VERTICAL SEQUENCE AND LATERAL TRANSITIONS IN THE FACIES OF A BARRED NEARSHORE ENVIRONMENT¹

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ABSTRACT: Nine tube cores 7 cm in diameter and up to 150 cm long from a nearshore, crescentic bar in Kouchibouguac Bay, New Brunswick, Canada reveal the vertical sequence and lateral transitions of facies previously identified only in shallow box cores. The facies are a) *inner-shelf-shoreface transition*: bioturbated fine sands and silts with remnant primary structures; b) *seaward slope*: planar lamination in medium-to-fine sands dipping gently seaward and composite bed sets of planar-to-ripple cross-lamination in fine sand (chevron lamination is rare); c) *bar crest*: low-angle, planar lamination dipping both landward and seaward and medium-scale trough cross-lamination in medium-to-coarse sands; d) *landward slope*: planar lamination dipping landward with small-scale, landward dipping trough cross-lamination (occasionally small-to-medium-scale trough cross-lamination is found with seaward dips); e) *trough*: massively bedded lags of coarse, gravelly sands with abundant shell fragments contrast with isolated, very thin units of massive silt and units of well-sorted sands. The latter display subhorizontal planar lamination and small-to-medium-scale trough cross-lamination; polymodal dips indicate bed-form migration landward, alongshore, and offshore.

Vertical sequences and lateral transitions seaward of the bar crest suggest that three wedge-shaped units (inner-shelf-shoreface transition, seaward-slope bar crest) interdigitate in an offlap-onlap sequence. To landward the trough and landward slope facies interfinger complexly, while the crest facies forms a simple onlap over landward slope facies. Total reworking of sediments within the bar-trough system is expected every 5 to 6 years, and long-term preservation is limited to the inner-shelf-shoreface transition, seaward slope, and trough facies.

INTRODUCTION

Over the last decade the facies associations of modern, wave-dominated coasts have been revealed through detailed box coring. In particular, the textures and structures of subaqueous, wave-formed bars have been well documented (Reineck 1963, 1976; Siebold 1963; Clifton et al. 1971; Hunter et al. 1979; Hayes 1969; Hayes and Kana 1976; Howard and Reineck 1972; Davis et al. 1972; Reineck and Singh 1971, 1973; Davidson-Arnott and Greenwood 1974, 1976; Chowdhuri and Reineck 1978; Davidson-Arnott and Pember 1980; Reineck and Cheng 1978; Ship 1984; Short 1984; Wright 1984). Furthermore, structures have been used as indices of sediment transport in determining the dynamics and possible origins of bars (Reineck 1963; Siebold 1963; Greenwood and Davidson-Arnott 1975, 1979; Greenwood and Mittler 1979; Greenwood and Hale 1980, 1982; Hunter et al. 1979). However, most studies examined very short cores (less than 0.45 m), and little knowledge of the deeper, internal structures was obtained. Hill and Hunter (1976) took pipe cores up to 1.3 m long across a barred nearshore off Padre Island, Texas, but did not illustrate any structures preserved below 0.2 m depth. Only Van den Berg (1977) describes cores up to 1.2 m long, but these were restricted to a ridge and runnel essentially above the mean low tide level.

In this paper a sequence of tube cores up to 1.50 m in length taken through a crescentic nearshore bar is pre-

sented: the cores cover the area from the inner-shelf-lower-shoreface transition, through the mid-shoreface to the seaward slope of an inner bar in this two-bar system. Objectives were to establish whether the surface facies (Davidson-Arnott and Greenwood 1974, 1976) extend to depth, define the lateral relationships at depth, and thereby gain insights into earlier phases of sedimentation in this stable, bathymetric configuration. One further aim was to establish whether a narrow core would allow identification of structures produced by large bed forms, previously recognized only in 30-cm-wide box cores. The latter is not trivial since the translation of many facies models, developed for recent systems, to ancient sequences may require identification of structural assemblages in small-diameter drill cores.

LOCATION

The study was carried out in Kouchibouguac Bay, which is located in the Southern Gulf of St. Lawrence at the western end of Northumberland Strait on the New Brunswick coast of Canada. The location, form, textures, and dynamics of this two-bar system together with the general environmental constraints have been documented previously (Greenwood and Davidson-Arnott 1975, 1979; Greenwood and Hale 1980). [Descriptions of the bed forms and surface structures in the inner system are to be found in Davidson-Arnott and Greenwood (1974) and detailed surface facies relationships for the subenvironments of the more stable outer bar in Davidson-Arnott and Greenwood (1976).]

