



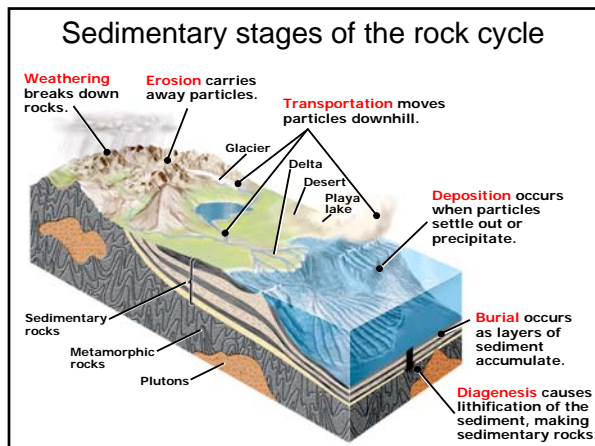
G-100
Lecture 11
Sedimentation

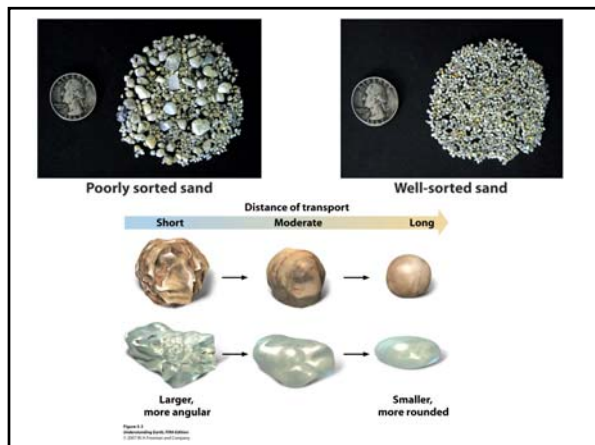
Sediments & Sedimentary Rocks

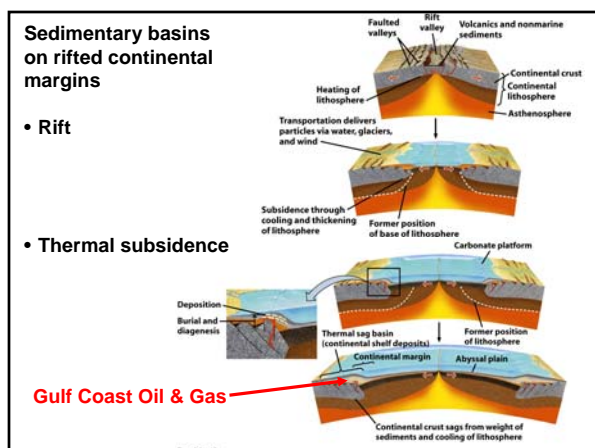
Why study them?

- Cover vast areas of earth's surface
 - *Continents and ocean floors*
- Host of many high-value resources:
 - *Groundwater, oil, gas, coal, mineral deposits (U)*
- Provide records of past surface processes:
 - *Paleo-climate, -ocean, -tectonics*


- How sedimentary rocks form
 - surface processes; weathering
 - "source to sink"
 - Lakes and oceans: "chemical mixing vats"
- Sedimentary basins
- Sedimentary environments
- Sedimentary structures
- Burial and diagenesis
- Classification schemes









WIRED MAGAZINE 15:09


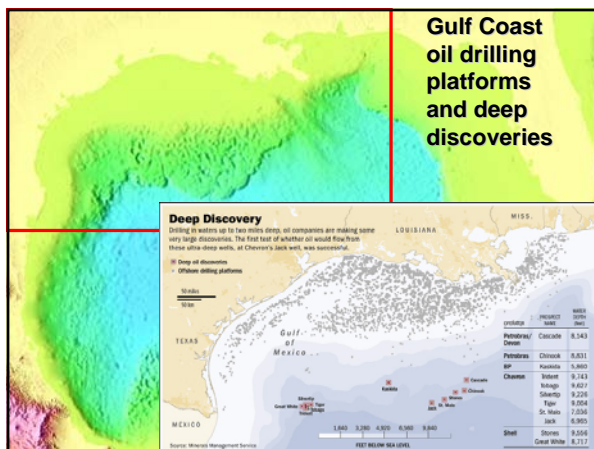
Pumped Up: Chevron Drills Down 30,000 Feet to Tap Oil-Rich Gulf of Mexico

