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55. VARIATIONS IN UPPER CRETACEOUS AND CENOZOIC CALCIUM CARBONATE PERCENTAGES, MAUD RISE, WEDDELL SEA, ANTARCTICA[1]

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ABSTRACT

An almost continuous Upper Cretaceous through Pleistocene biogenic sediment section was recovered from two sites on Maud Rise, a volcanic edifice in the Weddell Sea, off eastern Antarctica. Calcium carbonate values were determined for 1100 closely spaced samples using a Coulometrics CO_2 Coulometer.

Following a very brief decrease in the percentage of calcium carbonate immediately above the Cretaceous/Tertiary boundary, values remain high (~70%-80%), throughout most of the Paleocene, with variations primarily attributed to changes in the relative abundance of terrigenous and biogenic components. A small general decrease in calcium carbonate is observed from the upper Paleocene to lower middle Eocene. Eocene values continue to show small to moderate fluctuations. These fluctuations become more pronounced in the Oligocene as biosiliceous and carbonate sediments are mixed and interlayered. A distinct decrease in the calcium carbonate component is observed in the upper Oligocene through lower middle Miocene. Calcium carbonate becomes dominant again in the middle and lower upper Miocene, followed by almost exclusive biosiliceous sedimentation until the Pleistocene, where foraminifer-dominated calcareous ooze was recovered. Interpretation of this data will be carried out when a more finalized chronostratigraphy for the sequence has been produced.

INTRODUCTION

The calcium carbonate content of the sediment column is a function of production, dissolution, and dilution. In modern marine sections collected by piston cores, calcium carbonate stratigraphy commonly parallels stable isotope stratigraphy and has been used for stratigraphic correlation and to interpret global climatic variations (e.g., Hayes et al., 1969; Prell, 1978; Dunn et al., 1981). With the development of the hydraulic piston corer (HPC) and the extended core barrel (XCB), these studies were extended to include the remainder of the Cenozoic (e.g., Gardner, 1982; Pisias and Prell, 1985; Pisias et al., 1985).

During ODP Leg 113, an almost continuous Miocene to Cretaceous calcium carbonate section was recovered at Maud Rise, in the Weddell Sea (Figs. 1 and 2). Closely spaced calcium carbonate analyses were carried out on these samples to monitor percent variations and to relate them to glacial and oceanographic changes. Only the data are presented in this paper because more detailed interpretive studies require an accurate chronostratigraphy, which is still being determined (see Gersonde et al., this volume; Thomas et al., this volume).

SITE LOCATION AND BACKGROUND

Maud Rise is a volcanic edifice, located in the present-day Antarctic surface water mass (Fig. 1). Two sites were drilled on Maud Rise at different water depths as part of a depth transect to examine the history of vertical water-mass stratification on Upper Cretaceous through Neogene Antarctic sedimentation (Barker, Kennett, et al., 1988).

Site 689, in 2080 m of water, lies near the top of Maud Rise and is the shallower of the two sites (Fig. 1). The section penetrated 297.3 m of almost pure siliceous and calcareous oozes and chalk, with chert layers at the top and bottom of the sequence (Fig. 2A). The sediments range in age from late Campanian?/early Maestrichtian to Pliocene. Sedimentary hiatuses or condensed sequences are present throughout the section (Fig. 2A). Three lithologic units were identified: Unit I (0-31.0 mbsf) of middle/late Miocene to Pliocene age is dominated by biosiliceous ooze; Unit II (31.0-149.1 mbsf) consists of a mixture of biosiliceous (predominantly diatom) and calcareous (predominantly nannofossil) oozes ranging in age from late Eocene to middle/late Miocene; Unit III (149.1-297.3 mbsf) is represented by nannofossil ooze and chalk, with varying amounts of foraminifers and ranging in age from late Campanian?/early Maestrichtian to late Eocene (Barker, Kennett, et al., 1988). Hiatuses were identified at the Cretaceous-Tertiary, lower-upper Paleocene; upper Paleocene-middle Eocene; lower-upper Oligocene; lower-middle Miocene; and lower-upper Pliocene boundaries.

At Site 690, in 2914 m of water, on the southwestern flank of Maud Rise (Fig. 1), 321.1 m of sediment was penetrated, ranging in age from Campanian to Pleistocene (Fig. 2B). Sediment in the upper half of the sequence is almost pure siliceous and calcareous ooze with some mixed calcareous ooze/chalk intervals. Terrigenous sediment, dominantly fine grained, was recovered with the biogenic sediments in the lower half of the section. Chert was recovered only in the basal sediments. Compared to Site 689, fewer hiatuses are present and microfossil preservation is better. A major hiatus spans the middle-upper Eocene and part of the upper Eocene/lower Oligocene. As at Site 689, the upper Oligocene-lower Miocene and lower-middle Miocene hiatuses are present.

Five lithologic units were identified: Unit I, 0-24.2 mbsf, of late Miocene to Pleistocene age, consists of 2.2 m of foraminiferal ooze underlain by 22.0 m of biosiliceous ooze; Unit II, 24.2-92.9 mbsf, of early Oligocene to late Miocene age, is represented by a variety of pure and mixed siliceous and calcareous oozes, Unit III, 92.9-137.8 mbsf, of early Eocene to early Oligocene age, is dominated by calcareous ooze. Unit IV, 137.8-281.1 mbsf, of late Maestrichtian to early Eocene age, is composed of calcareous ooze/chalk with varying amounts of terrigenous components (clay, quartz, mica). Unit V, 281.1-317.0 mbsf, of late Campanian to early Maestrichtian age, consists of terrigenous components, volcanic glass, and calcium carbonate ooze-chalk. Unit V is directly underlain by basaltic basement.

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[1] Barker, P. F., Kennett, J. P., et al., 1990. *Proc. ODP, Sci. Results*, 113: College Station, TX (Ocean Drilling Program).

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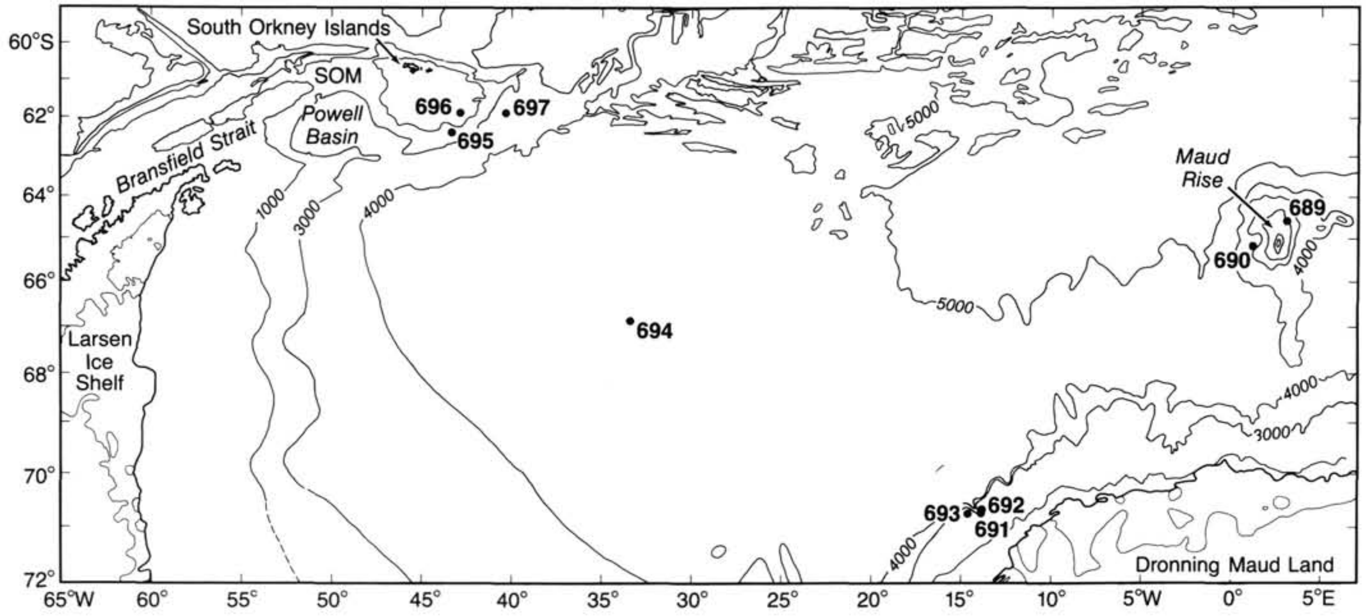

Figure 1. Generalized bathymetry (in meters) and location map, showing Maud Rise in the Weddell Sea and the location of ODP Leg 113 sites (from Barker, Kennett, et al., 1988).

METHODS

Two cm^3 samples were taken every 20–50 cm throughout the Cenozoic calcium carbonate intervals of Sites 689 and 690 and at wider spacing in siliceous and older intervals. Widely spaced samples within these intervals are due to poor core recovery or poor core quality. Approximately 1100 samples were analyzed. Depths given are from the top of the sampled interval. Samples were dried in either a 100°C oven or in a freeze dryer, powdered, weighed to the nearest milligram, and analyzed for calcium carbonate using a Coulometrics CO_2 Coulometer. The Coulometer has an accuracy of 0.15% (± 0.2 mg).

The Coulometrics titration technique measures all of the CO_2 that is liberated by acidifying and heating sediment samples in a closed system. To do this, the powdered samples are placed in a test tube that is attached to the Coulometer, placed in a heat shield, and 2N HCl is pumped into the test tube. The liberated CO_2 is transferred through scrubbers (solutions to remove interfering substances) by a CO_2-free gas into an absorption cell where it is titrated through coulometric means. The absorption cell contains an aqueous medium of thanolamine and a coulometric indicator. The interaction of the CO_2 and the cell solution creates a titratable acid. The coulometer forms a base electrically and titrates to an end point determined by the optical transmission of the indicator (Huffman, 1977). The pulse output was scaled and fed to a counter in terms of CO_2. A stable Coulometer reading indicates that all of the CO_2 has been evolved and titrated. The reading was recorded and the results were calculated in micrograms carbon and $CaCO_3$ ($\%CaCO_3 = \%C_{inorg} \times 8.334$). This method of calculation assumes that all of the CO_2 is liberated from calcium carbonate, but some of the CO_2 may be liberated from dolomite, siderite, or other carbonate minerals.

Age determinations are from Gersonde et. al. (this volume) and Thomas et al. (this volume), based on biostratigraphic correlations using the Berggren et al. (1985a; 1985b) time scale.

RESULTS

Calcium carbonate percentages exhibit a wide range of variation in the Maud Rise sediments (0%–100%; Tables 1–5; Figs. 3–7).

Upper Cretaceous

Upper Cretaceous samples range from 65% to 100% $CaCO_3$ at Site 689 and 56% to 92% at Site 690, with no systematic trend. Cyclic color variations, which coincide with calcium carbonate variations, are observed in the sediment. These cores were sampled only about every 50 cm because of the difficulty in distinguishing primary depositional effects from those due to induration and diagenesis. In Hole 690C, relatively high, (80%–90%) calcium carbonate values are present below the Cretaceous/Tertiary (K/T) boundary (Table 5, Fig. 7). A sharp, brief drop occurs immediately following the boundary (48%), followed by values in the high 80%'s.

