Slide 1

Understanding The Seafloor

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New Orleans, LA

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This is a presentation prepared in the Summer 2003 for the Gulf Coast COSSEE by Dr. Frank R. Hall

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Resources for pictures, etc. used in this presentation

US Geological Survey	John's Hopkins University	University of Wyoming
NASA	BayofFundy.com	American Museum of Natural History
National Center for Atmospheric research	University of North Carolina	University of North Dakota
Kohler, Inc.	NOAA	PlateTectonics.com
VIMS	World Book Encyclopedia	amonline.net.au
Columbia University	EPA	Bowling Green State University

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I'd like to thank

Dr. Robert Pockalny

University of Rhode Island
for Use of His Video
of a Mid Ocean Ridge

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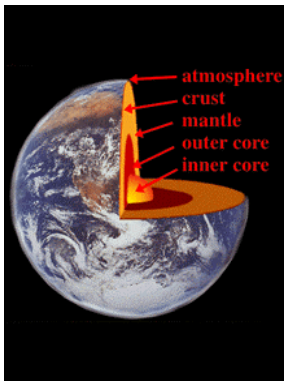
The Earth's Interior



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Three Rock Types on Earth's Crust

Granite

Basalt

Gabbro

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Where does the seafloor begin?

- *We have a terrestrial bias*
- *Earth's surface is > 70% water*
- *> 97% of this water is seawater*

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Land-Sea Morphology

From the World Book Encyclopedia

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The Seafloor is a “Basin”

Bathtub by Kohler

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Water Facts

Water source	Water volume, in cubic miles	Percent of total water
Oceans	317,000,000	97.24%
Icecaps, Glaciers	7,000,000	2.14%
Ground water	2,000,000	0.61%
Fresh-water lakes	30,000	0.009%
Inland seas	25,000	0.008%
Soil moisture	16,000	0.005%
Atmosphere	3,100	0.001%
Rivers	300	0.0001%
Total water volume	**326,000,000**	**100%**

Source: Nace, U.S. Geological Survey, 1967 and
The Hydrologic Cycle (Pamphlet), U.S. Geological Survey, 1984

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Map of the Seafloor

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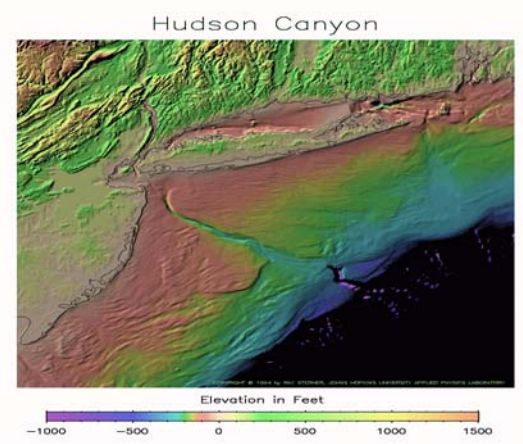
Passive Margins



An example of the structure of passive continental margins. Notice the delta lobe at the bottom. These are called “Deep-sea fans”.

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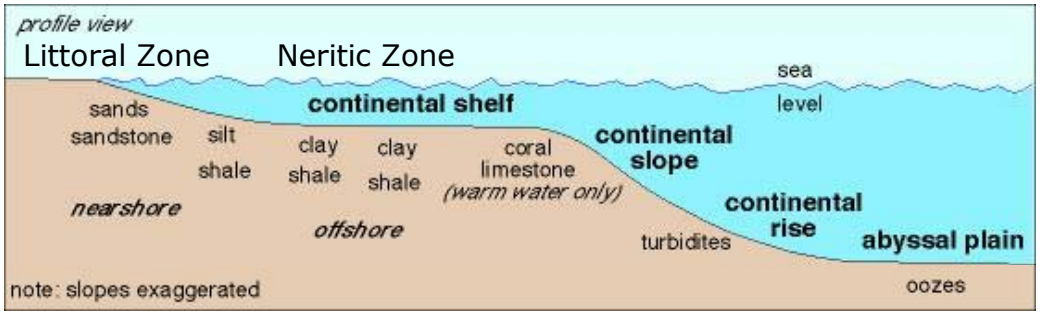
Passive Margin Profile



