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12. GRAIN-SIZE AND SEDIMENT-COLOR VARIATIONS OF PLEISTOCENE SLOPE SEDIMENTS OFF NEW JERSEY[1]

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ABSTRACT

The Pleistocene slope sediments off New Jersey consist of upward-coarsening and upward-thickening sedimentary cycles formed in response to glacio-eustatic sea-level changes and form a progradational slope clinoform. Each sedimentary cycle is bounded by heavily bioturbated or homogeneous fine-grained sediments characterized by lighter and bluish sediments deposited during the highstand of sea level. The cycle is dominated by darker and yellowish, laminated or thin, color-banded, coarse-grained sediments, including contorted or slumped structures. Related to the Quaternary sea-level changes, slope sediments were mainly deposited and prograded during the lowstands in sea level. The fine-grained sediments deposited during the highstand of sea level are characteristic and easily traceable bounding surfaces for slope successions. Therefore, it is interpreted, from a sequence stratigraphic view, that most progradational slope strata are formed as lowstand system tracts or shelf margin system tracts, not highstand system tracts.

INTRODUCTION

The continental slope is the zone between coastal to shelf areas and the basin floor. During the Quaternary, shelf areas were exposed and incised by fluvial processes during the lowstands of sea level. They were inundated and formed coastal-shelfal successions during the subsequent highstands of sea level. Whereas basin floor fans were formed during the lowstands of sea level, slope fans formed during the subsequent rise of sea level. Condensed sections were formed on slope and basin floor during the highstand of sea level (Posamentier et al., 1988; Vail et al., 1991). Progradational slope sediments are thought to form during the regressive phase of the sea-level cycle.

The purpose of this study is to clarify the characteristics of progradational slope sediments deposited in response to high-frequency sea-level changes during the Quaternary on the basis of grain size, sediment color, and core description data. During the Quaternary, this study area had a typical continental margin of siliciclastic sedimentation. Mixed carbonate-siliciclastic sedimentation, in relation to Quaternary sea-level changes, was demonstrated by Ocean Drilling Program (ODP) Leg 133 at the Australian margin (Glenn et al., 1993; Peerdeman and Davies, 1993; Feary et al., 1993), and Leg 150 provides an opportunity to address similar questions in a siliciclastic setting.

REGIONAL SETTING

The continental slope between the Hudson and Baltimore Canyons off New Jersey is located in the central part of the Baltimore Canyon Trough of the U.S. Atlantic margin (Fig. 1A). Quaternary sediments of the U.S. Atlantic margin are distributed as a narrow, seaward-thickening, sedimentary wedge developed at the shelf edge and two megasubmarine fans related to the Hudson-Connecticut and Delaware-Schuylkill-Susquehanna-Potomac dispersal systems on the continental rise (Poag, 1987, 1992). The Pleistocene sequences on the slope off New Jersey are divided into two sedimentary prisms separated from the deposits on the rise by an erosional swath that exposes Miocene to Eocene strata on the middle to lower slope (Fig. 1B; Hampson and Robb, 1985; Poag and Mountain, 1987). Both slope prisms show a ribbed fabric caused by cut and fill of extensive submarine canyon and channel systems. The updip prism, on the upper slope, is a prograding sedimentary wedge with a depocenter at the shelf edge and is seismically less chaotic than the downdip prism (Poag and Mountain, 1987). The downdip prism also shows a ribbed fabric. The depocenters of the downdip prism coincide with the locations of fan lobes and buried channels (Poag and Mountain, 1987). These slope sediments rest unconformably on truncated upper Miocene deposits and were deposited mainly during the middle to late Pleistocene (Hampson and Robb, 1985; Mountain, Miller, Blum, et al., 1994). Both depositional and erosional processes of Pleistocene slope sediments are thought to be major processes in a recent phase of canyon development (Robb et al., 1981; Twichell and Roberts, 1982). These Pleistocene slope sediments are covered with a thin, fine-grained Holocene surface layer, generally less than 2 m (Robb et al., 1981; Prior et al., 1984). This Holocene mud drapes over the Miocene to Eocene sediments in the erosional swath (Prior et al., 1984). Slope process is not active presently.

The Quaternary sequences in the shelf area between the Hudson and Delaware valleys are not thick. The late Pleistocene middle-shelf sediment wedge and outer-shelf sediment wedge connecting with the updip slope prism are distributed (Fig. 1; Milliman et al., 1990; Davies et al., 1992). Ancestral river valleys formed during the late Quaternary lowstand of sea level are related to the formation of these sedimentary wedges (Ewing et al., 1963; Twichell et al., 1977; Knebel et al., 1979; Swift et al., 1980; Milliman et al., 1990; Davies et al., 1992). The Hudson river was a major sediment source for shelf sediments (Darby, 1990). The modern outer shelf environment is dominated by erosion since the onset of the Holocene transgression (Knebel, 1979; Twichell et al., 1985).

SAMPLES

The Pleistocene slope sediments were taken from the upper to middle continental slope off New Jersey (Sites 902, 903, 904, and