Paleocene

The amount of Paleocene sediment recovery was very different at the two sites, primarily because of the hiatuses at Site 689. At Site 689, 6 m of lower Paleocene and 25 m of upper Paleocene were recovered (Table 1, Fig. 3). At Site 690, 21 m of lower Paleocene and 61 m of upper Paleocene sediment were recovered (Tables 4 and 5; Figs. 6 and 7). Lower Paleocene sediments have calcium carbonate values that average between 87% and 97% at Site 689 and 55% and 100% at Site 690. Upper Paleocene sediments also show a narrow range at Site 689 (82%–99%) and a wide range at Site 690 (56%–99%). At Site 690, the calcium carbonate percentages exhibit an overall small decreasing trend superimposed on these variations. The lower values are associated with darker, more clay rich layers, although there is not always a direct correlation with darkness and lower calcium carbonate values (Fig. 8). The clay minerals are dominantly composed of smectite (Robert and Maillot, this volume), and no mineralogical change is associated with the fluctuations in calcium carbonate values.

Recovery of lower Eocene sediments was much better at Site 690 than at Site 689, but recovery in the remainder of the Eocene was better at Site 689 (Tables 1 and 4; Figs. 3 and 6). The trend of decreasing calcium carbonate continues in the lower Eocene (Site 690), with values ranging between 58% and 91%. A small overall increase is observed in the remainder of the Eocene with values ranging from 70% to 100% (Site 689), and 64% to 90% (Site 690) for the middle Eocene, and 77% to 98%

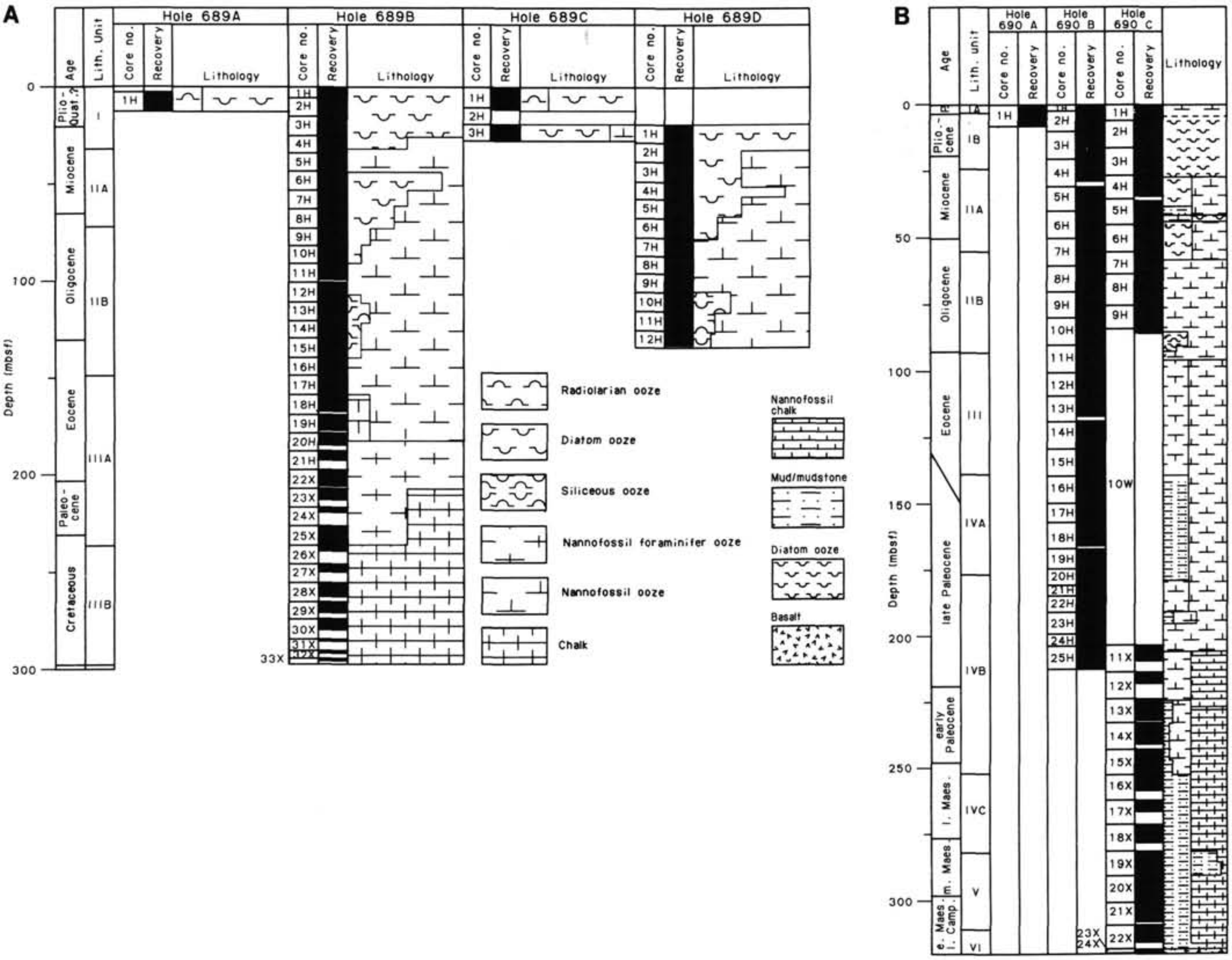

Figure 2. **A.** Simplified lithology for Site 689, including core number and recovery; ages are from shipboard data. **B.** Simplified lithology for Site 690, including core number and recovery; ages are from shipboard data (from Barker, Kennett, et al., 1988).

(Site 689) and 62% to 96% (Site 690) for the upper Eocene. Eocene sediments at both sites are primarily white nannofossil ooze, and the minor clay component is dominated by smectite with an increase in illite in the upper Eocene (Robert and Maillot, this volume).

The Oligocene section at Site 690 is two-thirds as thick as at Site 689, 40 m vs. 58 m (Tables 1 and 4; Figs. 3 and 6). Calcium carbonate values show the following ranges: lower Oligocene, 60%-100% (Site 689) and 51%-85% (Site 690), and upper Oligocene, 60%-99% (Site 689), and 39%-93% (Site 690). At both sites the range of calcium carbonate percentages becomes more variable upsection, with a distinct decrease in overall abundance in the upper Oligocene. Unlike the variations in the lower Paleocene, which were attributable to the influx of terrigenous sediment, the Oligocene fluctuations are attributed to variations in the siliceous component. Although these variations are not as readily distinguishable by color, they are commonly associated with textural changes (Fig. 9). There is also a change in clay mineralogy: smectite is replaced by illite associated with chlorite and mixed layer clays. This change is attributed to a change in weathering conditions on Antarctica caused by the development of cold and/or dry climate. The clay mineral change is observed throughout the entire Oligocene (Robert and Maillot, this volume).

Neogene

A hiatus marks the Oligocene–Miocene (Fig. 9) and early–middle Miocene boundary at both sites. The most marked change and highest variability in calcium carbonate values occurs during the Miocene (Tables 1-4; Figs. 3-6) with values as follows; lower Miocene, 0%-82% (Site 689) and 37%-70% (Site 690); middle Miocene, 0%-91% (Site 689) and 0%-87% (Site 690); and upper Miocene, 0%-46% (Site 689) and 0%-83% (Site 690). Throughout the lower and lower middle Miocene there is a gradual, although highly variable, decrease in calcium carbonate values. At both sites, the middle middle Miocene is a biosiliceous interval almost completely devoid of carbonate. The siliceous-rich interval is overlain by a carbonate-rich interval that stops at the middle–late Miocene boundary at Site 689 and continues into the upper Miocene at Site 690. Although terrigenous material is sparse, smectite is again thedominant clay mineral (Robert and Maillot, this volume).

During the Pliocene the sediments consist of almost exclusive biosiliceous sediments (Tables 1-4; Figs. 3-6). This domi-

Table 1. Calcium carbonate percentages for Hole 689B, taken between 4.00 and 291.50 mbsf depths. Data plotted in Figure 3.

