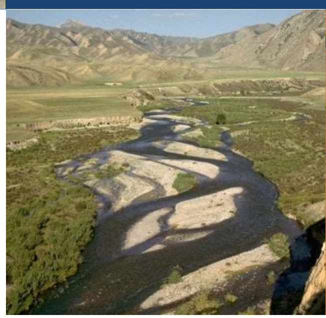
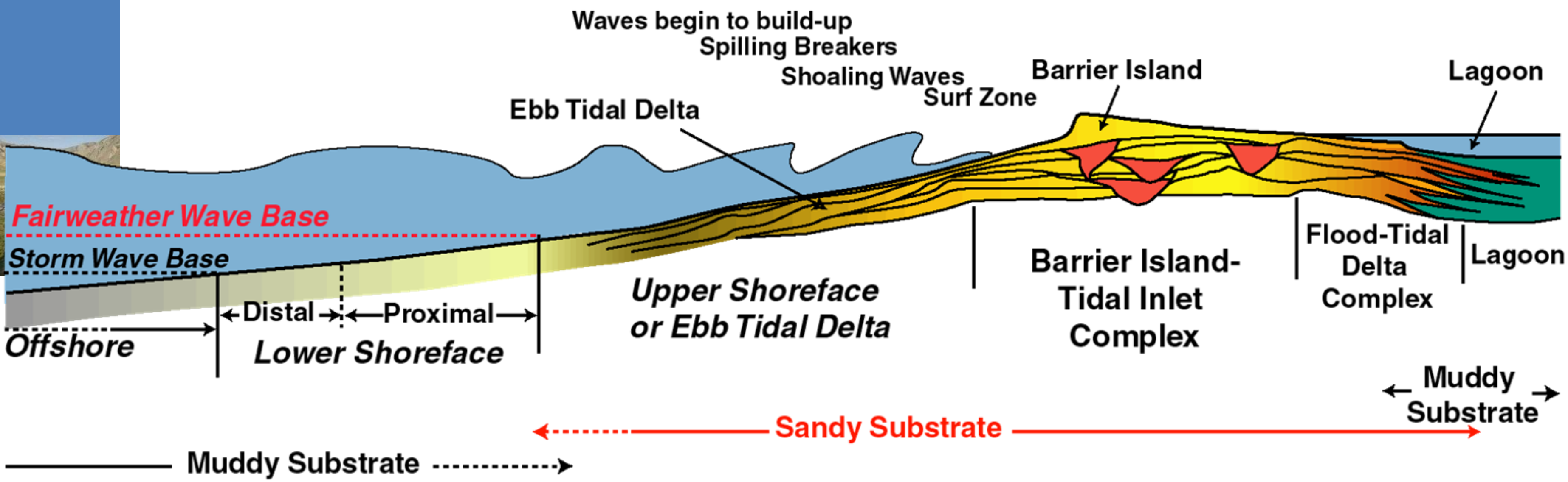
Depositional Environments
Lec. 7 Wave dominated shorelines

DSRG



Dr. EHAB M. ASSAL
Damietta University

Wave dominated shorelines



Wave processes

- As waves progress shoreward into the shallow shoaling zone, forward velocity of the waves slows, wave length decreases, and wave height increases. The waves eventually steepen to the point where orbital velocity exceeds wave velocity and the wave breaks, creating the **breaker zone**.

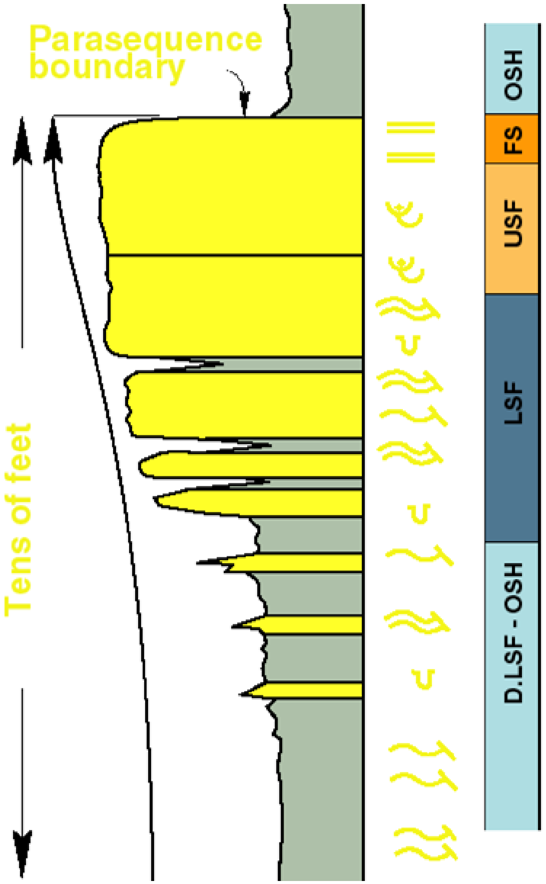
- Breaking waves generate turbulence that throws sediment into suspension and also brings about a transformation of wave motion to create the **surf zone.** In this zone, a high-velocity translation wave (a wave translated by breaking into a current, or bore, is projected up the upper shoreface, causing landward transport of bedload sediment and generation of a short-duration “suspension cloud” of sediment.

- At the shoreline, the surf zone gives way to the **swash zone** , in which a rapid, very shallow swash flow moves up the beach, carrying sediment in partial suspension, followed almost immediately by a backwash flow down the beach. The backwash begins at very low velocity but accelerates quickly. (If heavy minerals are present in the suspended sediment, they settle rapidly to generate a thin heavy-mineral lamina).

Wave processes

- Normal waves of moderate to low energy tend to produce a net landward and alongshore transport of sediments thus building up beaches.
- Storm waves cause erosion of the beach and a net displacement of sediments in a seaward direction.
- Sediments tend to be well sorted, positively skewed deposits (better sorted coarser half than finer half).
- Heavy minerals tend to accumulated on swash zone due to the slow backwash flow.