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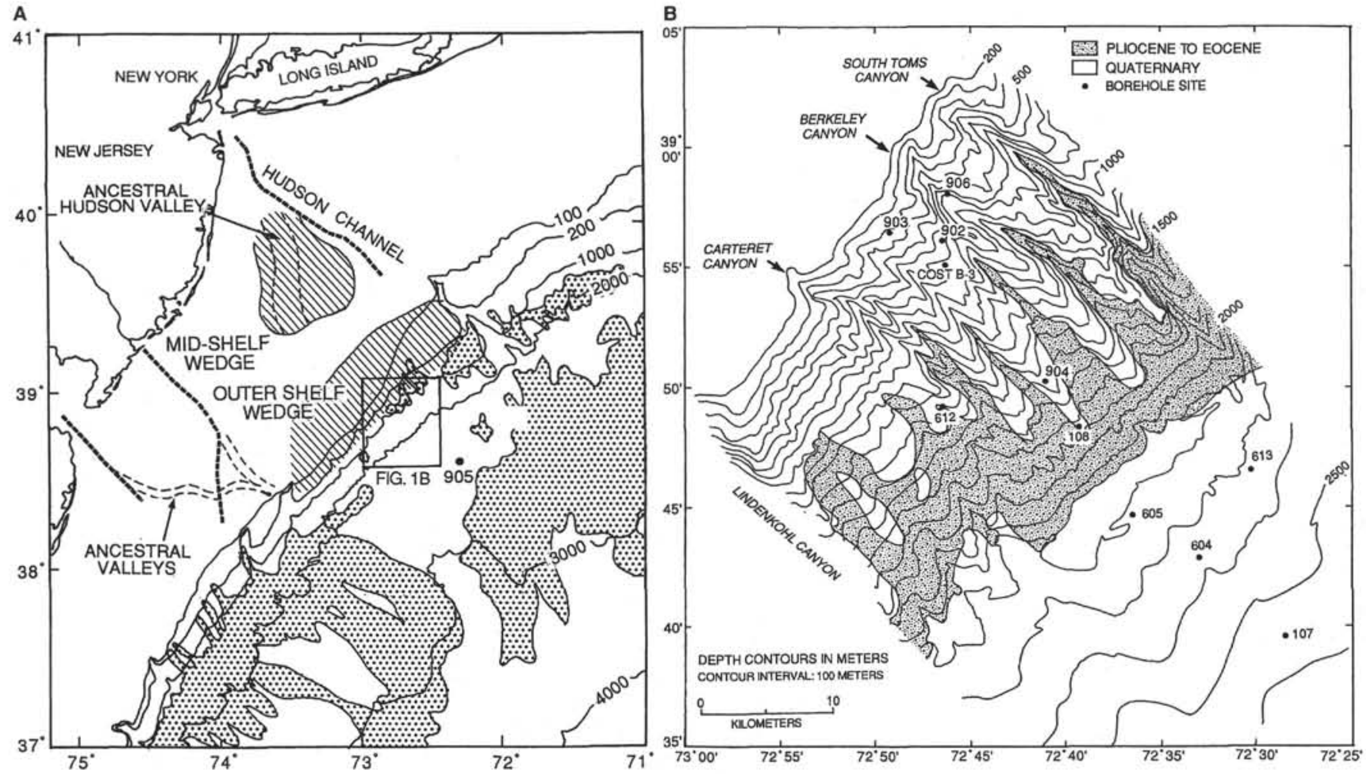

Figure 1. Location map of Sites 902, 903, 904, and 906 on the continental slope off New Jersey. **A.** Major depositional areas and shelf valleys off New Jersey. Modern shelf valleys and ancestral valleys are after Twichell et al. (1977), Knebel et al. (1979), Swift et al. (1980), and Davies et al. (1992). Mid-shelf wedge and outer shelf wedge are after Davies et al. (1992). Major depositional areas in the continental slope to the continental rise indicate the distribution of the Quaternary sediments >0.3 s in two-way traveltime after Poag (1992). **B.** Location of Sites 902, 903, 904, and 906 and geologic and bathymetric map of the New Jersey continental slope and rise simplified from Hampson and Robb (1985) and Poag (1985).

906: Mountain, Miller, Blum, et al., 1994; Fig. 1). Sites 902, 903, and 904 are located in the zone of complex Pleistocene sediments of the updip prism on the upper slope (Robb et al., 1981) and the zone of low-relief gullies on the upper to middle slope (Twichell and Roberts, 1982). Site 906 is located in the thalweg of modern Berkeley Canyon on the middle continental slope.

The cyclic variability of the gamma-ray attenuation porosity evaluator (GRAPE), bulk density, and whole-core magnetic susceptibility data show that these sediments were deposited under the influence of glacio-eustatic sea-level changes (Leg 150 Shipboard Scientific Party, 1994). The thickness of Quaternary sediments at these sites is 307.5 m for Hole 903A (water depth; 444.4 m), 122.1 m for Holes 902C (811 m) and 902D (808 m), 106.2 m for Hole 904A (1122.8 m) on the slope, and 43.3 m for Hole 906A (912.9 m). These sediments are mainly upper to middle Pleistocene in age and show a thickening in cores and seismic records in the upslope direction (Mountain et al., 1994). The thickness of the Holocene sediments covering the Pleistocene slope sediments is 0.8 m for Hole 902C, 1.3 m for Hole 902D, 0.2 m for Hole 903A, 4.3 m for Hole 904A, and 2.7 m for Hole 906A (Mountain, Miller, Blum, et al., 1994).

METHODS

Color Analysis

The Minolta color spectrophotometer (Model 2022) was used to accurately determine sediment color (Nagao and Nakashima, 1991, 1992; Shipboard Scientific Party, 1993, 1994). Enlarged color prints made from color slides of Holes 902C, 902D, 903A, 904A, and 905A were supplied by ODP and used for the sediment color analyses. A 150-cm length core section is 31.7–31.8 cm long on the prints, a reduction to about 21%. Each area analyzed was 4 mm in diameter on the prints, equivalent to 19 mm of cores. The density of analyzed points is four per section for Holes 902C, 902D, and 905A, and six for Holes 903A and 904A. Sediment color was described in the second CIE 1976 color space (L*a*b* color space: L* indicates lightness, a* and b* are the chromaticity coordinates, +a* is the red direction, −a* is the green direction, +b* is the yellow direction, and −b* is the blue direction). Print variation for 30 sheets indicates a sigma of 0.36 for L* and a* and one of 0.38 for b*.

Due to the differences of lighting conditions, marginal parts of the photo table show negative values for L*, a*, and b* by a few to several points in comparison with the central part. Figure 2 shows the marginal effects revealed by the measurement of the open "white" photo table on the color prints made from the color slide of Hole 902D, Core 150-902D-12H supplied by ODP. These marginal effects have not been corrected in the analyses of collected color data.

Grain-Size Analysis

Grain-size analyses were conducted on 628 samples using a Laser-diffraction particle size analyzer (McCave et al., 1986; Agrawal et al., 1991) with 64 separate detectors available at 0.1 to 500 µm range with one shot (model CILAS 1064). Samples were taken from Holes 902D, 903A, and 904A with a density of two per section. A sample was prepared for analysis by first disaggregating about 0.3 g of the sample in a weak hydrogen peroxide solution (about 3% by weight). The sample was then put in an ultrasonic bath (Kokusai