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
689B 1 03 101	04.00	00.00
689B 2 01 23	05.53	00.60
689B 2 03 20	08.50	02.90
689B 2 04 145	11.25	00.30
689B 2 05 20	11.50	01.20
689B 3 01 20	15.00	00.30
689B 3 03 20	18.00	00.20
689B 3 04 120	20.50	00.30
689B 3 05 21	21.00	01.00
689B 4 01 63	24.93	03.90
689B 4 03 63	27.93	00.50
689B 4 04 145	30.25	00.20
689B 4 05 63	30.93	50.70
689B 4 05 92	31.22	62.10
689B 4 06 90	32.70	81.30
689B 5 02 90	36.20	81.30
689B 5 04 90	39.20	91.30
689B 5 04 145	39.75	89.00
689B 5 06 90	42.20	90.00
689B 6 02 90	45.70	07.80
689B 6 04 67	48.47	01.20
689B 6 04 120	49.00	00.80
689B 6 06 90	51.70	36.80
689B 7 01 15	53.05	08.41
689B 7 01 60	53.50	26.74
689B 7 01 110	54.00	61.39
689B 7 02 15	54.55	19.99
689B 7 02 60	55.00	25.65
689B 7 02 90	55.30	54.60
689B 7 02 110	55.50	25.91
689B 7 03 15	56.05	00.83
689B 7 03 60	56.50	04.00
689B 7 03 110	57.00	11.50
689B 7 04 15	57.55	03.50
689B 7 04 60	58.00	40.90
689B 7 04 90	58.30	37.70
689B 7 04 110	58.50	23.57
689B 7 05 15	59.05	57.98
689B 7 05 60	59.50	81.55
689B 7 05 110	60.00	73.80
689B 7 06 15	60.55	57.14
689B 7 06 60	61.00	40.56
689B 7 06 90	61.30	00.20
689B 7 06 110	61.50	40.48
689B 7 07 15	62.05	24.07
689B 7 cc 5	62.29	13.99
689B 8 01 17	62.67	68.47
689B 8 01 70	63.20	58.39
689B 8 01 90	63.40	51.20
689B 8 01 118	63.68	60.89
689B 8 02 17	64.17	74.63
689B 8 02 70	64.70	72.97
689B 8 02 118	65.18	60.56
689B 8 03 17	65.67	47.56
689B 8 03 70	66.20	58.14
689B 8 03 90	66.40	63.10
689B 8 03 118	66.68	79.97
689B 8 04 17	67.17	74.72
689B 8 04 70	67.70	72.80
689B 8 04 118	68.18	70.05
689B 8 05 17	68.67	73.47
689B 8 05 70	69.20	78.64
689B 8 05 90	69.40	68.40
689B 8 05 118	69.68	82.55
689B 8 06 17	70.17	85.46
689B 8 06 70	70.70	75.80
689B 8 06 118	71.18	95.96
689B 8 07 10	71.60	80.88
689B 9 01 22	72.32	60.14
689B 9 01 70	72.80	75.80
689B 9 01 119	73.29	91.05
689B 9 02 22	73.82	95.13
689B 9 02 70	74.30	93.38
689B 9 02 90	74.50	89.60
689B 9 02 119	74.79	93.12
689B 9 03 22	75.32	84.22
689B 9 03 70	75.80	97.04
689B 9 03 119	76.29	84.04
689B 9 04 22	76.82	88.71
689B 9 04 70	77.30	92.37
689B 9 04 90	77.50	85.10
689B 9 04 114	77.74	85.72
689B 9 04 117	77.77	89.20
689B 9 05 22	78.32	91.30
689B 9 05 70	78.80	98.29
689B 9 05 119	79.29	87.88
689B 9 06 8	79.68	75.50
689B 9 06 22	79.82	81.70
689B 9 06 70	80.30	89.20
689B 9 cc 10	80.55	82.88
689B 10 01 22	81.92	63.47
689B 10 01 68	82.38	80.80
689B 10 01 123	82.93	82.53
689B 10 02 22	83.42	79.80
689B 10 02 68	83.88	76.96
689B 10 02 90	84.10	98.50
689B 10 02 123	84.43	86.96
689B 10 03 22	84.92	84.46
689B 10 03 68	85.38	86.38
689B 10 03 123	85.93	88.88
689B 10 04 22	86.42	91.21
689B 10 04 68	86.88	79.80
689B 10 04 90	87.10	84.10
689B 10 04 123	87.43	89.55
689B 10 05 22	87.92	83.71
689B 10 05 68	88.38	83.55
689B 10 05 123	88.93	89.21
689B 10 06 22	89.42	79.38
689B 10 06 68	89.88	83.38
689B 10 06 90	90.10	76.90
689B 11 01 45	91.75	79.38
689B 11 01 73	92.03	84.88
689B 11 01 90	92.20	83.10
689B 11 01 125	92.55	79.13
689B 11 02 23	93.03	78.88
689B 11 02 73	93.53	86.13
689B 11 02 125	94.05	82.21
689B 11 03 23	94.53	90.04
689B 11 03 73	95.03	91.54
689B 11 03 90	95.20	79.10
689B 11 03 125	95.55	87.21
689B 11 04 23	96.03	81.80
689B 11 04 73	96.53	72.47
689B 11 04 125	97.05	89.13
689B 11 05 23	97.53	81.71
689B 11 05 73	98.03	97.29
689B 11 05 90	98.20	84.90
689B 11 05 125	98.55	91.54
689B 11 cc 10	98.82	81.05
689B 12 01 21	101.21	59.89
689B 12 01 63	101.63	61.80
689B 12 01 70	101.70	70.94
689B 12 01 116	102.16	67.80
689B 12 02 26	102.76	65.72
689B 12 02 70	103.20	83.23
689B 12 02 118	103.68	77.64
689B 12 03 21	104.21	82.71
689B 12 03 62	104.62	85.10
689B 12 03 70	104.70	60.72
689B 12 04 112	105.10	86.00
689B 12 03 116	105.16	83.71
689B 12 04 21	105.71	88.30
689B 12 04 70	106.20	97.62
689B 12 04 107	106.57	87.21
689B 12 05 21	107.21	81.99
689B 12 05 64	107.64	83.00
689B 12 05 70	107.70	85.38
689B 12 05 116	108.16	79.38
689B 12 06 21	108.71	63.26
689B 12 06 70	109.20	100.00
689B 12 06 116	109.66	71.13
689B 12 07 21	110.21	72.59
689B 12 cc 13	110.51	67.38
689B 13 01 22	110.82	75.13
689B 13 01 63	111.23	63.90
689B 13 01 69	111.29	70.17
689B 13 01 120	111.80	69.68
689B 13 01 134	111.94	78.63
689B 13 02 22	112.32	86.72
689B 13 02 69	112.79	78.82
689B 13 02 122	113.32	69.80
689B 13 03 22	113.82	83.25
689B 13 03 63	114.23	90.00
689B 13 03 69	114.29	88.29
689B 13 03 122	114.82	89.21
689B 13 04 22	115.32	79.13
689B 13 04 69	115.79	89.71
689B 13 04 122	116.32	91.40
689B 13 05 22	116.82	89.29
689B 13 05 63	117.23	92.60
689B 13 05 120	117.80	84.30
689B 13 06 22	118.32	85.12
689B 13 06 71	118.81	84.86
689B 13 06 125	119.35	72.81
689B 13 07 22	119.82	78.89
689B 13 cc 21	120.13	82.55
689B 14 01 23	120.43	85.51
689B 14 01 62	120.82	85.10
689B 14 01 70	120.90	81.05
689B 14 01 120	121.40	81.59
689B 14 02 23	121.93	93.80
689B 14 02 70	122.40	89.35
689B 14 02 123	122.93	87.76
689B 14 03 23	123.43	91.55
689B 14 03 63	123.83	87.40
689B 14 03 70	123.90	84.90
689B 14 03 123	124.43	86.93
689B 14 04 23	124.93	90.63
689B 14 04 70	125.40	87.11
689B 14 04 123	125.93	89.50
689B 14 05 23	126.43	84.85
689B 14 05 61	126.81	87.10
689B 14 05 70	126.90	86.62
689B 14 05 120	127.40	87.95
689B 14 06 23	127.93	87.22
689B 14 06 70	128.40	88.38
689B 14 06 123	128.93	77.38
689B 14 07 25	129.45	82.05
689B 14 cc 9	129.61	85.29
689B 15 01 22	130.12	82.84
689B 15 01 72	130.62	84.43
689B 15 01 64	130.64	87.50
689B 15 01 123	131.13	89.68
689B 15 02 22	131.62	88.10
689B 15 02 72	132.12	91.88
689B 15 02 123	132.63	90.49
689B 15 03 22	133.12	86.35
689B 15 03 64	133.54	89.20
689B 15 03 72	133.62	85.55
689B 15 03 123	134.13	87.08
689B 15 04 22	134.62	88.14
689B 15 04 72	135.12	93.37
689B 15 04 112	135.52	87.90
689B 15 04 114	135.54	90.21
689B 15 05 22	136.12	94.55
689B 15 05 64	136.54	88.80
689B 15 05 72	136.62	88.63
689B 15 05 123	137.13	97.71
689B 15 06 22	137.62	90.06
689B 15 06 72	138.12	94.38
689B 15 06 123	138.63	94.15
689B 15 07 21	139.11	95.38
689B 16 01 23	139.63	87.02
689B 15 cc 14	139.64	83.41
689B 16 01 62	140.00	95.80
689B 16 01 73	140.13	94.62
689B 16 01 118	140.58	94.55
689B 16 02 23	141.13	96.82
689B 16 02 73	141.63	93.63
689B 16 02 118	142.08	93.20
689B 16 03 23	142.63	93.72
689B 16 03 62	143.02	90.10
689B 16 03 73	143.13	91.79
689B 16 03 118	143.58	92.47
689B 16 04 23	144.13	91.37
689B 16 04 73	144.63	90.28
689B 16 04 118	145.08	93.37
689B 16 05 23	145.63	91.25
689B 16 05 63	146.03	94.50
689B 16 05 73	146.13	95.38
689B 16 05 118	146.58	91.55
689B 16 06 23	147.13	87.15
689B 16 06 73	147.63	95.20
689B 16 06 118	148.08	90.55
689B 16 07 23	148.63	94.24
689B 16 cc 9	149.01	92.23
689B 17 01 22	149.32	94.88
689B 17 01 59	149.69	95.10
689B 17 01 73	149.83	92.14
689B 17 01 127	150.37	89.24
689B 17 02 22	150.82	90.65
689B 17 02 127	151.87	87.71
689B 17 03 22	152.32	87.86
689B 17 03 58	152.68	90.30
689B 17 03 73	152.83	91.55
689B 17 03 127	153.37	89.86
689B 17 04 22	153.82	91.49
689B 17 04 73	154.33	90.39
689B 17 05 22	155.32	90.37
689B 17 05 58	155.68	94.10
689B 17 05 73	155.83	91.28
689B 17 05 127	156.37	92.13
689B 17 06 22	156.82	89.40
689B 17 07 22	158.32	91.31
689B 17 cc 9	158.79	92.94
689B 18 01 22	159.02	99.71
689B 18 01 74	159.54	93.62
689B 18 01 123	160.03	84.29
689B 18 02 22	160.52	79.71
689B 18 02 74	161.04	83.96
689B 18 02 90	161.20	94.00
689B 18 02 123	161.53	88.96
689B 18 03 22	162.02	91.71
689B 18 03 74	162.54	84.29
689B 18 03 123	163.03	84.63
689B 18 04 22	163.52	80.55
689B 18 04 74	164.04	81.88
689B 18 04 90	164.20	82.50
689B 18 04 112	164.42	71.50
689B 18 04 113	164.43	72.88
689B 18 05 22	165.02	81.63
689B 18 05 74	165.54	70.05
689B 18 05 123	166.03	88.46
689B 18 06 22	166.52	78.38
689B 18 CC 10	166.78	70.30
689B 18 06 90	167.20	87.00
689B 19 01 21	168.71	88.21
689B 19 01 73	169.23	87.46
689B 19 01 123	169.73	86.88
689B 19 02 21	170.21	81.96
689B 19 02 90	170.90	85.10
689B 19 02 123	171.23	71.38
689B 19 03 21	171.71	83.46
689B 19 03 123	172.73	84.46
689B 19 04 21	173.21	87.22
689B 19 04 90	173.90	98.10
689B 19 04 123	174.23	86.46
689B 19 05 21	174.71	90.63
689B 19 05 123	175.73	86.80
689B 19 06 21	176.21	80.88
689B 19 06 52	176.52	90.70
689B 19 06 73	176.73	89.89
689B 20 01 26	178.36	74.72
689B 20 01 85	178.95	88.88
689B 20 01 125	179.35	83.13
689B 20 02 26	179.86	86.89
689B 20 02 85	180.45	91.21
689B 20 02 90	180.50	93.00

Table 1 (continued).