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Continental Shelf

Littoral (0-20m)
Neritic (20-500m)

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Littoral Zone

Shallowest, Tidally Influenced
Where the Oceans meet the Land

- *Marshes*
- *Estuaries*
- *Beaches, Bars, Barrier Islands, Cheniers*
- *Coral Reefs*
- *Deltas*

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Hurricane Lili: 2002

Severe storms impact the Littoral zone

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Marshes

- *Habitats for many forms of life*
- *Typically quiet in terms of currents*
- *Sediments are typically fine-grained (muds)*

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Estuaries

Satellite Image of Delaware and Chesapeake Bays

Semi-enclosed water bodies

There are four kinds of estuaries

The following four slides are from the University of North Carolina

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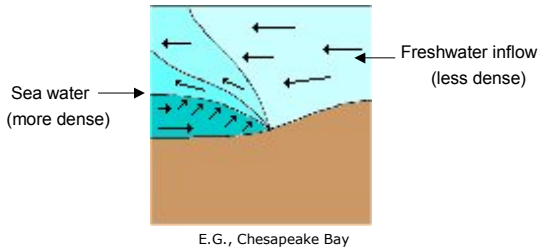
Salinity structure of an estuary

1) Highly stratified estuary (Salt-Wedge)



E.G., Chesapeake Bay

Large riverine inputs: Fresh water floats on top of salt

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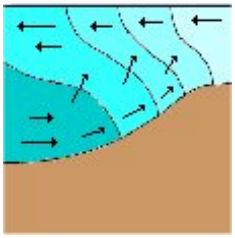
Salinity structure of an estuary

2) Partially mixed



E.G., San Francisco Bay

Tides mix salt water into fresh

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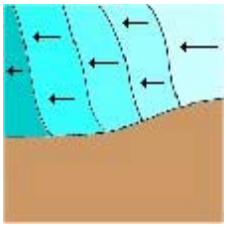
Salinity structure of an estuary

3) Well mixed



E.G., Narragansett Bay

Low riverine inputs, large tidal influence mixes waters

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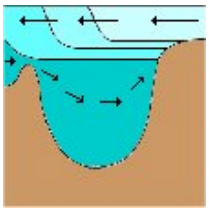
Salinity structure of an estuary

4) Fjord-type estuaries



E.G., Inderbitzen Fjord (Canada)

Only found where glaciers have influenced the coast.

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Beaches, Bars, Barrier Islands, Cheniers

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Deltas

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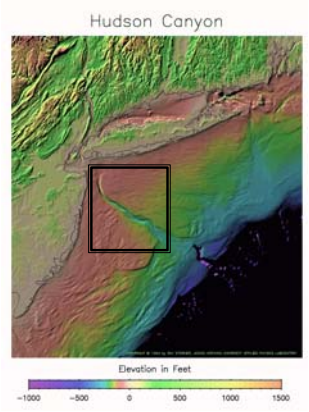
Neritic Zone



On most passive margins, neritic zones are basically inactive. That is to say, sediments are typically not being delivered to this part of the shelf by rivers. A notable exception is the Shelf off Brasil where the Amazon River brings sediemnts up to the shelf break.

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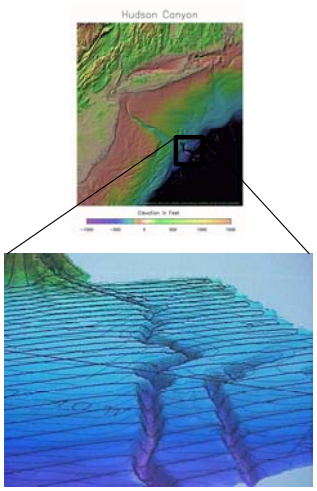
Continental Slope



The Hudson Canyon is an example of an incised feature on continental slopes. Passive margins, canyons are typically inactive

