Reading Material

(see website for course)

"Ocean Basins",
from "Oceanography"
M.G. Gross, Prentice-Hall

Who Cares?

Indonesia	earthquake ⇒ landslide ⇒ tsunami
New Orleans	hurricane ⇒ wind ⇒storm surge

Oil & Gas
Minerals (metals, fertilizer)
Sand and Gravel for concrete

Fate of contaminated sediments
Harbor siltation
Beach erosion
Sea-level rise
Carbon burial, greenhouse gases, global warming

History of Earth recorded by marine sedimentary deposits

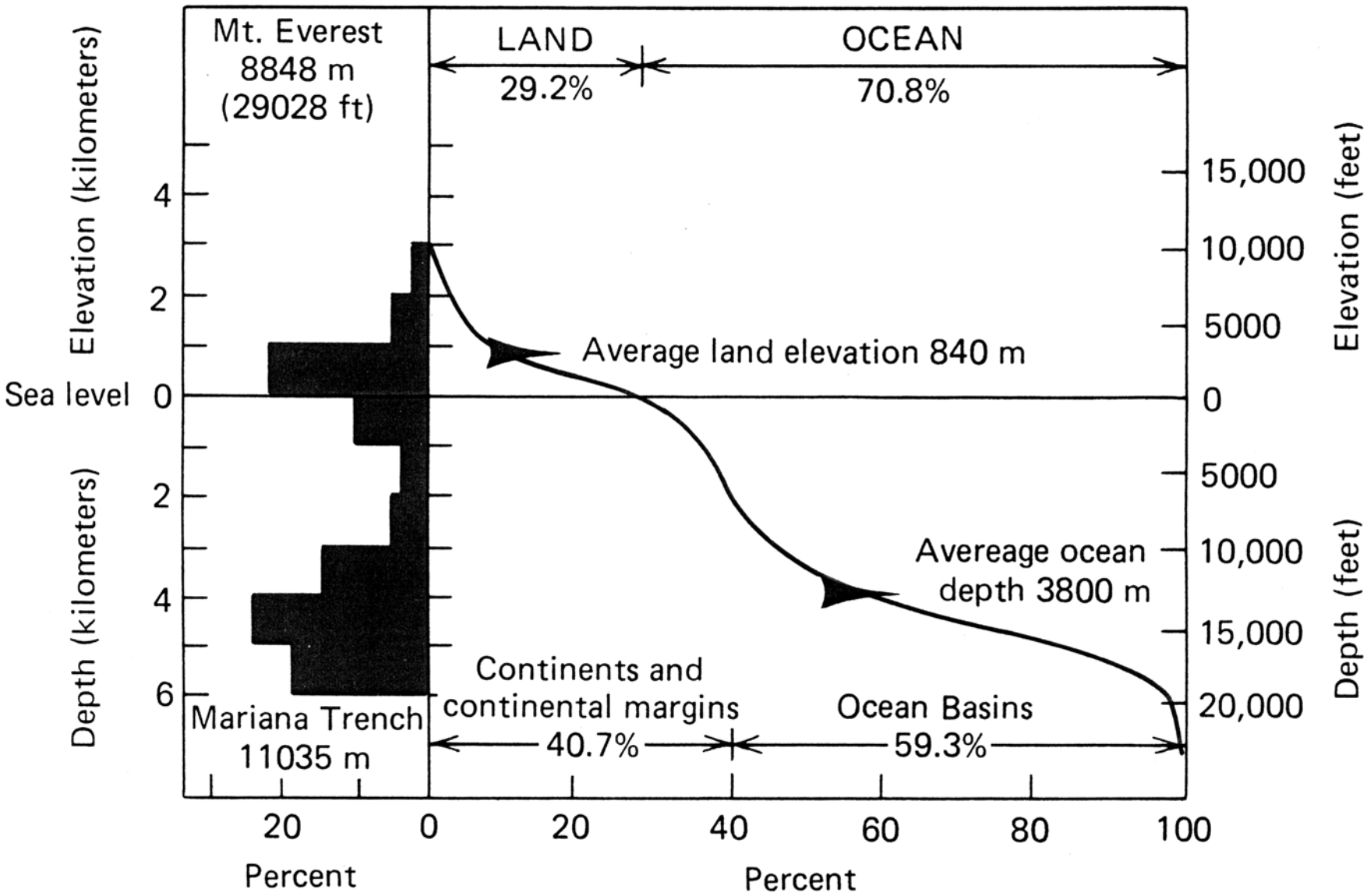
Ocean Basins

What creates the Earth's surface?

What is the shape of the surface below sea level (the seafloor)?

What types of sediment are burying the seafloor?

Hypsographic Curve



Earth's Surface

Hypsographic Diagram

- 30% land
- 10% continental margins (boundary)
- 60% deep sea

Two distinct levels for Earth surface

- 0-1000 m above sea level
- 4000-5000 m below sea level

These represent two distinct types of crust (Earth's rigid upper layer)

- continental crust – thick, granite, not so dense
- oceanic crust – thin, basalt, denser

Plate Tectonics – mechanism that moves crust

Plates

separate pieces of crust

move due to convection of heat in underlying layer (Mantle)