By Amanda Griscom Little 08.21.07
The Cajun Express has bored the deepest offshore well in Gulf history.
Photo: Michael Sogrove

"Isn't this transcendent?" Paul Siegele shouts as he presses his nose to the window of a Bell 430 chopper hurtling through a sky thick with rain and pitchfork lightning. We're flying over the Gulf of Mexico, above some 3,500 oil production platforms, and Siegele is pointing them out with the verve of a birder — here a miniature oil rig known as a monopod; over there a drill ship almost as big as the Titanic; still farther out, platforms looking like huge steel chandeliers that dropped out of the storm-shaken clouds.

Siegele has reason to be giddy. He works for Chevron, and his team is sitting on several new record-breaking discoveries in the Gulf, a region that many geologists believe may have more untapped oil reserves than any other part of the world. On this trip, the 48-year-old vice president for deepwater exploration has come to a rig called the Cajun Express to oversee final preparations before drilling begins on the company's 30-square-mile Tahiti field.

Looming like an Erector set version of Hellboy — with cranes for arms, a hydraulic drill for its head, and a 200-foot derrick for a body — the rig appears at once menacing and toylike. But the real spectacle is below the surface: A drill is plunging down through 4,000 feet of ocean and more than 22,000 feet of shale and sediment — a syringe prodding Earth's innermost veins. That 5-mile shaft will soon give Chevron the deepest active offshore well in the Gulf. Some land drills have gone deeper, but extracting oil from below miles of freezing salt water and unyielding sediment creates a set of technical problems that far exceed those faced on terra firma.



Sedimentary environments

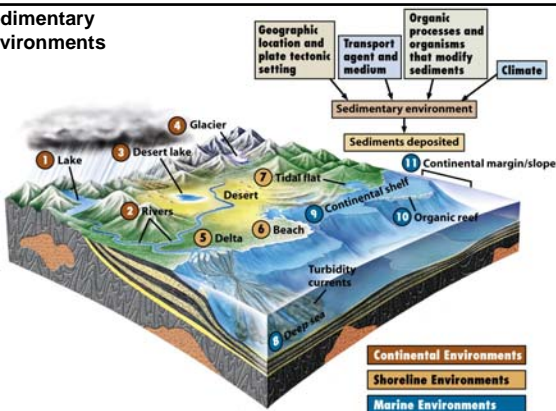


Figure 5-5 part 1
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Table 5.2 Major Chemical and Biological Sedimentary Environments

Environment	Agent of Precipitation	Sediments
SHORELINE AND MARINE		
Carbonate (includes reef, bank, deep sea, etc.)	Shelled organisms, some algae; inorganic precipitation from seawater	Carbonate sands and muds, reefs
Evaporite	Evaporation of seawater	Gypsum, halite, other salts
Siliceous: deep sea	Shelled organisms	Silica
CONTINENTAL		
Evaporite	Evaporation of lake water	Halite, borates, nitrates, carbonates, other salts
Swamp	Vegetation	Peat

Table 5-2
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Sedimentary Structures

- Bedding (stratification)