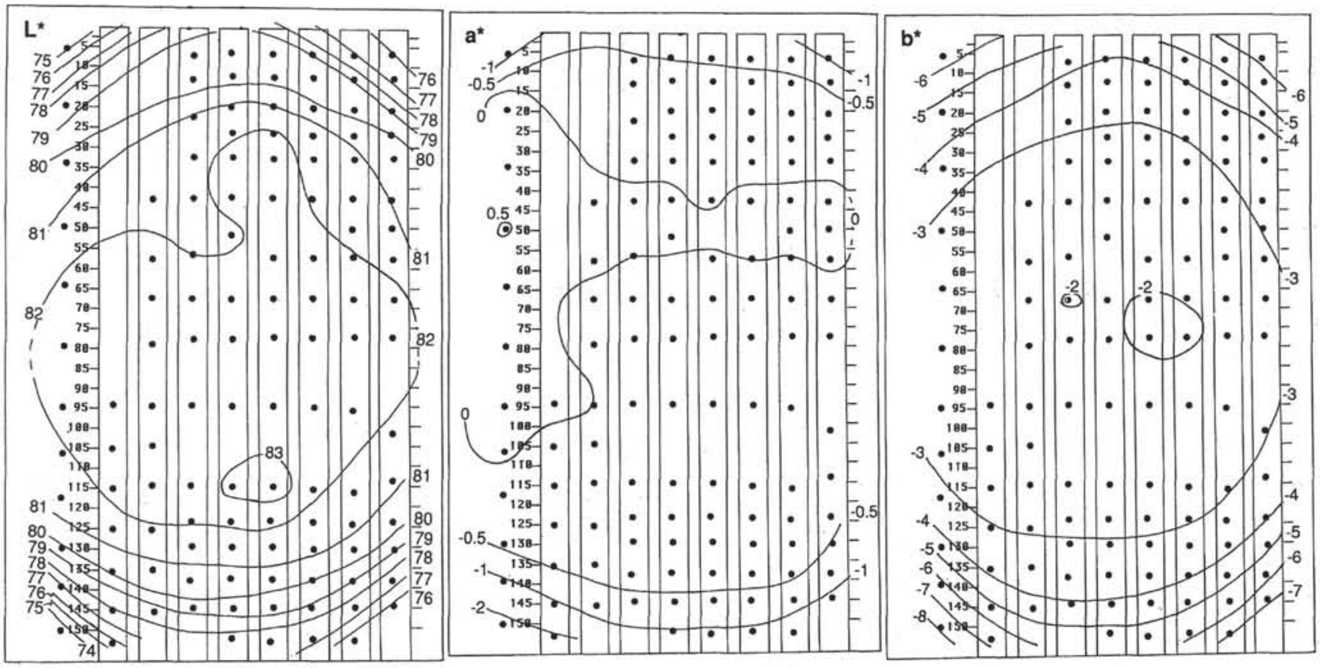

Figure 2. Marginal effects of the differences of lighting condition on the photo table. Solid circles indicate points analyzed.

Electric UT-20, 300W, 26 kHz) for 20 min to remove excess hydrogen peroxide and disaggregate (Nelsen, 1983). A 0.55 g/L Calgon solution was used for dispersing the sample. For samples containing coarser grains (>0.5 mm in diameter), samples were separated into finer and coarser fractions using a 0.5-mm diameter sieve before the laser analysis. These coarse-grained samples were only from the lower part of the lower Pleistocene Unit IIB of Hole 903A (Sections 150-903A-39X-2 to 41X-2). The analysis of split samples indicates a reproducibility of a sigma of 0.09 phi for median grain size of 6.6 phi.

RESULTS

Sediment Color

Sediment color variations for Pleistocene sediments are shown in Figure 3. Due to the marginal effect of lighting, 1.5-m and 9.5-m cycles are easily recognized (Fig. 4). Although these variations are not small, the results of sediment color analysis for Holes 902C and 902D indicated a good relationship (Fig. 3A, B). In particular, b* has a wide range of changes in comparison with the lighting variation. This change in Site 902 sediments shows a similar pattern to the GRAPE data. It is therefore suggested that sediment-color data vary in response to Pleistocene glacial-interglacial cycle. The change of L* also shows a similar pattern; a*, however, does not show clear contrast for this cycle. L* and b* have a positive relationship for all holes (Fig. 5).

Grain Size

The median grain sizes show variations mostly in silt size (4–8 phi; Fig. 6). The range of grain sizes for the middle to upper Pleistocene sediments is 4.8–8.7 phi in Site 902, 3.2–8.6 phi in Site 903, and 4.5–8.6 phi in Site 904. Sediments of Site 903 are coarsest in median grain size and contain many sand grains. The lower half of the middle Pleistocene sediments in Site 903 from 200 to 340 meters below seafloor (mbsf) shows clearly upward-coarsening on a scale of tens of meters.

Sediment Color and Grain Size

Coarsening of grain size accompanies a decrease in L* (darker) and the increase in b* (yellower) at Site 903 (Fig. 7). This relationship is not found for Site 904. Because analyzed horizons for grain size and sediment color were different for Site 902, similar analysis was not done. However, in general, for Site 902, intervals indicating high b* values may coincide with coarse-grained intervals.

DISCUSSION

Correlation

Correlation between Sites 902 and 903 can be suggested based on sedimentary cycles consisting of upward-coarsening and upward-fining succession bounded by fine-grained sediments (Fig. 8). Twelve sedimentary cycles from A to L for Site 903 and 10 from A to J for Site 902 have been recognized for the Pleistocene sediments. For cycles A to C in Site 902, grain size data were not available, so the lowest values of GRAPE data were used instead. Based on the following key intervals and seismic reflectors P1–3 (Lorenzo and Hesselbo, this volume), sedimentary cycles have been correlated between both sites.

The coarse-grained interval from 200 to 215 mbsf at Site 903 is correlative with the coarse-grained interval from 75 to 85 mbsf at Site 902, as determined by the correlation of the P3 seismic reflector (Lorenzo and Hesselbo, this volume) and high value zone of carbonate content (Mountain, Miller, Blum, et al., 1994).

The coarse-grained interval from 100 to 120 mbsf at Site 903 is correlated with the coarse-grained interval from 35 to 45 mbsf at Site 902, as determined by the correlation of high value zone of carbonate content, and the lowest occurrence of *Emiliania huxleyi* (Mountain, Miller, Blum, et al., 1994). The coarse-grained interval approximately 130 mbsf at Site 903 is also correlated with the interval from 45 to 50 mbsf at Site 902 as determined by the correlation of the P2 seismic reflector (Lorenzo and Hesselbo, this volume).

