Primary Textures in Experimentally Formed Oolite Cross-Strata

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By Christopher J. Schenk

Abstract

Fourteen experiments were conducted to describe the primary textures in subaqueous cross-strata formed by sandflows in sediment composed of oolitic sand. Primary textures studied were grain-size grading, sorting, and porosity exhibited by the experimentally produced cross-strata. Nearly all of the cross-strata were formed by the process of sandflow, a response to slope instability brought about by continued grainfall deposition on the foreset surface. In the formation of a sandflow cross-stratum, a series of small sandflows occurred; most of the preexisting grainfall deposits, as well as some of these smaller sandflows, were redeposited downslope by a large sandflow. The processes associated with sandflow produced the textural variations that defined each cross-stratum.

Each sandflow cross-stratum became coarser grained downslope in response to grain rearrangements during the causative flows. In many cases, the finer grained oolites were removed from the bulk of the flowing mass of oolitic sand and accumulated near the plane of shear on the upper part of the foreset surface; this process caused some of the sandflow cross-strata on the upper part of the foreset surface to exhibit inverse grading. Toward the lower part of the foreset surface, the sandflow cross-strata became coarser grained and were mostly ungraded. Such coarser grained cross-strata characteristically formed an angular contact with the base of the foreset. Within each cross-stratum, because finer grained oolites are removed during each sandflow, the sorting improves markedly downslope from moderately sorted near the top of the foreset to well sorted at the base. The interparticle porosity also increased downslope within each cross-stratum. Porosity on the upper half of the foreset ranged from 36 to 45 percent, averaging 40 percent, whereas the porosity on the lower half of the foreset ranged from 40 to 47 percent, averaging 45 percent.

INTRODUCTION

The purpose of this paper is to describe the primary textures in cross-strata produced in oolitic sand on a 1-m-long foreset surface in a laboratory flume. Primary textures exhibited by the experimentally formed cross-strata include grain-size grading, sorting, and porosity. The development of cross-strata at or near the angle of repose results from flow separation and expansion to the lee of a bedform (fig. 1). These processes result in decreased competency of the flow and cause sediment previously transported in suspension and bedload to be deposited onto the sloping foreset surface. Most of the coarser grained bedload is deposited at the top of the foreset slope, a process termed "collective settling" (Jopling, 1964, 1965). The finer grained bedload and the sediment previously in suspension transport are deposited onto the foreset surface in such a way that the amount of deposition decreases downslope. Hunter (1977) called this process "grainfall." Continued deposition causes the upper part of the foreset surface to attain the angle of initial yield, the angle above which slope failure occurs (Allen, 1970). The resulting sandflow redistributes all or part of the unstable grainfall deposit downslope, and high-angle sandflow cross-strata are produced.

Hunter (1977) illustrated that primary textures differ between eolian cross-strata due to grainfall and those due to sandflow, which together make up the bulk of eolian foreset deposits. He attributed the differences in grain-size grading, sorting, and porosity to the processes of deposition responsible for the development of each type of stratification. Several recent studies of cross-stratified, oolitic carbonates have also illustrated textural variations in high-angle, foreset deposits (Evans, 1983, 1984; Halley and Evans, 1983). The experiments described in this paper were undertaken (1) to investigate the role depositional processes have in producing textural variations in subaqueous cross-strata composed of oolitic sand, and (2) to document the primary textures exhibited by the cross-strata.

METHODS OF STUDY

Fourteen experiments were conducted in a small tank (fig. 1) fitted with a 1-m-long foreset slope. A steady flow of water transported oolitic sand, introduced to the flow by a box situated above the tank, over the brink of the foreset surface. Most of the deposition took place on

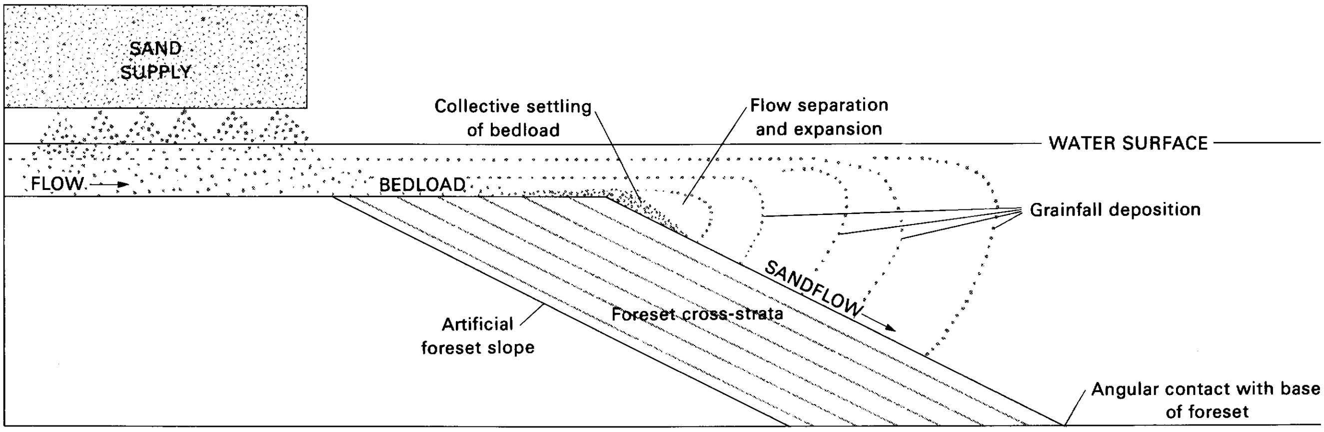

Figure 1. The processes of flow separation and expansion at and beyond the brink of a bedform cause sediment, previously transported in suspension and (or) as bedload, to be deposited onto the sloping foreset surface. Continued sedimentation leads to slope instability and subsequent failure of the sediment; the result is the formation of a cross-stratum. The experimental set-up simulated the processes of flow separation and expansion over the brink of a 1-m-long foreset slope. Oolitic sand was fed into the flow from a box above the tank.