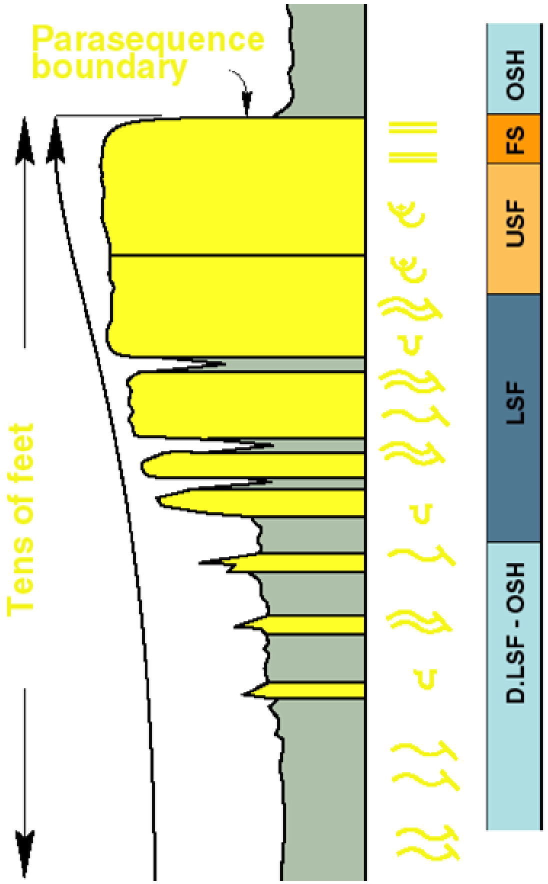
Offshore



Characteristics:

- Mostly mudstone
- Wave ripples
- Bioturbated
- High diversity of trace fossils

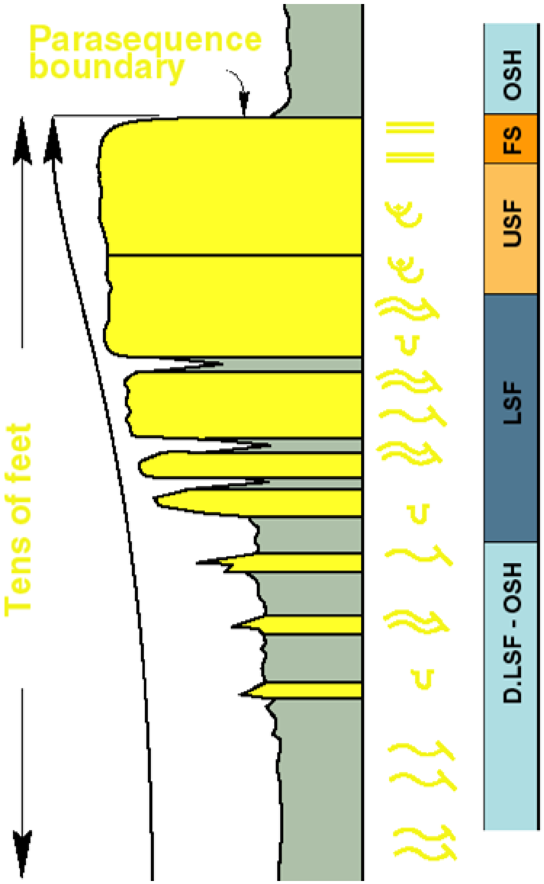
Lower shoreface

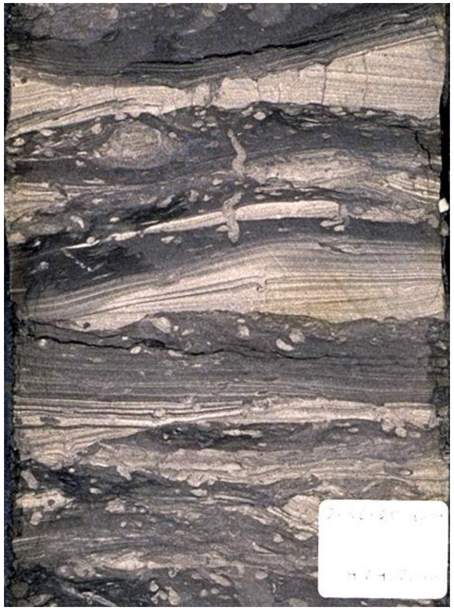


Characteristics:

- Hummocky cross bedding, single storm beds or amalgamated
- Wave ripples
- Discontinuous beds
- Very fine-grained sandstone to siltstone
- Open marine burrows, *Ophiomorpha*

Distal lower shoreface





Characteristics:
- Thin HCS beds
- Gutter casts
- Wave ripples
- Discontinuous beds

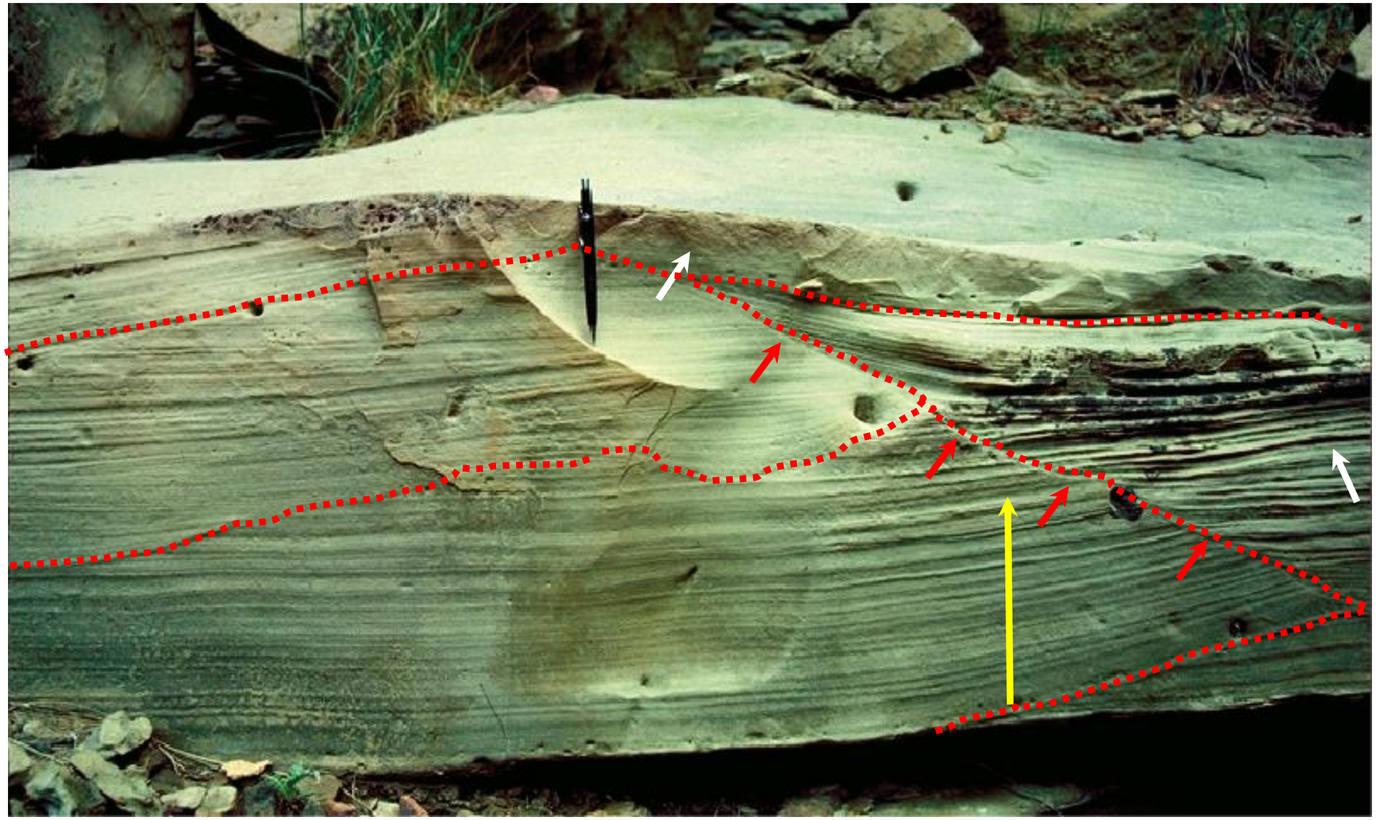
Lower shoreface

Hummocky cross-stratification:

Hummocky Cross-stratification

- •Convex upward lamina
- •Lamina onlap truncation surfaces
- •Lamina flatten upward
- •Nonparallel truncation surfaces

- •Very fine- to coarse-grained sand
- •Episodic deposition - tops of beds burrowed in distal shoreface
- •Amalgamated beds in proximal shoreface



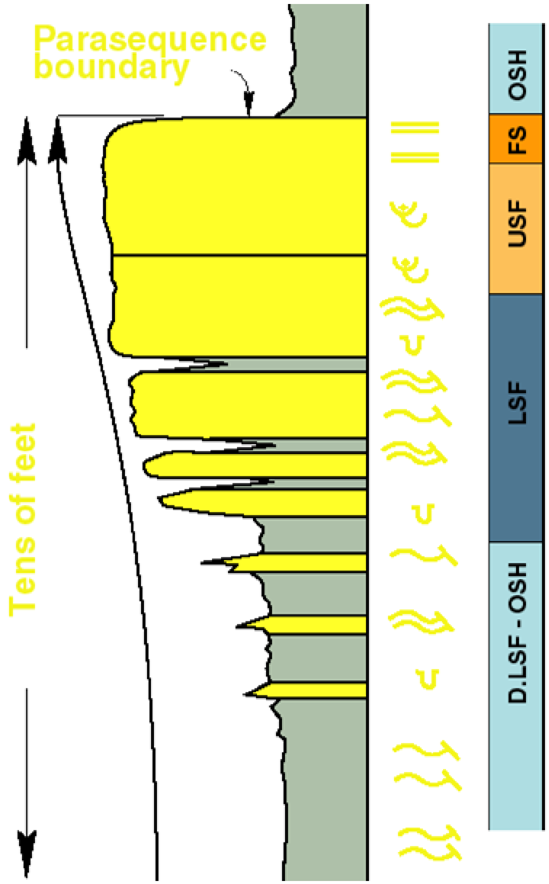
Lower shoreface

Ophiomorpha

Pleistocene, Florida

Cretaceous Blackhawk Formation, Utah

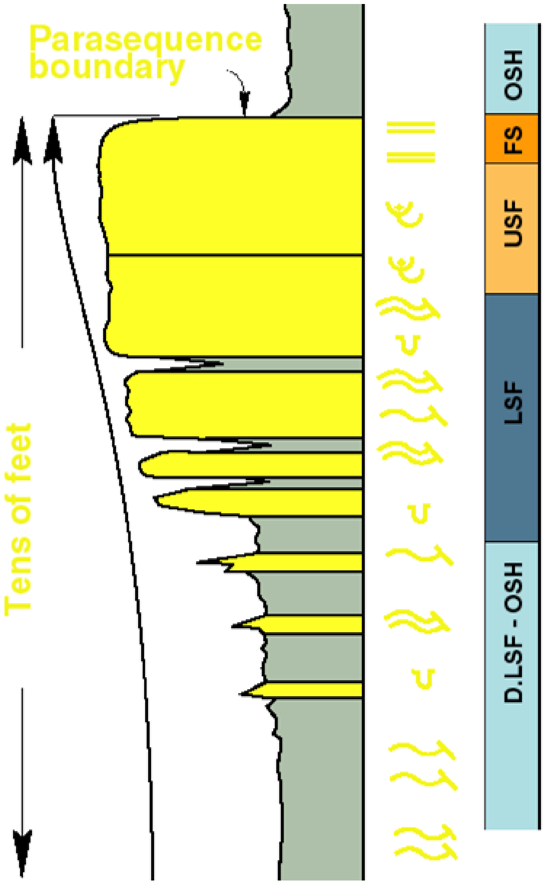
Upper shoreface

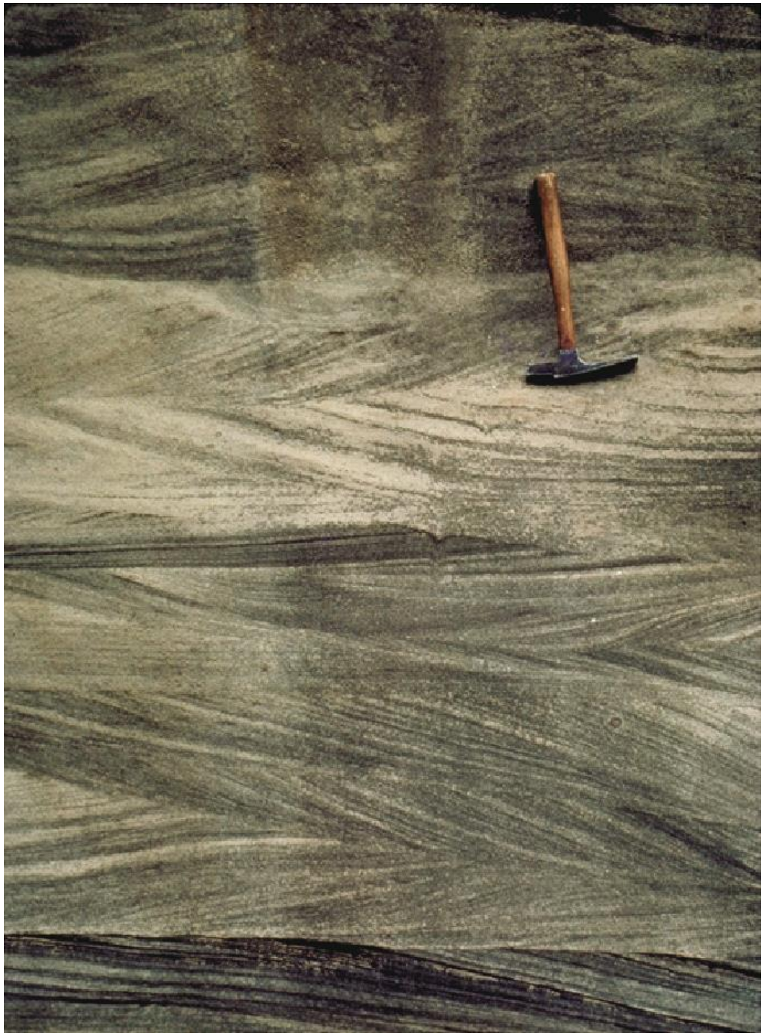


Characteristics:

- Breaking waves indicate zone of upper shoreface
- Longshore currents distribute sediment
- Troughs are oriented generally parallel to shore