Accumulation rates for Site 903 are two to three times larger than those of Site 902, and the ratio of the accumulation rates for Site 903

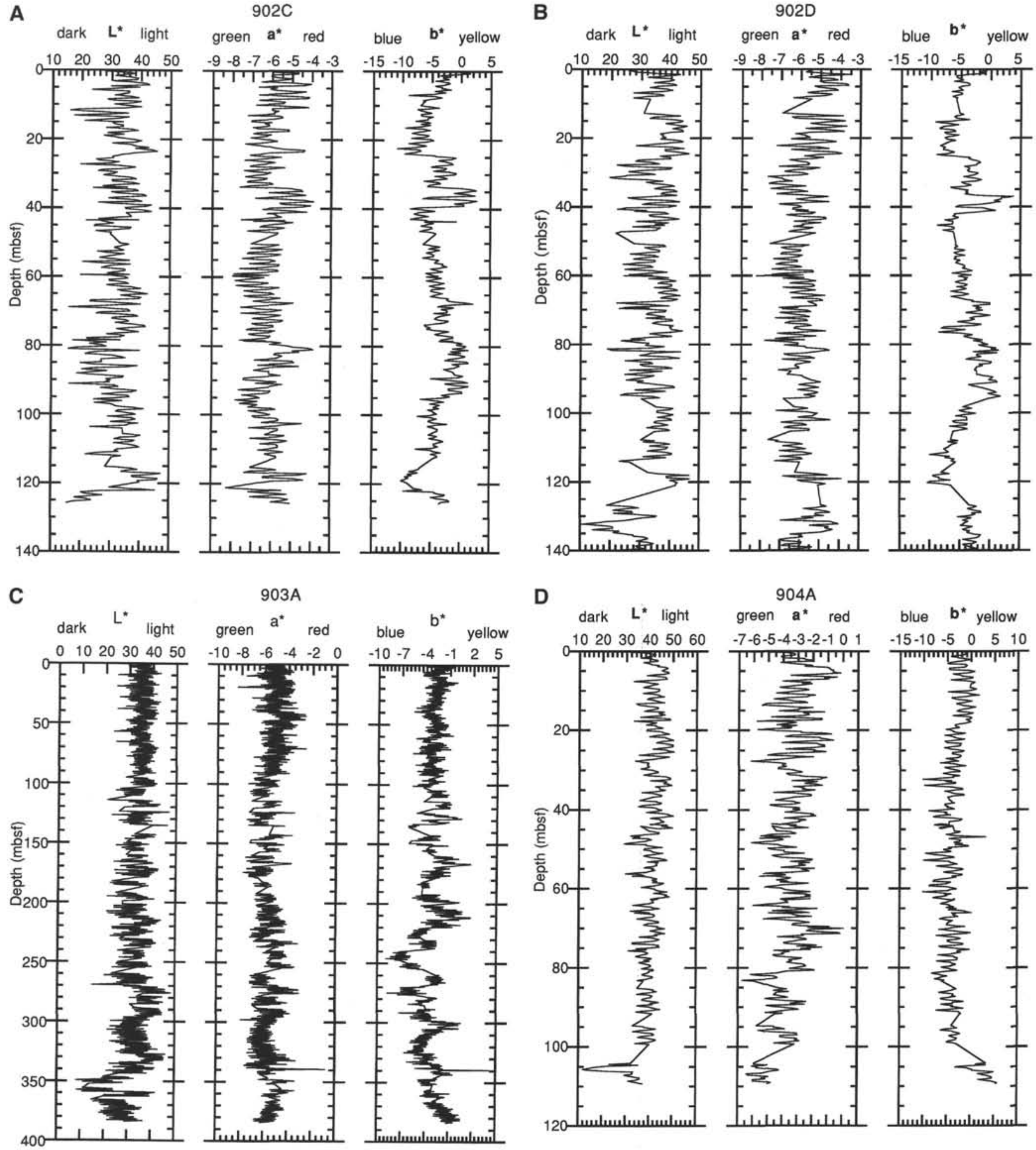

Figure 3. Sediment color variations for Holes 902C (**A**), 902D (**B**), 903A (**C**), 904A (**D**), and 905A (**E**).

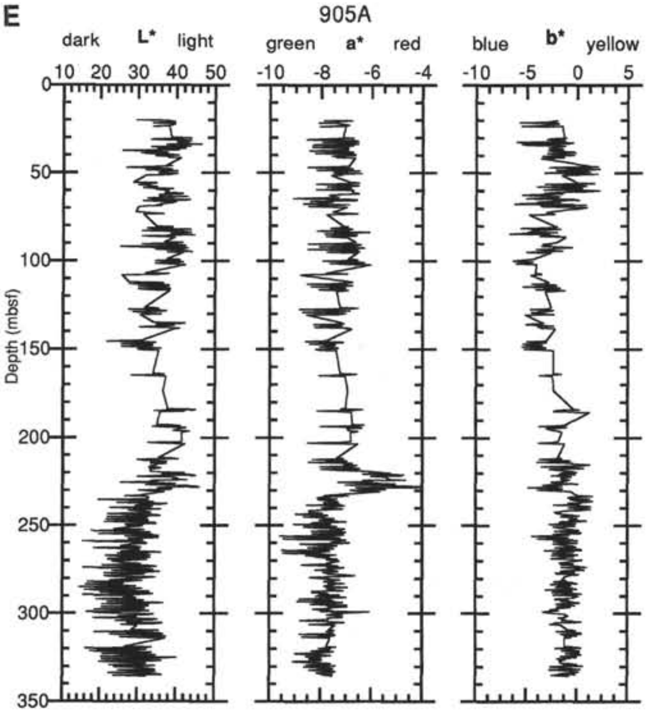

Figure 3 (continued).

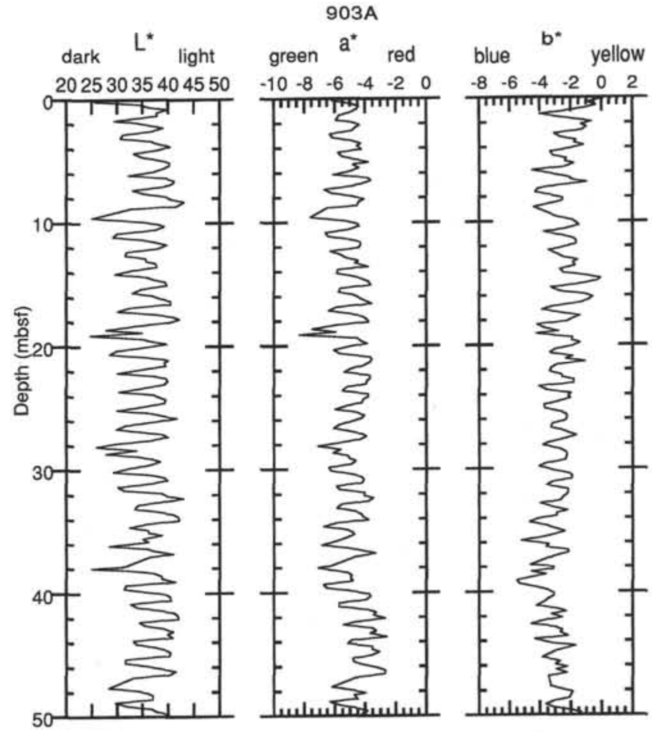

Figure 4. Section and core length cycles created by the marginal effect in sediment color for Hole 903A.

to those of Site 902 increases upward (Fig. 9). Accumulation rates on the continental slope during the Pleistocene were highest on the upper slope and increased toward the end of the Pleistocene.

