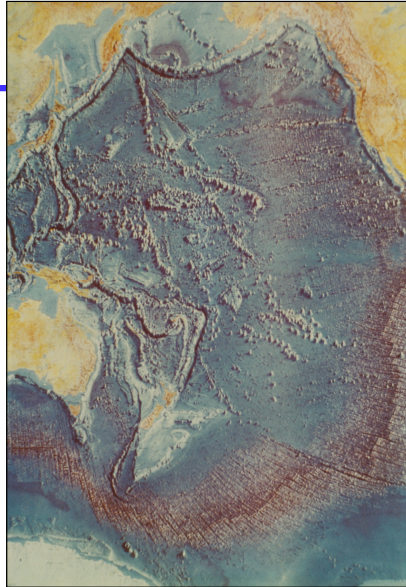


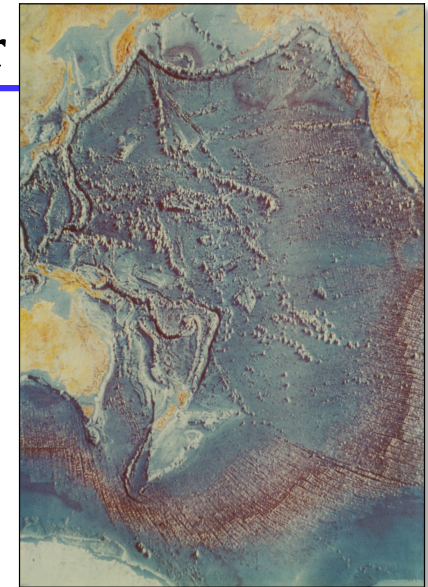
# The Sea Floor

- An overview of the drained oceans
  - Some graphics from Sverdrup, Duxbury & Duxbury Introduction to the World's Oceans
  - Garrison Fig. 4.31, pp. 108-109; Fig. 4.22 p. 101



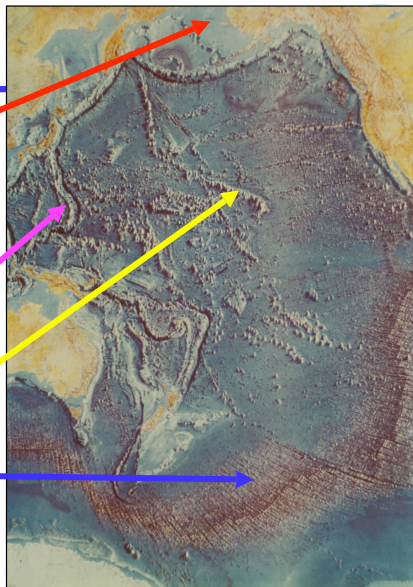
# The Sea Floor

- Not just a uniform smooth bottom or random variation
  - Where are oceans shallowest?
  - Deepest?
- Organized features that reflect underlying order & processes



# The Sea Floor

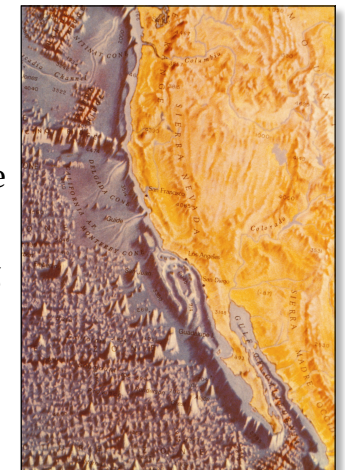
- Broad shallow areas drop abruptly to depths
  - Continental margin
- Deep trenches ring the Pacific
- Islands in linear chains
- Long submerged mountain range
  - Mid-ocean ridge