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FIG. 1.—Nearshore profile, Kouchibouguac Bay, New Brunswick. Tube core locations are shown with their depth and relationship to the major morphodynamic subenvironments.

METHOD

Cores were obtained using pre-cut lengths of plastic piping of 7.0 cm inside diameter. The corer was driven vertically into the sand by SCUBA divers using a 30-kg sleeve hammer operating on a steel cap and rod guide fitted as an extension to the top of the pipe. Core orientation was accomplished by scribing a line along the length of the pipe and maintaining it facing shoreward; this also allowed detection and correction of tube rotation. Upon completion of core penetration (occasionally not to its full extent), the maximum penetration depth was marked on the outside. To secure and mark the top of the core, the corer was filled with dyed sand and capped. Core extraction was aided by a hand-operated hydraulic jack, and premature extrusion of the core was prevented by a vacuum developed below the plastic cap. Once fully extracted, the bottom of the corer was also capped for transport. Two problems were encountered with the tube cores. (1) It was difficult to maintain a vertical position at the start of coring; it was sometimes necessary to correct the alignment after the cover was driven in about 10–20 cm. This correction was small, but orientation of subhorizontal laminae may be distorted in the preserved units. (2) Core compaction was between 2 and 10 cm with maxima associated with the softer sediments.

The core was cut lengthwise using a table saw into two unequal halves to expose a shore-normal section. A relief peel of the larger half was made by applying a mixture of Araldite (CIBA-Geigy 6005) and hardener (CIBA-Geigy 850) in a 1:1 ratio, which in turn was covered by cheesecloth for additional strength. After 24 hours curing time the peel could be removed, photographed, and logged. Samples of sediment from structures within the core were also taken for grain-size analysis.

Core location was fixed by triangulation or by reference

to previously fixed markers on the nearshore slope. Figure 1 documents these locations, the sedimentary subenvironments, and their hydrodynamic characteristics. All cores were taken on a single transect across the central saddle of one crescentic bar.

VERTICAL SEQUENCES

Inner-shelf-Shoreface Transition.—Core 9 (not illustrated) was taken 7.5 m below low water, approximately 700 m offshore (Fig. 1), and consists of extensively bioturbated, very fine sands with some silts. Polychaete burrows occur in profusion, and a shell of the sand dollar (*Dendraster* sp.) is preserved in nonliving position at the base of the core. However, not all the stratification is destroyed; both low-angle and subhorizontal planar lamination are visible, as are units of small-scale, landward-dipping trough cross-lamination.

The structures described above indicate that at this water depth, sediment reactivation is restricted to storm waves and then only during the larger storms. For example, the maximum characteristic wave height and period recorded at this depth for a storm with a recurrence interval close to that of the most probable annual maximum (Hale and Greenwood 1980) were 1.94 m and 8 s, respectively, and the measured depth of activity was only 5 cm. Tidal currents at this depth produce little reactivation and bedding genesis. In 6.5 m of water in the Bay, Davidson-Arnott (1975) recorded maximum tidal flows of 36 cm s^{-1} , but these were relatively rare, and the vast majority of flows were less than 15 cm s^{-1} . Figure 3a illustrates a box core taken immediately after a storm at the same location as the tube core: note the small-to-medium-scale trough cross-lamination at the top of the core with a mud clast in the larger unit. These structures overlie subhorizontal planar lamination and extensively

FIG. 2.—Tube cores: (a) Core 8; (b) Core 7; (c) Core 6; (d) Core 5. The letters used here and subsequently refer to structural types: subhorizontal planar lamination—*a*; low-angle planar lamination—*b*; high-angle planar cross-lamination—*c*; small-scale trough cross-lamination—*d*; medium-scale trough cross-lamination—*e*; “festoon” lamination—*f*; tabular cross-lamination—*g*; chevron lamination—*h*; bioturbated fine sands—*i*; massive, poorly sorted, coarse sand—*j*; massive, poorly sorted, gravelly sand—*k*; massive, poorly sorted, sandy gravels—*l*; silt—*m*; peat—*n*. In these and all other cores the section is normal to the shore, which is to the right. Vertical scale in centimeters.

bioturbated fine sands and silts, although the truncation is surprisingly diffuse. One unit of trough cross-lamination has steep landward dips and a set thickness of 12 cm: it has foresets which pinch out down-dip, and it is similar to lunate megaripple structures characteristic of much shallower water. Thus, large storm waves induce both small oscillation ripples and, occasionally, megaripples at this depth. However, bioturbation is rapid, destroying much of the original structure: only faint traces of lamination are visible in a second box core taken two days after the period of storm-wave activity (Fig. 3b). The parallel lamination stratified with thick units of bioturbated silts and sands is similar to the "parallel-laminated-to-burrow" sets found by Howard (1971) and others on both barred and nonbarred coastlines under moderate-to-low wave energy (Reineck and Singh 1971, 1973; Howard and Reineck 1972; Shipp 1984).