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
689B 20 02 125	180.85	88.13
689B 20 03 26	181.36	84.21
689B 20 03 85	181.95	88.54
689B 20 03 125	182.35	87.54
689B 20 04 26	182.86	76.13
689B 20 04 85	183.45	82.21
689B 20 04 90	183.50	89.50
689B 20 04 125	183.85	83.38
689B 20 05 26	184.36	84.29
689B 21 01 21	188.01	90.46
689B 21 01 72	188.52	82.38
689B 21 01 90	188.70	93.30
689B 21 01 127	189.07	88.21
689B 21 02 21	189.51	88.38
689B 21 02 72	190.02	83.71
689B 21 02 127	190.57	82.30
689B 21 03 21	191.01	90.29
689B 21 03 22	191.02	86.46
689B 21 03 72	191.52	90.38
689B 21 03 90	191.70	94.40
689B 21 03 127	192.07	87.54
689B 21 CC 9	192.17	89.21
689B 22 01 81	198.31	85.10
689B 22 02 22	199.22	91.54
689B 22 03 22	200.72	91.87
689B 22 03 78	201.60	89.60
689B 22 04 112	203.12	91.00
689B 22 05 51	204.01	95.10
689B 22 06 15	205.15	92.30
689B 23 01 26	207.46	83.47
689B 23 01 41	207.60	81.70
689B 23 01 73	207.93	85.38
689B 23 01 129	208.49	92.13
689B 23 02 19	208.89	92.79
689B 23 02 73	209.43	94.04
689B 23 02 129	209.99	90.54
689B 23 02 136	210.06	89.50
689B 23 03 26	210.46	82.96
689B 23 03 73	210.93	91.63
689B 23 03 107	211.27	93.30
689B 23 03 129	211.49	94.37
689B 23 04 19	211.89	92.80
689B 23 04 84	212.54	92.37
689B 23 CC 9	212.76	91.87
689B 24 01 20	217.10	91.13
689B 24 01 63	217.53	93.04
689B 24 01 109	217.99	98.87
689B 24 CC 5	218.13	92.54
689B 24 CC 10	218.18	89.60
689B 24 CC 33	218.41	85.54
689B 25 01 7	226.67	77.88
689B 25 01 55	227.15	89.54
689B 25 01 59	227.19	94.30
689B 25 01 119	227.79	97.29
689B 25 01 135	227.95	95.30
689B 25 02 18	228.28	95.54
689B 25 02 50	228.60	94.05
689B 25 02 72	228.82	93.21
689B 25 02 122	229.32	91.29
689B 25 03 60	230.20	95.30
689B 25 03 108	230.68	87.13
689B 25 03 125	230.85	92.88
689B 25 04 57	231.67	93.46
689B 25 04 112	232.22	92.30
689B 25 04 133	232.43	93.80
689B 25 05 29	232.89	93.46
689B 25 05 124	233.84	93.21
689B 25 06 64	234.74	92.30
689B 25 06 70	234.80	80.55
689B 25 06 108	235.18	91.71
689B 25 CC 5	235.26	92.88
689B 25 CC 20	235.41	85.88
689B 26 01 20	236.50	83.05
689B 26 01 70	237.00	95.96
689B 26 01 130	237.60	95.29
689B 26 CC 18	238.16	85.96
689B 27 01 22	246.22	88.63
689B 27 01 62	246.62	72.80
689B 27 02 21	247.71	99.71
689B 27 02 120	248.70	88.38
689B 27 03 20	249.20	89.88
689B 27 03 80	249.80	78.88
689B 27 CC 4	250.11	96.21
689B 28 01 20	255.80	92.87
689B 28 01 72	256.32	85.79
689B 28 01 114	256.74	89.04
689B 28 01 120	256.80	86.79
689B 28 02 21	257.31	75.38
689B 28 02 75	257.85	86.29
689B 28 02 129	258.39	90.63
689B 28 03 70	259.30	85.38
689B 28 03 112	259.72	91.50
689B 28 03 113	259.73	83.38
689B 28 04 14	260.24	73.05
689B 28 04 65	260.75	78.63
689B 28 04 148	261.58	77.80
689B 28 CC 16	261.76	91.13
689B 28 CC 22	261.82	91.71
689B 29 01 18	265.38	87.04
689B 29 01 59	265.79	78.96
689B 29 01 112	266.32	93.62
689B 29 01 140	266.60	90.80
689B 29 02 15	266.85	89.13
689B 29 02 66	267.36	89.71
689B 29 02 121	267.91	90.29
689B 29 02 136	268.06	84.00
689B 29 03 22	268.42	74.05
689B 29 03 55	268.75	78.96
689B 29 03 116	269.36	76.55
689B 29 CC 22	269.67	78.21
689B 30 01 25	275.15	85.46
689B 30 01 76	275.66	95.54
689B 30 01 128	276.18	82.46
689B 30 01 135	276.25	84.00
689B 30 02 15	276.55	72.38
689B 30 02 75	277.15	83.96
689B 30 02 129	277.69	90.71
689B 30 03 18	278.08	89.21
689B 30 03 63	278.53	64.64
689B 30 03 115	279.05	89.04
689B 30 CC 4	279.18	83.13
689B 30 CC 8	279.22	95.29
689B 32 CC 23	291.51	90.00

Table 2. Calcium carbonate percentages for Hole 689C, taken between 0.20 and 27.50 mbsf depths. Data plotted in Figure 4.

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
689C 1 01 15	00.15	05.10
689C 1 01 20	00.20	05.12
689C 1 01 80	00.80	08.16
689C 1 01 135	01.35	00.50
689C 1 02 15	01.65	00.30
689C 1 02 20	01.70	01.24
689C 1 02 80	02.30	00.25
689C 1 02 135	02.85	00.75
689C 1 03 15	03.15	00.30
689C 1 03 20	03.20	02.16
689C 1 03 80	03.80	00.17
689C 1 03 135	04.35	00.25
689C 1 04 15	04.65	00.20
689C 1 04 20	04.70	00.08
689C 1 04 80	05.30	01.58
689C 1 04 135	05.85	00.25
689C 1 05 15	06.15	00.30
689C 1 05 20	06.20	00.25
689C 1 05 80	06.80	00.66
689C 1 05 135	07.35	01.41
689C 1 06 15	07.65	00.30
689C 1 06 20	07.70	01.33
689C 1 06 80	08.30	03.99
689C 1 06 135	08.85	01.16
689C 1 07 15	09.15	00.30
689C 1 07 20	09.20	02.91
689C 3 01 20	18.30	21.52
689C 3 01 80	18.90	06.91
689C 3 01 90	19.00	07.60
689C 3 01 135	19.45	00.42
689C 3 02 20	19.80	00.42
689C 3 02 80	20.40	00.33
689C 3 02 90	20.50	00.50
689C 3 02 135	20.95	02.42
689C 3 03 20	21.30	00.83
689C 3 03 80	21.90	00.25
689C 3 03 90	22.00	00.30
689C 3 03 135	22.45	00.17
689C 3 04 20	22.80	02.33
689C 3 04 80	23.40	45.81
689C 3 04 90	23.50	37.50
689C 3 04 135	23.95	19.57
689C 3 05 20	24.30	04.08
689C 3 05 80	24.90	04.08
689C 3 05 90	25.00	06.20
689C 3 05 135	25.45	00.92
689C 3 06 20	25.80	03.08
689C 3 06 80	26.40	00.08
689C 3 06 90	26.50	00.30
689C 3 06 135	26.95	00.25
689C 3 07 20	27.30	00.50
689C 3 07 42	27.52	02.80

nance continues into the Pleistocene where it is reversed by the reappearance of calcium carbonate sediments. The Pleistocene calcium carbonates, in contrast to the rest of the Cenozoic carbonates, are dominated by foraminifers rather than nannofossils.

SUMMARY

Approximately 1100 calcium carbonate measurements were made on Upper Cretaceous through Pleistocene sediments from two sites on Maud Rise, Weddell Sea. Percentage of calcium carbonate shows moderate variability in the Upper Cretaceous through upper Eocene sediments, with a slight, general decrease from the upper Paleocene to lower/middle Eocene. Variations are primarily attributed to changes in the relative abundance of terrigenous and biogenic carbonate component.

Fluctuations become more pronounced in the Oligocene, with a distinct decrease in calcium carbonate in the upper Oligocene

Table 3. Calcium carbonate percentages for Hole 689D, taken between 18.90 and 56.20 mbsf depths. Data plotted in Figure 5.

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
689D 1 01 80	18.90	22.27
689D 1 01 135	19.45	12.57
689D 1 02 80	20.40	00.67
689D 1 02 135	20.95	00.00
689D 1 03 20	21.30	02.41
689D 1 03 80	21.90	02.63
689D 1 03 135	22.45	00.42
689D 1 04 20	22.80	35.40
689D 1 04 80	23.40	31.74
689D 1 04 135	23.95	24.40
689D 1 05 80	24.90	00.49
689D 1 06 20	25.80	00.42
689D 1 06 80	26.40	00.99
689D 1 07 20	27.30	00.17
689D 2 01 20	27.80	00.33
689D 2 01 80	28.40	00.42
689D 2 01 135	28.95	00.99
689D 2 02 20	29.30	00.17
689D 2 02 80	29.90	02.74
689D 2 02 135	30.45	00.08
689D 2 03 20	30.80	00.08
689D 2 03 80	31.40	76.96
689D 2 03 135	31.95	54.06
689D 2 04 20	32.30	56.06
689D 2 04 135	33.45	83.33
689D 2 05 20	33.80	84.63
689D 2 05 80	34.40	80.88
689D 2 05 135	34.95	73.47
689D 2 06 20	35.30	80.88
689D 2 06 80	35.90	78.89
689D 2 06 135	36.45	83.38
689D 2 07 20	36.80	65.97
689D 2 07 80	37.40	81.88
689D 3 01 19	37.49	81.47
689D 3 01 134	38.64	92.79
689D 3 02 19	38.99	93.96
689D 3 02 80	39.60	89.96
689D 3 02 134	40.14	88.38
689D 3 03 19	40.49	94.04
689D 3 03 80	41.10	90.88
689D 3 03 134	41.64	81.88
689D 3 04 19	41.99	80.30
689D 3 04 80	42.60	40.56
689D 3 04 134	43.14	00.25
689D 3 05 19	43.49	00.83
689D 3 05 80	44.10	08.57
689D 3 05 134	44.64	00.50
689D 3 06 19	44.99	04.58
689D 3 06 80	45.60	08.41
689D 3 06 134	46.14	05.49
689D 4 01 136	48.36	19.90
689D 4 02 20	48.70	36.07
689D 4 02 81	49.31	33.56
689D 4 02 136	49.86	06.33
689D 4 03 20	50.20	00.00
689D 4 03 81	50.81	01.66
689D 4 03 137	51.37	00.25
689D 4 04 20	51.70	01.33
689D 4 04 80	52.30	00.83
689D 4 04 137	52.87	57.89
689D 4 05 20	53.20	79.97
689D 4 05 80	53.80	22.24
689D 4 05 138	54.38	44.90
689D 4 06 20	54.70	70.47
689D 4 06 80	55.30	46.81
689D 4 06 139	55.89	39.40
689D 4 07 20	56.20	34.90

and lower middle Miocene. These variations are attributed to relative changes in the siliceous vs. carbonate component. Calcium carbonate again becomes the dominant component in the middle and lower upper Miocene, followed by almost exclusive biosiliceous sedimentation in the upper Miocene and Pliocene. Calcium carbonate sediments were deposited again in the Pleistocene.

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Table 4. Calcium carbonate percentages for Hole 690B, taken between 0.90 and 213.50 mbsf depths. Data plotted in Figure 6.