# The Continental Margin



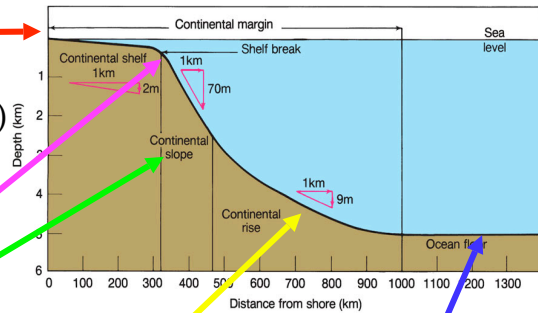
- Where are the edges of the continents? Not at the water's edge.
- Defined partly by the slope of the bottom
- & partly by the underlying rock & sediment
  - More next lecture



# The Continental Margin



- Margin = shelf + slope + rise (or trench)
- Drops off more steeply at shelf break to form slope
- Starts to level off to form rise
- Levels off in deep water to form level abyssal plain

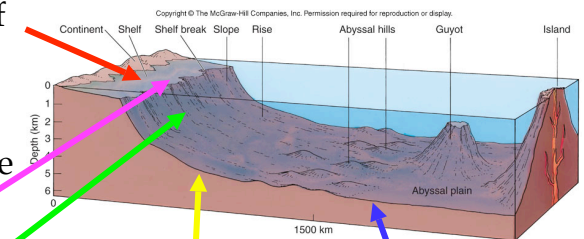


Garrison Fig. 4.11 p. 95

# The Continental Margin



- Margin = shelf + slope + rise (or trench)
- Drops off more steeply at shelf break to form slope
- Starts to level off to form rise
- Levels off in deep water to form level abyssal plain

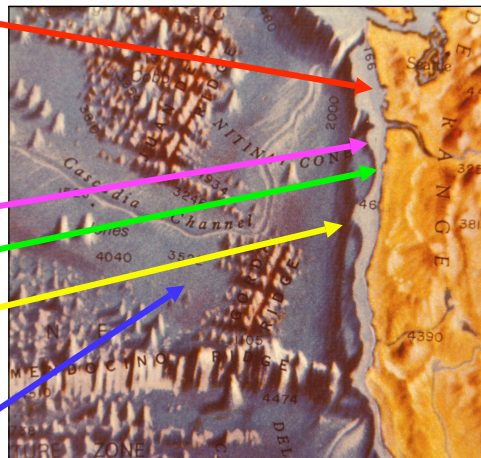


Sverdrup Fig. 3.12 p. 107

# The Continental Margin



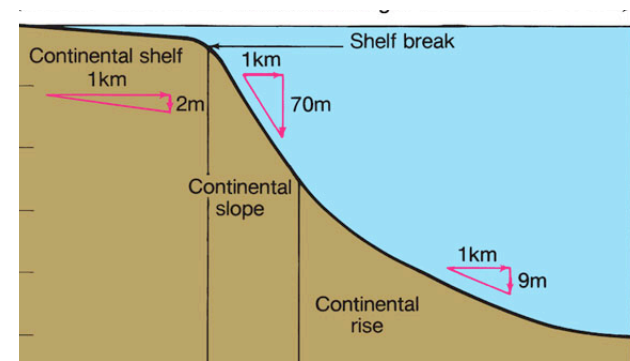
- Shelf break depth averages 130 m (430 ft)
  - off WA ~200m
- Drops off more steeply at shelf break to form slope
- Starts to level off to form rise
- Levels off in deep water to form level abyssal plain



# Features of the Margin



- Never steep on average; no visible steepness except on slope (1-70 m/km)

