76	0.36	3.92	0.06	0.40	–	20	85	50	23	86	<6	2.75	2.22	M-gl.m.
14, CC	123.5	15.76	0.42	3.76	0.06	0.43	–	20	83	46	20	80	<6	2.98	2.02	M-gl.m.
16, CC	171.0	8.00	0.33	3.72	0.06	0.40	–	19	83	46	23	79	<6	3.02	2.14	M-gl.m.
18, CC	209.0	8.76	0.30	3.81	0.06	0.47	–	25	76	55	17	82	<6	3.19	2.22	M-gl.m.
19, CC	228.0	9.00	0.30	3.92	0.06	0.44	–	21	79	51	24	77	<6	3.17	2.29	M-gl.m.
20, CC	247.0	10.51	0.36	4.42	0.06	0.54	–	42	100	76	22	90	<6	2.89	1.93	M-gl.m.
21, CC	266.0	0.25	0.27	5.08	0.04	0.54	–	43	101	76	27	82	<6	3.24	2.14	M-gl.m.
23-3, 10-12	304.1	3.00	0.66	4.88	0.03	0.61	–	40	105	84	31	86	<6	3.28	2.08	M-gl.m.
24, CC	323.0	2.50	0.18	4.83	0.07	0.53	–	51	107	80	29	84	<6	3.58	1.86	M-gl.m.
25, CC	342.0	0.25	1.20	3.96	0.02	0.56	–	48	97	76	19	73	<6	2.73	2.00	T-si.
26-2, 137-139	354.6	59.04	0.36	1.45	0.04	0.17	–	18	36	29	19	24	<6	0.95	1.39	C
26, CC	361.0	10.00	0.72	3.57	0.02	0.46	–	40	97	67	19	77	<6	2.29	2.21	T-si.
27-2, 120-122	373.4	3.00	0.75	3.98	0.02	0.50	–	35	99	71	19	77	<6	2.73	1.93	Dt.
27, CC	380.0	9.00	0.75	4.13	0.02	0.47	–	35	98	69	29	77	<6	2.45	1.96	Dt.
28-2, 100-102	392.2	5.75	0.54	3.93	0.02	0.53	–	36	95	76	37	77	<6	2.29	2.11	Dt.
28, CC	399.0	0.50	0.75	3.42	0.02	0.39	–	38	89	61	22	54	<6	2.02	2.33	Dt.
29-2, 30-32	400.9	3.50	0.75	3.40	0.02	0.63	–	35	92	72	22	67	<6	1.84	2.08	T-si.
29, CC	408.5	0.00	2.10	3.61	0.02	0.63	–	38	90	72	22	72	<6	2.21	1.86	T-si.
30-2, 35-37	410.5	0.75	1.02	3.89	0.02	0.59	–	41	91	72	26	76	<6	2.43	1.98	Dt.
30, CC	418.0	0.00	0.96	4.04	0.02	0.60	–	45	100	74	26	76	<6	2.57	2.06	T-si.
31-2, 68-70	420.3	0.00	1.20	4.02	0.02	0.63	–	50	100	74	26	67	<6	2.50	1.89	T-si.
31, CC	427.5	0.00	1.20	3.56	0.02	0.56	–	44	92	72	21	66	<6	2.27	1.96	T-si.
32-2, 50-52	429.6	0.00	1.59	3.72	0.02	0.62	–	44	98	69	19	64	<6	2.17	1.94	T-si.
32, CC	437.0	0.50	1.38	3.67	0.02	0.56	–	42	99	69	24	72	<6	2.41	1.92	T-si.
33-2, 59-61	439.2	0.50	2.14	3.59	0.02	0.62	–	44	91	63	26	61	<6	2.18	1.85	T-si.
33, CC	446.5	0.00	1.77	3.42	0.03	0.56	–	53	95	64	26	59	<6	2.17	2.32	T-si.
34-2, 59-61	448.7	2.00	2.46	3.30	0.02	0.59	–	61	99	74	24	67	<6	2.24	2.05	T-si.
34-4, 62-64	451.9	0.50	2.52	4.01	0.03	0.49	–	50	88	52	20	68	<6	1.95	1.93	T-si.
34, CC	456.0	0.25	1.89	3.96	0.02	0.55	–	44	103	41	18	54	<6	1.96	1.95	T-si.
Site 342																
1-1, 49-51	0.5	11.26	0.21	4.30	0.08	0.40	–	22	84	38	21	70	<6	3.00	1.80	T.m.
1-3, 51-53	3.5	18.01	0.24	3.84	0.11	0.44	–	28	67	37	18	87	<6	2.19	2.06	T.m.
1, CC	9.0	6.50	0.63	4.23	0.08	0.47	–	32	81	41	24	92	<6	2.56	2.06	T.m.
2-3, 120-122	42.0	0.75	0.21	4.97	0.08	0.52	–	48	101	49	26	90	<6	2.75	2.20	T.m.
2, CC	47.0	14.76	0.42	4.86	0.12	0.49	–	34	98	53	22	95	<6	2.46	2.05	T.m.
3-1, 89-91	86.0	0.00	0.66	6.00	0.03	0.69	–	44	103	79	33	95	<6	2.63	2.53	T-si.
3-3, 119-121	89.6	–	–	5.07	0.03	0.63	–	57	102	53	21	103	<6	2.58	2.57	T-si.
3, CC	94.5	–	–	3.63	0.03	0.46	–	44	83	52	21	62	<6	1.96	2.85	T-si.
4, CC	132.5	–	–	2.50	0.02	0.25	–	31	71	49	18	50	<6	1.32	2.78	D-R-S
5-1, 100-102	133.6	–	–	2.98	0.02	0.34	–	28	72	37	19	60	<6	1.70	2.78	D
5-3, 100-102	136.7	–	–	2.53	0.02	0.30	–	28	72	43	20	56	<6	1.50	2.78	D
5-4, 100-102	138.3	–	–	2.95	0.02	0.35	–	34	71	46	19	57	<6	1.45	2.80	D
5-5, 100-102	139.9	–	–	3.14	0.02	0.35	–	28	65	43	19	54	<6	1.64	2.69	D

