

GEOLOGY 1301: EARTH SYSTEMS

Spring 2005

Tuesday and Thursday, 9:30 AM – 10:50 AM

Instructor: Neil Tabor

Lecture: Room 131; Dallas Life and Sciences Building

Text:

Earth's Dynamic Systems, 10th edition, Hamblin and Christiansen

Lab Manual:

Laboratory Manual in Physical Geology, 6th edition, Busch (editor)

	<u>Date</u>	<u>Lecture Topic (Assigned reading)</u>
Week 1	Jan. 13	Introduction (Chap. 1&2)
Week 2	Jan. 18 Jan. 20	Minerals (Chap. 3) Minerals (Chap. 3)
Week 3	Jan. 25 Jan. 27	Minerals (Chap. 3) Igneous Rocks & Processes (Chap. 4)
Week 4	Feb. 1 Feb. 3	Igneous Rocks & Processes (Chap. 4) Sedimentary Rocks (Chap. 5)
Week 5	Feb. 8 Feb. 10	Sedimentary Rocks (Chap. 5) Metamorphic Rocks (Chap. 6)
Week 6	Feb. 15 Feb. 17	1st LECTURE EXAM Structural Geology (Chap. 7)

	<u>Date</u>	<u>Lecture Topic (Assigned reading)</u>
Week 7	Feb. 22 Feb. 24	Geologic Time (Chap. 8) Geologic Time (Chap. 8)
Week 8	Mar. 1 Mar. 3	Earthquakes, Magnetism, Plate Tectonics (Chaps. 17, 18, 19, 20, 21) Earthquakes, Magnetism, Plate Tectonics (Chaps. 17, 18, 19, 20, 21)
Week 9	Mar. 8 Mar. 10	Earthquakes, Magnetism, Plate Tectonics (Chaps. 17, 18, 19, 20, 21) Atmosphere, Hydrologic Cycle, Weathering (Chap. 10)
Week 10	Mar. 12-20	SPRING BREAK – No Class
Week 11	Mar. 22 Mar. 24	2nd LECTURE EXAM Slopes and River Systems (Chaps. 11 & 12)

	<u>Date</u>	<u>Lecture Topic (Assigned reading)</u>
Week 12	Mar. 29 April 31	River Systems (Chap. 12) Groundwater (Chap. 13)
Week 13	April 5 April 8	Shoreline Systems (Chap. 15) Glaciers (Chap. 14)
Week 14	April 12 April 14	Glaciers (Chap. 14) 3rd LECTURE EXAM
Week 15	April 19 April 21	Tectonics and Landscapes (Chap. 23) Earth Resources (Chap. 24)
Week 16	April 26 April 28	Earth Resources (Chap. 24) REVIEW
	May 6	FINAL EXAM 3:00-6:00 PM

Grading system for GEL 1301

Lecture: 75%
Laboratory: 25%

-The lecture portion of the grade is based on the average of the best 3 of the 4 lecture examination scores. All examinations are equally weighted. Three examinations are given during the semester, the fourth examination is given during the Final examination period. If one of the first three examinations is missed, the final is your make-up examination.

-The laboratory portion of the grade is based on the average of 10 different laboratory exercises (60% of total lab grade) and two laboratory examinations (40% of total lab grade).

Office Hours

Tuesday: 11:00 A.M. – 1:00 P.M.; Thursday: 1:00 – 2:00 P.M.

Room 327 Heroy

*****Disability Accommodations:** Students needing academic accommodations for a disability must first contact Ms. Rebecca Marin, Coordinator, Services for Students with Disabilities (214-768-4557) to verify the disability and establish eligibility for accommodations. They should then schedule an appointment with the professor to make appropriate arrangements. (See University Policy N. 2.4.)

*****Religious Observance:** Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy N. 1.9.)

*****Excused Absences for University Extracurricular Activities:**

Students participating in an officially sanctioned, scheduled University extracurricular activity will be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalogue)

What is Geology?

- Greek Roots
- Among Oldest of Natural Sciences
- Sparked from Humanities Curiosity to understand place in Nature

QuickTime™ and a Sorenson Video 3 decompressor are needed to see this picture.