Relationship to Sedimentary Facies

Most of the contorted and thinly bedded intervals are found in relatively coarse-grained intervals. Contorted beds are recognized in the lower part of Cycle A at Hole 902D, in the upper part of Cycle E and in Cycle J. Thin, color-banded or thinly bedded to laminated intervals more than 1 m thick are found in the middle to lower part of Cycle A, in the lower part of Cycle E, and in Cycle F. At Hole 903A, contorted beds are recognized in the middle part of Cycle I and in the lower part of Cycle J. Thin, color-banded or thinly bedded to laminated intervals more than 1 m thick are found in the middle of Cycle A, in the middle to upper part of Cycle C, in the lower part of Cycle I, and in the upper part of Cycle J (cores in Mountain, Miller, Blum, et al., 1994).

The fine-grained sediments characterizing cycle boundaries are heavily bioturbated or homogenous (cores in Mountain, Miller, Blum, et al., 1994), and they indicate lighter and more bluish sediment color.

The uppermost parts of cycles commonly show abrupt facies changes from the coarsest grained sediments to the finer grained sediments (e.g., cycle boundaries /A, D/E, G/H, and K/L at Hole 903A, cycle boundaries B/C and F/G at Hole 902D, cycle boundaries /A, B/C, and F/E at Hole 902C). The coarse-grained sediments contain very coarse quartz sand, scattered shell fragments, glauconite, and diatomaceous sediments (cores in Mountain, Miller, Blum, et al., 1994).

The sedimentary cycles cannot be related with confidence from Hole 903A, a proximal site, to Hole 904A, a distal site on the slope (Fig. 1).

Correlation with Oxygen Isotope Record

The lowest occurrence (LO) of *Emiliania huxleyi* and the highest occurrence (HO) of *Pseudoemiliania lacunosa* are correlative with oxygen isotope Stages 8 (ca. 285 ka) and 12/13 (ca. 475 ka), respectively (Berggren et al., 1980; Pujos, 1985). The former datum is found at 40–45 mbsf at Site 902, at 95 mbsf at Site 903, and 37.5 mbsf at Site 904. The latter datum is found at 113.7 m at Site 902, 278.5 mbsf at Site 903, and 104.12 mbsf at Site 904 (Mountain, Miller, Blum, et al., 1994). The LO of the *E. huxleyi* datum is in coarser sediments in Cycle D. The HO of *P. lacunosa* is in finer sediments close to cycle boundary J/K in Cycle J. The *Emiliania huxleyi* Acme Zone, indicating an age in 75–83 ka (oxygen isotope Stage 5), is identified at 0.2 mbsf at Site 902, 9.5 mbsf at Site 903, and within 0 to 8.62 mbsf at Site 904 (Mountain, Miller, Blum, et al., 1994).

Coarser sediments are more common during glacial stages indicating lowstands of sea levels. Furthermore, accumulation rates of coarser sediments are higher than those of finer sediments. Coarser sediments also show well-preserved original sedimentary structures including contorted and slump structures. The greatest volume of sediment associated with each sedimentary cycle is interpreted to have been deposited during the lowstands of sea level, as the cycles consist mostly of these coarser sediments.

On the basis of these sedimentary facies, the correlation of nannofossil datum, and GRAPE data (Mountain, Miller, Blum, et al., 1994), cycle boundaries are correlated with oxygen isotope stages in the following manner. Cycle boundary J/K is correlative with the Stage 12/13 boundary. Therefore, coarser sediments in Cycle J are placed within Stage 12. As Cycles I and H form an upward-coarsening succession at Hole 903A and a broad coarser sediment interval at Hole 902D, Cycles I and H are correlative with Stage 10, and cycle boundary I/J is correlative with Stage 11. Cycle boundaries G/H, C/D, and /A are Stage 9, Stage 7, and Stage 5, respectively (Fig. 8; Table 1).

Relationship to Sea-Level Changes

Cycle boundaries characterized by fine-grained sediments are thought to form under low sediment supply during the highstand of sea level. Therefore, these boundaries are the flooding surfaces of se-