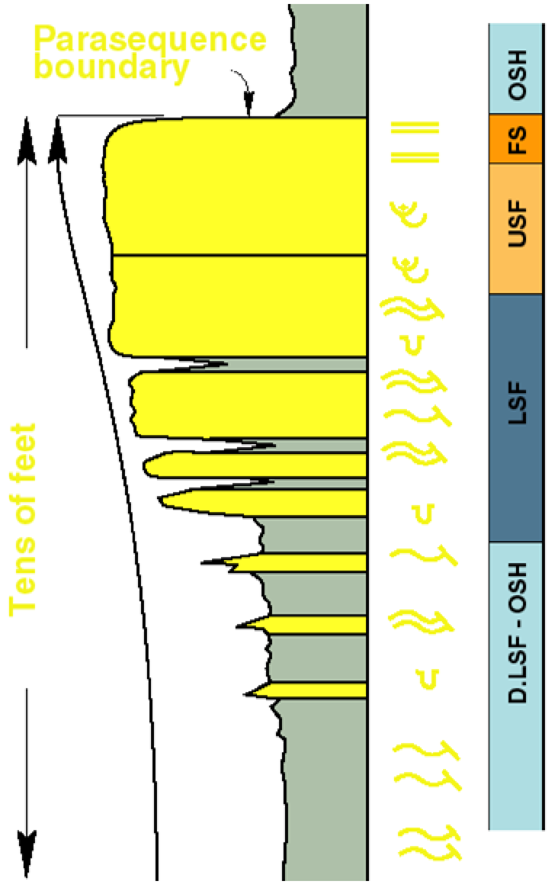
Upper shoreface

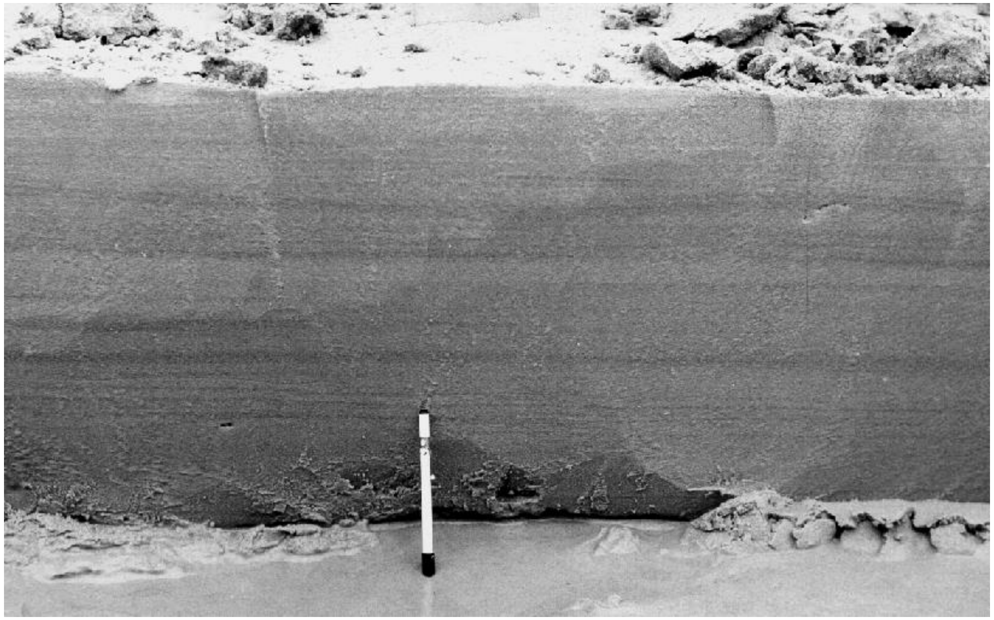




Characteristics:
- Trough cross bedding
- Fine to medium grain size, may include gravel
- Little bioturbation