Earth Compared to Other Planets

- The Solar System
 - The inner planets
 - Rocky planets near the Sun
 - Mercury, Venus, Earth & Mars
 - The outer planets
 - Giant gaseous planets
 - Jupiter, Saturn, Uranus, Neptune
 - Pluto, a small icy planet, furthest from the Sun

Earth Compared to Other Planets

- Composition varies between the inner and outer planets
 - Density reveals distinct differences
 - The rocky inner planets have densities of 3 g/cm³ or more
 - The gaseous outer planets have densities of 1.6 g/cm³ or less

Earth - A Unique Planet

- **A small blue planet**
 - Dominated by oceans
 - Continents vary from icy to desert regions
 - Liquid water is an obvious feature
 - Keeps Earth's surface in a state of change
 - Supports life



Water On Earth

- **Why on Earth?**
 - Water exists as a liquid between 0 and 100 °C
 - Earth's distance from the Sun allows all three states of matter to exist for H₂O
 - Water has led to life on Earth
 - Living things have helped shape the Earth
 - Photosynthesis -> oxygen atmosphere

Earth

- **Internal Heat**
 - Produces changes in the Earth's features
 - Slow movement of lithospheric plates
 - Sources of internal heat
 - Radioactive decay
 - Potassium, Uranium, Thorium are naturally occurring radioactive elements
 - Decay releases heat energy
 - Accretionary heat from the Earth's formation

Other Inner Planets

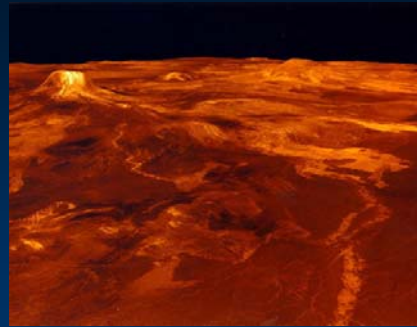
- **Mercury**
 - Closest to the Sun
 - Similar to the Moon with cratered surface
 - No evidence of current geologic activity
 - Small and more rapidly cooled
 - Volcanic activity is very old



Other Inner Planets

- Venus
 - Closest in size to Earth
 - Internal heat is still causing the surface to be reshaped
 - Closer to the Sun and warmer
 - No significant water
 - Atmosphere is composed primarily of CO₂ and has a pressure 90x Earth's

Volcanos pepper the Venutian Landscape.

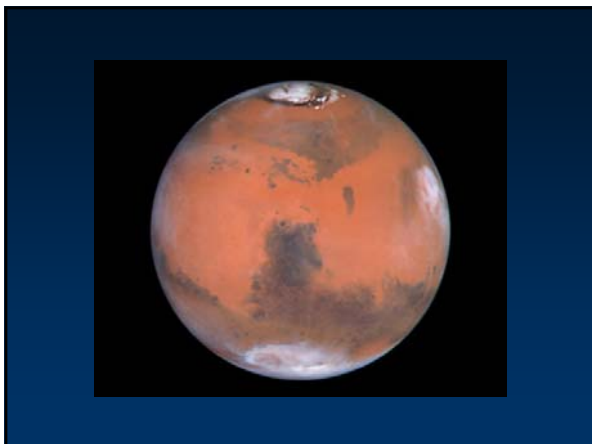


MAAT MONS Volcano, Venus - Over 5 miles high!



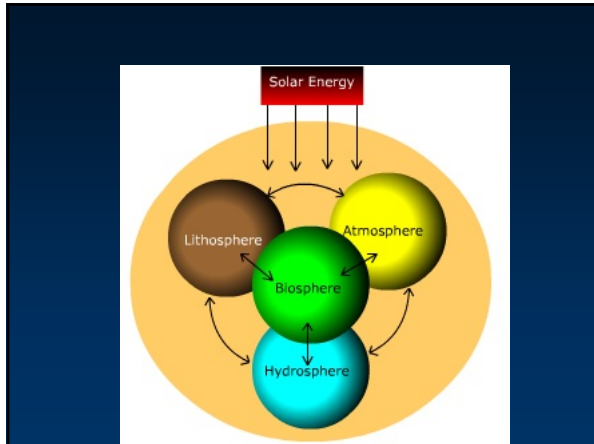
Other Inner Planets

- Mars
 - Evidence of significant past geologic activity
 - Volcanoes, rift valleys, wind blown dunes and river valleys
 - Modern geologic activity is probably minimal
 - Thin atmosphere with cold temperatures