Seaward Slope.—Cores 8 and 7 (Fig. 2a, b), taken at 4.5 m and 2.7 m depth, respectively, illustrate facies development on the lower and upper seaward slope. The most common facies present in shallow cores and dominating the upper and lower portions of Core 7 is the composite bed set of subhorizontal planar-to-ripple lamination. These bed sets form under a decreasing symmetrical oscillatory flow as storm waves decay (Davidson-Arnott and Greenwood 1976; Greenwood and Hale 1980; Greenwood and Mittler 1984). A storm cycle origin has been ascribed to similar units in other marine (Reineck and Singh 1971; Greenwood and Mittler 1979; Shipp 1984) and nonmarine (Davidson-Arnott and Pember 1980; Greenwood 1984) environments dominated by waves. It should be noted that the core in deeper water (Fig. 2b) consists primarily of subhorizontal planar lamination and the odd unit of small-scale trough cross-lamination. The composite bed sets are absent. This may result from two factors. First, the bulk of the preserved stratification is in relatively coarse sand, and finer sands, within which planar-to-ripple couplets are most common, have been bioturbated, as is the case in the upper portion of Core 8 (Fig. 2b). Second, it is possible that only the higher-energy structures (planar lamination) are preserved at this depth, with successive storms truncating the lower-energy (ripple lamination) units.

Also present on the upper-seaward slope (Fig. 2b) are larger units of landward-dipping trough cross-lamination produced by asymmetric oscillation ripples migrating under strongly transformed waves near the bar crest. There is no evidence for medium-scale cross-stratification produced by lunate megaripples, and the upper units in the core are still subject to bioturbation by sand dollars. However, a distinct landward dip to the planar lamination in the lowest one-third of the core suggests that at this time of deposition the bar crest may have been to the seaward. Indeed, the juxtaposition of both landward and seaward-

FIG. 3.—Box cores: (a) poststorm core taken in 7.5 m of water at location of tube core 9; (b) strongly bioturbated core taken at same location as (a) after quiescent period of 2 days; (c) mid-seaward slope

core illustrating composite bed sets of planar-to-ripple cross-lamination; (d) trough cross-lamination produced by migrating lunate megaripples (note the curved erosional bases, varying thicknesses of individual laminae, pinching-out of laminae down dip, curved to sigmoidal form of laminae, and general high angle of cross-lamination but with increasing angles associated with upward building of the set); (e) landward slope core illustrating subhorizontal to landward-dipping planar lamination and small-scale, landward-dipping, trough cross-lamination (note the oblique nature of the latter in some instances to give "festoon" lamination); (f) trough core illustrating (1) extreme textural variability and landward and seaward-dipping trough cross-lamination, (2) "festoon"-type bedding, and (3) massive, coarse, and fine beds and high skeletal carbonate content. The 10-cm-bar scale shown in (f) applies to all peels.

dipping planar laminations in the middle section of Core 7 (Fig. 2b) suggests that repeated changes in orientation of the sedimentation surface took place during bar development.

Bar Crest.—Core 6 (Fig. 2c) is characterized in its upper 0.75 m by two structures: medium-scale, high-angle cross-laminations with curved erosional bases in medium-to-coarse sands are stratified with low-angle planar laminations. In one set, high angles of dip near the top decrease markedly towards the base. Even more significant is the high proportion of seaward-dipping cross-laminae on a sedimentation surface which must have been dipping landward, as indicated by planar lamination in the upper half of the core. Furthermore, the individual cross-laminae are variable in thickness and frequently thin or even pinch out in the direction of dip: the thickest laminae occur in the coarser grades, and thicknesses here exceed those of any other core. These characteristics typify structures produced by lunate megaripple migration (Fig. 3d) which, in the central saddle of the crescentic bars, occurs under both landward and seaward flows (Greenwood and Davidson-Arnott 1975; Greenwood and Hale 1980, 1982). Although megaripples may exceed 0.50 m in height and be separated by distances of several meters, it is clearly possible to identify their structural characteristics even in a 7-cm-diameter core.