plates can move in different directions, and collide

Collisions

a) two continental plates collide, form high mountain ranges

e.g., Himalayas

b) two ocean plates collide, form island arc and submarine trench

e.g., Aleutian Islands, Aleutian Trench

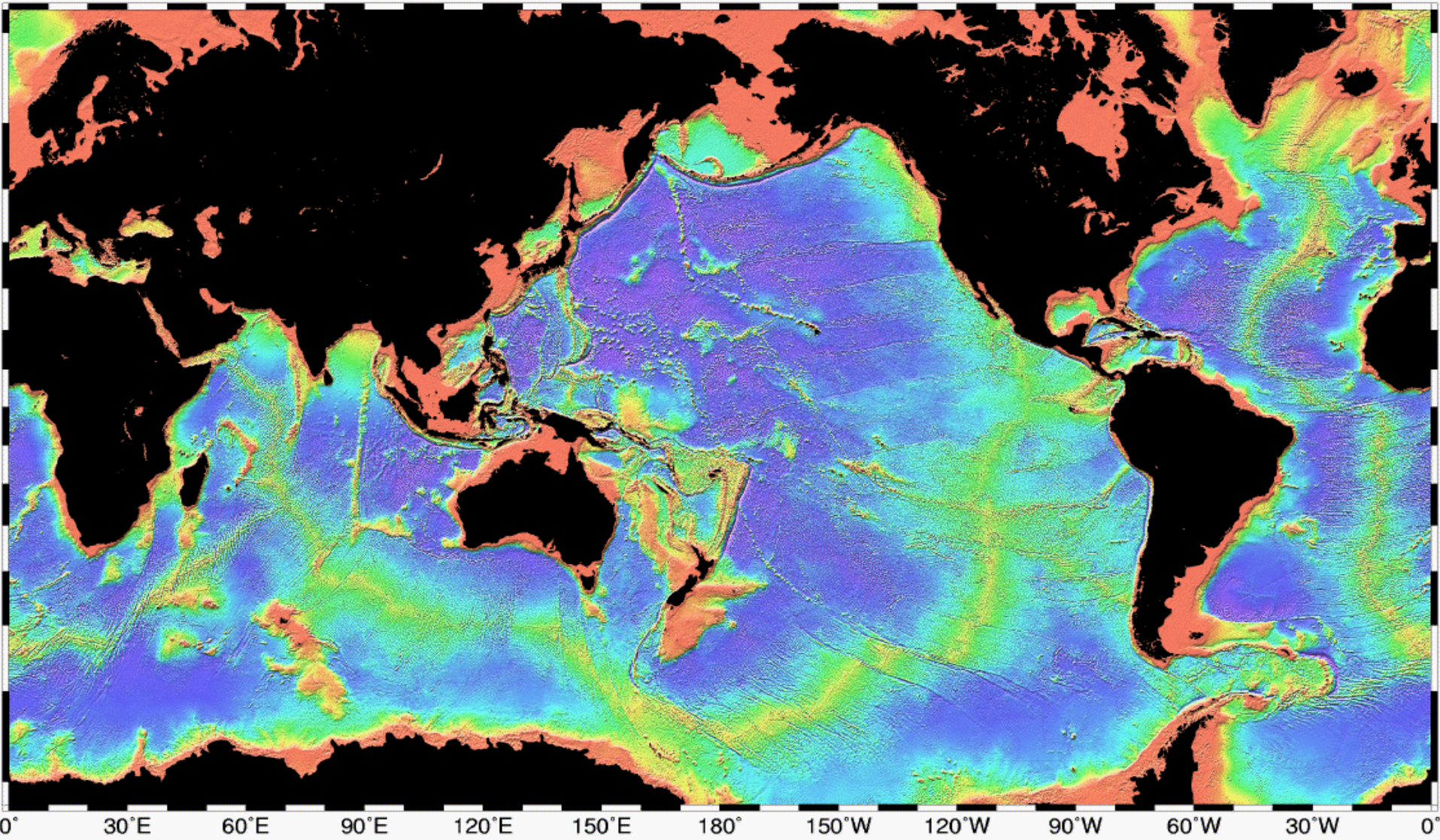
c) ocean and continental plates collide, form mountains and trench

e.g., Andes and Peru-Chile Trench

Subduction

occurs when ocean crust carried down into Mantle (e.g., b and c above)

basalt and sediment heated to form volcanic magma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0°

Bathymetry

Mid-Ocean Ridges (underwater mountain ranges)

- water depth – 2000-4000 m
- can be less – where islands occur (e.g., Iceland)
- volcanic eruptions create new ocean crust
- hot basalt, thermal expansion creates elevation
- moves away from ridge axis in both directions