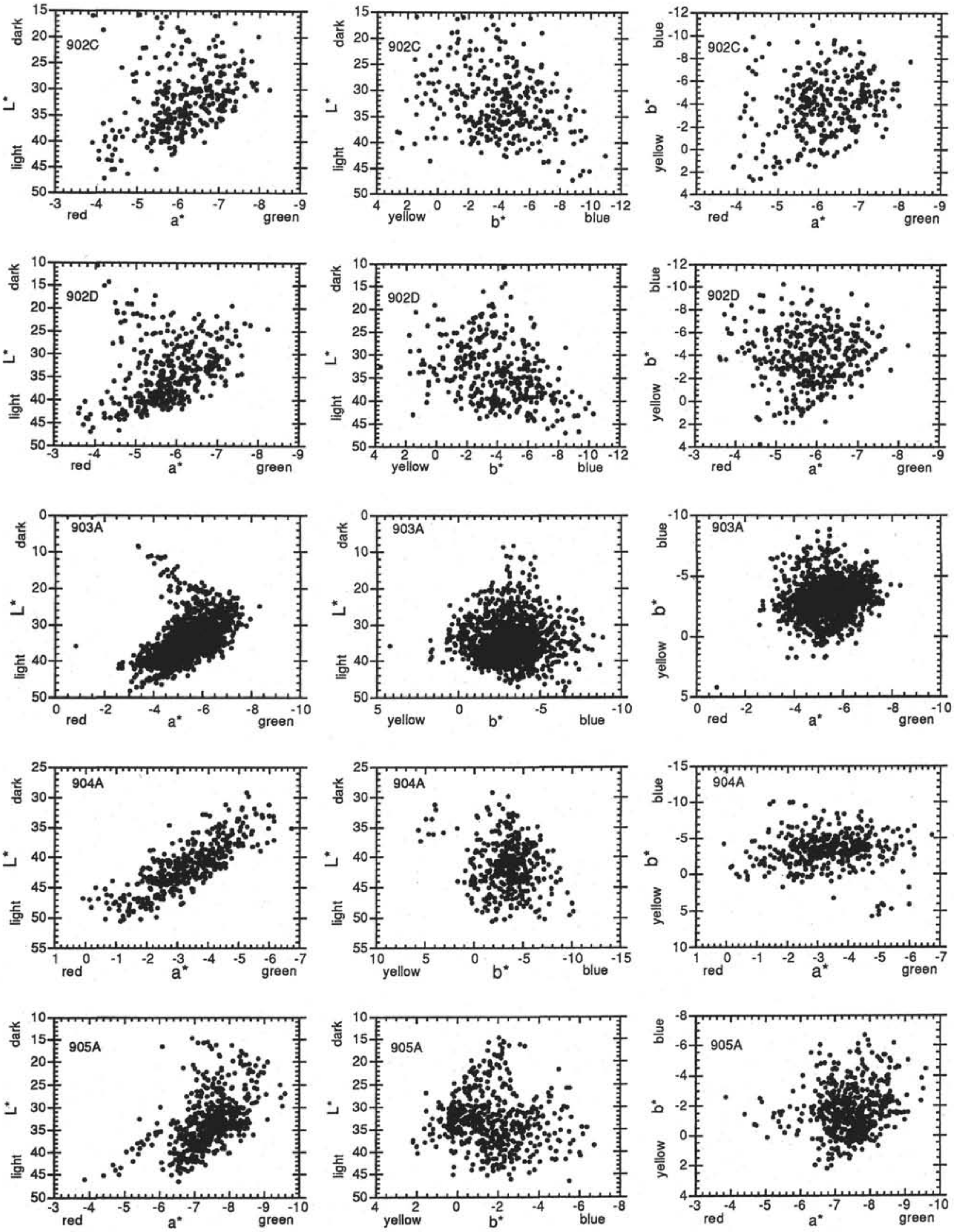

Figure 5. Relationship among L*, a*, and b* for Holes 902C, 902D, 903A, 904A, and 905A.

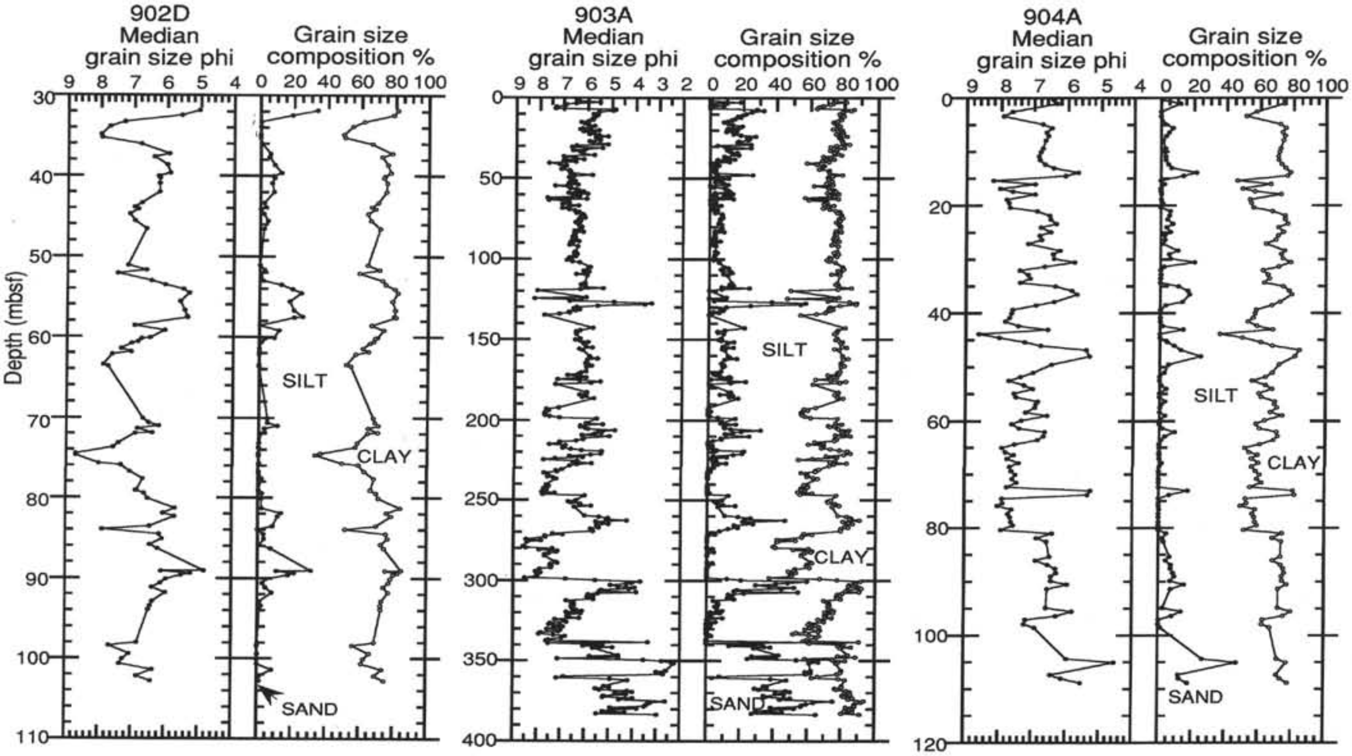

Figure 6. Grain-size variations for Holes 902D, 903A, and 904A.