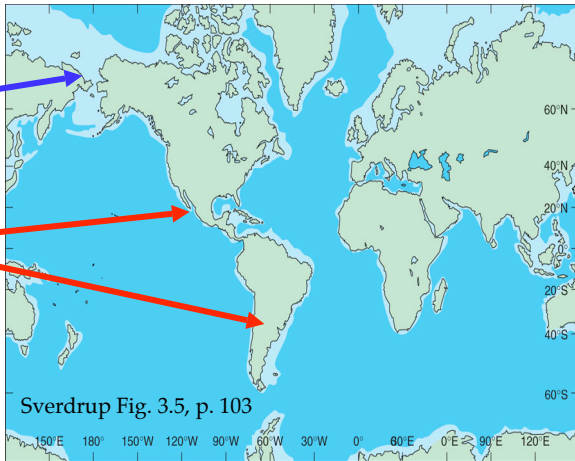




# Features of the Margin



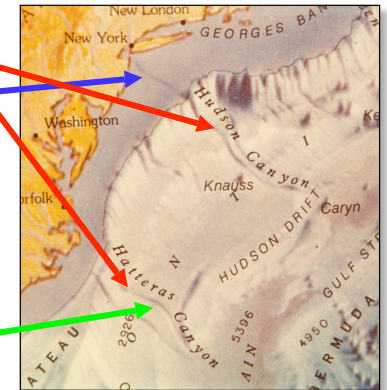
- Some places very broad (Arctic)
- Some very narrow (W. coast Americas)
- Related to slope of adjacent land



# Features of the Margin



- Terrestrial sediments cover rock on shelf
- Slope may be incised by deep, steep canyons
  - Usually formed off major rivers
  - Scoured by landslides & turbidity currents
  - Garrison Fig. 4.16 p. 98
- Rise is accumulation of sediment from shelf



# Features of the Margin



- Sea level variable over geologic time
- Removal of ocean water to terrestrial glaciers during Ice Ages lowered sea level about 180 m
- Shelf break was shoreline during last Ice Age, 12,000 years ago.



# Features of the Margin



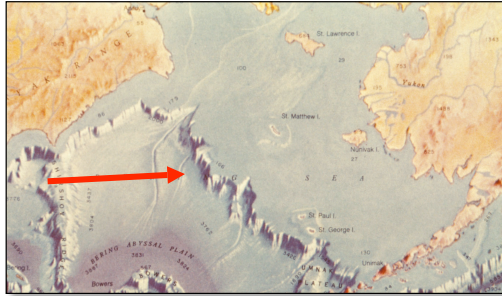
- Bering Strait--more than just shallow water
  - 60 m deep channel = **Land bridge** during Ice Age
- Pacific & Arctic Oceans barely connect



# Features of the Margin



- Reveals actual extent & shape of continents
- Actual geologic boundary between continents & sea floor beneath the rise (trench)
- Difference in bedrock of continents & deep-sea floor.
  - Boundary usually covered by sediments of rise.

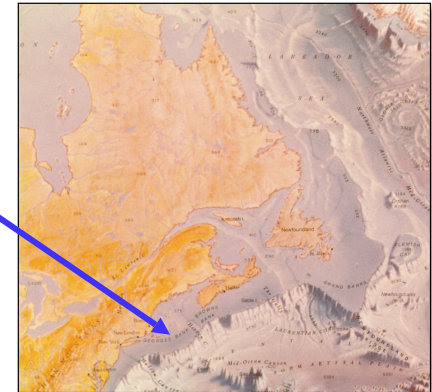


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# Features of the Margin



- Rich fishery grounds because of mixing in shallow water
  - Bering Sea
  - Grand Banks
  - Georges Bank



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# Features of the Margin



- Rich fishery grounds because of mixing in shallow water
  - Gulf of Mexico
- Also rich deposits of oil & gas
  - From buried plankton sediments



15

# Features of the Margin



- Rich fishery grounds because of mixing in shallow water
  - North Sea
  - Oil & gas
- British Isles are geologically part of Europe



16

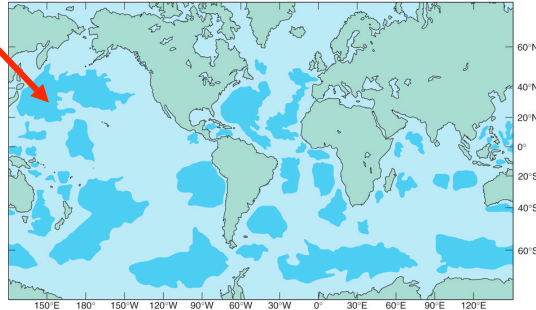


# The Deep-Sea Floor



- Abyssal plains

- Average depth 5000 m
- Deeper than Mt. Rainier is high
- Very flat & sedimented
- Cover greatest area of sea floor and globe (30%) of any single feature (continents 29%)