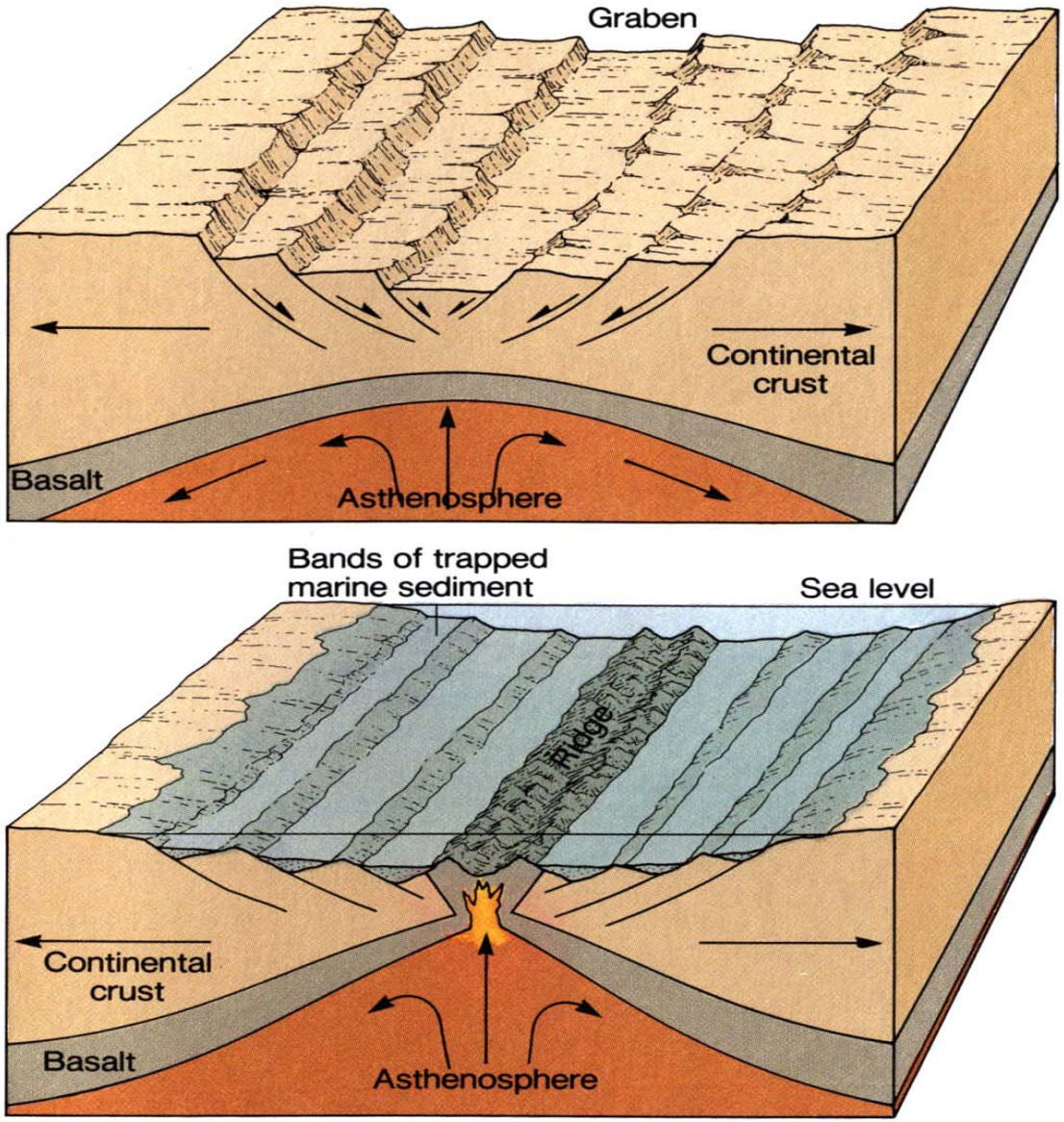
Abyssal basins

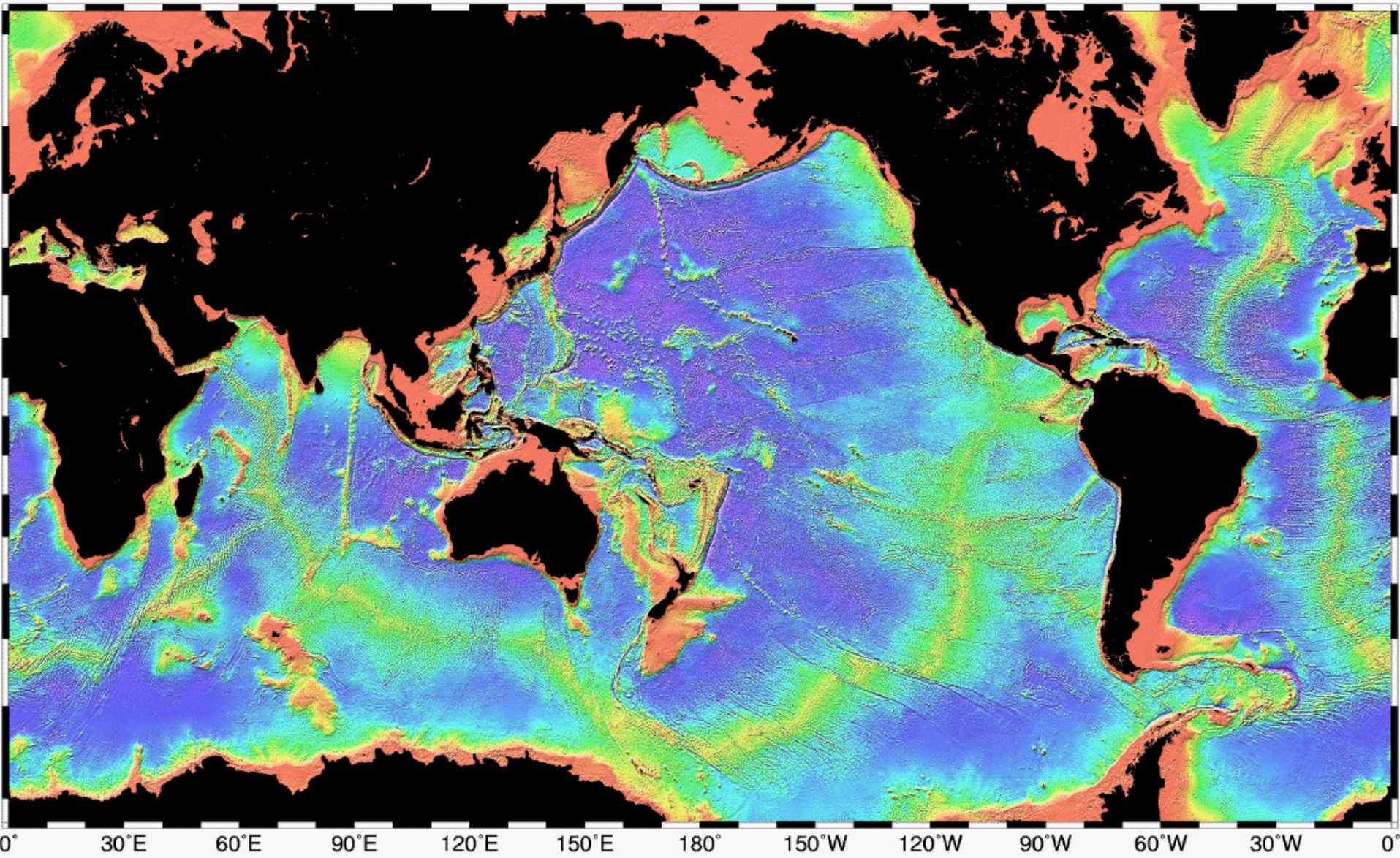
- water depth – 4000-6000 m (only trenches are deeper)
- abyssal hills, include rough relief from volcanic formation
- abyssal plains, smooth surface due to burial by sediment

Continental margins

- created by sediment from land that builds into ocean basins

Opening of new ocean and formation of mid-ocean ridge

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Sub-Environments on Continental Margins