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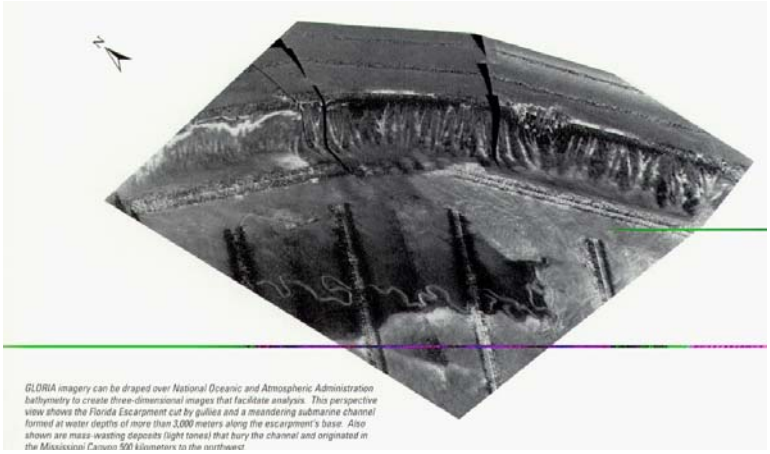
Continental Rise
Deep-Sea Fans



USGS Image of the Mississippi River fan

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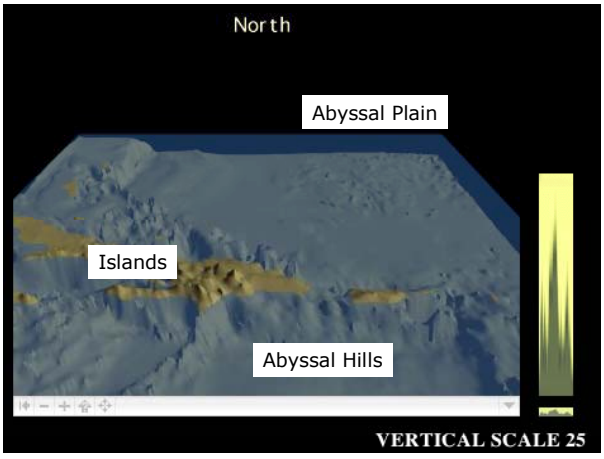
The Abyss
Nares Abyssal Plain



Abyssal Hills exist under the abyssal plain: the sediment cover results in a smooth seafloor.

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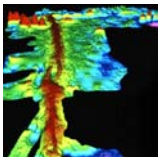
(Mid) Ocean Ridges aka Spreading Centers



- *The longest, continuous feature on the Earth's Crust.*
- *A volcanic mountain chain that stretches around the world*

In the Atlantic and Indian Oceans, the Ridge is indeed in the "Middle". Hoewever, in the pacific, it is on the eastern side of the basin. Thus, it is called the "East pacific Rise". Breakes along the path of the ridge are called "Fracture Zones" or "Transform Faults".

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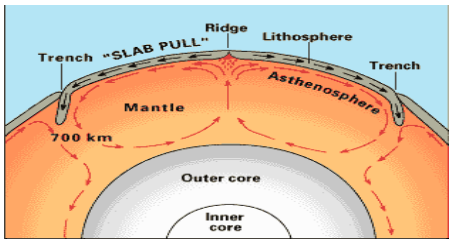
Spreading Centers and Plate Tectonics



At spreading centers, new seafloor is crated as hot, molten rock rises through the volcanoes. This is the upward movement of convection cells within the mantle.

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The Graben of the East Pacific Rise

Video taken from the Alvin on the East Pacific Rise in 1994

(From Dr. Robert Pockalny, University of Rhode Island)

A graben is a depression. In this case, it denotes the axial valley associated with the east pacific Rise.

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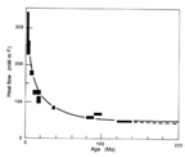
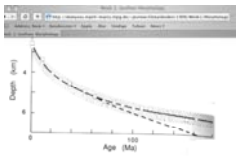
Heat Flow and Plate Tectonics





- *As you move way from the spreading center, you move into older oceanic crust older seafloor*
- *As the seafloor ages, it slowly cools, increases in density, and sinks to deeper depths.*

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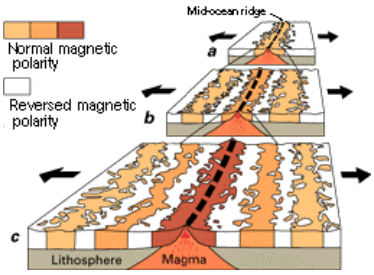
Spreading Centers: Evidence of Plate Tectonics



Magnetic Stripes that Parallel the Ridge

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Trenches: Subduction Zones

The seafloor around Australia has the Philippine Plate colliding with the Pacific Plate that dives underneath forming a trench.