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
690B 1 01 90	00.90	76.60
690B 1 02 90	01.70	72.00
690B 2 01 20	02.30	26.57
690B 1 06 90	02.60	86.10
690B 2 01 80	02.90	04.41
690B 2 01 135	03.45	01.58
690B 2 02 20	03.80	01.25
690B 2 02 81	04.41	00.50
690B 2 02 90	04.50	00.00
690B 2 02 135	04.95	00.33
690B 2 03 14	05.24	00.60
690B 2 03 20	05.30	00.08
690B 2 03 135	06.45	00.33
690B 2 04 20	06.80	00.17
690B 2 04 81	07.41	00.17
690B 2 04 90	07.50	00.00
690B 2 04 135	07.95	00.33
690B 2 05 20	08.30	00.58
690B 2 05 81	08.91	00.08
690B 2 05 135	09.45	00.50
690B 2 06 20	09.80	00.17
690B 2 06 81	10.41	00.08
690B 2 06 90	10.50	00.00
690B 2 06 135	10.95	00.17
690B 2 07 21	11.31	00.08
690B 3 01 20	11.90	00.08
690B 3 01 82	12.52	00.25
690B 3 01 135	13.05	00.75
690B 3 02 20	13.40	00.08
690B 3 02 82	14.02	00.25
690B 3 02 90	14.10	00.00
690B 3 03 20	14.90	00.25
690B 3 03 82	15.52	00.08
690B 3 03 135	16.05	00.17
690B 3 04 12	16.32	00.30
690B 3 04 20	16.40	00.17
690B 3 04 82	17.02	00.00
690B 3 04 90	17.10	00.00
690B 3 04 119	17.39	00.08
690B 3 05 20	17.90	00.17
690B 3 05 84	18.54	00.17
690B 3 05 135	19.05	00.17
690B 3 06 20	19.40	00.33
690B 3 06 84	20.04	00.17
690B 3 06 90	20.10	00.00
690B 3 06 135	20.55	00.25
690B 3 07 20	20.90	00.17
690B 4 01 20	21.60	00.17
690B 4 01 80	22.20	00.42
690B 4 01 89	22.30	00.80
690B 4 01 135	22.75	00.08
690B 4 02 20	23.10	00.17
690B 4 02 80	23.70	00.17
690B 4 02 135	24.25	00.08
690B 4 03 20	24.60	20.24
690B 4 03 80	25.20	66.39
690B 4 03 89	25.30	71.90
690B 4 03 135	25.75	83.13
690B 4 04 14	26.04	80.90
690B 4 04 20	26.10	83.47
690B 4 04 80	26.70	78.64
690B 4 04 135	27.25	87.38
690B 4 05 20	27.60	72.72
690B 4 05 80	28.20	86.97
690B 4 05 88	28.30	84.60
690B 4 05 135	28.75	85.30
690B 4 06 20	29.10	83.72
690B 4 06 80	29.70	84.22
690B 4 06 135	30.25	77.97
690B 5 01 20	31.30	83.27
690B 5 01 80	31.90	43.23
690B 5 01 88	31.98	84.30
690B 5 01 135	32.45	86.97
690B 5 02 20	32.80	85.13
690B 5 02 80	33.40	85.38
690B 5 02 135	33.95	13.24
690B 5 03 20	34.30	01.00
690B 5 03 80	34.90	08.83
690B 5 03 89	34.99	36.30
690B 5 03 135	35.45	00.60
690B 5 04 20	35.80	00.42
690B 5 04 80	36.40	00.33
690B 5 04 135	36.95	00.58
690B 5 04 145	37.05	00.00
690B 5 05 20	37.30	00.42
690B 5 05 80	37.90	00.42
690B 5 05 89	37.99	00.80
690B 5 05 135	38.45	00.92
690B 5 06 20	38.80	00.33
690B 5 06 80	39.40	01.42
690B 5 06 135	39.95	00.67
690B 5 07 20	40.30	00.58
690B 6 01 20	41.00	23.91
690B 6 01 81	41.61	26.24
690B 6 01 89	41.69	32.80
690B 6 01 135	42.15	54.06
690B 6 02 20	42.50	15.08
690B 6 02 81	43.11	00.50
690B 6 02 135	43.65	53.23
690B 6 03 20	44.00	68.81
690B 6 03 81	44.61	70.31
690B 6 03 90	44.70	66.60
690B 6 03 135	45.15	79.30
690B 6 04 20	45.50	74.89
690B 6 04 81	46.11	60.23
690B 6 04 120	46.50	40.40
690B 6 05 20	47.00	53.06
690B 6 05 81	47.61	53.73
690B 6 05 89	47.90	53.30
690B 6 05 135	48.15	65.64
690B 6 06 20	48.50	64.89
690B 6 06 81	49.11	37.40
690B 6 06 135	49.65	71.80
690B 6 07 20	50.00	72.22
690B 7 01 20	50.60	63.64
690B 7 01 80	51.20	64.64
690B 7 01 89	51.30	69.00
690B 7 01 135	51.75	78.05
690B 7 02 20	52.10	79.05
690B 7 02 80	52.70	76.72
690B 7 02 135	53.25	74.72
690B 7 03 20	53.60	81.80
690B 7 03 80	54.20	83.97
690B 7 03 89	54.30	83.90
690B 7 03 135	54.75	70.97
690B 7 04 20	55.10	71.47
690B 7 04 80	55.70	82.72
690B 7 04 135	56.25	75.22
690B 7 05 20	56.60	81.30
690B 7 05 80	57.20	84.88
690B 7 05 89	57.30	88.60
690B 7 05 135	57.75	84.97
690B 7 06 20	58.10	89.46
690B 7 06 80	58.70	85.30
690B 7 06 135	59.25	87.88
690B 7 07 20	59.60	89.88
690B 7 CC 20	60.13	83.88
690B 8 01 20	60.30	81.13
690B 8 01 80	60.90	82.05
690B 8 01 89	61.00	83.10
690B 8 01 134	61.44	73.72
690B 8 02 20	61.80	84.47
690B 8 02 80	62.40	85.47
690B 8 02 134	62.94	81.47
690B 8 03 20	63.30	81.38
690B 8 03 80	63.90	47.73
690B 8 03 89	64.00	55.70
690B 8 03 134	64.44	39.23
690B 8 04 20	64.80	70.22
690B 8 04 134	65.94	73.89
690B 8 05 20	66.30	72.72
690B 8 05 89	67.00	74.40
690B 8 06 20	67.80	76.14
690B 8 06 80	68.40	78.97
690B 8 06 134	68.94	77.55
690B 8 07 20	69.30	61.31
690B 9 01 20	70.00	80.47
690B 9 01 80	70.60	82.30
690B 9 01 89	70.70	76.10
690B 9 01 135	71.15	92.55
690B 9 02 80	72.10	67.56
690B 9 02 135	72.65	76.39
690B 9 03 20	73.00	71.72
690B 9 03 80	73.60	63.56
690B 9 03 90	73.70	70.50
690B 9 03 135	74.15	78.30
690B 9 04 20	74.50	76.23
690B 9 04 117	75.57	72.20
690B 9 05 20	76.00	76.30
690B 9 05 88	76.70	60.30
690B 9 06 20	77.50	64.97
690B 9 06 80	78.10	70.14
690B 9 06 135	78.65	76.05
690B 9 07 20	79.00	74.47
690B 10 01 72	80.12	63.06
690B 10 01 135	80.75	83.38
690B 10 02 20	81.10	67.39
690B 10 02 72	81.62	50.73
690B 10 02 90	81.80	61.70
690B 10 02 135	82.25	55.56
690B 10 03 20	82.60	53.48
690B 10 03 72	83.12	69.64
690B 10 03 135	83.75	85.30
690B 10 04 20	84.10	84.05
690B 10 04 72	84.62	83.80
690B 10 04 90	84.80	63.60
690B 10 04 135	85.25	63.64
690B 10 05 20	85.60	61.80
690B 10 05 72	86.12	51.06
690B 10 05 135	86.75	66.81
690B 10 06 20	87.10	65.39
690B 10 06 72	87.62	69.97
690B 10 06 90	87.80	66.00
690B 10 06 135	88.25	78.97
690B 10 07 20	88.60	75.14
690B 10 07 72	89.12	69.14
690B 11 01 20	89.30	79.97
690B 11 01 80	89.90	82.22
690B 11 01 90	90.00	82.60
690B 11 01 135	90.45	86.55
690B 11 02 20	90.80	89.21
690B 11 02 80	91.40	81.06
690B 11 02 135	91.95	82.13
690B 11 03 20	92.30	83.38
690B 11 03 80	92.90	62.48
690B 11 03 90	93.00	87.90
690B 11 03 135	93.45	87.63
690B 11 04 20	93.80	89.05
690B 11 04 80	94.40	91.71
690B 11 04 135	94.95	87.63
690B 11 05 20	95.30	90.71
690B 11 05 80	95.90	84.30
690B 11 05 90	96.00	83.00
690B 11 05 135	96.45	89.55
690B 11 06 20	96.80	89.05
690B 11 06 80	97.40	94.05
690B 11 06 135	97.95	91.71
690B 11 07 20	98.30	96.38
690B 12 01 20	99.00	90.38
690B 12 01 81	99.61	91.96
690B 12 01 135	100.15	95.96
690B 12 02 81	101.11	74.89
690B 12 02 90	101.20	78.70
690B 12 02 135	101.65	78.14
690B 12 03 20	102.00	78.25
690B 12 03 81	102.61	68.56
690B 12 03 135	103.15	74.80
690B 12 04 20	103.50	85.47
690B 12 04 81	104.11	75.89
690B 12 04 85	104.15	76.90
690B 12 04 120	104.50	89.70
690B 12 04 135	104.65	85.63
690B 12 05 20	105.00	86.63
690B 12 05 81	105.61	76.05
690B 12 06 20	106.50	84.80
690B 12 06 90	107.20	74.70
690B 12 06 135	107.65	74.97
690B 13 01 19	108.69	86.54
690B 13 01 135	109.85	70.89
690B 13 02 19	110.19	83.63
690B 13 02 81	110.81	90.38
690B 13 02 90	110.90	79.60
690B 13 02 135	111.35	79.47
690B 13 03 19	111.69	83.47
690B 13 03 135	112.85	84.55
690B 13 04 81	113.81	87.47
690B 13 04 90	113.90	73.10
690B 13 04 135	114.35	78.30
690B 13 05 19	114.69	79.47
690B 13 05 81	115.31	82.83
690B 13 05 135	115.85	81.38
690B 13 06 19	116.19	75.05
690B 13 06 90	116.90	76.40
690B 13 06 135	117.35	85.49
690B 13 07 19	117.69	80.88
690B 14 01 19	118.69	86.63
690B 14 01 82	119.32	77.05
690B 14 01 90	119.40	78.40
690B 14 01 135	119.85	67.97
690B 14 02 19	120.19	71.47
690B 14 02 82	120.82	83.72
690B 14 02 90	120.90	86.60
690B 14 02 135	121.35	74.22
690B 14 03 19	121.69	67.88
690B 14 03 82	122.32	80.55
690B 14 03 90	122.40	81.30
690B 14 03 135	122.85	79.63
690B 14 04 19	123.19	77.47
690B 14 04 90	123.60	81.90
690B 14 04 82	123.82	80.05
690B 14 04 135	124.35	83.72
690B 14 05 19	124.69	84.92
690B 14 05 90	125.40	79.30
690B 14 05 135	125.85	67.89
690B 14 06 19	126.19	73.64
690B 14 06 81	126.81	73.97
690B 14 06 135	127.35	82.72
690B 14 07 19	127.69	87.88
690B 15 01 10	128.20	74.30
690B 15 01 20	128.30	78.22
690B 15 01 58	128.68	81.05
690B 15 01 81	128.91	75.47
690B 15 01 108	129.18	76.22
690B 15 01 135	129.45	77.47
690B 15 02 10	129.70	77.47
690B 15 02 20	129.80	78.14
690B 15 02 58	130.18	74.47
690B 15 02 81	130.41	78.97
690B 15 02 90	130.50	72.10
690B 15 02 108	130.68	64.31
690B 15 02 135	130.95	69.97
690B 15 03 10	131.20	68.64
690B 15 03 20	131.30	70.31
690B 15 03 58	131.68	75.22
690B 15 03 81	131.91	68.81
690B 15 03 108	132.18	81.80
690B 15 03 135	132.45	74.89
690B 15 04 10	132.70	71.39
690B 15 04 20	132.80	79.30
690B 15 04 58	133.18	71.89
690B 15 04 81	133.41	74.35
690B 15 04 108	133.68	80.23
690B 15 04 135	133.95	77.72
690B 15 05 10	134.20	78.80
690B 15 05 20	134.30	67.97
690B 15 05 58	134.68	66.14
690B 15 05 81	134.91	62.22
690B 15 05 91	135.01	78.10

Table 4 (continued).