Continental shelf

- **smooth, gently dipping (less than 0.1 degrees)**
- **land surface during lowstand of sea level**
- **glacial ice melted and flooded portion of continent**

Continental slope

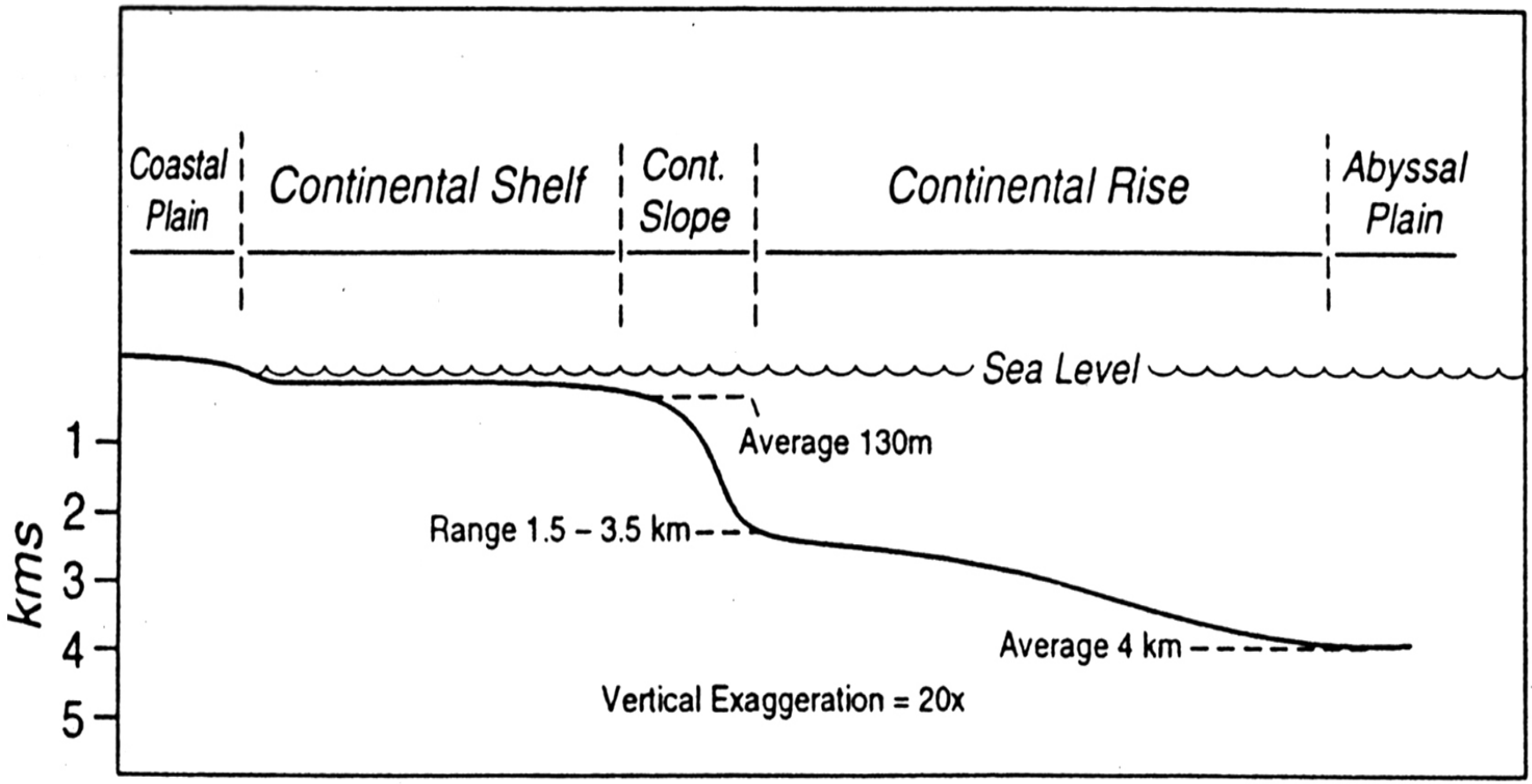
- steep (more than 4 degrees), rough topography
- edge of continental crust
- submarine canyons, larger than canyons on land
- not eroded by rivers directly (too deep), but by slurry of sediment