Foreshore

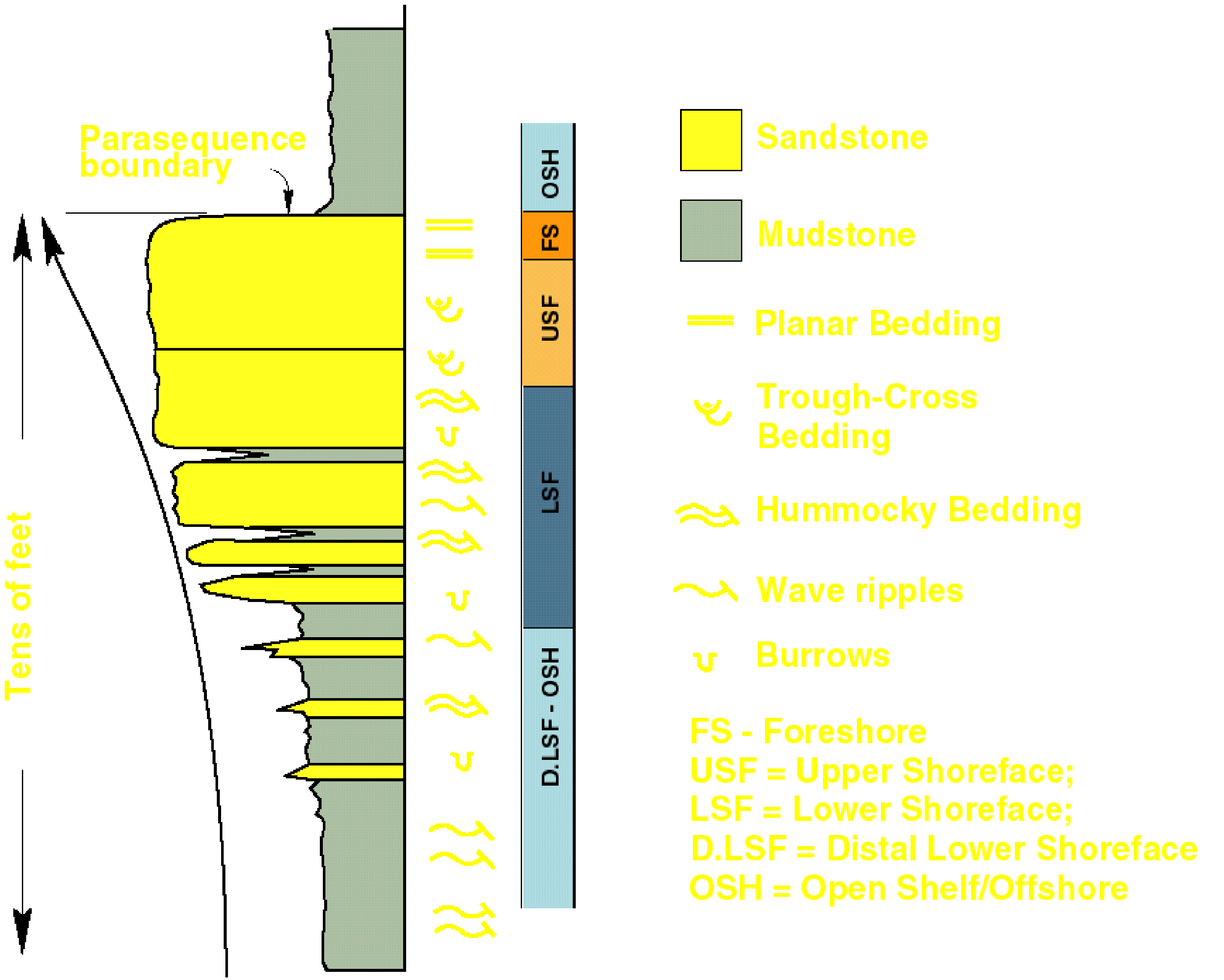




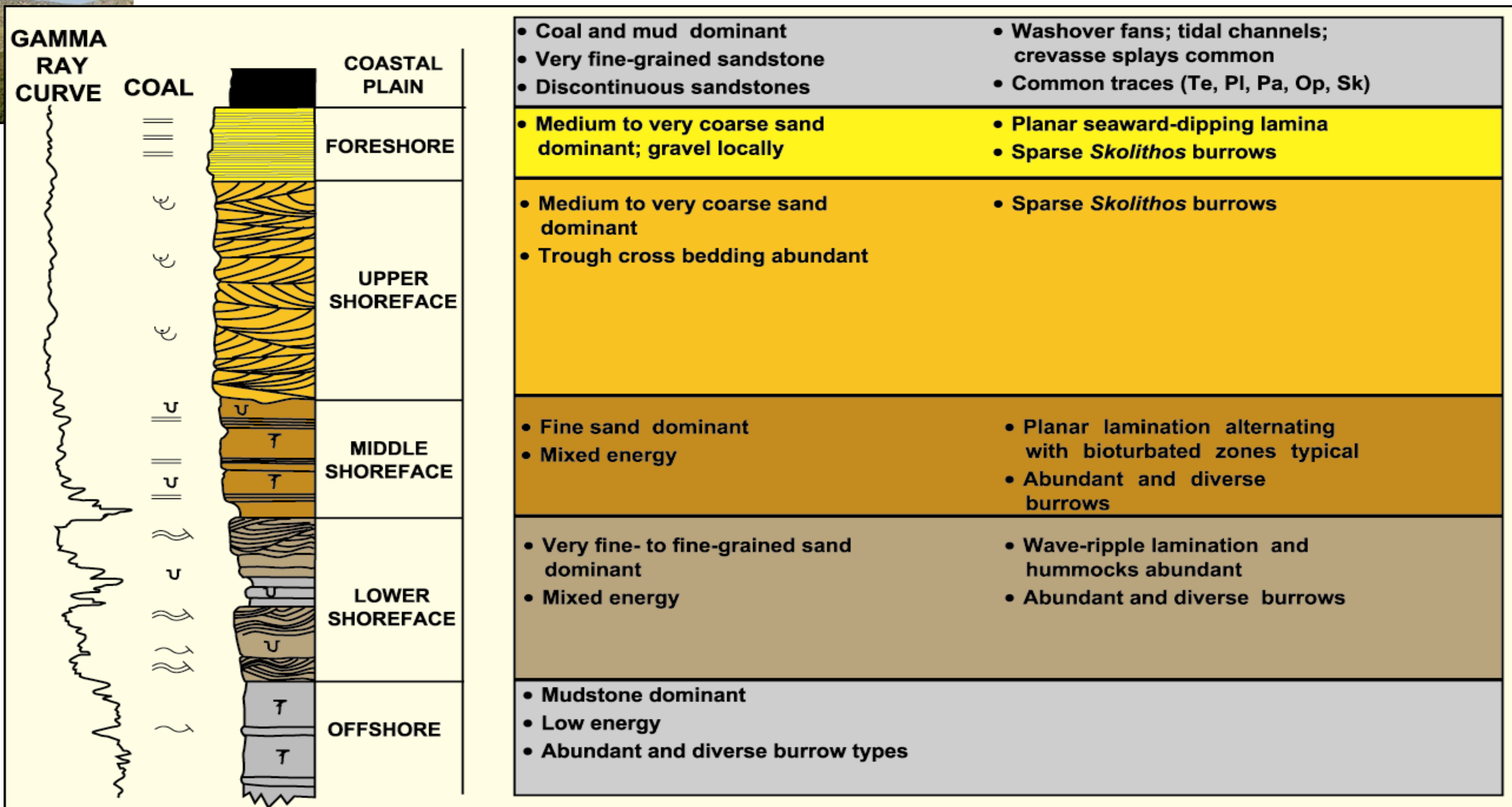
Characteristics:

- Low angle, planar bedding
- Good sorting
- Fine to medium grain size

Beach parasequence



Vertical facies succession





Barrier-island system

❖ Three environments: Recognition of ancient barrier-island complexes requires that this intimate association of the three environments be recognized.

- Sandy-barrier chain: subtidal to subaerial barrier-beach complex.
- Enclosed lagoon, estuary, or marsh: the back-barrier, subtidal-intertidal region,
- Tidal inlets, flood and ebb tidal deltas: Channels that cut through the barrier and connect the back-barrier lagoon to the open sea

Boggs (2006), p.312

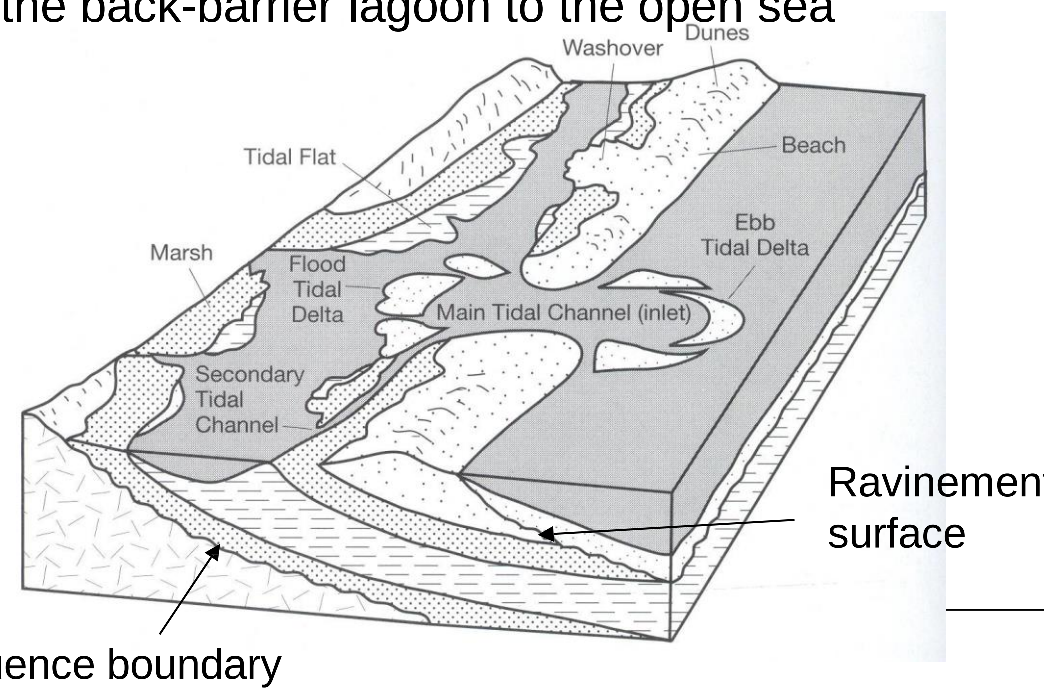


Figure 9.23
Generalized model illustrating the various subenvironments in a transgressing barrier-island system. [From Reinson, G. E., 1992, Transgressive barrier island and estuarine systems, *in* Walker, R. G., and N. P. James (eds.), Facies models, Fig. 3, p. 180, reproduced by permission of Geological Association of Canada.]