the upper one-fourth of the foreset slope, a situation that led to sandflow. After a sufficient thickness (about 15 cm) of oolitic sand was deposited by a succession of sandflows, the experiment was terminated. These experiments were not conducted under closely controlled hydraulic conditions but were valuable in that the processes of grainfall and sandflowage and the development of cross-strata could be observed directly.

After seven of the experiments, the tank was drained and latex peels were prepared in trenches dug in the center of the deposit parallel to the dip of the foreset slope. The damp sand along the trench was smoothed, and cheesecloth was affixed to the sand surface. Liquid latex was then painted onto the cheesecloth, and was drawn by capillarity into the damp sand behind. After several hours, the latex dried and the cheesecloth was peeled away from the sand face; as much as 2 cm of sand from the undisturbed cross-strata adhered to the cloth.

After allowing the latex to fully cure, oriented samples for thin sections were cut from each peel. These samples were cut in a vertical orientation parallel to the direction of sediment transport; therefore, the strata dipped at the angle of repose across each thin section. Ten thin sections were prepared from each peel: two each from approximately 5, 25, 50, 75, and 100 cm downslope. All thin sections were impregnated with blue epoxy to contrast oolites and intergranular porosity.

Intergranular porosity was measured on each sample using a point counting technique, and approximately 650 points were counted on each of the seventy thin sections. Halley (1978) demonstrated that porosity obtained by point counting can be subject to several errors, due to the effects of grain curvature and so on, but care was taken to reduce the possible magnitude of these errors. Grain-size grading and sorting were observed directly in each thin section, and sorting was compared visually to diagrams modified from those of Pettijohn and others (1972).

The oolites (about 500 lb) used in the experiments were obtained from shoals near Bimini Island, Bahamas, by E. D. McKee. The oolites are medium grained, moderately well sorted, and fine skewed (using the limits of Folk, 1968; fig. 2). The mean size and sorting are similar to values given for many oolite deposits, both modern and ancient (Carr, 1973).

OBSERVATIONS

All of the cross-strata formed by the process of sandflow. Most of the sand was deposited onto the upper part of the foreset surface by grainfall, which resulted in slope instability and failure and redeposition of the grainfall deposits by sandflow. The sandflows, in general, did not begin across the entire width of the foreset, but rather were localized in one area. Many of the sandflows ceased movement before reaching the base of the slope. Generally, several sandflows stopped at various levels on the slope before one finally reached the base. In the process, the one larger flow that reached the base redeposited some sediment from the previous sandflows that did not. Each sandflow interfered, to some degree, with the stratum it was overriding and caused several grain layers to be removed from the upper part of the preexisting deposit. These grains were incorporated into the subsequent flow. The original depositional thickness was seldom preserved in the cross-strata owing to this "plowing" process.

Each sandflow began at the top of the foreset surface as a small slump that quickly degenerated into a sandflow, in which all the grains were in motion relative to one another. The initial slump and sandflow acted to

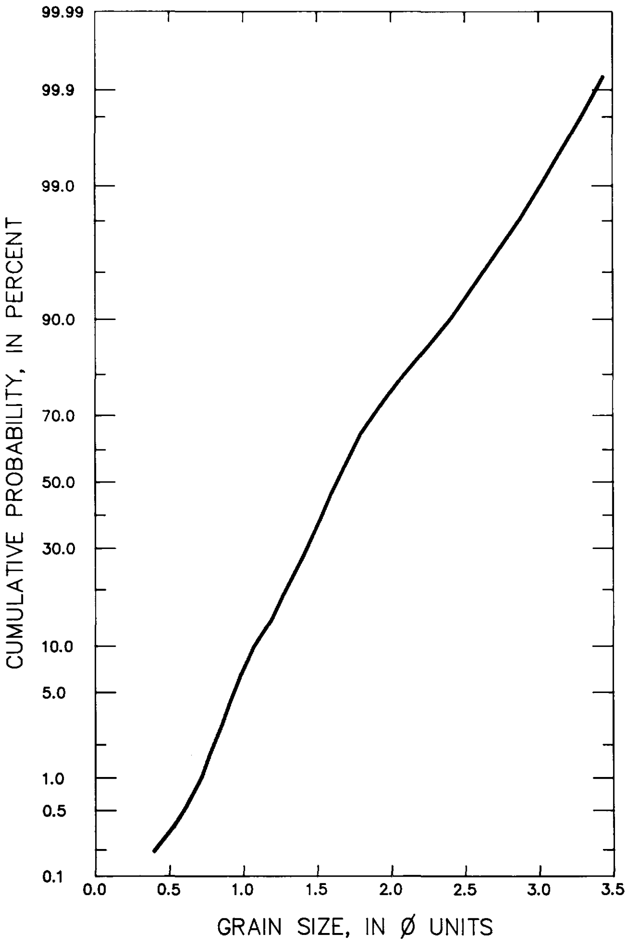

Figure 2. The oolitic sand used in the experiments was medium grained (mean = 1.710ϕ), moderately well sorted (σ = 0.520ϕ), and fine skewed (SK = 0.17). The millimeter equivalents of phi (ϕ) units are as follows:

	—gravel—				—sand—				—silt—				—clay—
phi (ϕ)	−3	−2	−1	0	1	2	3	4	5	6	7	8	9
mm	8	4	2	1	0.5	0.25	0.125	0.062	0.031	0.016	0.008	0.004	0.002

disperse the grains and resulted in a very loose flow of sand. Observations of this process through the glass wall of the tank indicated that, shortly after the initiation of movement, the relatively coarser grains traveled along the sides, front, and top of the snout of the flow; this sorting allowed the finer grained oolites to accumulate along the plane of the flow. In the formation of a discrete cross-stratum, many small, early sandflows stopped after having moved only a short distance from the top of the foreset, and the finer grains were not completely removed from these flows. Deposits of several of these small flows steepened the slope and allowed a subsequent larger sandflow to incorporate some of these deposits and then to proceed to the base of the foreset slope. The mechanism that operated to place the finer grained oolites near the base of the flows acted quickly, so that most of the finer grained oolites remained on the upper one-third of the foreset slope. Most of the cross-stratum, therefore, was composed of the relatively coarser grains.

The contacts between most of the individual sandflows were sharp, particularly on the upper part of the foreset. Here, the finer grains along the base of each cross-stratum provided a distinct textural contrast with the coarser oolites of the stratum below. The amount of finer grained oolites along the base of each cross-stratum decreased significantly about one-third of the way down the slope, and therefore, the contacts on the lower part of the slope were much less distinct, but still discernible. Little grainfall deposition took place on the lower part of the foreset surfaces. All of the sandflows on the lower part of the foreset were stacked without intercalated grainfall deposits. What little grainfall deposition did occur on the lower part of the slope either sifted into the interstices of the larger oolites or was plowed up and incorporated into the next sandflow. In all the experiments, the sandflows stopped at a fairly constant angle of repose of approximately 27°. The contact between the cross-strata and the base of the foreset was angular in all cases.

In all the experiments, the sandflows were not continuous, but intermittent, in that there was some time interval between successive sandflows. The frequency of sandflow, as well as the duration and amount of movement of each sandflow, was quite irregular. However, despite this uneven mode of formation, each set of cross-strata observed in the trenches consisted of a series of discrete sandflow cross-strata. Each cross-stratum was bounded by more or less sharp contacts representing the events in which the larger flows reached the base of the slope at the expense of the smaller flows. The larger flows, therefore, redeposited two types of existing cross-strata: grainfall deposits on the upper part of the foreset and many smaller sandflows that had not reached the lower half of the slope. Many more smaller flows had taken place than were represented in the deposit, as they were a partial source of sand for the larger flows. The larger sandflows were always more laterally extensive, involving nearly the entire area of the foreset, whereas the smaller flows were much more localized and lobate in shape.

The regularity of the experimentally produced cross-strata resulted from the deposits of these larger sandflows, the primary sources for which were sand deposits already on the foreset slope. A critical volume of sand was necessary before a sandflow could reach the base of the slope. This volume of sand was built up by the numerous small sandflows that did not reach the base of the slope. The regularity of the cross-strata had no relation to the movement of smaller scale bedforms across the topset surface—as there was none—or to sediment "pulses" either by volume or by grain size over the brink. Smith's (1972) field observations of bedforms in the

Platte River led him to conclude that the movement of ripples and ripple troughs across the stoss slope and over the brink of fluvial sand waves was responsible for the textural variations in the foreset deposits, because the troughs were coarser grained than the ripples themselves. Jopling (1964) concluded on the basis of flume experiments that processes upstream of the brink of the foreset acted to segregate grain sizes and thus constituted a first-order control on the textural variations in cross-strata. Deposition of alternating coarser and finer grained sand would produce repetitive textural variations. However, these two interpretations cannot be generally applied, as similar textural variations can arise by sandflow alone, as demonstrated here.

Grain-Size Grading

The most obvious visual grain-size grading in each cross-stratum is in a downslope direction (fig. 3). This grading was observed in each cross-stratum, both where the deposits lay against the glass wall of the tank and where they were cut by the trenches, which were located in the center of the tank. Previous studies of cross-strata have illustrated this grading in many different types of bedforms from diverse environments, as well as in several studies of experimentally formed cross-strata (table 1).