Continental rise

- more gentle gradient and relief
- sediment from land piled on ocean crust

Trenches (collision of plates, deepest places in ocean)

Abyssal plains (sediment from land buries abyssal hills)



Trailing-Edge Margin

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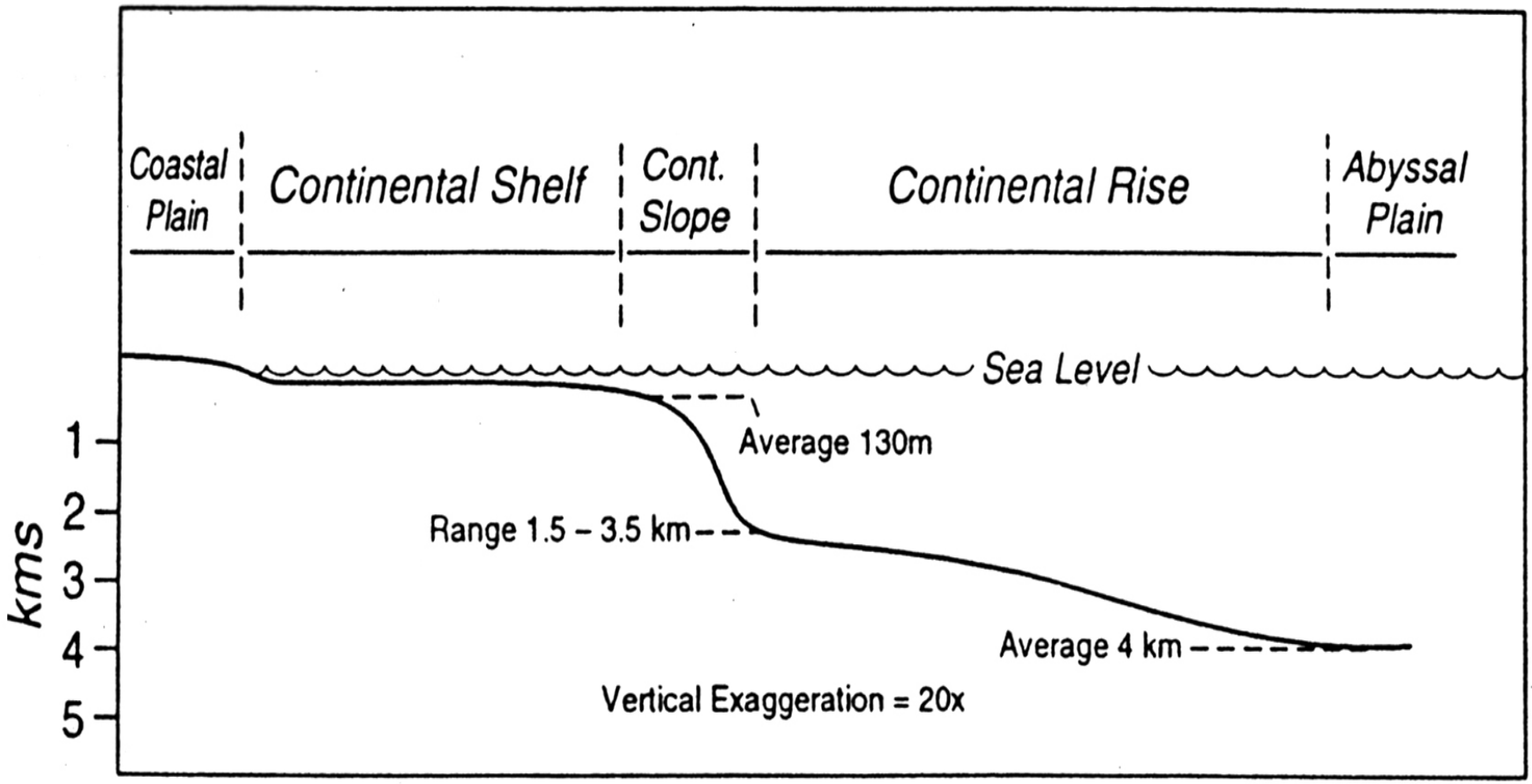
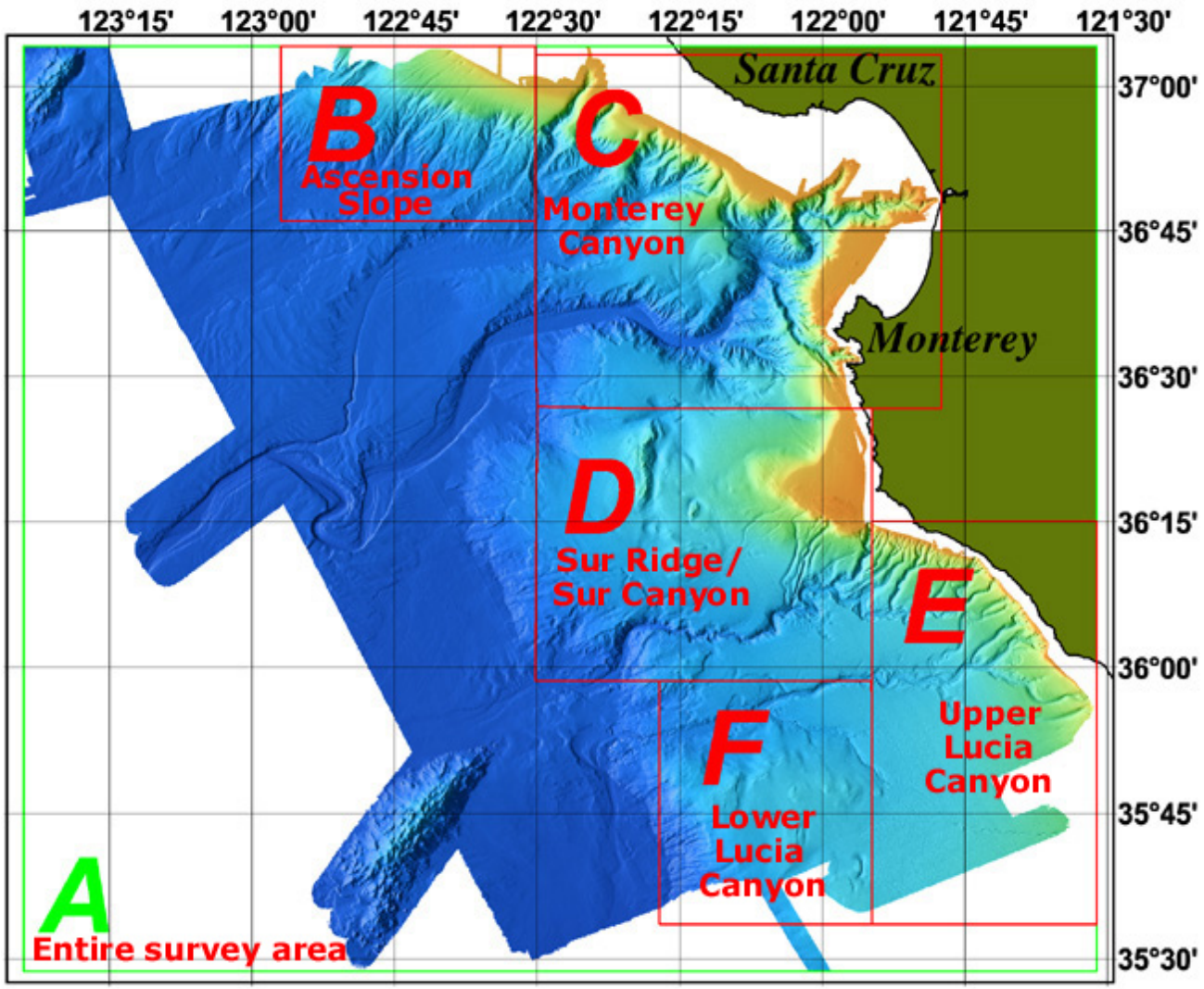
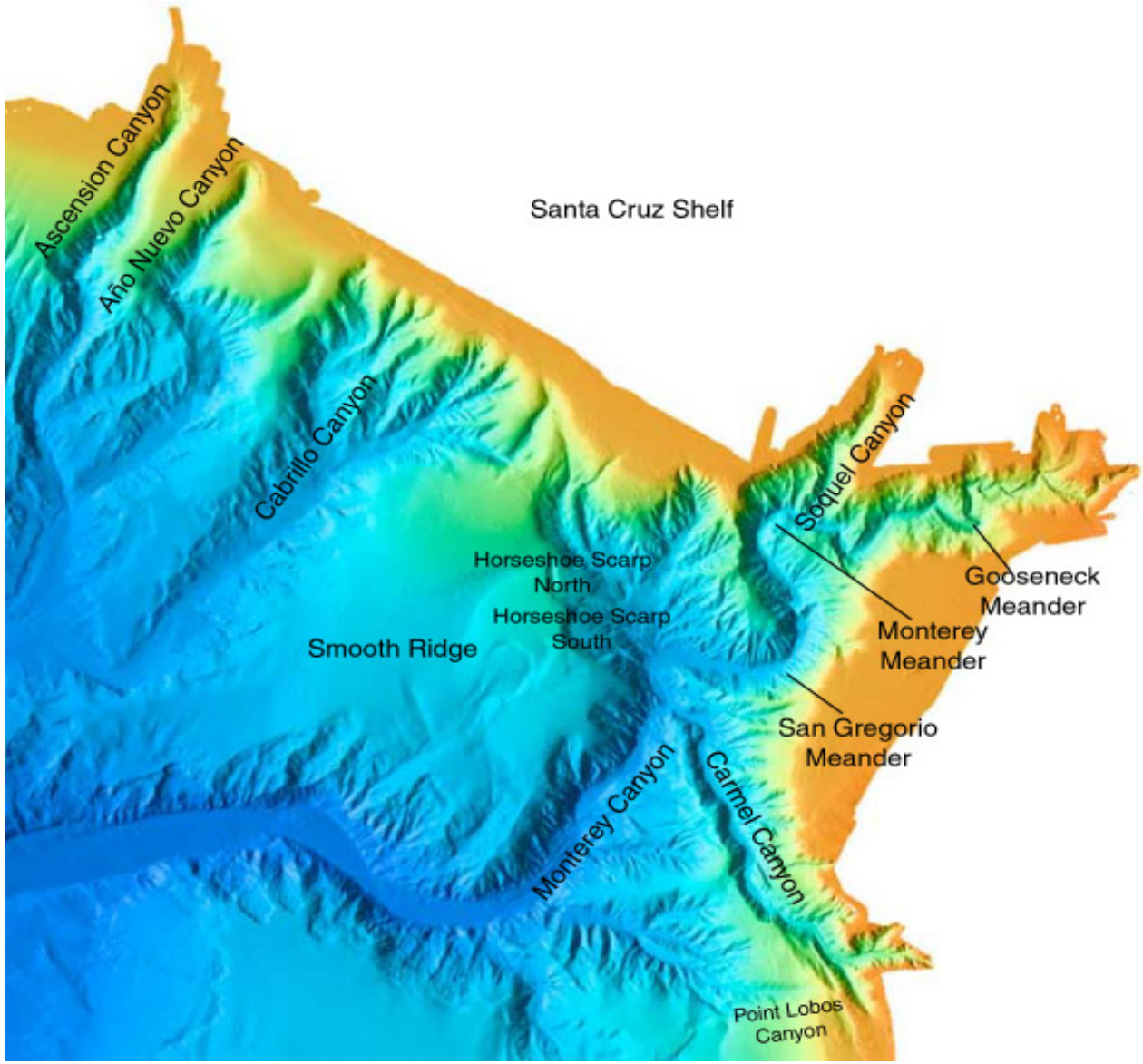