Barrier-island system

- **Washover fan**: occur where storm-driven waves cut through and overtop barriers, washing lobes of sandy beach sediment into the back-barrier lagoon.
- **Sediment**: consists dominantly of fine- to medium-scale landward-dipping foreset bedding.
- **Tidal-channel**: occur where tidal currents cut through barriers into inner lagoons. **Sediments**: dominantly of sand, commonly have an erosional base marked by coarse lag sands and gravels; bidirectional large- to small-scale planar and trough cross-beds that may display a general fining-upward textural trend.
- **Tidal-delta**: form on both the lagoonal side of the barrier (flood-tidal delta) and the seaward side of the barrier (ebb-tidal delta). **Sediments**: dominantly of sands attaining a vertical thickness of tens of meters; highly varied succession of planar and trough cross beds that may dip in either a landward or a seaward direction.
- **Tidal-flat**: form along the margins of the mainland coast and the back of the barrier. **Sediments**: grade from fine- to medium-grained ripple-laminated sands in lower areas of the tidal flats through flaser- and lenticular-bedded fine sand and mud in midtidal flats to layered muds in higher parts of the flats.

Back-barrier sediments

Lagoonal and marsh: occur in low-energy back-barrier lagoon and grade laterally into higher energy, sandy deposits of tidal channels, deltas, and washover lobes. **Sediment**: dominantly of interbedded fine sands, silts, muds, and peat deposits that may be characterized by disseminated plant debris, brackish-water fossils such as oysters, and horizontal to subhorizontal layering.

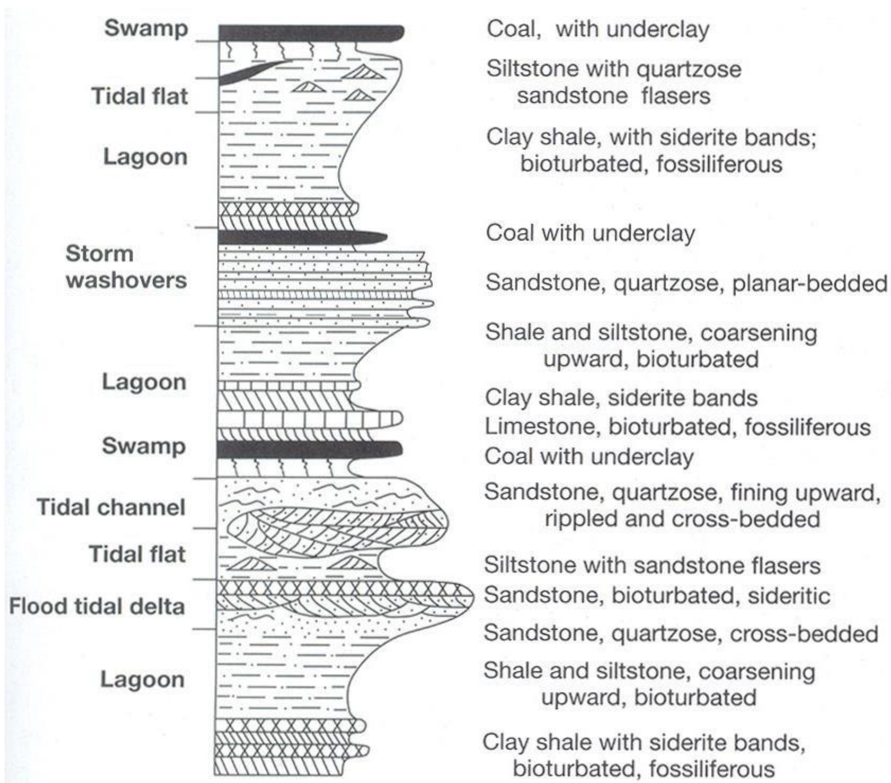


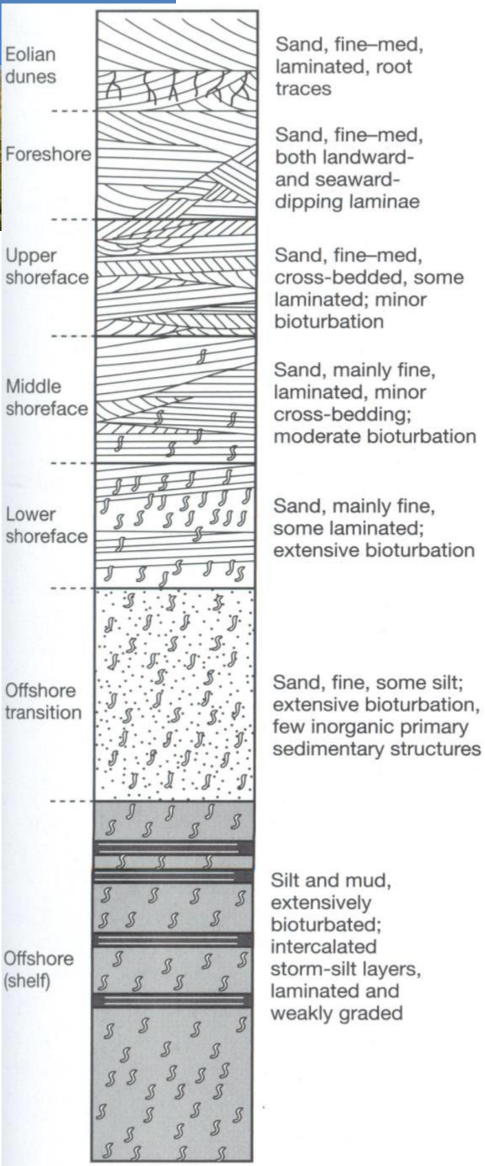
Figure 9.27
Generalized succession of facies deposited in a back-barrier environment, Carboniferous of eastern Kentucky and southern West Virginia. Such successions range from 7.5 to 24 m thick. [After Horne, J. C., J. C. Ferm, F. T. Caruccio, and B. P. Baganz, 1978, Depositional models in coal exploration and mine planning in Appalachian region: Am. Assoc. Petroleum Geologists Bull., v. 62, Fig. 4, p. 2385, reprinted by permission.]