At subduction zones, older ocean floor, that began at the spreading centers, dive into the mantle. Earthquakes are very common in areas of subduction.

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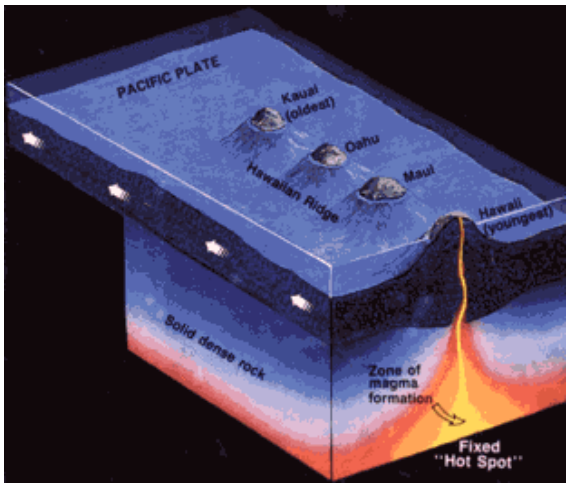
Hot Spots
The Formation of Hawai'i



Your homework assignment relates to this phenomenon. Are hotspots permanent features on the Earth?

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Deep-Sea Sediments
Four Sources

- *Terrigenous (derived from land)*
- *Biogenic (remains of organisms)*
- *Chemical (usually as precipitates)*
- *Extraterrestrial (micrometeorites and tektites)*

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Terrigenous

Rivers

Wind

Glaciers

Icebergs

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Terrigenous

Volcanic Eruption: Mt. Pinatubo

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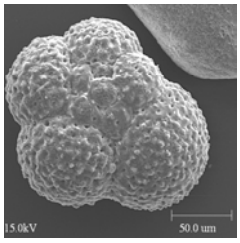
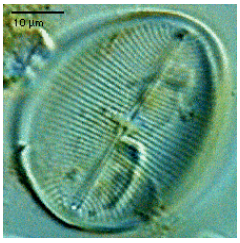
Biogenic



Calcareous



Siliceous

Chitonous

Phosphatic

Phosphatic includes things like fish scales and bones.
In addition to calcareous foraminifera, there are also “agglutenated” varieties that make their shells out of surrounding sediment.

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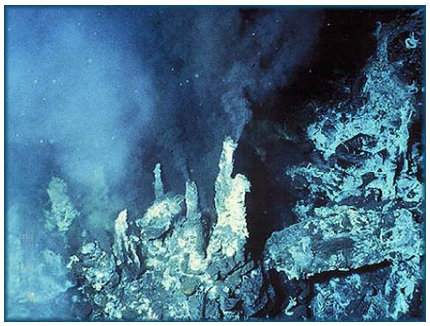
Chemical



Black Smoker from a Hydrothermal Vent

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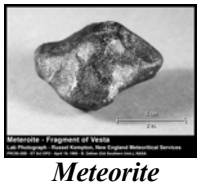
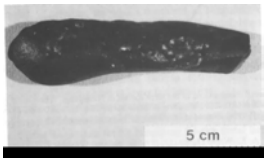
Extraterrestrial



Meteorite



Tektite

- *Meteorites impact the Earth from outer space.*
- *Although grouped with "extraterrestrial" objects, tektites are actually created from Earth materials that are ejected into the air when a meteorite hits.*

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Homework Assignment

HOTSPOTS *are thought of as "fixed" features on the Earth's surface, but are they really?*

<u>This will be your homework assignment:</u>

Examine and report on new data that suggests that the Hawaiian Hotspot moved over time. Prepare a 3-5 page (1 inch margins, 1.5 line-space, 12 pt Times New Roman font) report on Hotspots and the implications of the Hawaiian Hotspot moving.

Examine the results of Ocean Drilling Leg 197:
http://www-odp.tamu.edu