Sverdrup Fig. 3.11, p. 107

# Features on Deep-Sea Floor



- Seamounts

- Steep, volcanic, may be several km high
- May break surface as islands

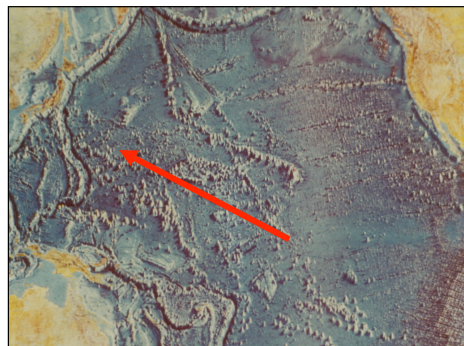


<http://oceanexplorer.noaa.gov/gallery/maps/maps.html>  
<http://oceanexplorer.noaa.gov/explorations/02alaska/logs/jul08/media/goaflyby.html>

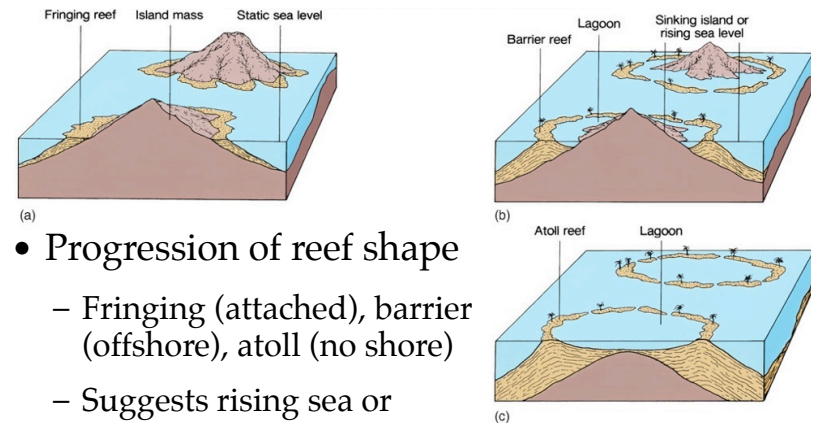
# Seamounts



- Typically occur as long linear chains
  - Many roughly parallel chains in Pacific
- From SE to NW:
  - Increase in age
  - Decrease in elevation
  - Decrease in volcanic activity



# Coral Reefs & Islands



- Progression of reef shape
  - Fringing (attached), barrier (offshore), atoll (no shore)
  - Suggests rising sea or sinking island (Darwin)

Garrison Fig. 12.27 p. 293, Sverdrup Fig. 3.13 p. 110

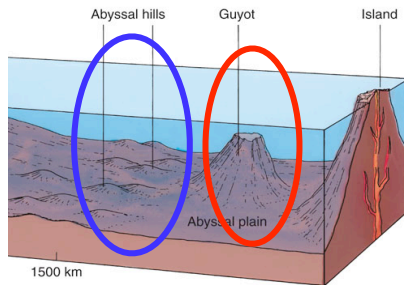
## Features on Deep-Sea Floor

### • Guyots

- A type of seamount, flat-top from surface erosion, summit about 1 km below surface