- Cross-bedding
- Graded bedding
- Ripples
- Bioturbation structures

Cross-bedding

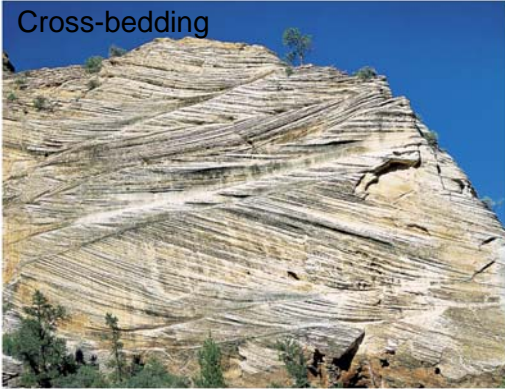
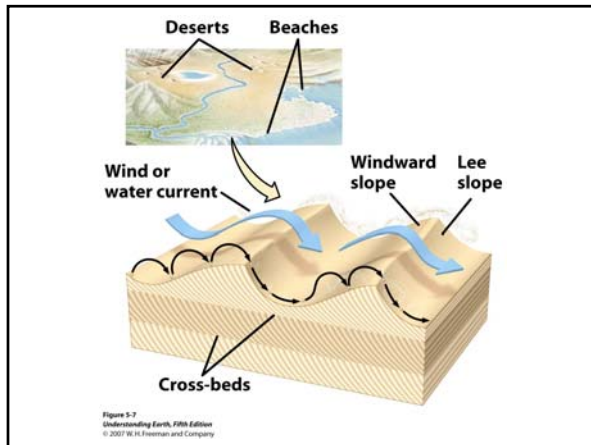


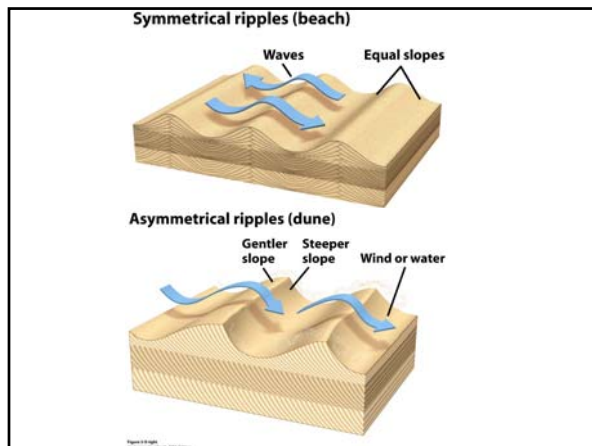
Figure 5-6
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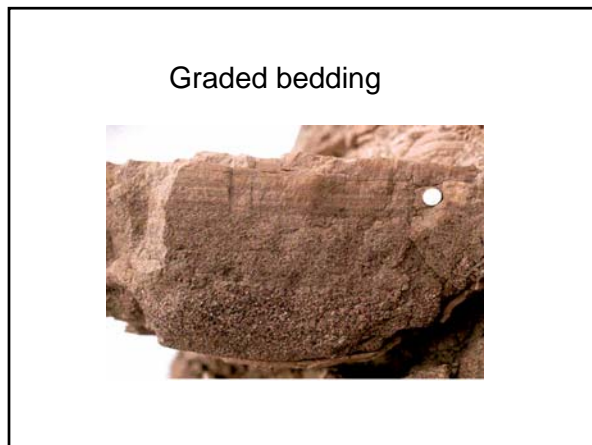


