

## GEOL 117 web notes Class #8

Topics:

PLATE BOUNDARY TYPES

TESTING THE PLATE TECTONICS MODEL

Earthquakes

Heat Flow

Sea Floor subsidence

The HOT SPOT hypothesis

Paleogeography: plate position reconstructions

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### **Plate Tectonics- Review:**

Lithosphere consists of rigid plates

Plates move over the soft asthenosphere.

Plates are either

(1) oceanic only or

(2) continental + oceanic.

Thus, continents move as "passengers" on plates.

### **Plate boundaries -- Where plates contact each other**

Divergent

- Plates move apart
- New oceanic lithosphere is created
- Sea-floor "spreading centers" (Hess) or mid-ocean ridges

Convergent -- Collision zones

What happens depends on the density of the material involved.

Oceanic plates can be "subducted" into mantle.

Continental plate -- can't be subducted- less dense...deformed and thickened

Transform -- plates slide past one another.

Fracture zones in mid-ocean ridges

Longer plate boundaries as well, e.g., San Andreas Fault, CA

### **Back to Harry Hess: Why wasn't he dismissed as Wegener had been???????**

-- New Evidence Forced the Scientific Community to Question the Old Paradigm

Evidence for sea-floor spreading and plate tectonics

I: Evidence existing in early 60's

1) Distribution of earthquakes

- Earthquakes at all plate boundaries

- Deep (>100km) earthquakes only in subduction zones

2) Heat flow from the sea floor

Greater at MOR's and decreasing with increasing distance from MOR's

II: Testable Hypotheses Generated by Hess and Others

1) Thickness and age of sediments on the sea floor

-- Deep Sea Drilling Program tested this

-- Ages of sediments (bottom of pile) are as expected...older far away from MOR's

2) Magnetization of ocean crust

## **Ocean basins - many features explained by plate tectonics theory**

Age and thickness of sediments

Volcanic features

Seamounts

Guyots- flat-topped seamounts

Coral atolls

Chains of volcanic islands (e.g., Hawaii)

Deep-ocean basins are simply oceanic lithosphere that has cooled and subsided as it spreads away from mid-ocean ridge spreading centers, where it was created. Cooling and subsidence explains the origin of features like guyots and coral atolls -- they were once volcanic islands that subsided as lithosphere cooled and spread. The distribution and age of ocean sediments are explained because the floor of the ocean should increase in age with distance from mid-ocean ridge spreading centers.

### **Isostatic adjustment**

- **The mantle is NOT liquid! But...** over many thousands of years, and because the distances are so great, the mantle deforms in a plastic manner
- If the earth's crust gets loaded down (e.g., by a glacier) it will sink lower...Similar to a cargo ship (Fig. 2-16)
- LESS DENSE MATERIAL "FLOATS" HIGHER
- DENSER MATERIAL FORMS DEPRESSIONS OR LOWER AREAS

Young Oceanic Lithosphere is hotter, and therefore less dense, "FLOATS" HIGHER

- As the lithosphere ages and cools, it "sinks" lower
- This is why mid-ocean ridges are higher than the deep ocean basins

### **Guyots- flat-topped submarine mountains**

FORMED AS FOLLOWS:

1. Islands
2. Subsidence
3. Waves erode high parts- flattened
4. Subsidence below surface

### **Coral Atolls- ring-shaped coral islands**

1. Islands
2. Subsidence- coral reef forms a ring
3. Subsidence of volcano below surface
4. Coral reef grows upward- needs sunlight
5. Ring-shape after volcano is gone

### **The Hot Spot Theory**

1. Stationary plume of rising hot mantle material
2. Plate migrates over plume
3. Active volcanoes- over plume
4. Extinct volcanoes- moved away from plume, forming a chain

There are many of these

Their trails appear to give information about past plate motions