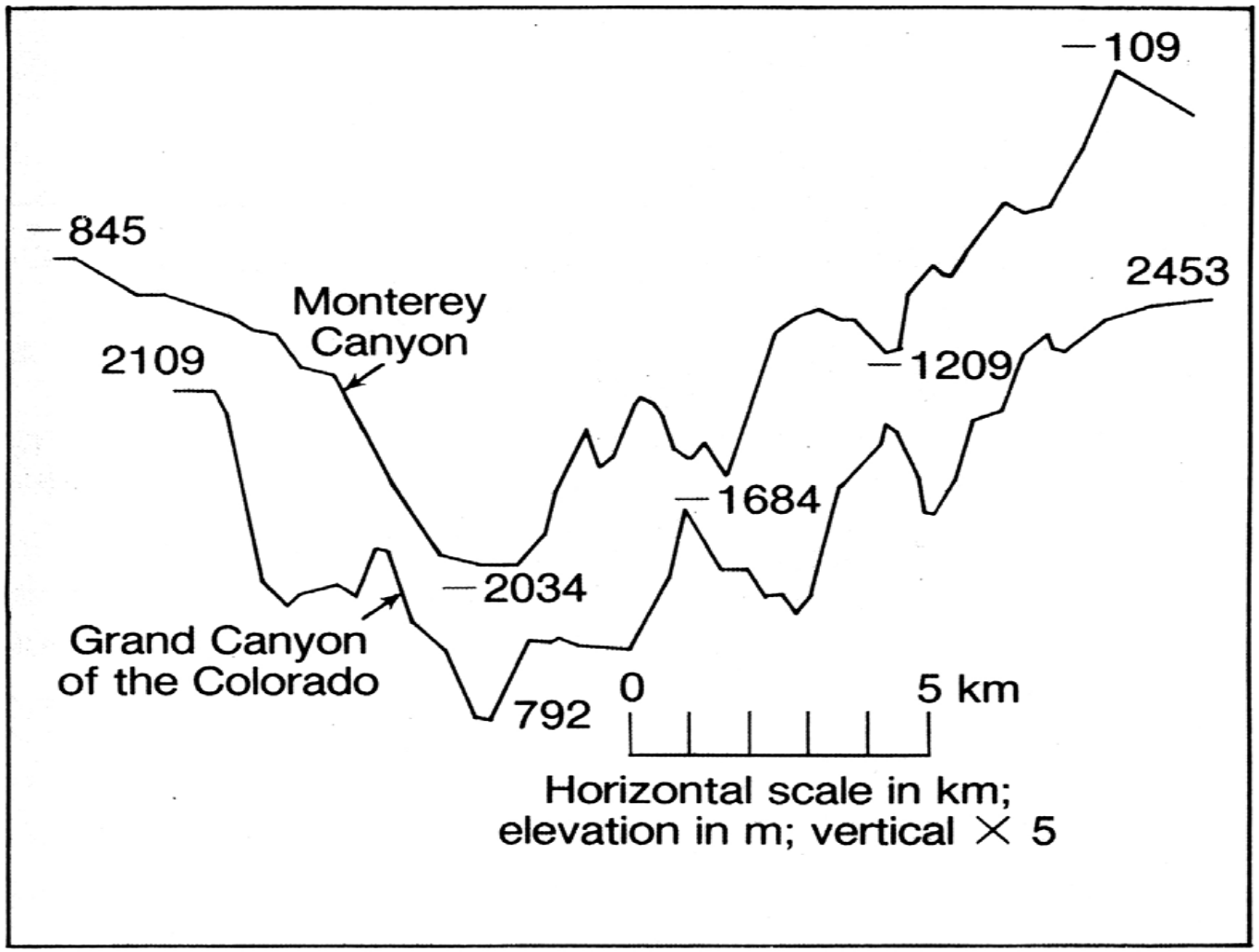
Trailing-Edge Margin

Central California area of Monterey Canyon



Monterey Canyon




109
845
Monterey
Canyon
2453
2109
1209
1684
2034
Grand Canyon
of the Colorado
792
0
5 km
Horizontal scale in km;
elevation in m; vertical × 5

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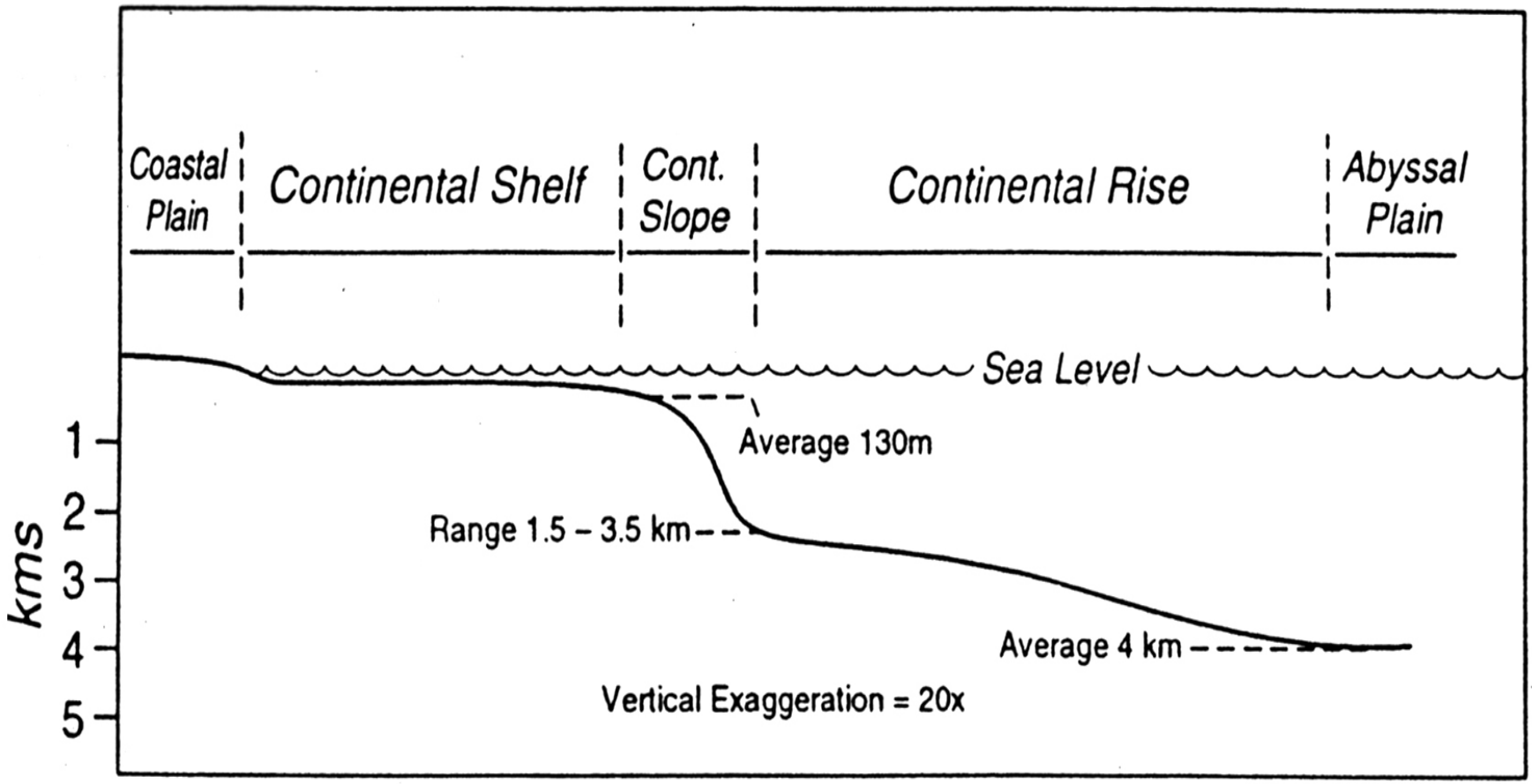


Trailing-Edge Margin

Continental Margins

Two types:

Trailing-edge margins

continental and oceanic plates move in same direction at same speed

examples – margins around Atlantic Ocean

contain: coastal plain (was continental shelf during higher sea level)

broad continental shelf

continental slope and rise

Collision margins

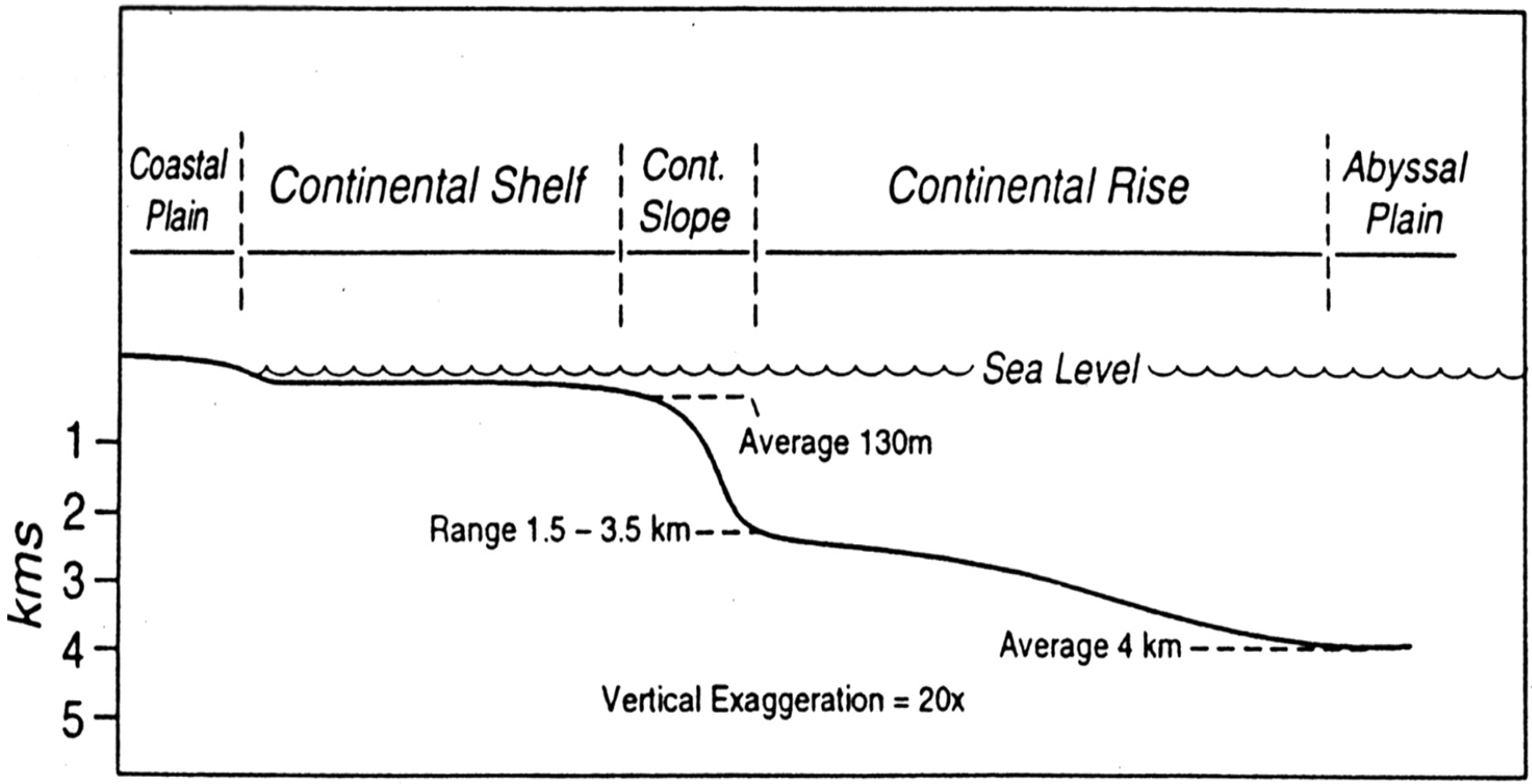
continental and oceanic plates move toward each other

examples – margins around Pacific Ocean

contain: coastal mountain range, volcanoes, earthquakes

narrow, steep continental shelf

continental slope and submarine trench



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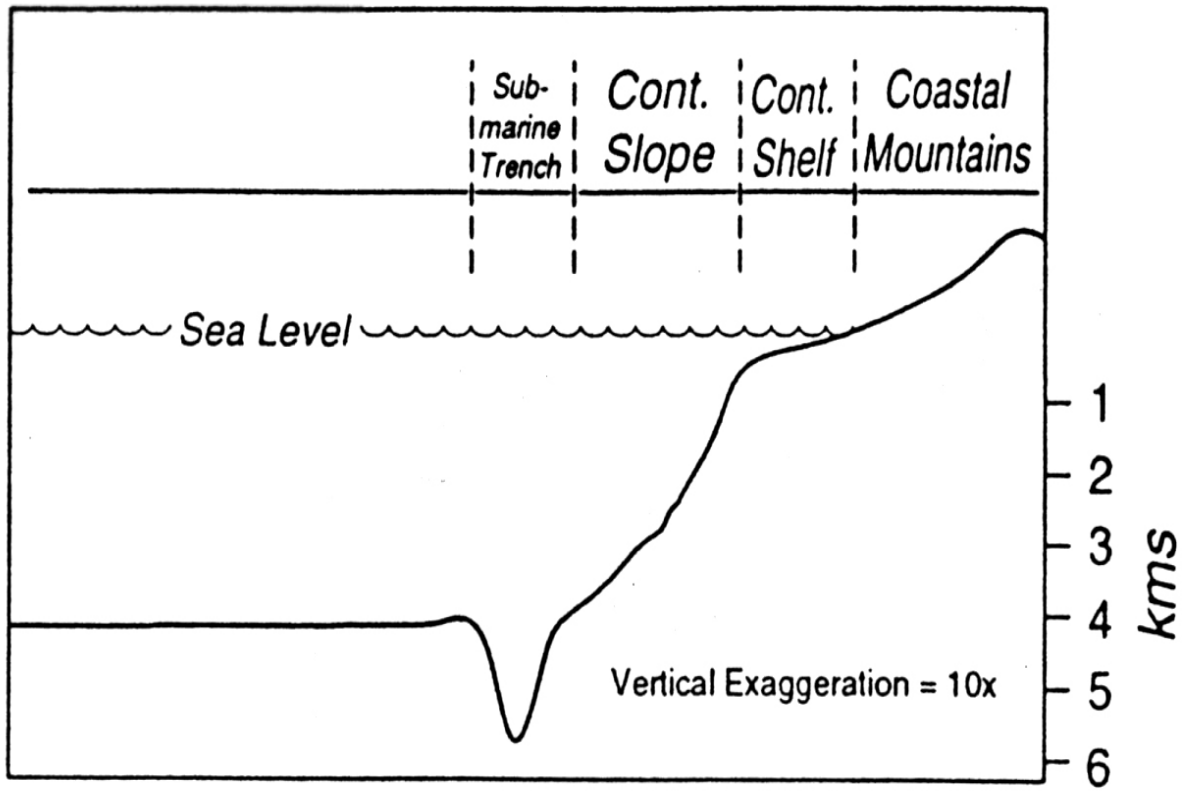


Collision Margin

Materials filling ocean basins

Dissolved chemicals

especially from rivers and mid-ocean ridges (volcanic eruptions)

some remain dissolved (e.g., producing salt water)

some precipitate inorganically (e.g., producing Manganese nodules)

some precipitate organically (e.g., producing biogenic oozes)

Solid particles, from:

winds (aeolian) – dust blown from land, only important in deepest ocean
forms "red clay"