Earth's Outermost Layers

- The most dynamic portion of the Earth
 - Atmosphere
 - Thin gaseous envelope surrounding Earth
 - Hydrosphere
 - Water layer dominated by the oceans
 - Biosphere
 - All living things on the planet
 - Lithosphere
 - Rocky outer shell



The Atmosphere

Thin gaseous envelope surrounding Earth

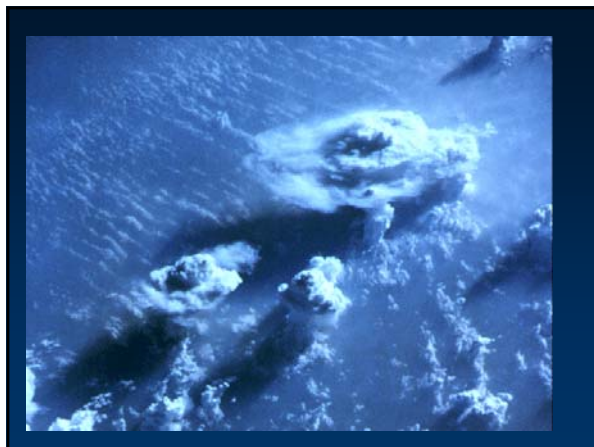
- Insignificant fraction of Earth's total mass (<0.01%)
 - Moves easily, interacts with oceans and landmasses
 - Solar heat drives atmospheric circulation
 - Evaporation and precipitation of water play a role in circulation

The Atmosphere

- Composition is unique in our solar system
 - 78% nitrogen
 - 21% oxygen (not present in early atmosphere)
 - Minor amounts of carbon dioxide, argon and water vapor

The Hydrosphere

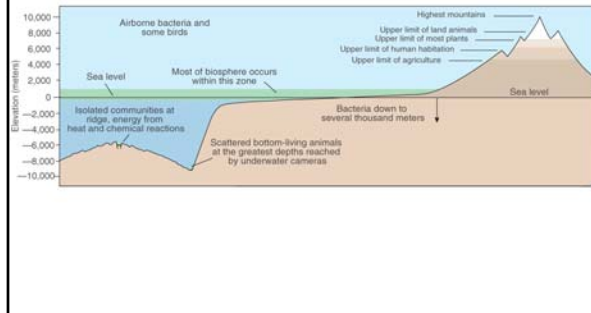
- Total mass of water on or near the Earth's surface
 - Covers 71% of Earth's surface
 - ~98% in oceans
 - 2% in glaciers, groundwater, lakes and streams (fresh water)
 - The presence of water moderates climates and shapes the Earth's surface



The Biosphere

- All life on Earth
 - Animals & plants on land, in the sea and air
 - Microorganisms, the most common form of life
 - Forms a narrow zone near the Earth's surface

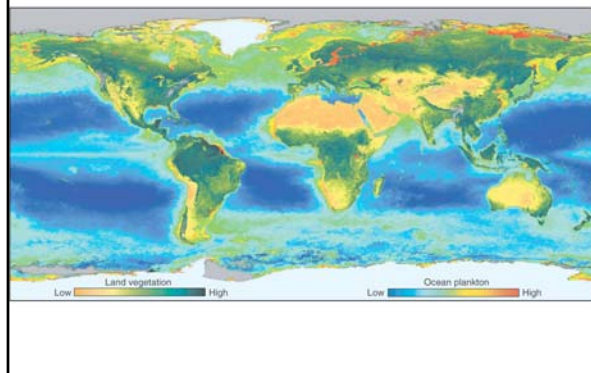
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The Biosphere

- The diversity of life
 - 1.6 million known species
 - mammals only ~4000 species (0.025%)
 - 30 million or more may exist
 - Local environment controls distribution
 - Temperature, pressure & chemistry
 - Wide range of environmental conditions