Megaripples result from strong asymmetries in the fluid motion. Such asymmetry can result simply from wave shoaling over the shallow sections of the bar crest. It may also result from secondary interactions in the incident wave field (Greenwood and Sherman 1984), superimposition of rip currents on the wave oscillations (Greenwood and Davidson-Arnott 1975, 1979; Greenwood and Hale 1982), or as a response to reflected standing-gravity-wave and edge-wave-drift velocities (Carter et al. 1973; Holman and Bowen 1982). In the latter four instances seaward migration can be induced in the trough, landward slope, and bar crest.

Hill and Hunter (1976) suggest that planar lamination dominates bar crests and medium-scale cross-lamination is restricted to the troughs and attributable to megaripples generated by longshore currents. Similarly Davidson-Arnott and Pember (1980) find few if any medium-scale cross-stratified units on the crests of multiple bars in the Canadian Great Lakes. However, this lack is probably texturally controlled (Clifton 1976), since such structures are dominant in other marine and non-marine, low-to-high-wave energy environments (Reineck and Singh 1971; Greenwood and Mittler 1979; Hunter et al. 1979; Shipp 1984; Greenwood 1985).

The lower part of Core 6 is dominated by subhorizontal planar and small-scale trough cross-lamination in medium-to-fine-grained sand. The cross-laminae dip landward and are produced by migration of oscillation ripples. "Festoon lamination" indicates flow oblique to the slope and may result from combined oscillatory and longshore currents. Such structures are generally associated with the

landward slope (Fig. 3e) in the area of wave reformation (Davidson-Arnott and Greenwood 1976).

Landward Slope.—Core 5, located at a mid-landward slope position, illustrates transition down the landward slope to its toe and junction with the trough (Fig. 2d). The upper section comprises low-angle, landward-dipping planar lamination plus small-scale, landward-dipping trough cross-lamination typical of the landward slope here and in other marine sites, where the bars are sufficiently large (Greenwood and Mittler 1979; Shipp 1984). At a depth of 0.53 m, a marked textural discordancy is produced by a 3-cm-thick organic unit with masses of included shell fragments. Two explanations are possible: (1) quiescent settling of organic suspensate, presumably in a trough; and (2) incorporation of lagoonal peat during deposition on the landward slope. Compaction of the organics, inclusion of many shell fragments, and coherent bedding with laminae above and below suggest the latter. Below this discordancy is 0.5 m of alternating seaward- and landward-dipping cross-lamination at high angles reflecting lunate megaripple migration. Seaward transports across the toe of the landward slope have been well documented in box cores (Greenwood and Davidson-Arnott 1979; Greenwood and Hale 1980). Smaller units of landward-dipping trough cross-lamination and the subhorizontal planar lamination in fine sands at the base of the core are again typical of the lower landward slope, with the proximity of the trough being indicated by the trapping of a kelp-rafter sandstone pebble.

Trough.—Core 4 (Fig. 4a), taken in 4.6 m of water, marks the toe of the landward slope (Fig. 1). The upper third of the core is coarse, granule-bearing sand with a sharp erosional separation from medium- to fine-grained sands below. Bimodally dipping trough cross-laminae in the coarse sand reflect megaripple migration landward and seaward across the toe of the slope. Although the slope here would be less than 2 degrees, seaward flows appear also on the steeper mid-to-upper landward slope, reflecting a contiguous flow, as suggested by the rip-cell model of bar dynamics proposed by Greenwood and Davidson-Arnott (1979).

Below the coarse sands are trough cross-laminations and planar laminations in fine sand, together with a unit of planar lamination in coarse sand. The first structures illustrate both landward and shore-parallel dips, but the last two structures dip landward only or are subhorizontal. The core in total suggests interdigitation of landward-slope and true trough sediments. A thin band of very fine sand and silt in the lowermost part of the core suggests quiescent settling: such units are commonly thicker in box cores but seem not to be preserved extensively. They appear as only very thin, isolated units in this core and others from the trough (Fig. 4b). This further suggests that fines are only stored temporarily in the upper shore-face, a fact long recognized by others.

The deepest part of the trough (Fig. 1) is characterized by Cores 3 (Fig. 4b) and 2 (Fig. 4c). Both exhibit extremes

FIG. 4.—Tube cores: (a) Core 4; (b) Core 3; (c) Core 2; (d) Core 1. Letters as in Figure 2. Vertical scale in centimeters.