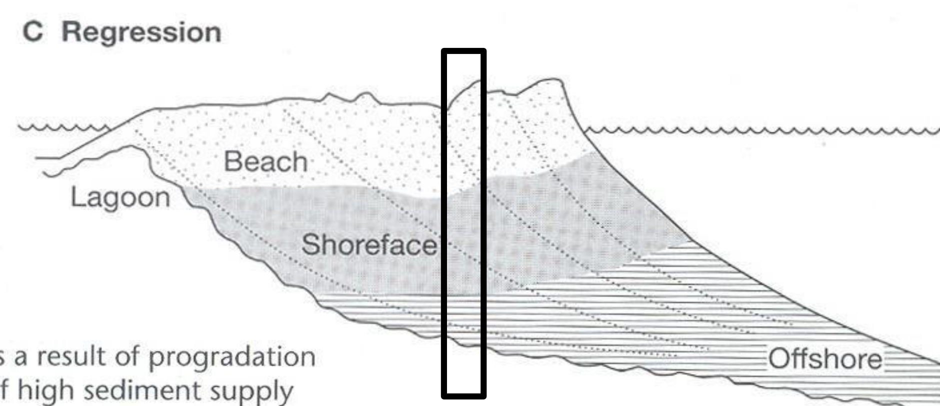
Ancient beach and barrier-island sediments

In response to the change of relative sea level and amount of sediment supply the shoreline may move in a landward direction (transgression) or in a seaward direction (regression).

Regression leads to deposition of back-barrier lagoonal and marsh deposits over sandy deposits of the barrier beach-beach complex.

Barriers tend to be transformed into strand plains, producing dominantly sandy facies in which beach deposits overlie shoreface deposits.





C. Facies formed as a result of progradation under conditions of high sediment supply relative to sea-level change. [A and B after

Figure 9.25
Idealized succession of beach sediments on a low-energy, prograding, Holocene beach. [After Reineck, H. E., and I. B. Singh, 1980, Depositional sedimentary environments, 2nd ed., Fig. 534, p. 387, reprinted by permission of Springer-Verlag, Heidelberg.]

Boggs (2006), p.312

Transgression causes deposition of barrier-beach deposits on top of back-barrier lagoonal and marsh deposits.

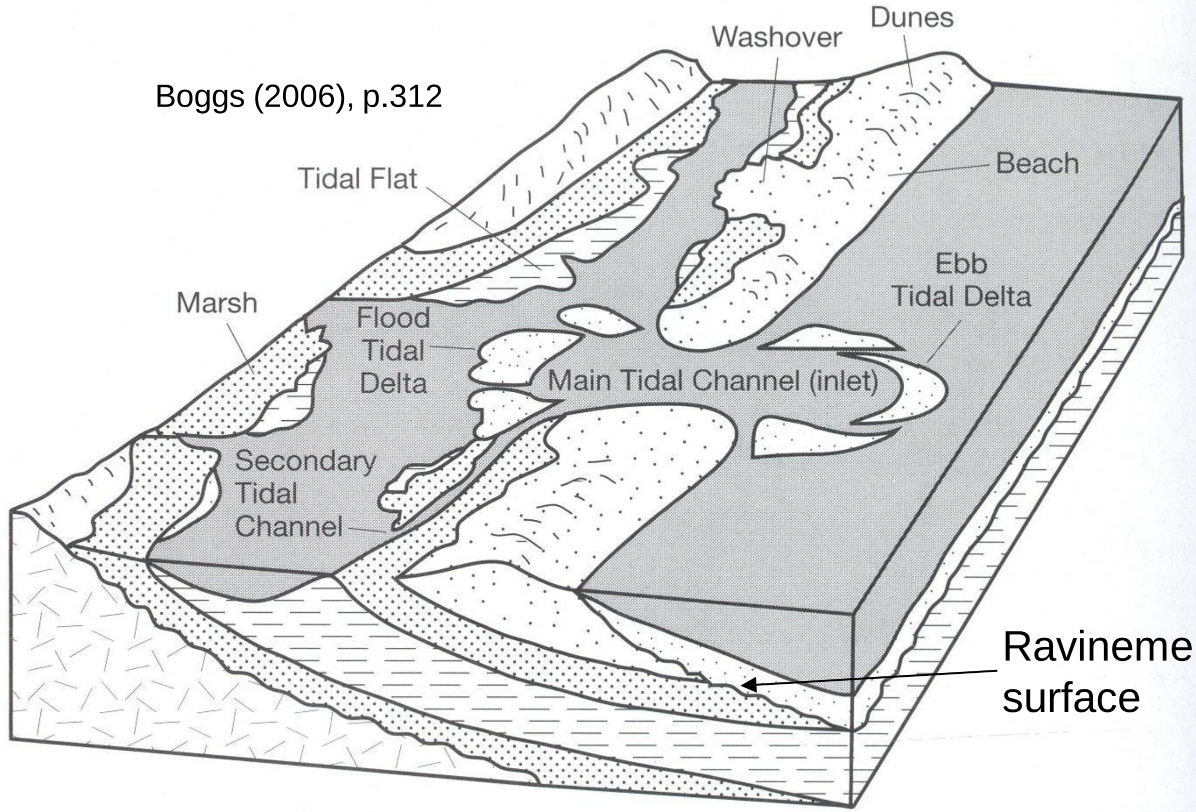
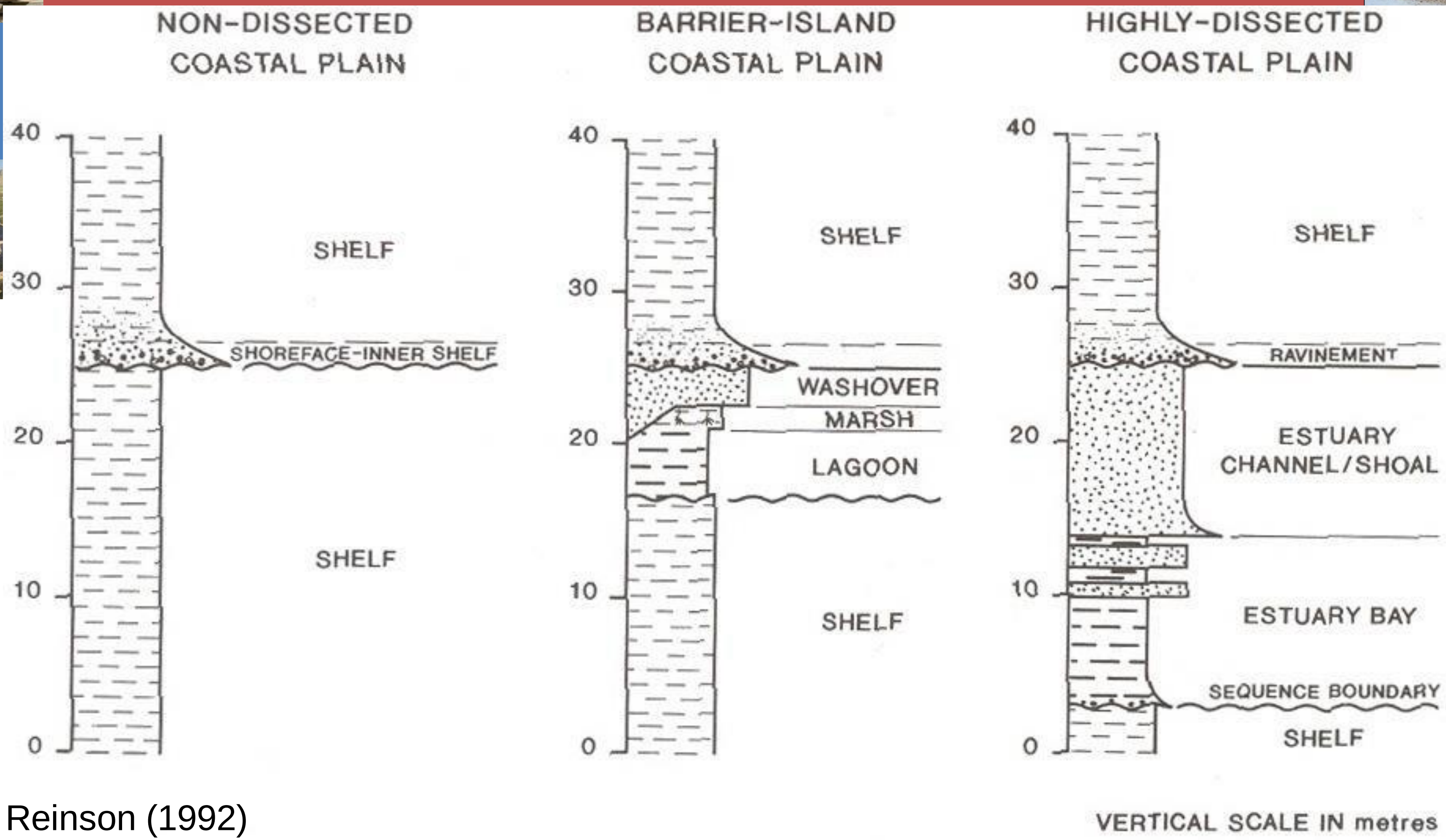