[a]Sediment type: M.-gl.m. = marine-glacial mud; T-si. = terrigenous siliceous (diatom) mud; D = diatom ooze; T.m. = terrigenous mud; D-R-S = diatom, radiolarian, spicule ooze; R = radiolarian ooze; C. = coccolith ooze; Dt. = diatomite.

regime allowed a high diatom productivity (sometimes radiolarians). In all probability, the favorable regime of that time was created by: (1) different circulation systems of water masses than now and in the Pleistocene, (2) active volcanic processes, and (3) upwelling of cool water on the Vøring Plateau.

Investigations of Recent sediments (Emelyanov, 1973; Emelyanov et al., 1975) show that under upwelling areas (i.e., southwest Africa littoral) diatom oozes from, with a rich C_{org} content. The C_{org} content in Miocene sediments is 2-5 times richer than in Recent sediments.

Late Eocene diatom oozes (Site 341) were deposited in other tectonic and hydrochemical situations. Apparently, the late Eocene sea was deeper than in the Miocene. This conclusion is confirmed by: (1) a very rich clay fraction (<0.01 mm), (2) a low content of quartz and feldspar, and (3) a very low C_{org} and P content. Similar contents are typical for pelagic diatom oozes (Emelyanov et al., 1975). The role of volcanism in the Eocene was less than in the Miocene, confirmed by low concentrations of Fe, Ti, Ni, and Cr, typical for volcanogenic sediments.

The volcanic products would have been delivered from Iceland and Jan-Mayen, as well as from closer sources. Eocene diatomites of Lim-Fiord (Denmark) contain volcanic ash, possibly from the volcanic Skagerrack region (Holtedahl, 1955). The Tertiary sub-

TABLE 5
Comparison of Chemical Composition of Sediments from the Vøring Plateau with the Percent Sediments of the Atlantic Ocean and Baltic Sea (Russian Data)

Sediment Type[a]	No. of Samples	Content (%) $CaCO_3$	C	Fe	Mn	Ti	P	Cu 10^{-4}	Zn 10^{-4}	Ni 10^{-4}	Co 10^{-4}	Cr 10^{-4}	Cd 10^{-4}	Content (%) K_2O	Na_2O
							Voring Plateau								
M-Gl. (Site 339)	13	8.82	0.54	3.96	0.05	0.51	0.06	29	85	40	17	88	<5	2.86	1.98
M-GL. (Site 341)	16	7.19	0.44	4.06	0.05	0.47	–	28	88	58	23	82	<6	2.97	2.22
(Site 340)	31	1.11	0.24	2.27	0.02	0.24	0.01	43	79	40	20	32	<6	1.29	3.93
T-Si (Site 341)	19	1.92	1.35	3.75	0.02	0.54	–	43	95	68	23	69	<6	2.28	2.02
							Baltic Sea								
T.a.-p.m.	40	0.73	3.32	4.25	0.05	0.39	0.07	46	155	35	–	95	<6	–	–
Moraines	8	14.64	0.37	2.06	0.04	0.25	0.06	–	–	–	–	–	–	–	–
							Atlantic Ocean								
T.S.	60	–	0.56	2.85	0.05	0.35	0.07	66	83	38	–	68	<6	1.67	2.16
T.S.	20	–	0.60	7.00	0.14	1.12	0.13	55	103	35	–	145	<6	1.56	3.28
D.O.	8	–	5.77	1.50	0.02	0.14	0.48	–	–	72	–	109	<6	1.40	7.54

[a]M.-Gl. = marine-glacial mud, D = diatom ooze, D.t. = diatomite, T.a.-p.m. = terrigenous silty-clayey mud, T.S. = terrigenous sediments (sand, silt, clay), V.S. = volcanic sediments, D.O. = diatom ooze (southwest Africa shelf), T-Si. = terrigenous siliceous mud.

sidence of the Norwegian shelf was accompanied by volcanic activity, reflected by the presence of volcanic ash and glass in the diatom oozes of the Vøring Plateau.

However, the role of volcanism in Tertiary sedimentation was less than at present in the Norwegian sea (Emelyanov and Kharin, 1974). Low admixture of pyroclastic material and probable enriching of seawater by Si and P are the results of the influence of volcanism. No direct influence of volcanism/hydrothermal activity on the sedimentation pattern has taken place. Authigenic minerals (Fe-sulfides, glauconite) present in the lower deposits may be a result of diagenetic alterations of the volcanic material.

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