### • Abyssal hills

- Rounded, <1000m high above sea floor
- Covered with fine sediment



Sverdrup Fig. 3.12 p. 107

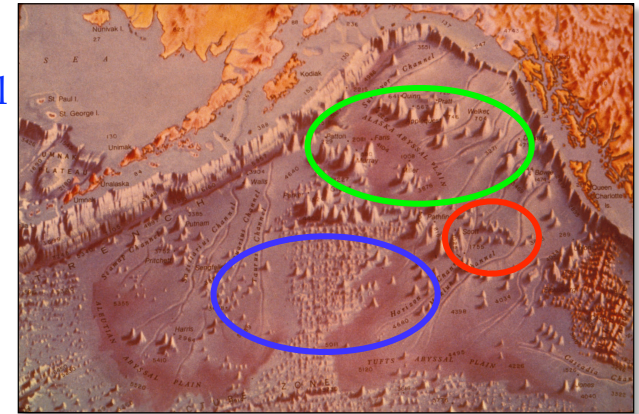
21

## Features on Deep-Sea Floor

### • Seamounts

### • Guyots

### • Abyssal hills

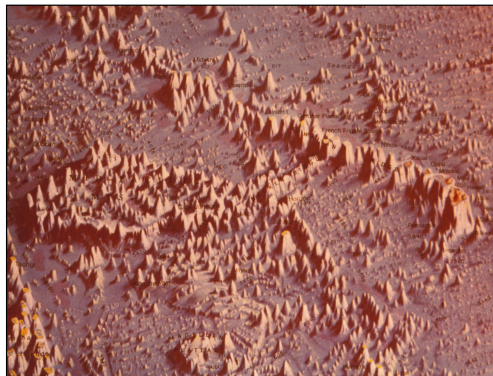


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## Hawaii Seamounts

### • Linear chain from SE to NW:

- Increase in age
- Decrease in elevation
- Decrease in volcanic activity
- Increase in coral reef maturity

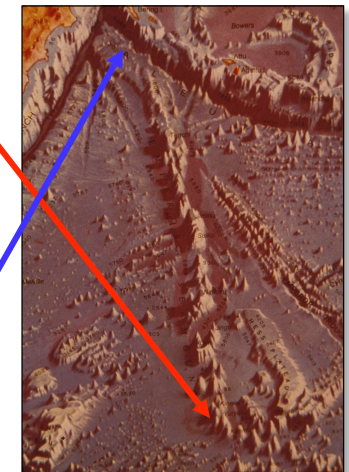


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## Emperor Seamounts

### • Linear chain from SE to N

- Change in linear direction
- Dip beneath the surface
- Increase in age
- Decrease in elevation
- All extinct volcanoes
- Disappear into Aleutian Trench



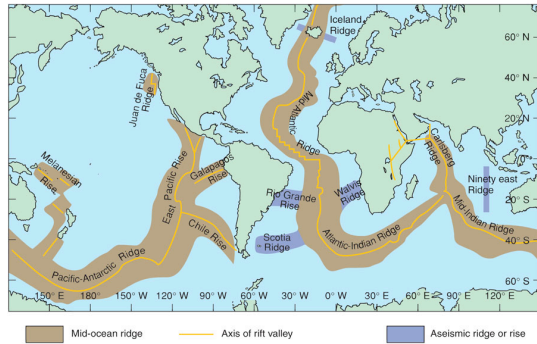
24



# Ridges and Rises



- Great mountain range system running through all the world oceans
- 65,000 km (40,000 miles)
- Longer than Earth's circumference

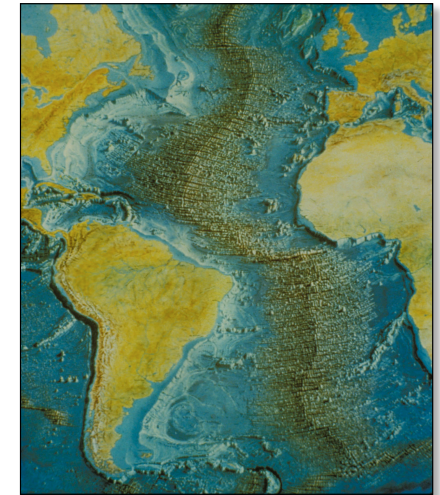


Garrison Fig. 4.21 p. 100, Sverdrup Fig. 3.14 p. 111

# Ridges & Rises



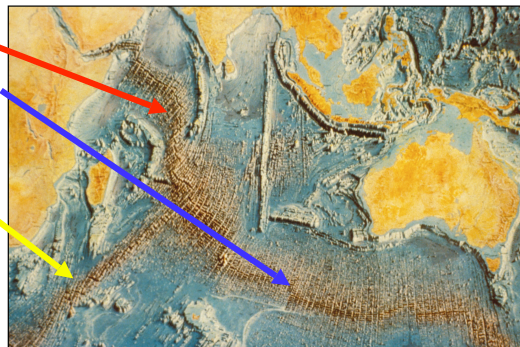
- Height 1-2 km (3500-7000 ft)
- Width 1000 km (600 miles)
- Steep-sided portions of range are called mid-ocean ridges
  - Mid-Atlantic
  - Mid-Indian