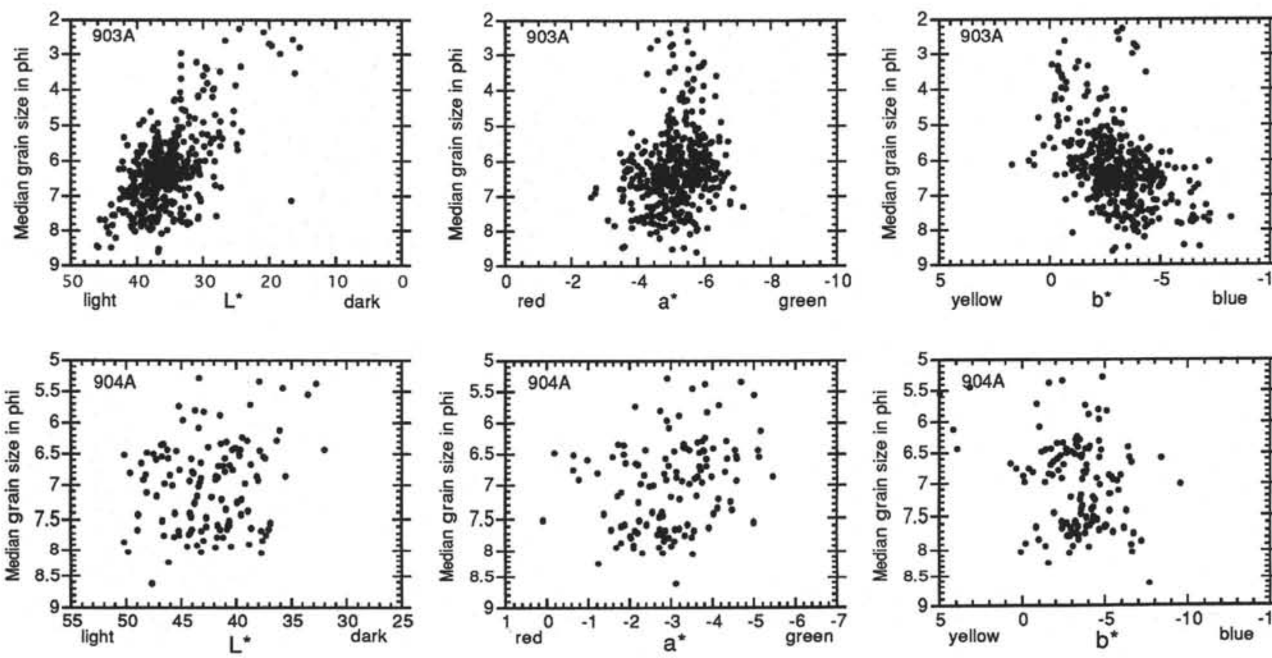

Figure 7. Relationship between grain size and sediment color for Holes 903A and 904A.

quence stratigraphy (Van Wagoner et al., 1988). Coarse-grained sediments bearing scattered coarse grains, shell fragments, and glauconite overlain by flooding surfaces are interpreted as transgressive sands (Saito et al., 1989; Saito, 1991) from their stratigraphic position and character.

Average accumulation rates at Sites 902, 903, and 904 during the middle Pleistocene are approximately 30, 75, and 30 cm/k.y., respectively (Mountain, Miller, Blum, et al., 1994). Modern accumulation rates on the slope, however, are less than 20 cm/k.y. (Hampton and Robb, 1985). This difference implies that most of sediments on the

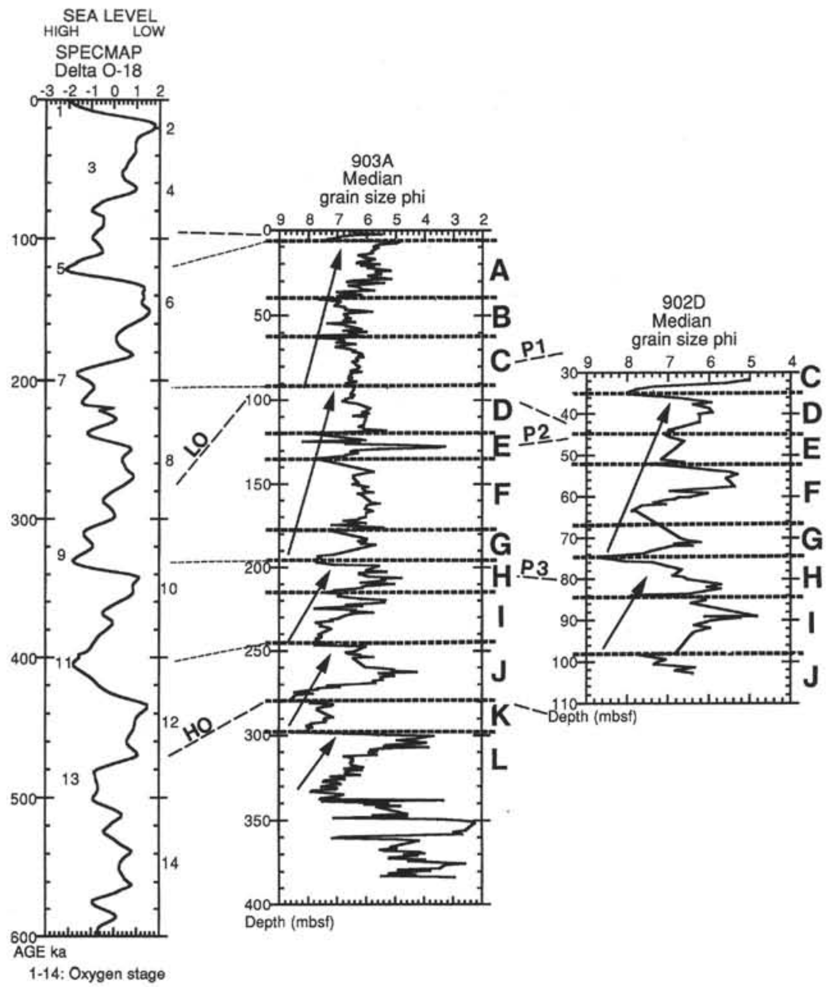

Figure 8. Sedimentary cycles for Holes 902D and 903A. Arrows indicate estimated 100-k.y. sedimentary cycles from oxygen isotope Stages 14 to 6. A to L show sedimentary cycles. Cycle boundary F/G for Hole 902D is based on GRAPE data. LO = the lowest occurrence of *Emiliania huxleyi,* HO = the highest occurrence of *Pseudoemiliania lacunosa,* P1 to P3 = seismic reflectors.

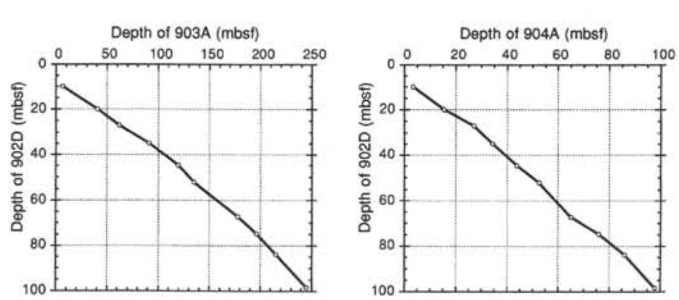

Figure 9. Cycle thickness relationships between Holes 902D and 903A, and Holes 902D and 904A.

slope were deposited during the lowstand of sea level, in particular at the upper slope Site 903.

Canyon Development

The Pleistocene slope sediments of Sites 902, 903, 904, and 906 on the upper to middle slope lack sediments of oxygen isotope Stages 2 to 4 of the last glacial epoch and also lack thick lower Pleistocene sediments. Prior et al. (1984) showed a faster sedimentation rate during 12 to 30 ka in the late Pleistocene (Stage 2) than during the Holocene on the lower slope and the upper rise. The Pleistocene sediments of Site 905, taken from the upper continental rise offshore New Jersey, 34.5 km from the foot of the slope, consist mainly of the lower Pleistocene mass-transport deposits. These deposits are about 200 m thick, whereas the middle to upper Pleistocene sediments at this site are less than 20 m thick (Fig. 1; Mountain, Miller, Blum, et al., 1994). The depocenter offshore of New Jersey has shifted between the upper to middle slope and the lower slope to the continental rise during the Quaternary. Missing sediment of oxygen isotope Stages 2 to 4 at drilled sites on the upper slope is thought to be the result of slumping that occurred during the last glacial period before the deposition of the Holocene mud cover. Relict slope morphology characterized by surficial slumping and scours (Robb et al., 1981; Twichell and Roberts, 1982) may have formed mainly in this period.