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
690B 15 05 108	135.18	72.19
690B 15 05 135	135.45	87.30
690B 15 06 10	135.70	81.88
690B 15 06 20	135.80	90.38
690B 15 06 58	136.18	80.13
690B 15 06 81	136.41	80.38
690B 15 06 90	136.50	87.30
690B 15 06 108	136.68	77.72
690B 15 06 135	136.95	81.40
690B 15 07 10	137.20	64.64
690B 15 07 22	137.32	76.47
690B 15 07 58	137.68	76.30
690B 16 01 10	137.90	75.30
690B 16 01 20	138.00	71.14
690B 16 01 60	138.40	62.06
690B 16 01 80	138.60	57.79
690B 16 01 90	138.70	60.30
690B 16 01 120	139.00	64.97
690B 16 01 135	139.15	78.97
690B 16 02 10	139.40	77.22
690B 16 02 60	139.90	75.89
690B 16 02 80	140.10	64.89
690B 16 02 120	140.50	71.05
690B 16 02 135	140.65	70.89
690B 16 03 10	140.90	71.22
690B 16 03 20	141.00	78.30
690B 16 03 60	141.40	74.72
690B 16 03 80	141.60	89.80
690B 16 03 90	141.70	77.50
690B 16 03 120	142.00	72.47
690B 16 03 135	142.15	71.80
690B 16 04 10	142.40	72.80
690B 16 04 20	142.50	58.49
690B 16 04 60	142.90	75.05
690B 16 04 80	143.10	73.14
690B 16 04 120	143.20	73.60
690B 16 05 10	143.90	75.55
690B 16 05 20	144.00	81.22
690B 16 05 60	144.40	75.80
690B 16 05 80	144.60	85.22
690B 16 05 90	144.70	83.70
690B 16 05 120	145.00	79.05
690B 16 05 135	145.15	77.55
690B 16 06 10	145.40	79.47
690B 16 06 20	145.50	70.80
690B 16 06 60	145.90	84.14
690B 16 06 80	146.10	79.80
690B 16 07 10	146.90	65.89
690B 16 07 20	147.00	71.05
690B 17 01 10	147.60	78.30
690B 17 01 20	147.70	66.47
690B 17 01 60	148.10	81.01
690B 17 01 90	148.10	81.70
690B 17 01 79	148.29	76.72
690B 17 01 120	148.70	76.30
690B 17 01 135	148.85	80.63
690B 17 02 10	149.10	76.73
690B 17 02 20	149.20	79.22
690B 17 02 60	149.60	85.05
690B 17 02 79	149.79	81.06
690B 17 02 120	150.20	87.63
690B 17 02 135	150.35	86.30
690B 17 03 10	150.60	80.59
690B 17 03 20	150.70	78.64
690B 17 03 60	151.10	72.80
690B 17 03 79	151.29	73.55
690B 17 03 90	151.40	73.10
690B 17 03 120	151.70	76.30
690B 17 03 135	151.85	76.39
690B 17 04 10	152.10	78.14
690B 17 04 20	152.20	79.14
690B 17 04 60	152.60	84.30
690B 17 04 80	152.80	69.14
690B 17 04 120	153.20	80.80
690B 17 04 135	153.35	74.19
690B 17 05 10	153.60	83.30
690B 17 05 20	153.70	79.78
690B 17 05 60	154.10	78.89
690B 17 05 78	154.28	72.72
690B 17 05 90	154.40	74.00
690B 17 05 120	154.70	74.29
690B 17 05 135	154.85	67.91
690B 17 06 10	155.10	83.38
690B 17 06 20	155.20	80.30
690B 17 06 60	155.60	73.80
690B 17 06 80	155.80	74.97
690B 17 06 120	156.20	87.63
690B 17 06 135	156.35	72.05
690B 17 07 10	156.60	79.01
690B 17 07 20	156.70	83.30
690B 18 01 12	157.32	70.37
690B 18 01 20	157.40	75.30
690B 18 01 60	157.80	77.15
690B 18 01 82	158.02	74.22
690B 18 01 90	158.10	79.70
690B 18 01 107	158.27	77.75
690B 18 01 135	158.55	77.89
690B 18 02 12	158.82	72.89
690B 18 02 20	158.90	73.64
690B 18 02 60	159.30	72.72
690B 18 02 82	159.52	79.97
690B 18 02 107	159.77	82.97
690B 18 02 135	160.05	80.55
690B 18 03 12	160.32	74.97
690B 18 03 20	160.40	72.30
690B 18 03 60	160.80	81.63
690B 18 03 82	161.02	74.88
690B 18 03 90	161.10	79.80
690B 18 03 107	161.27	86.05
690B 18 03 135	161.55	69.97
690B 18 04 12	161.82	86.88
690B 18 04 20	161.90	88.13
690B 18 04 60	162.30	91.46
690B 18 04 82	162.52	83.97
690B 18 04 107	162.77	81.63
690B 18 04 135	163.05	80.47
690B 18 05 12	163.32	87.71
690B 18 05 20	163.40	84.05
690B 18 05 60	163.80	80.55
690B 18 05 82	164.02	85.05
690B 18 05 90	164.10	85.50
690B 18 05 107	164.27	78.72
690B 18 05 135	164.55	88.05
690B 18 06 12	164.82	74.14
690B 18 06 20	164.90	78.80
690B 18 06 60	165.30	82.30
690B 18 06 82	165.52	77.86
690B 18 06 107	165.77	77.47
690B 18 06 135	166.05	87.05
690B 18 07 12	166.32	83.80
690B 19 01 10	167.00	89.55
690B 19 01 20	167.10	89.71
690B 19 01 60	167.50	91.55
690B 19 01 80	167.70	91.38
690B 19 01 90	167.80	94.50
690B 19 01 107	167.97	98.54
690B 19 01 135	168.25	95.38
690B 19 02 10	168.50	89.63
690B 19 02 20	168.60	94.38
690B 19 02 60	169.00	93.96
690B 19 02 80	169.20	83.13
690B 19 02 107	169.47	82.30
690B 19 02 135	169.75	84.13
690B 19 03 10	170.00	68.81
690B 19 03 20	170.10	73.97
690B 19 03 60	170.50	67.31
690B 19 03 80	170.70	75.64
690B 19 03 90	170.80	66.10
690B 19 03 107	170.97	82.55
690B 19 03 135	171.25	82.55
690B 19 04 10	171.50	86.63
690B 19 04 20	171.60	91.46
690B 19 04 60	172.00	88.21
690B 19 04 80	172.20	86.88
690B 19 04 112	172.22	80.80
690B 19 04 107	172.47	73.39
690B 19 05 10	173.00	83.72
690B 19 05 20	173.10	83.38
690B 19 05 60	173.50	83.38
690B 19 05 80	173.70	78.14
690B 19 05 107	173.97	70.56
690B 19 CC 20	174.23	84.40
690B 20 01 10	174.40	78.47
690B 20 01 20	174.50	85.63
690B 20 01 60	174.90	83.30
690B 20 01 80	175.10	86.72
690B 20 01 90	175.20	85.70
690B 20 01 115	175.45	89.96
690B 20 01 133	175.63	82.30
690B 20 02 10	175.90	84.80
690B 20 02 60	176.40	78.30
690B 20 02 80	176.60	82.22
690B 20 02 115	176.95	85.30
690B 20 03 10	177.40	86.13
690B 20 03 20	177.50	82.97
690B 20 03 60	177.90	80.80
690B 20 03 80	178.10	76.72
690B 20 03 90	178.20	88.70
690B 20 03 115	178.45	84.63
690B 20 03 133	178.63	80.72
690B 20 04 10	178.90	85.55
690B 20 04 60	179.40	78.39
690B 20 04 80	179.60	79.38
690B 20 04 115	179.95	81.30
690B 20 04 124	180.04	79.97
690B 21 01 20	180.50	81.88
690B 21 01 135	181.65	87.88
690B 21 02 20	182.00	74.80
690B 21 02 90	182.70	83.70
690B 21 02 135	183.15	87.88
690B 21 03 20	183.50	88.80
690B 21 03 71	184.01	87.30
690B 21 04 10	184.40	84.60
690B 21 03 135	184.65	82.47
690B 22 01 20	185.40	78.72
690B 22 01 135	186.55	87.96
690B 22 02 20	186.90	88.13
690B 22 02 90	187.30	85.80
690B 22 02 80	187.50	89.13
690B 22 02 135	188.05	90.21
690B 22 03 20	188.40	90.80
690B 22 03 80	189.00	85.97
690B 22 03 120	189.40	81.10
690B 22 04 20	189.90	74.39
690B 22 04 80	190.50	82.13
690B 22 04 90	190.60	89.00
690B 23 01 15	191.35	80.47
690B 23 01 85	192.05	82.30
690B 23 01 135	192.55	90.05
690B 23 02 15	192.85	92.63
690B 23 02 85	193.55	91.05
690B 23 02 90	193.60	92.70
690B 23 02 135	194.05	90.55
690B 23 03 15	194.35	90.38
690B 23 03 85	195.05	88.13
690B 23 03 135	195.55	85.88
690B 23 04 15	195.85	88.30
690B 23 04 85	196.55	91.38
690B 23 04 90	196.60	91.20
690B 23 04 135	197.05	85.13
690B 23 05 15	197.35	92.30
690B 24 01 20	198.40	92.55
690B 24 01 72	198.92	89.63
690B 24 01 135	199.55	87.96
690B 24 02 20	199.90	83.83
690B 24 02 92	200.30	86.40
690B 24 02 72	200.42	86.63
690B 24 02 135	201.05	89.13
690B 24 03 20	201.40	88.46
690B 24 03 72	201.92	87.80
690B 24 03 135	202.55	88.30
690B 24 04 20	202.90	87.05
690B 24 04 72	203.42	89.55
690B 24 04 93	203.63	91.10
690B 25 01 20	204.40	88.63
690B 25 01 80	205.00	85.80
690B 25 01 135	205.55	65.06
690B 25 02 20	205.90	87.47
690B 25 02 80	206.50	87.88
690B 25 02 90	206.60	91.10
690B 25 02 135	207.05	87.47
690B 25 03 20	207.40	92.88
690B 25 03 80	208.00	86.30
690B 25 03 135	208.55	92.63
690B 25 04 20	208.90	90.80
690B 25 04 80	209.50	90.71
690B 25 04 90	209.60	90.90
690B 25 04 112	209.82	76.60
690B 25 05 20	210.40	89.46
690B 25 05 80	211.00	56.14
690B 25 05 135	211.55	91.88
690B 25 06 20	211.90	90.63
690B 25 06 80	212.50	90.80
690B 25 06 90	212.60	83.10
690B 25 06 135	213.05	93.05

Table 5. Calcium carbonate percentages for Hole 690C, taken between 204.30 and 294.45 mbsf depths. Data plotted in Figure 7.