# Ridges & Rises



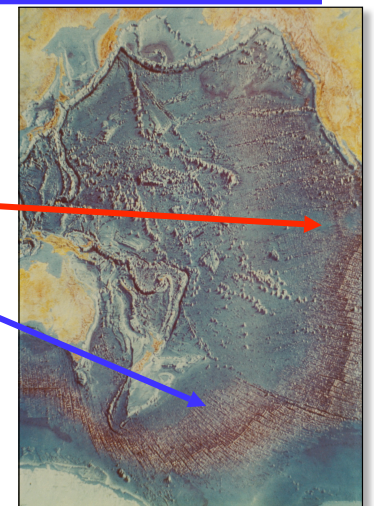
- Steep-sided portions of range are called mid-ocean ridges
  - Carlsberg
  - Mid-Indian
  - Atlantic-Indian



# Ridges & Rises



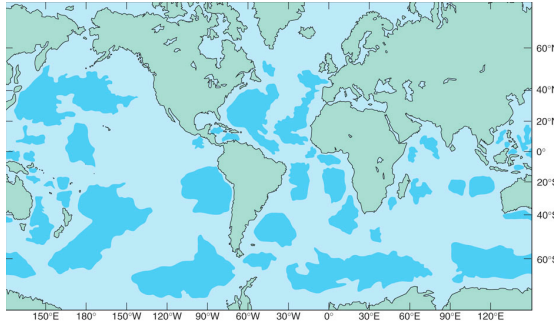
- Gradually inclined portions of range are called "rises"
  - E. Pacific Rise
  - Pacific-Antarctic is a ridge
  - Different from continental rise
- Notice E. Pacific Rise is not in middle of Pacific



# Ridges and Rises



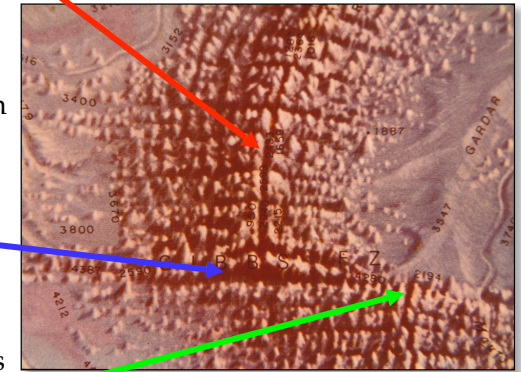
- Ridges/rises and continental masses separate the oceans into numerous basins
- Isolate pockets of deep water over abyssal plains from each other.



# Ridges and Rises



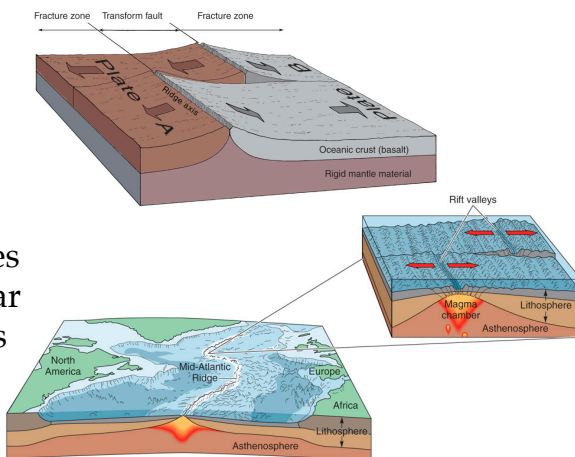
- Rift valley along center of ridge top axis
  - Width 15-50 km (9-30 miles)
  - Depth 500-1500m (1500-5000 ft)
- Steep-sided fracture zones perpendicular to ridges axis
  - Rift valley forms offset segments