Distribution of Biomass on Earth

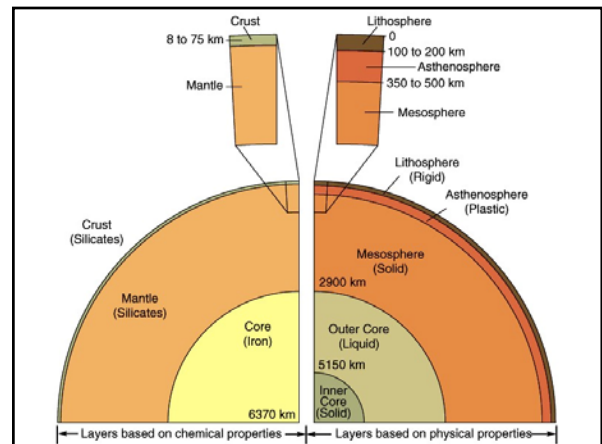


The Biosphere

- The biosphere as a geologic force
 - Current atmosphere produced by biosphere
 - Ocean composition influenced by biosphere
 - Fossils fuels
 - Fossils record past Earth environments
 - Current living species account for only 10% of known species throughout geologic history

Earth's Internal Structure

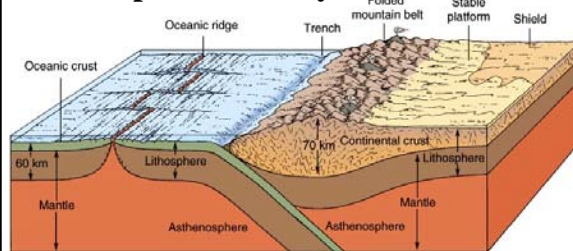
- The solid Earth has a layered structure
 - Layers defined by **composition** and **physical** properties



Compositional Layers

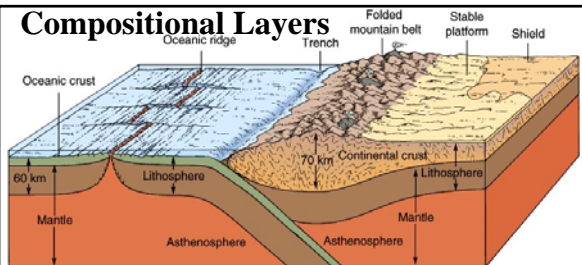
- Crust
 - Outermost compositional layer
 - Definite change in composition at the base of the crust
 - Crust may be divided into 2 types
 - Continental crust
 - Oceanic crust

Compositional Layers



- **Continental Crust**
 - Thicker than oceanic crust - up to 75 km
 - Less dense - 2.7 g/cm^3
 - Strongly deformed
 - Much older - may be billions of years old

Compositional Layers



- **Oceanic Crust**
 - Thinner than continental crust
 - about 8 km
 - More dense - 3.0 g/cm^3
 - Much younger - < 200 million years old
 - Comparatively undeformed
 - Composed of basalt

Compositional Layers

- **Mantle**
 - Largest layer in the Earth
 - 2900 km thick
 - 82% by volume
 - 68% by mass
 - Composed of silicate rocks with abundant iron and magnesium
 - Density ranges from 3.2 to 5 g/cm^3
 - Fragments found in some volcanic rocks

Compositional Layers

- **Core**
 - Central mass about 7000km in diameter
 - Average density of 10.8 g/cm^3
 - 16% by volume, 32% of mass
 - Metallic iron

“Earth as a gigantic smelter”

Physical Layers

- **Lithosphere**
 - Crust + upper portion of the mantle
 - Solid & rigid
 - Thickness ranges from 10 km beneath oceans to 300 km in continental areas

Physical Layers

- Asthenosphere
 - Upper layer in the mantle
 - Temperature and pressure combine to allow rock to partially melt
 - Rocks are soft and plastic
 - Flow slowly, easily deformed
 - Boundary with lithosphere is defined by mechanical properties, not composition