The observations made during this study on the events leading to this downslope grading generally follow the descriptions outlined in previous experimental studies by Allen (1965) and Jopling (1964; 1965). After the initiation of movement, the finer grains somehow accumulated near the base of the sandflow on the upper part of the foreset, leaving the coarser grains to make up the bulk of the flow that reached the base of the slope. The nature of the mechanism that operated to concentrate the finer grains near the base of the flow was interpreted to be dispersive pressure, as formulated by Bagnold (1954). Bagnold theorized that the coarser grains would be forced to the upper, free surface of the flow

Table 1. Grain-size grading in some sandflow cross-strata

[Leaders (---) indicate no data]

Cross-strata environment	Observed grading	Type of sand	Reference
Subaqueous	Coarsening downslope	Modern oolitic	Imbrie and Buchanan (1965).
Do ________	________ do ________	Jurassic oolitic	Klein (1965).
Do ---------	________ do ________	Pleistocene oolitic	Evans (1983).
Do ________	Coarsening downslope, normal grading	Mississippian oolitic	Handford (1978).
Experimental subaqueous	Coarsening downslope	Siliciclastic	Jopling (1964, 1965).
Do ---------	________ do ________	______ do ______	Allen (1965).
Theoretical sandflows	Coarsening downslope, inverse grading	______	Bagnold (1954).
Experimental subaqueous	Coarsening downslope	Siliciclastic	Allen (1968).
Subaqueous	________ do ________	Cretaceous siliciclastic	Allen and Narayan (1964).
Do ________	________ do ________	Modern siliciclastic	Collinson (1970).
Do ________	________ do ________	Pennsylvanian siliciclastic	Visher (1965).
Do ________	________ do ________	Modern siliciclastic	Ore (1964).
Do ________	________ do ________	______ do ______	Smith (1972).
Experimental subaqueous & subaerial	Inverse grading	Siliciclastic	Sallenger (1979).
Experimental subaerial	Coarsening downslope, subtle inverse grading	______ do ______	Fryberger and Schenk (1981).
Do ________	Coarsening downslope, weak inverse grading	______ do ______	Schenk (1983).
Subaerial	Coarsening downslope, inverse grading	______ do ______	Inman and others (1966).
Do ________	Coarsening downslope, indistinct inverse grading	______ do ______	Hunter (1977).
Do ________	Coarsening downslope, inverse to normal grading	______ do ______	Ahlbrandt and Fryberger (1982).
Do ________	Coarsening downslope, inverse grading	______ do ______	Kocurek and Dott (1981).