# Ridges and Rises



- Rift valley along center of ridge top axis
- Steep-sided fracture zones perpendicular to ridges axis
  - Rift valley forms offset segments

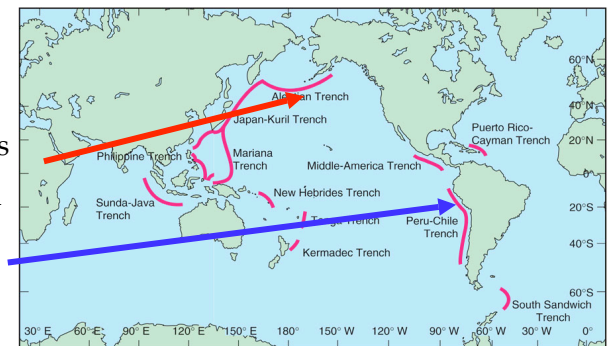


Garrison Fig. 4.24 p. 103, Sverdrup Fig. 2.26 p. 75 & 2.29 p. 76

# Trenches and Island Arcs



- Deepest places (esp. in Pacific) tend to be at edges rather than in center of ocean
- Parallel volcano chains
  - Island arcs
  - Terrestrial volcanic mountain ranges



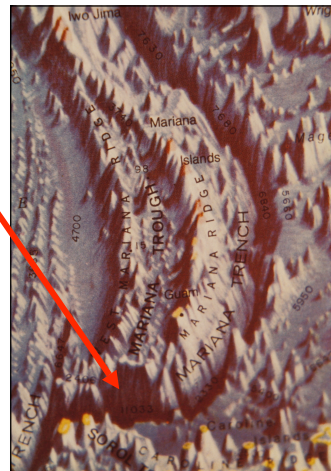
Garrison Fig. 4.29 p. 107, Sverdrup Fig. 3.15, p. 111



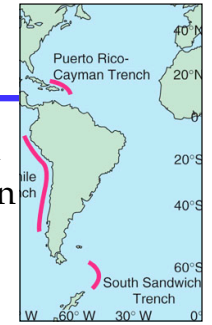
# Trenches & Island Arcs



- Deepest spot in ocean
  - Challenger Deep in the Mariana Trench
  - 11,000 m (almost 7 miles)



# Trenches & Island Arcs



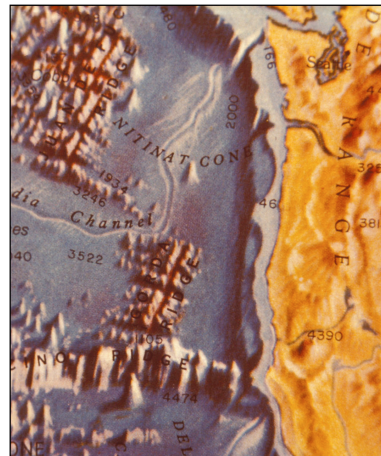
- Trenches are much more common in the Pacific than the Atlantic or Indian
  - Puerto Rico - Cayman & S. Sandwich



# Trenches & Island Arcs



- Trench adjacent to a continent replaces continental rise
  - But no trench is visible along US W Coast despite volcanoes (Why not?).
- Mountain chains (island or continent) parallel to trench different from those on plain
  - No uniform trend in elevation, age, volcanic activity



# Summary



- Submerged continent - sea floor boundary
- Deepest sea floor is at edges, not center
  - Long, curved trenches with earthquake activity
- Mountain range in mid-ocean floor
  - Site of earthquake & volcanic activity
  - Rift valleys, fracture zones
- Islands are not randomly distributed
  - Form long chains, often parallel
  - Progression in elevation, age, & volcanic activity in some cases, not others
    - Seamounts, guyots, abyssal hills, coral reefs