Physical Layers

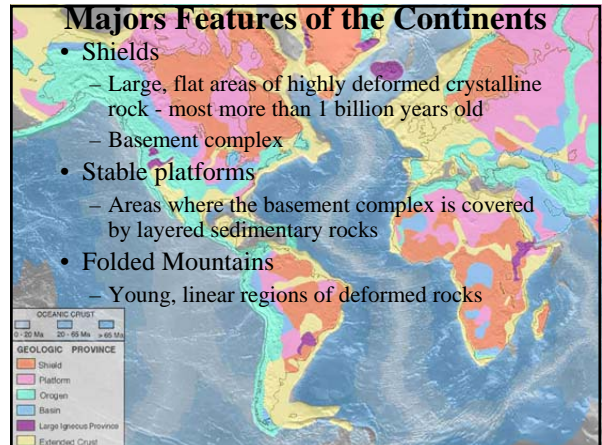
- Mesosphere
 - Solid region between asthenosphere and core
 - Rocks gain rigidity and mechanical strength

Physical Layers

- Outer Core
 - ~2270 km thick
 - Liquid, flows
 - Flow creates magnetic field
- Inner Core
 - ~1200 km thick
 - Solid

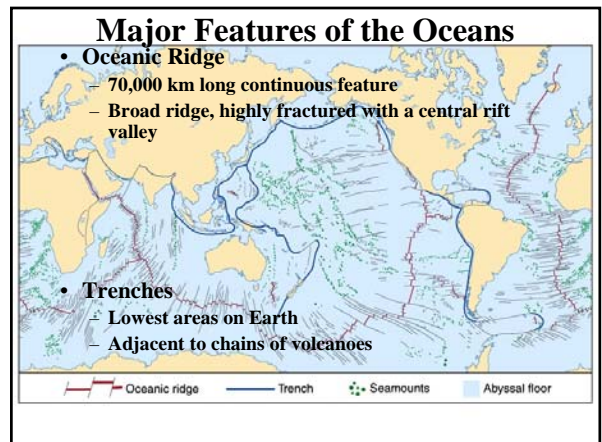
Major Features of the Continents

- Shields
 - Large, flat areas of highly deformed crystalline rock - most more than 1 billion years old
 - Basement complex
- Stable platforms
 - Areas where the basement complex is covered by layered sedimentary rocks
- Folded Mountains
 - Young, linear regions of deformed rocks

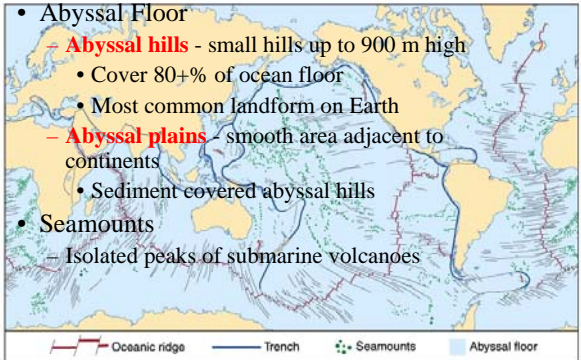


Major Features of the Oceans

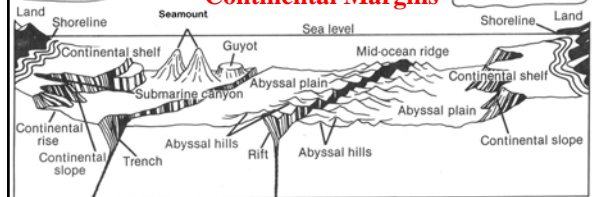
- Oceanic Ridge
 - 70,000 km long continuous feature
 - Broad ridge, highly fractured with a central rift valley
- Trenches
 - Lowest areas on Earth
 - Adjacent to chains of volcanoes



Major Features of the Oceans

- Abyssal Floor
 - **Abyssal hills** - small hills up to 900 m high
 - Cover 80+% of ocean floor
 - Most common landform on Earth
 - **Abyssal plains** - smooth area adjacent to continents
 - Sediment covered abyssal hills
 - Seamounts
 - Isolated peaks of submarine volcanoes
- 
- Legend: Oceanic ridge (red dashed line), Trench (blue line), Seamounts (green dots), Abyssal floor (light blue area)

Major Features of the Oceans Continental Margins



Continental shelf - submerged portions of continents
- 11% of continents are submerged today

Continental slope - long slope from
continents to ocean basin

End of Chapter 1