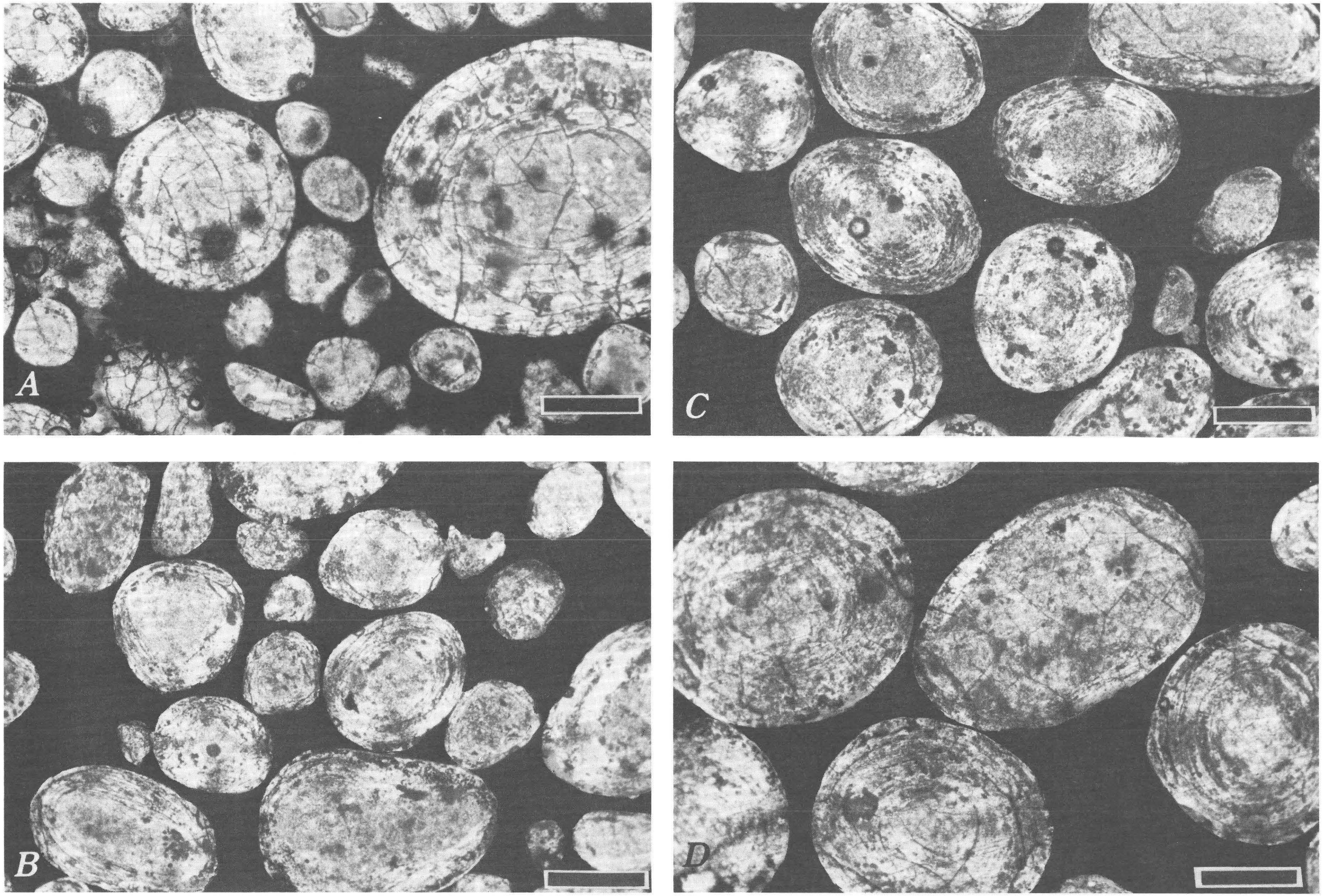

Figure 3. Photomicrographs showing that the median grain size of the oolites increased downslope in each cross-stratum. This is the most pronounced textural characteristic of sandflow cross-stratification. *A*, Sample E2, 6 cm downslope; *B*, sample E3, 24 cm downslope; *C*, sample E5, 49 cm downslope; *D*, sample E10, 99 cm downslope. All four photomicrographs were taken at the same scale (bar = 0.2 mm) to facilitate comparisons.

by grain collisions, as these forces would be greatest on the larger grains. Concomitantly, the finer grains would be forced to the base of the flow. Middleton (1970) and Middleton and Southard (1978) suggested that this phenomenon may be kinetic rather than dynamic, in that the finer grains would simply sift down through the interstices of the larger grains during dilation of the sand, shortly after initial movement. However, Sallenger (1979) concluded from a series of experiments on grading in sandflow cross-strata that dispersive pressure may indeed produce this grain-size segregation.

One of the characteristics of this grain-size segregation, at least for the oolitic sand used in this study, is that each cross-stratum from about midslope to the base was composed almost entirely of the coarser oolites. The finer grained oolites, for the most part, were concentrated in the lower part of each cross-stratum on the upper part of the foreset slope. Some of the cross-strata were inversely graded on the upper part of the foreset slope because of the presence of these finer grained oolites. This characteristic diminished downslope. The coarser grained parts of each cross-stratum (downslope) generally were not visibly graded in the direction normal to the plane of the foreset (fig. 4). In thin section, a few of the coarser grained foresets exhibited a slight normal grading, in which the grain size diminished slightly, in a direction upwards from and normal to the plane of the foreset. Ahlbrandt and Fryberger (1982) reported normal grading in some subaerial sandflow cross-strata (table 1).

Horizontal exposures were made at several levels downslope in two of the experimental deposits. In these exposures the thickness of each cross-stratum was exaggerated, and the vertical grain size grading (normal to the foreset slope) in a cross-stratum was accentuated. These exposures demonstrated that some of the cross-strata were inversely graded only on the upper part of the foreset slope, whereas the cross-strata on the lower part of the slope were coarser grained and largely ungraded. Differences in grain packing probably resulted in the slight textural variations that define each cross-stratum on the lower part of the foreset.

Sorting

Visual estimates indicated that sorting improved downslope within each cross-stratum (fig. 5), as a result of fewer finer grained oolites in this direction (table 2). The improved sorting can be attributed to the mechanism