FIG. 5.—Vertical sequences of textures and structures and interpreted lateral correlations of facies in the wave-formed bar, Kouchibouguac Bay. Numbers refer to core locations in Figure 1.

of texture and structure indicative of widely fluctuating flow velocities. The most striking feature is the presence of poorly sorted, poorly stratified units with kelp-rafted clasts up to 6 cm in diameter and fractured shells of all sizes. Winnowing by combined oscillatory and longshore currents during storms produces such lags. In contrast, finer sediments accumulate by suspension settling during post-storm periods (Fig. 4b). Another distinctive feature is the "festoon" lamination (Fig. 4c), resulting from sinuous crested ripples migrating parallel to shore under longshore currents. Such units are not, however, contiguous enough to warrant separate facies designation as suggested by Hunter et al. (1979). Both the largest clasts and the "festoon" lamination occur on the landward side of the trough (cf. Cores 4, 3, and 2). This is the location identified by Greenwood and Sherman (1983) where maximum shore-parallel flows occur under breaking waves over barred topography.

Seaward Slope of Inner Bar.—The trough merges landward with the seaward slope of the inner bar, and Core 1 (Fig. 1), taken in 2.7 m of water, penetrates the full bar height (Fig. 4d). The lower two-thirds of core reveal steeply landward-dipping (up to 30°) plane-parallel lamination. Reactivation surfaces are scarce, suggesting rapid deposition on an actively migrating slip face. Bar-front migration during storms does produce tabular sets of me-

dium-scale cross lamination (Davidson-Arnott and Greenwood 1974). In the tube core, dip angles decrease up through the set to subhorizontal planar lamination with some megaripple cross-lamination. The latter typifies water shallowing as the bar builds upwards (Hayes 1969; Wunderlich 1972; Davidson-Arnott and Greenwood 1974). The location of Core 1 seaward of the contemporary bar crest suggests that sedimentation on a migrating avalanche face is dominant during bar growth in the inner system. Hunter et al. (1979) note that such structures constitute a minor part of the oblique bars of Oregon, although Van den Berg (1977) shows their dominance in intertidal ridges during rapid lateral accretion. Onshore migration rates up to 12 m per month in Kouchibouguac Bay (Greenwood and Davidson-Arnott 1975) account for the structural contrast with the Oregon bars where alongshore migration is dominant.

LATERAL TRANSITIONS

While it is difficult with so few cores to be definitive about lateral facies change, strong correlations between structural assemblages and morphodynamic subenvironments allow a reasonable interpretation. Figure 5 documents for a number of key cores the vertical sequences and their environmental interpretation; Figure 6 is the facies model of the bar-trough system.

Seaward of the crest, the bar comprises three interdigitated, wedge-shaped facies produced respectively in the inner-shelf-shoreface transition, seaward slope, and bar crest (Fig. 6). Cores 9, 8, and 7 (Fig. 5) illustrate the increase in number of facies and their wedge-shaped arrangement progressively up the seaward slope. This arrangement could be produced simply by variation in the position of the profile as it moves seaward and then landward. Such movements occur both as a response to individual storms and, more importantly, during the alongshore migration of the crescentic form (Greenwood and Davidson-Arnott 1975). Landward of the morphological crest, the bar-crest facies forms an on-lap with the underlying landward slope facies (Fig. 6; Core 6, Fig. 5), which itself interdigitates in a more complex manner with the trough facies (Fig. 6; Core 5, Fig. 5). In a landward direction, the texturally and structurally varied trough sediments will interdigitate with the simpler inner bar facies (Fig. 6). Bioturbated sediments at the base of Cores 3 and 8 suggest that lower-shoreface facies may underlie the bar complex at least as far as the trough: certainly at the depths of occurrence, 5.75 m and 5.5 m, these bioturbated units are only found at the surface on the lower seaward slope of the outer bar.

STRUCTURAL PRESERVATION

It is clear from the preceding descriptions that structural assemblages representative of distinct morphodynamic subenvironments are all well preserved at depth within the outer-bar system. Two questions are pertinent to this preservation: first, when were the internal structures produced, and second, what is the potential for long-term preservation?

FIG. 6.—Simple model of facies association in a wave-formed, nearshore bar. Note the vertical exaggeration necessarily distorts the slopes of the facies junctions. Cores 2-9 are indicated by the vertical lines; they are scaled correctly in their correct position from landward to seaward.