Figure 9.23
Generalized model illustrating the various subenvironments in a transgressing barrier-island system. [From

Ravinement surface: A surface generated by marine reworking and erosion during shoreline transgression. Beach and upper shoreface deposits are presumably eroded and transported to the lower shoreface, or offshore as storm beds, or to the lagoon as washover deposits.

Transgression through erosional shoreface retreat

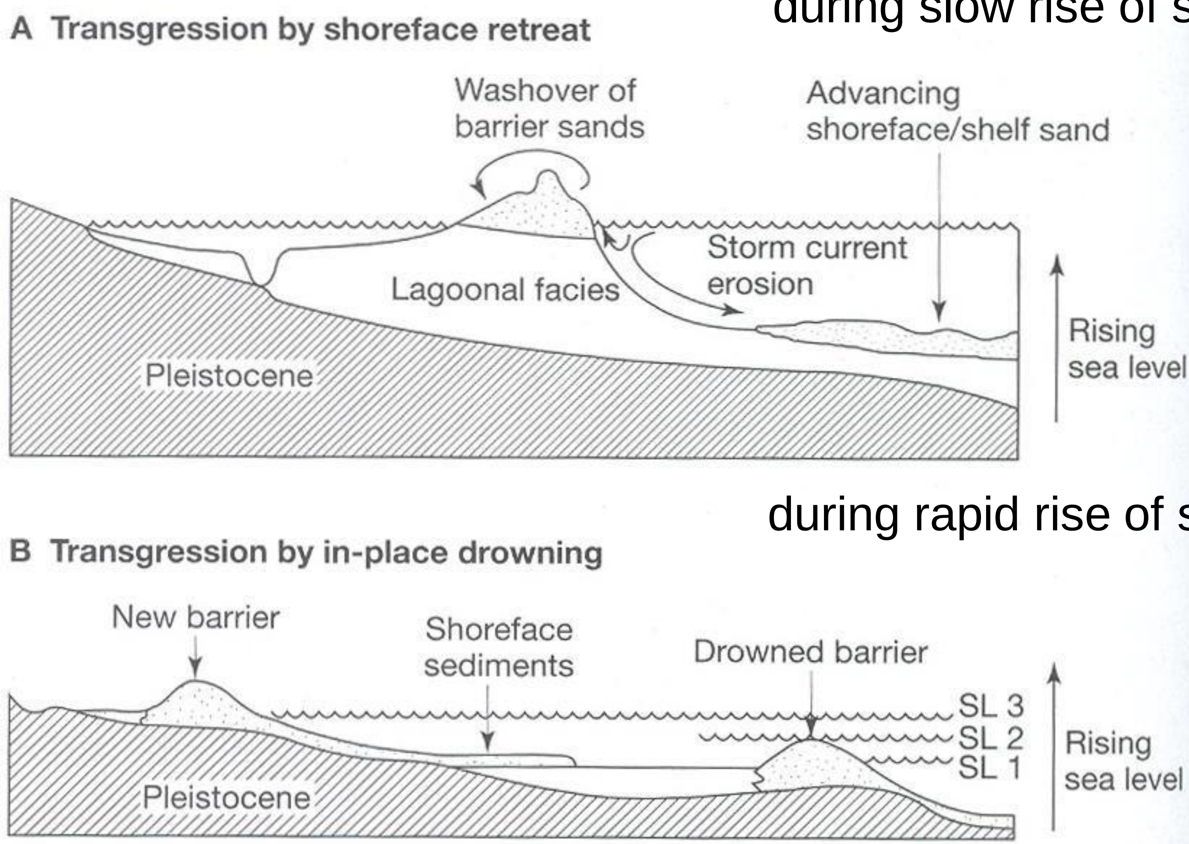


Reinson (1992)

Figure 17 Generalized "end-member" transgressive facies successions for nondissected, barrier-island, and highly dissected coastal plain settings.

Transgressive beach and barrier-island deposits may be generated by two mechanisms

during slow rise of sea level



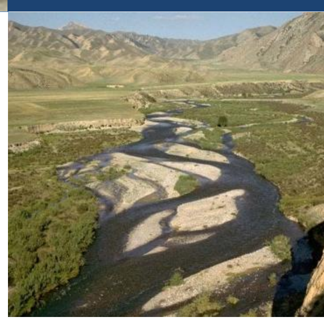
during rapid rise of sea level

Figure 9.26
Barrier-island facies generated by transgression and regression. A. Transgression owing to shoreface retreat during gradual sea-level rise. B. Effects of rapid sea-level rise, producing in-place drowning (SL = sea level).

Boggs (2006), p.316

Thank You !

DSRG



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