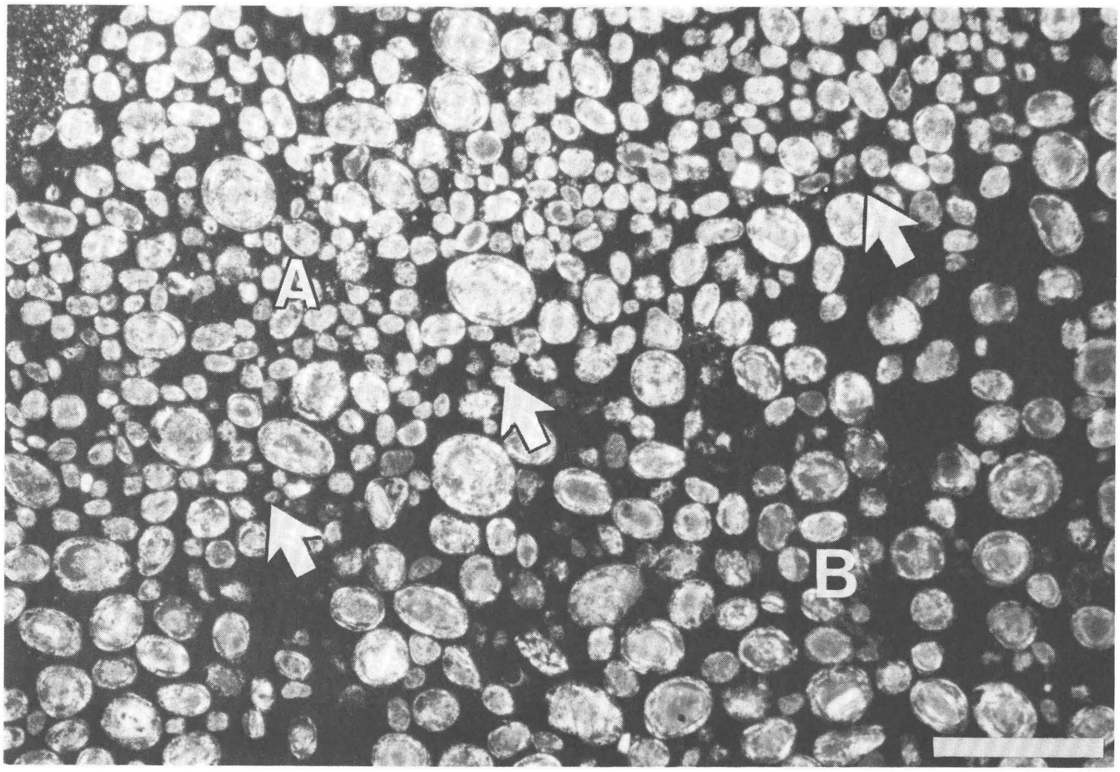

Figure 4. Photomicrograph illustrating inverse grading exhibited by a cross-stratum on the upper part of the foreset slope. The arrows mark the boundary between the finer grained lower part of a cross-stratum *A*, and the coarser grained upper part of underlying stratum *B*. The inverse grading is "dirty" in that some coarser grained oolites were present among the finer grain oolites. Sample D4, 25 cm downslope. Bar scale = 1 mm.

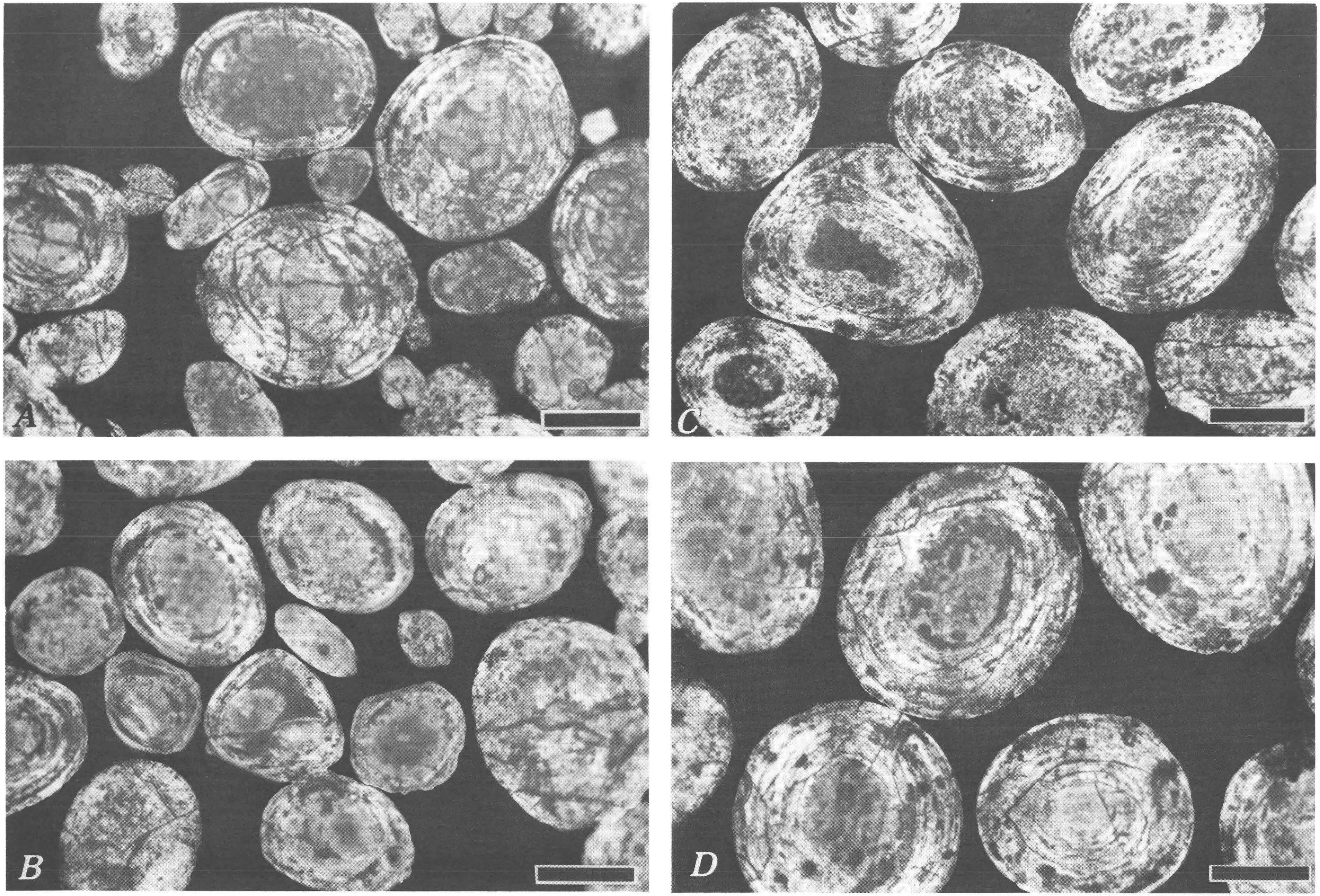

Figure 5. Photomicrographs showing that sandflow caused the sorting to improve downslope within each sandflow cross-stratum. The finer grained oolites moved toward the base of each flow during movement and were deposited on the foreset surface. The sand that reached the base of the slope was relatively free of finer grained oolites (see also fig. 4*A–D*). *A*, Sample C2, 3 cm downslope; *B*, sample C4, 25 cm downslope, *C*, sample C6, 50 cm downslope, *D*, sample C10, 100 cm downslope. All four photomicrographs were taken at the same scale (bar = 0.2 mm) to facilitate comparisons.