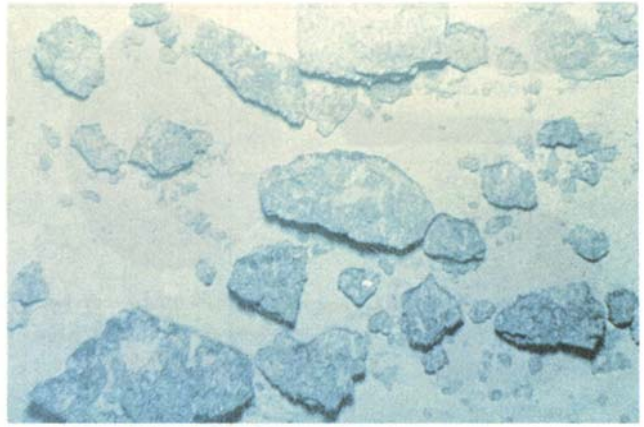
rivers (fluvial) – most important source
90% mud (silt, clay), 10% sand

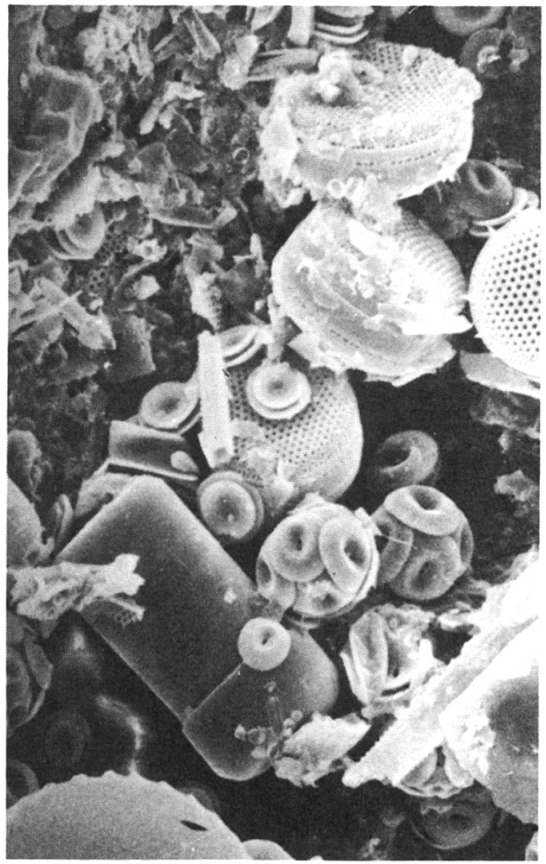
glaciers (glacial) – greatest impact at high latitudes
supplies wide range of sizes (boulders to rock flour)

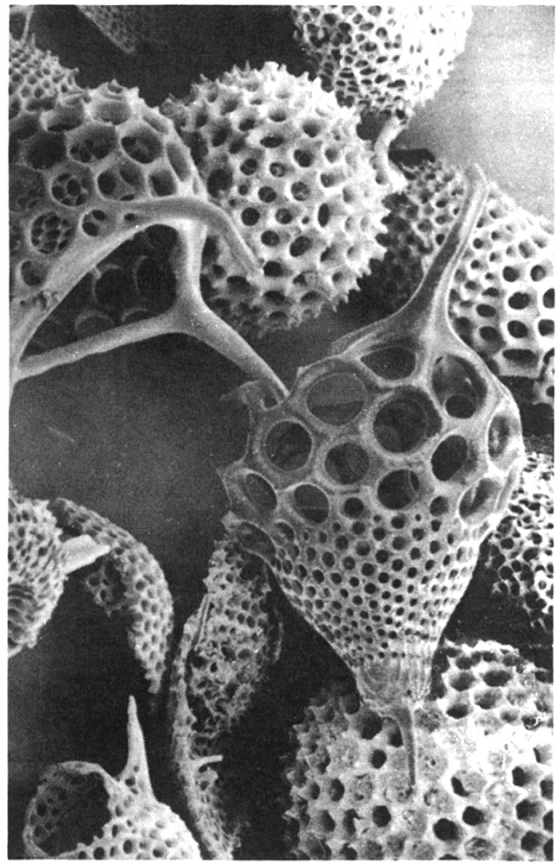
Authigenic Sediments

(manganese nodules)

and red clay







Biogenic Sediments, microscopic in size

(single-celled plants and animals)

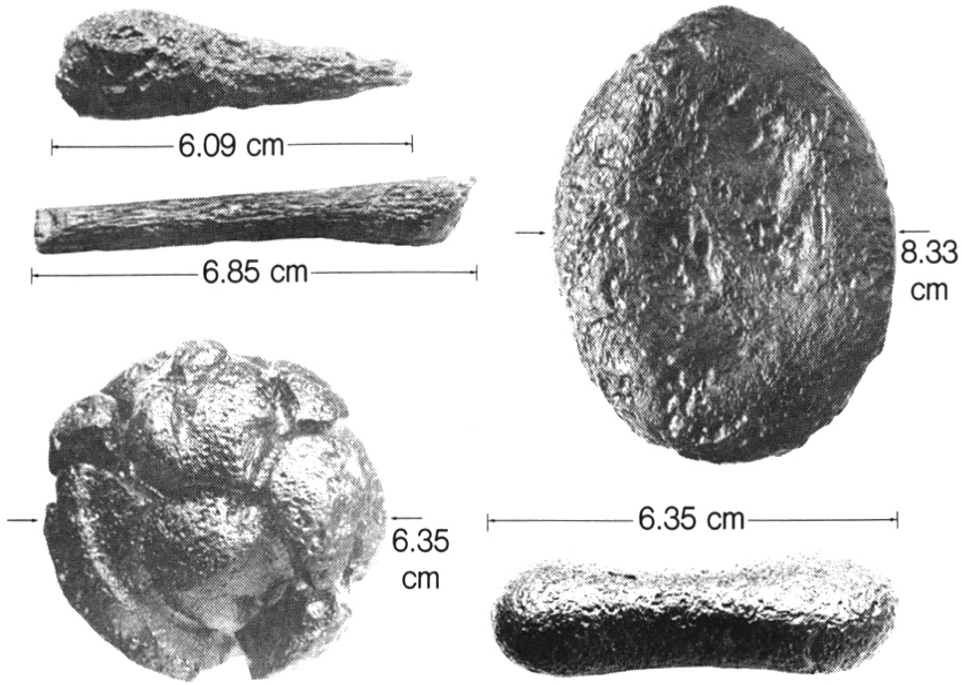
Classification of marine sediments

Lithogenic – from disintegration of rock on land
aeolian, FLUVIAL, and glacial sources

Biogenic – organic precipitation of dissolved components
dominated by single-celled plants and animals (create oozes)
calcium carbonate (limestone) = calcareous
silicon dioxide (opal) = siliceous

Authigenic – inorganic precipitation of dissolved components
seawater becomes supersaturated with regard to some chemicals

Cosmogenic – from outside Earth
meteorites, usually very small (tektites)



Cosmogenic Sediments
tektites (micrometeorites)

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