Hole, core, sec. interval (cm)	Depth (mbsf)	CaCO3 (%)
690C 11 01 10	204.30	75.89
690C 11 01 25	204.45	77.64
690C 11 01 65	204.85	79.05
690c 11 01 75	204.95	81.13
690C 11 01 83	205.03	78.80
690C 11 01 107	205.27	72.80
690C 11 01 121	205.40	87.80
690C 11 01 125	205.45	86.05
690C 11 02 5	205.75	73.22
690C 11 02 10	205.80	86.55
690C 11 02 25	205.95	79.14
690C 11 02 35	206.05	89.38
690C 11 02 63	206.33	89.38
690C 11 02 65	206.35	93.71
690C 11 02 75	206.45	80.63
690C 11 02 107	206.77	89.29
690C 11 02 111	206.81	87.81
690C 11 02 125	206.95	76.74
690C 11 02 147	207.17	87.63
690C 11 03 9	207.29	89.05
690C 11 03 10	207.30	85.88
690C 11 03 25	207.45	83.47
690C 11 03 53	207.73	89.63
690C 11 03 65	207.85	88.05
690C 11 03 75	207.95	84.80
690C 11 03 107	208.27	92.63
690C 11 03 109	208.29	84.22
690C 11 03 110	208.30	77.14
690C 11 03 112	208.32	71.50
690C 11 04 10	208.80	90.55
690C 11 04 25	208.95	85.38
690C 11 04 51	209.21	96.63
690C 11 04 58	209.28	91.63
690C 11 04 61	209.31	93.80
690C 12 01 18	214.08	92.13
690C 12 01 90	214.80	91.80
690C 12 01 129	215.19	90.56
690C 12 02 129	216.69	91.38
690C 12 03 19	217.09	92.30
690C 12 CC 16	217.64	97.38
690C 13 01 20	223.80	95.46
690C 13 01 80	224.40	76.64
690C 13 01 135	224.95	92.21
690C 13 02 20	225.30	98.74
690C 13 02 80	225.90	90.55
690C 13 02 135	226.45	70.56
690C 13 03 20	226.80	92.55
690C 13 03 80	227.40	67.47
690C 13 03 135	227.95	87.88
690C 13 04 20	228.30	89.46
690C 13 04 80	228.90	92.71
690C 13 04 135	229.45	91.55
690C 13 05 20	229.80	77.55
690C 13 05 80	230.40	90.88
690C 13 05 135	230.95	89.71
690C 13 05 147	231.07	83.20
690C 13 06 20	231.30	87.05
690C 13 06 80	231.90	87.88
690C 14 01 81	234.01	86.97
690C 14 01 135	234.55	55.39
690C 14 02 20	234.90	88.21
690C 14 02 81	235.51	77.22
690C 14 02 135	236.05	100.00
690C 14 03 20	236.40	83.05
690C 14 03 81	237.01	85.88
690C 14 03 135	237.55	84.63
690C 14 04 115	238.95	88.70
690C 15 01 23	243.13	89.13
690C 15 01 132	244.22	87.55
690C 15 02 31	244.71	87.05
690C 15 02 135	245.75	86.80
690C 15 03 27	246.17	85.22
690C 15 03 136	247.26	62.56
690C 15 04 14	247.54	48.40
690C 15 04 104	248.44	89.30
690C 15 05 17	249.07	80.97
690C 15 05 106	249.96	90.63
690C 15 06 26	250.66	77.97
690C 15 06 124	251.64	83.80
690C 15 07 14	252.04	85.47
690C 17 02 115	264.45	89.10
690C 17 CC 2	266.53	83.80
690C 18 01 1	271.41	61.10
690C 18 04 68	276.58	92.10
690C 19 01 40	281.50	74.30
690C 19 04 105	286.65	76.10
690C 20 01 34	291.14	56.20
690C 20 03 145	295.25	64.70

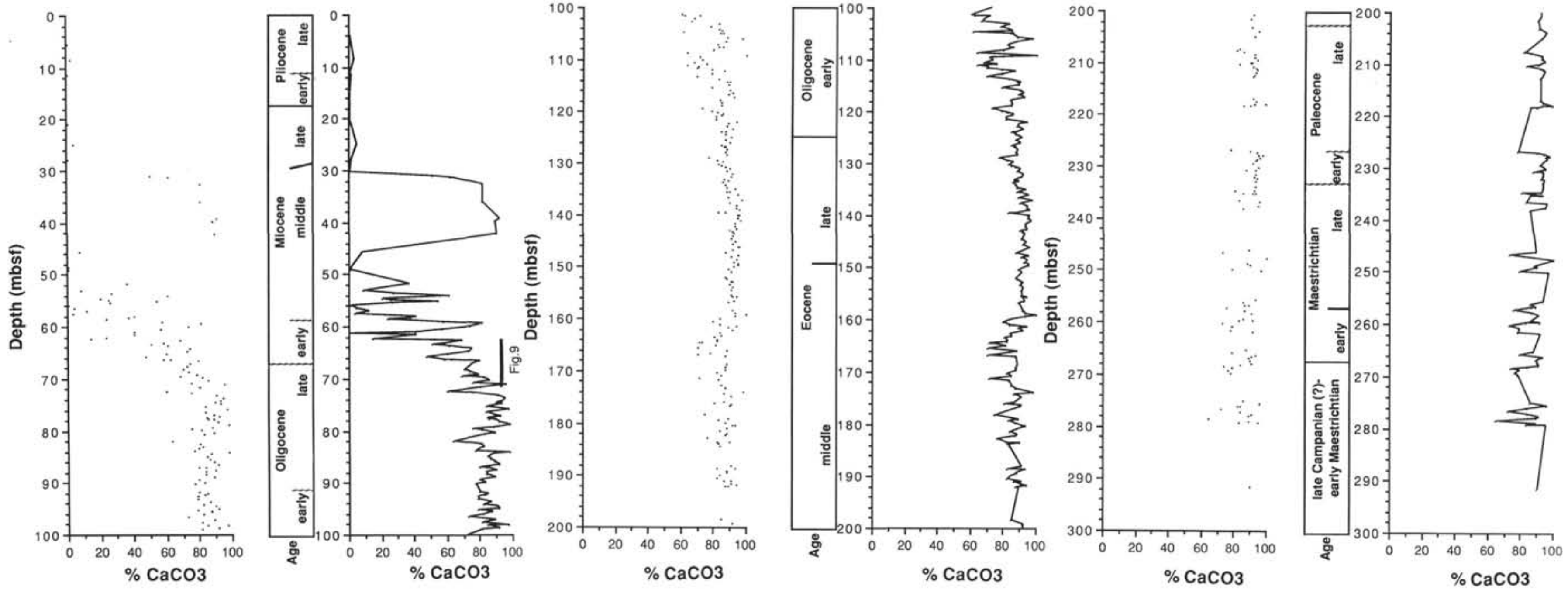

Figure 3. Calcium carbonate percentages for Hole 689B, taken between depths 4.00 and 291.50 mbsf. Ages are from Gersonde et al. (this volume) and Thomas et al. (this volume); wavy lines indicate hiatuses. Data given in Table 1.

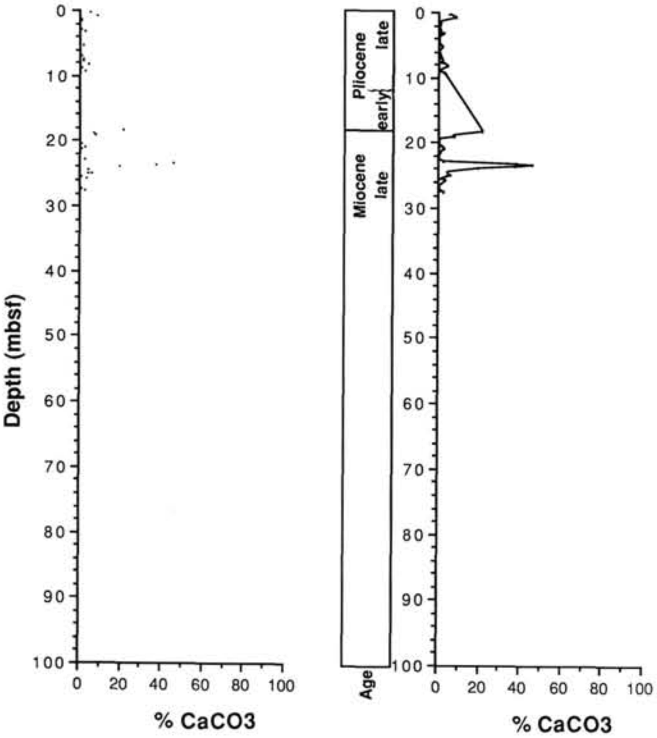

Figure 4. Calcium carbonate percentages for Hole 689C, taken between depths 0.20 and 27.50 mbsf. Ages are from Gersonde et al. (this volume) and Thomas et al. (this volume); wavy lines indicate hiatuses. Data given in Table 2.

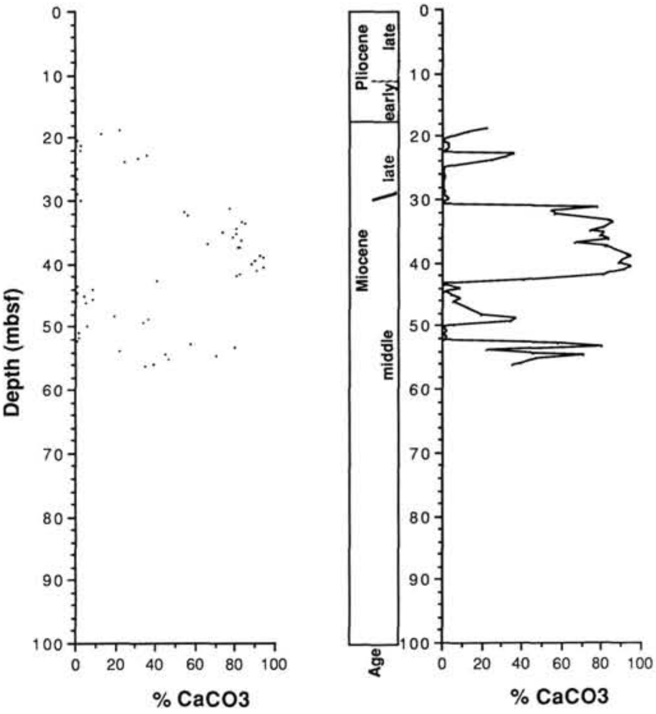

Figure 5. Calcium carbonate percentages for Hole 689D, taken between depths 18.90 and 56.20 mbsf. Ages are from Gersonde et al. (this volume) and Thomas et al. (this volume); wavy lines indicate hiatuses. Data given in Table 3.