Table 2. Summary of petrographic observations
[Leaders (---) indicate no grading; M, moderately sorted; MW, moderately well sorted; W, well sorted]

Sample number	Distance downslope (cm)	Sorting (visual estimate)	Grain size grading	Interparticle porosity (percent)
A1	2	M	---	40
A2	4	M	---	41
A3	23	M	inverse	40
A4	24	M	---	38
A5	49	M	inverse	40
A6	50	M to MW	inverse	42
A7	72	MW	---	44
A8	73	MW	---	43
A9	97	MW	---	47
A10	98	MW to W	---	47
B1	11	M	inverse	38
B2	12	M	---	38
B3	24	M	---	39
B4	25	M	---	36
B5	52	MW	---	40
B6	53	MW	---	42
B7	77	MW to W	---	44
B8	78	MW to W	---	42
B9	98	W	---	46
B10	99	W	---	47
C1	2	M	inverse	37
C2	3	M	---	36
C3	24	M	---	37
C4	25	M to MW	---	40
C5	49	MW	---	40
C6	50	MW	---	40
C7	74	MW to W	---	45
C8	75	W	---	45
C9	99	W	---	45
C10	100	W	---	45
D1	4	M	inverse	43
D2	10	M	inverse	41
D3	24	M	---	41
D4	25	M	---	45
D5	49	MW	---	45
D6	50	M	---	44
D7	74	MW	---	44
D8	75	MW	normal	44
D9	96	W	---	45
D10	99	W	---	46
E1	5	M	---	40
E2	6	M	---	40
E3	24	M	---	40
E4	25	M	inverse	43
E5	49	MW	---	43
E6	50	M to MW	---	45
E7	74	MW to W	---	45
E8	75	MW to W	---	46
E9	98	W	---	46
E10	99	W	---	45
F1	3	M	inverse	39
F2	4	M	inverse	40
F3	24	M	---	42
F4	25	M	inverse	41

Table 2. Continued

Sample number	Distance downslope (cm)	Sorting (visual estimate)	Grain size grading	Interparticle porosity (percent)
F5	49	M	---	40
F6	50	M to MW	---	42
F7	74	M to MW	---	45
F8	75	MW	normal	45
F9	98	MW	---	45
F10	99	W	---	47
G1	3	M	---	36
G2	4	M	---	39
G3	25	M	---	39
G4	27	M	---	43
G5	49	MW	---	43
G6	50	MW	---	44
G7	74	MW	---	44
G8	75	MW	---	43
G9	97	W	---	44
G10	98	MW to W	---	46

that operated to remove the finer grains from the bulk of each sandflow during movement. There is little information from the literature with which to compare this type of sorting within a single sandflow cross-stratum. Ore (1964) examined some foreset cross-strata in sand waves of the South Platte River and found the opposite relationship; that is, sorting decreased downslope within a cross-stratum.

Interparticle Porosity

Measurements of porosity on seventy samples of impregnated oolitic cross-strata averaged 42.5 percent with a standard deviation of 3 percent (fig. 6). The porosity increased in a downslope direction within each cross-stratum. Interparticle porosity on the upper half of the foreset was as low as 36 percent, as high as 45 percent, and averaged 40 percent, whereas on the lower half of the foreset, the porosity was as low as 40 percent, as high as 47 percent, and averaged 45 percent. The increase in porosity downslope coincided with an improvement in the sorting in that direction. Many studies have demonstrated that as sorting improves, the porosity increases (Fraser, 1935; Rogers and Head, 1961; Beard and Weyl, 1973). Graton and Fraser (1935) and more recent workers have demonstrated that packing also influences porosity. Loosely packed sand exhibits porosities as high as 50 percent, whereas tighter packed sand can exhibit porosities as low as 25 percent. According to these extremes, the range of porosities measured during this study are on the high end; these results reflect the loose packing of sand deposited by the process of sandflow.

Measurements of porosity in thin section by point counting can be subject to several errors, all of which act to slightly underestimate the true intergranular porosity. The use of blue epoxy and ultrathin thin sections probably reduced the magnitude of these possible errors. In addition, only the interparticle porosity was evaluated in thin section; intraparticle porosity, if present, was not included because it simply cannot be resolved in thin section. Therefore, the porosity data in table 2 consists of interparticle porosity only.

DISCUSSION

These experiments have demonstrated that each oolitic sandflow cross-stratum is composed mostly of the coarser grained oolites, which are arranged in angle-of-repose cross-strata that terminate abruptly at the base of the foreset slope. The finer grained oolites are present mainly in the lower part of the cross-strata at the top of the foreset. The inverse grading produced the textural contrasts that outline the cross-strata. The textural contrasts diminish rapidly downslope, as the content of finer grains decreases, such that coarser, ungraded sandflow cross-strata are in depositional contact with each other. These textural variations were the result of sandflow and processes that are associated with sandflow because there were no grainfall deposits intercalated with the cross-strata.