The answer to the first question depends upon the dynamic nature of the bars. The outer-bar form is an extremely stable bathymetric configuration; it is present from year to year and is never destroyed by either waves or ice (Greenwood and Davidson-Arnott 1975). High littoral drift rates in the Bay suggest the bar form remains in steady-state equilibrium under conditions of considerable sediment transport (Greenwood and Davidson-Arnott 1979; Greenwood and Mittler 1984). Changes in bar form and position do occur under storm waves, however, and the amount and frequency of contemporary sediment reactivation is crucial in determining the age of sediments at depth. Study of sediment reactivation during storms using depth-of-activity rods (Greenwood and Hale 1980; Greenwood and Mittler 1984) reveals maxima over the shallowest part of the bar as expected, although these do not exceed 0.70 m even with waves of 2 m, which are near the maximum in this fetch-limited environment. Furthermore, during any single storm, the percentage of bar sediments reactivated is not more than twelve percent and on average only five percent of the total sediment volume in the bar (Greenwood and Mittler 1984). However, the crescentic form is itself subject to a slow migration alongshore of 10 m per month during the ice-free months (Greenwood and Davidson-Arnott 1975). Since the bar profile at the crescent horns is displaced significantly landward of that at the crescent saddle (Fig. 7a) and since each profile is subject to sequential displacement during successive storms (Fig. 7b), it is highly probable that nearly total sediment reworking will occur during the time the bar takes to migrate a distance equal to its own wavelength. If the rate of migration quoted earlier is reasonable and movement occurs for eight to nine months, then a period of only five or six years is needed

for the bar to migrate a distance equal to an average wavelength of 500 m. Geologically speaking, this is an extremely short residence time for sediments.

The question of longer-term preservation potential of the outer bar-trough facies and, indeed, the way preservation might take place, is extremely difficult. As pointed out by Hunter et al. (1979), preservation will depend upon

FIG. 7.—Profiles across the crescentic bar system, Kouchibouguac Bay: (a) across the shoal or horn (line CN) and the crescent saddle (line CF) of a single bar; (b) displacement of the bar profile during annual alongshore migration of the bar form.

the rates and directions of bar migration, shoreline migration, and sea-level change. Incorporation of nearshore deposits in the stratigraphic record most commonly occurs during progradation, with or without changes in relative sea level. At any instant in time, because of displacement of the profile during alongshore migration, only the trough, lower-seaward slope, and inner-shelf facies would likely be preserved by aggradation. The bar crest and landward-slope facies would have the smallest likelihood of preservation since the equilibrium bar-trough form would tend to migrate seaward as progradation occurred and effectively remove these facies. Only in the inner bar does consistent landward migration of the total bar form occur (Greenwood and Davidson-Arnott 1975) with occasional welding to the beach face, which would then allow preservation by burial under beach-face sediments during progradation (Curry et al. 1969; Davis et al. 1972; Van den Berg 1977). It is likely, therefore, that large, subaqueous bars of the type described here would frequently be difficult to identify in the stratigraphic record. Indeed, conclusive identification of ancient, subaqueous, wave-formed bars is rare (see Ly 1982 for one probable example).

CONCLUSIONS

Facies typical of surface subenvironments of a recent, subtidal, wave-formed bar, previously identified only in 30-cm-wide box cores, can also be identified at depth in 7-cm-diameter tube cores. Vertical sequences and lateral transitions suggest the seaward side of the bar unit is composed of three interdigitated, wedge-shaped units (inner shelf, seaward slope, bar crest). On the landward side, the trough and landward slope facies interfinger in a complex manner while the bar-crest facies tends to form a simple onlap over landward-slope facies.

Total reworking of sediments within the bar-trough system is to be expected every 5 to 6 years as a result of profile adjustments during storms and the alongshore migration of the crescentic bar form. Since the bar is an equilibrium form and would almost certainly migrate during progradation, the long-term preservation of facies would be limited to those of the inner shelf, seaward slope (lower section), and trough facies (cf. Hunter et al. 1979). Models consisting of the simple vertical stacking of laterally adjacent facies (à la Walther) to include bar crest and landward-slope facies, as suggested by some authors (Reineck and Singh 1971, 1973; Shipp 1984), are therefore unlikely to represent the norm. Recognition of barred, nearshore systems in the stratigraphic record will therefore be difficult and, indeed, only under the unusual conditions of preservation of bar crest and/or rip-current facies (see Ly 1982; Dupre 1984) will confirmation be made.

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