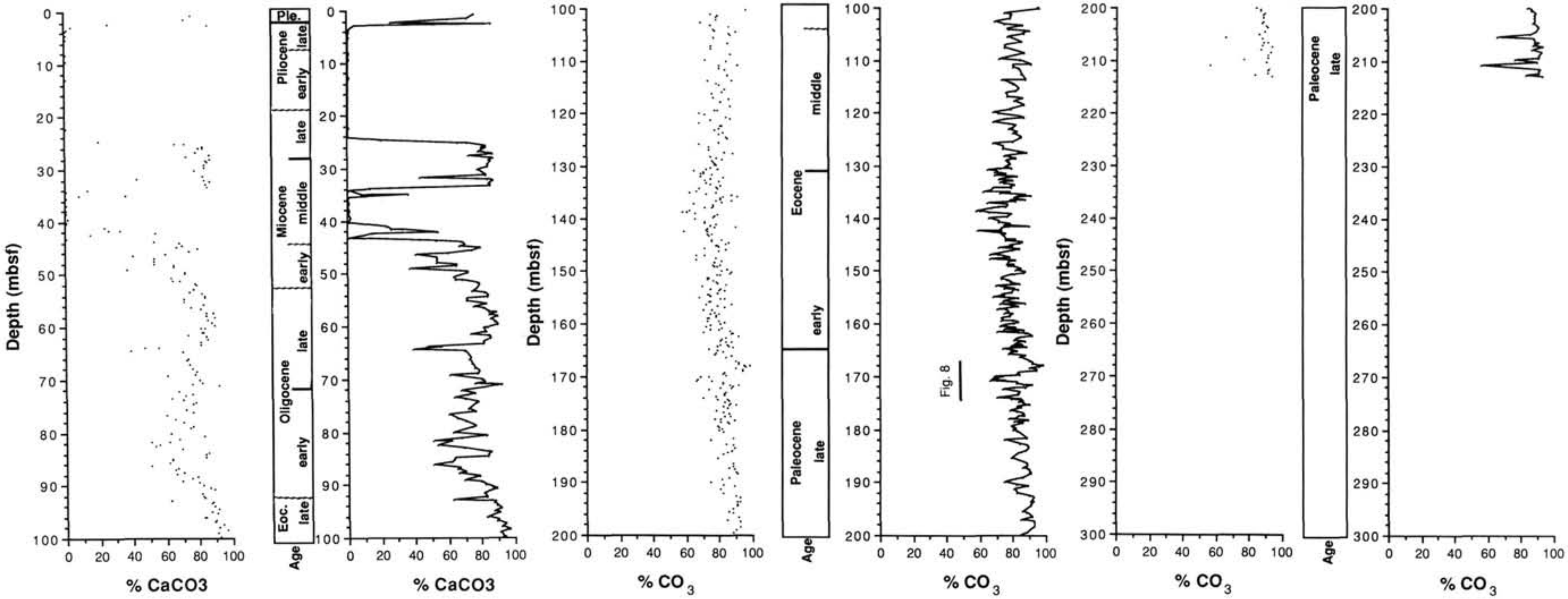

Figure 6. Calcium carbonate percentages for Hole 690B, taken between depths 0.90 and 213.50 mbsf. Ages are from Gersonde et al. (this volume) and Thomas et al. (this volume); wavy lines indicate hiatuses. Data given in Table 4.

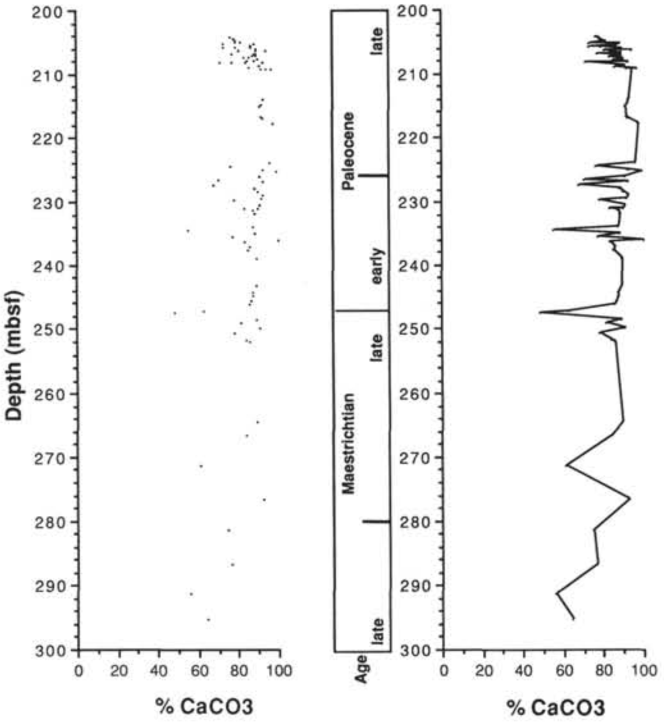

Figure 7. Calcium carbonate percentages for Hole 690C, taken between depths 204.30 and 294.45 mbsf. Ages are from Gersonde et al. (this volume) and Thomas et al. (this volume). Data given in Table 5.

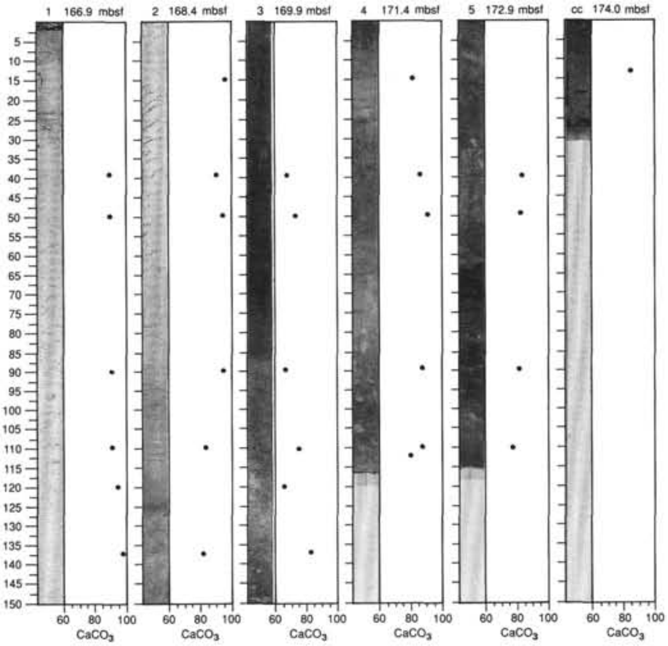

Figure 8. Calcium carbonate percentages plotted adjacent to a photograph of Core 113B-690B-19H (166.9–174.3 mbsf). Color changes are primarily due to relative changes in the clay content. Depth (mbsf) is given for the top of each section.

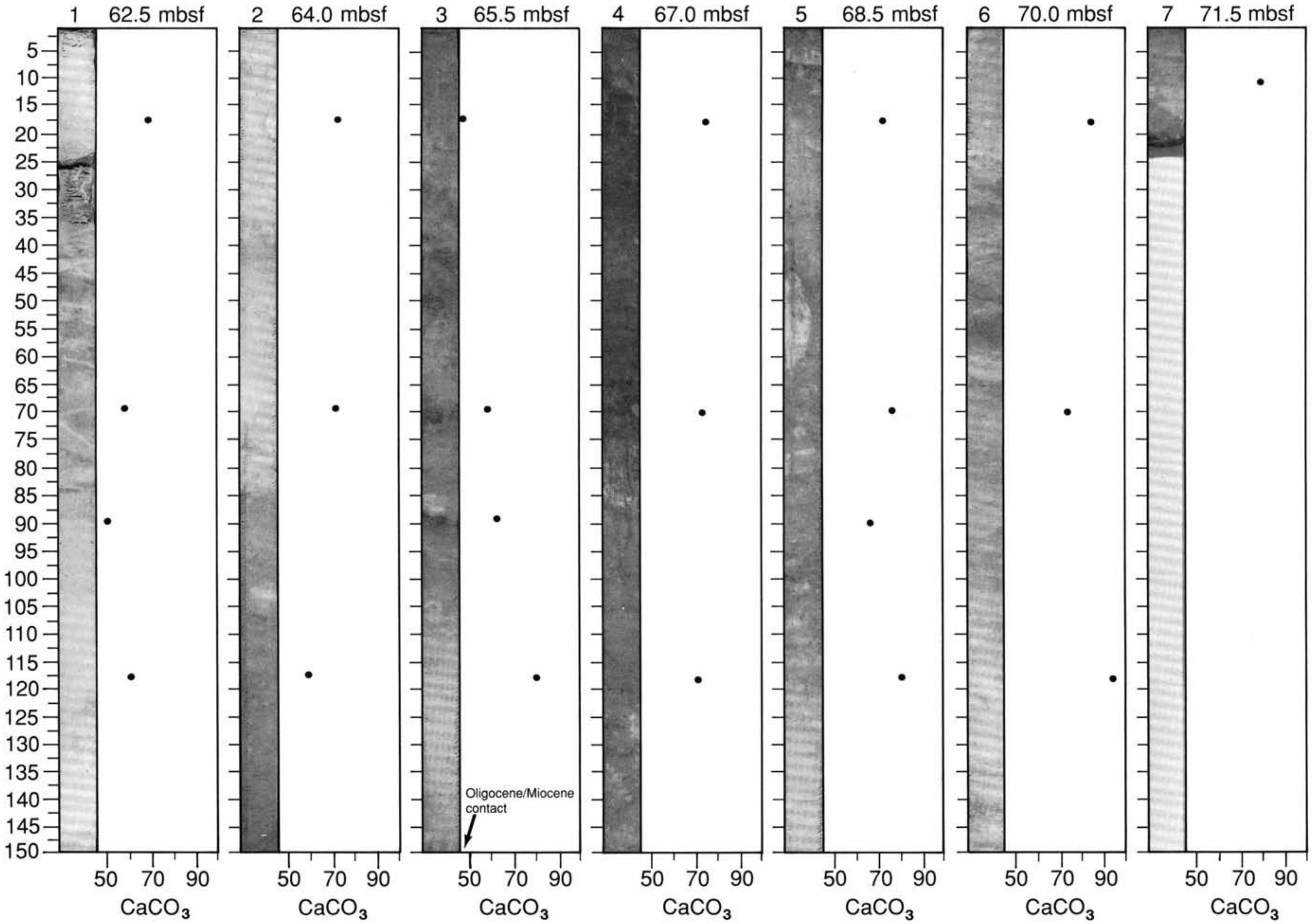

Figure 9. Calcium carbonate percentages plotted adjacent to a photograph of Core 113B-689B-8H (62.5–72.1 mbsf). Color changes are primarily due to relative changes in the siliceous vs. carbonate biogenic content. Textural changes, not readily visible in the photograph, are present. Depth (mbsf) is given for the top of each section.