The Hudson River is a major source of sediments offshore of New Jersey (Darby, 1990). The Hudson River supplied terrigenous materials to the outer shelf and upper slope areas off New Jersey in the late Quaternary. Knebel et al. (1979) and Swift et al. (1980) showed an ancestral Hudson valley on the shelf extending southward toward the study area. Milliman et al. (1990) and Davies et al. (1992) indicated that the outer shelf sediment wedge off New Jersey formed during the last lowstand of sea level and the subsequent rise of sea level. Sediment supply from the Hudson River during the lowstand of sea level

Table 1. Depth of the boundaries of sedimentary cycles for Sites 902, 903, and 904.

Cycle boundary	902D (mbsf)	903A (mbsf)	904A (mbsf)	Oxygen isotope stages
/A	10.00	6.38	3.38	5
A/B	20.00	40.58	15.38	
B/C	27.00	61.87	27.05	
C/D	34.85	91.13	34.33	7
D/E	44.71	119.50	43.87	
E/F	52.10	134.90	52.55	
F/G	67.20	177.70	65.04	
G/H	74.71	196.00	75.88	9
H/I	83.96	215.10	86.05	
I/J	98.40	244.90	97.88	11
J/K		278.90		13
K/L		298.30		

in the Quaternary must play an important role in the progradation and upbuilding of the upper slope sediments. It is estimated that in response to the formation of the sediment wedge at the shelf margin, the upper slope off New Jersey has a steep gradient and is characterized by closely spaced canyon systems with low-relief gullies (Twichell and Roberts, 1982).

During the highstands of sea level, terrigenous materials have been trapped mostly within the coastal to inner shelf areas (Ashley et al., 1991; Wellner et al., 1993), and hemipelagic fine-grained sediment has covered the slope area (Robb et al., 1981; Stanley et al., 1983; Prior et al., 1984). This fine-grained sediment is a good correlative interval for slope sediments. During the lowstands of sea level since 0.5 Ma, terrigenous materials, mostly derived from the ancestral Hudson River, formed the shelf edge sediment wedge showing progradational clinoforms on the upper slope. Slumping may have been an important process extending submarine canyons and valleys (Robb et al., 1981), as shown by missing sediments of oxygen isotope Stages 2–4 at these sites, and small slump features and contorted sediments are characteristic of the coarse-grained intervals of slope sediments.

Relationship with Sequence Stratigraphic Model

Progradational slope sediment showing an upward-coarsening and upward-thickening succession is one of major depositional lithosomes in a depositional sequence. This is thought to be a highstand systems tract (Posamentier et al., 1988; Greenlee et al., 1992) or shelf margin system tract (Posamentier et al., 1988).

Related to high-frequency sea-level changes in the Quaternary, transgressive to highstand system tracts have been formed mainly at the present coastal plain to nearshore zones on the U.S. Atlantic margin, as barrier islands and strandplain systems (Cronin et al., 1981; Ashley et al., 1991; Wellner et al., 1993) and incised-valley systems (Ashley and Sheridan, 1994; Belknap et al., 1994). The system tracts also have been formed on the shelf as sediment wedges, surficial sand sheets, sand bodies (Knebel and Spiker, 1977; Swift et al., 1980; Milliman et al., 1990). Lowstand system tracts were formed as deep-sea fans (Ericson et al., 1961; Stanley et al., 1971; Cleary et al., 1977) and shelf-margin deltas (Ewing et al., 1963; Suter and Berryhill, 1985).

The Pleistocene sediments taken from the upper slope area off New Jersey also show that the Quaternary progradational slope sediments have been formed mainly during the lowstands of sea level for the last 0.5 Ma. Therefore most of these slope sediments should be interpreted as a part of shelf-margin systems tract or lowstand systems tract, not highstand systems tract for 4th- to 5th-order sequence stratigraphy. The fine-grained intervals correlated with the highstand of sea level are interpreted as highstand systems tract, and transgressive sands overlaid with the fine-grained sediments are interpreted as a transgressive systems tract.

During the middle to late Miocene period, ancient shelf breaks were located in the middle of the present Atlantic shelf (Greenlee et al., 1992; Miller and Mountain, 1994). The middle to late Miocene progradational slope strata are recognized below the modern shelf. The strata consist of thick prograding wedges that coarsen upward from slope mudstone into homogeneous delta-plain and delta-front sandstone. These are interpreted as highstand system tracts (Greenlee et al., 1992). The approximately contemporaneous shallow marine strata, however, were deposited at the areas of the present New Jersey coastal plain located shoreward of the ancient shelf breaks (Sugarman et al., 1993; Pazzaglia, 1993). This relationship is similar to that between the Quaternary slope sediments off New Jersey and the Quaternary coastal plain to inner shelf sediments (Cronin et al., 1981; Ashley et al., 1991; Wellner et al., 1993). If the Quaternary analogues are applied to ancient sequence models, most of ancient progradational slope sediments recognized below the present shelf can be interpreted as shelf-margin system tracts or lowstand system tracts, not highstand system tracts. On the other hand, 95% of siliciclastic sediment was transported and deposited onto the continental rise during the Quaternary (Poag, 1992). Moreover, their major depositional areas are megasubmarine fans related to the Hudson-Connecticut and Delaware-Schuylkill-Susquehanna-Potomac dispersal systems on the continental rise and basin plain (Poag, 1987, 1992). Great care is needed to interpret progradational slope strata in sequence stratigraphic analysis.

SUMMARY

Pleistocene slope sediments off New Jersey consist of upward-coarsening and upward-thickening sedimentary cycles formed in response to glacio-eustatic sea-level changes. These sediments form a progradational slope. Each sedimentary cycle is bounded by heavily bioturbated or homogeneous fine-grained sediments characterized by lighter and bluish sediments deposited during the highstand of sea level. Each cycle is mainly darker and yellowish in color with laminated or thin, color-banded, coarse-grained sediments, including contorted or slumped structures. Related to the Quaternary sea-level changes, slope sediments were mainly deposited and prograded during the lowstands in sea level. Therefore, it is interpreted that most progradational slope strata are formed as lowstand system tracts or shelf margin system tracts, not highstand system tracts.

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