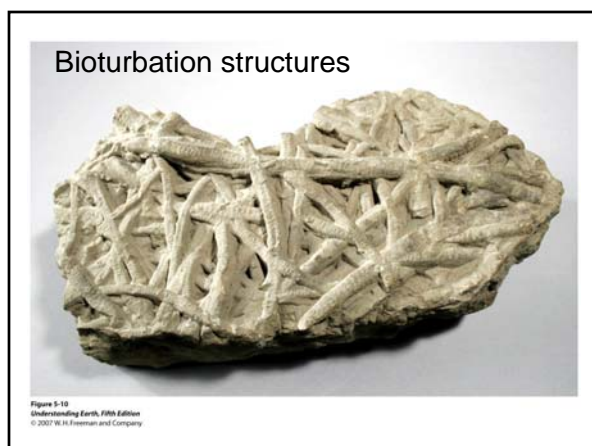
Ripples

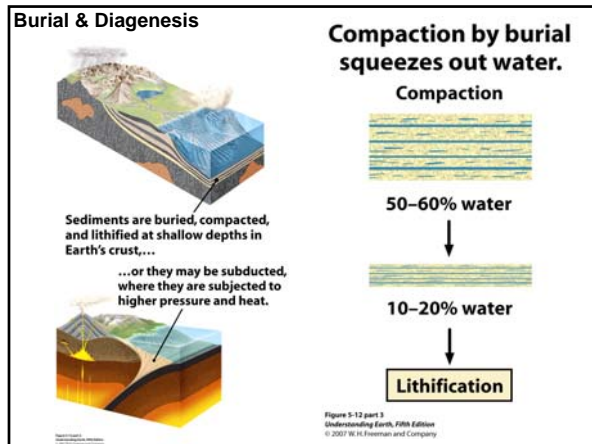


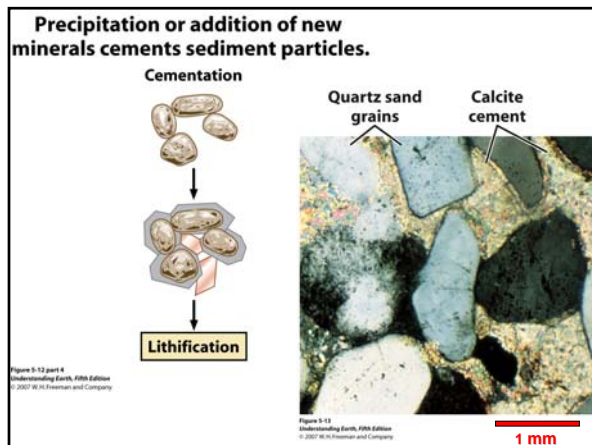
Figure 5-8 left
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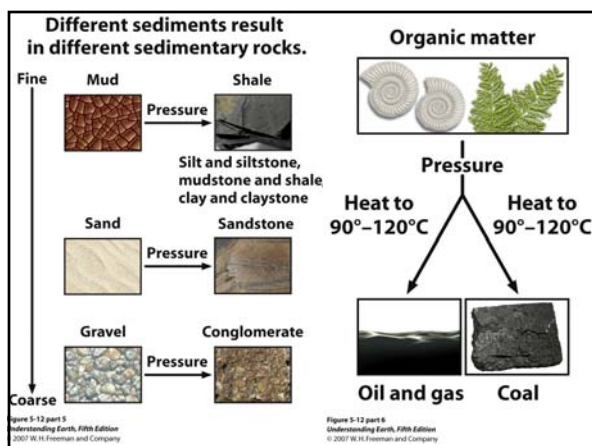




Table 5.3 Major Classes of Clastic Sediments and Sedimentary Rocks


Particle Size	Sediment	Rock
COARSE Larger than 256 mm 256-64 mm 64-2 mm	GRAVEL Boulder Cobble Pebble	Conglomerate
MEDIUM 2-0.062 mm	SAND	Sandstone
FINE 0.062-0.0039 mm	MUD Silt	Siltstone
Finer than 0.0039 mm	Clay	Mudstone (blocky fracture) Shale (breaks along bedding) Claystone



Conglomerate



Sandstone



Shale

Classes of siliciclastic sediments and rocks
texture & composition

Arkose: feldspar-rich

Lithic sandstone: rock fragment-rich

Quartz arenite: pure quartz

Graywacke: matrix-rich

1 mm

Alluvial fan

Delta


Beach

1 mm


Deep-sea fan

Table 5.4 Classification of Biological and Chemical Sediments and Sedimentary Rocks


Sediment	Rock	Chemical Composition	Minerals
BIOLOGICAL Sand and mud (primarily bioclastic)	Limestone	Calcium carbonate (CaCO_3)	Calcite (aragonite)
Siliceous sediment	Chert	Silica (SiO_2)	Opal, chalcedony, quartz
Peat, organic matter	Organics	Carbon compounds; Carbon compounded with oxygen and hydrogen	(coals, tell, gas)
No primary sediment (formed by diagenesis)	Phosphorite	Calcium phosphate ($\text{Ca}_3(\text{PO}_4)_2$)	Apatite
CHEMICAL No primary sediment (formed by diagenesis)	Dolostone	Calcium-magnesium carbonate ($\text{CaMg}(\text{CO}_3)_2$)	Dolomite
Iron oxide sediment	Iron formation	Iron silicate: oxide (Fe_2O_3); limonite, carbonate	Hematite, siderite
Evaporite sediment	Evaporite	Sodium chloride (NaCl) calcium sulfate (CaSO_4)	Gypsum, anhydrite, halite, other salts




Limestone



Chert



Gypsum



Halite