Grain size of grainfall cross-strata characteristically decreases downslope, unlike the texture of sandflow cross-strata (Hunter, 1977; Schenk, 1983). The juxtaposition of these two types of cross-strata would result in a marked textural contrast that could be present along the bounding surface all the way down to the base of the slope. Evans (1983) described "couplets" of coarser and finer grained oolite laminae in foreset deposits of the Pleistocene Miami Limestone. These couplets extended, in most cases, to the base of the foreset slope. The results of these experiments suggest that these couplets were probably not formed by sandflow alone, but are the result of grainfall deposition and periodic sandflow. The resulting foreset deposit is characterized by finer grained grainfall cross-strata intercalated with coarser grained sandflow cross-strata. Two other attributes of grainfall

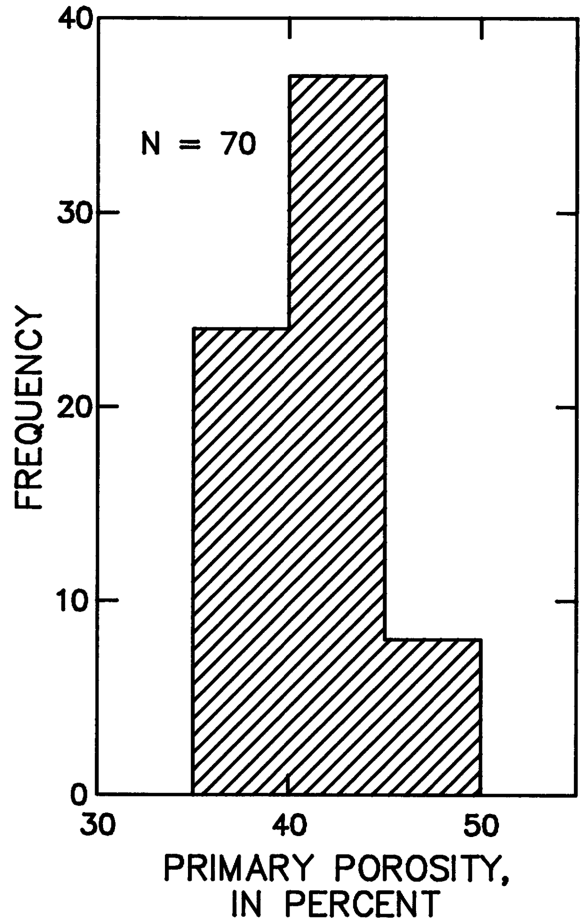

Figure 6. Interparticle porosity of the oolitic cross-strata ranged from a low of 36 percent to a high of 47 percent, with an average of 42.5 percent and a 3 percent standard deviation. Porosity generally increased downslope within each cross-stratum. Most of the higher porosity values were recorded from strata on the lower half of the foreset.

cross-strata are that sets thin downslope and in many cases form tangential contacts with the base of the foreset slope. Tangential contacts, possibly formed by grainfall deposits, are common in the Miami Limestone (Evans, 1983).

The regular alternation of the coarser and finer grained foreset deposits in the Miami Limestone is one of its most striking attributes. The experiments reported here suggested that this regularity can be produced simply by continuous grainfall deposition, punctuated by periodic sandflow; therefore, there is no need to invoke special hydrodynamic conditions, such as steady or uniform flow. The sandflows in the experiments were quite irregular in size and temporal spacing, but the sets of cross-strata were of similar dimensions. This phenomena occurred because only the largest sandflows reached the base of the foreset slope. In the process, these larger sandflows redeposited the oolites in the grainfall deposits and the smaller sandflow deposits. It appeared that once a critical volume of sand was available, a large sandflow would occur and would reach the base of the slope; the same volume would be needed to produce the next cross-stratum. The fixed volume produced the regularity of the foreset cross-strata.

Based on the published photographs of the Miami Limestone, in contrast, it appeared that grainfall deposits were preserved between discrete sandflows that reached the base of the slope. There are several possible reasons for this basic difference. First, the experimental hydrodynamic regime may have been quite different from the regime that formed the cross-strata in the Miami Limestone, resulting in a higher rate of grainfall deposition. Second, the bedforms responsible for the sets of oolitic cross-strata may have been smaller than the 1-m-long foreset surface used in the experiments; grainfall could then have been deposited farther down the foreset slope and preserved between the successive sandflows. Finally, the Pleistocene oolites that were deposited to form the Miami Limestone may have had a predepositional range of grain sizes that was significantly wider than the oolites used in these experiments. Thus, there could have been a greater proportion of finer grained oolites available for grainfall deposition during formation of the Miami Limestone.

The sets of cross-stratified oolitic sand in the Miami Limestone are variable in thickness, but most of the sets are about 30 cm thick (Evans, 1984). The degree of preservation of a bedform during migration is dependent upon the angle of bedform climb relative to the stoss-side slope, among other factors (Rubin and Hunter, 1982). The smaller the climb angle relative to the stoss-side angle, the smaller the amount of bedform preserved. The results of the experiments reported here indicated that—because of the increase in grain size in each sandflow cross-stratum—as less of the upper part of each bedform is preserved, the remaining cross-strata are coarser grained and better sorted and exhibit higher interparticle porosities.

CONCLUSIONS

These experiments have demonstrated that sandflow influenced the primary textural characteristics of oolitic foreset cross-strata. Some sandflow cross-strata exhibited inverse grading on the upper part of the foreset, but became largely ungraded on the lower part. The accumulation of finer grained oolites on the upper part of the foreset led to an improvement in sorting downslope. Along with sorting, the interparticle porosity also increased downslope within each sandflow cross-stratum.

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