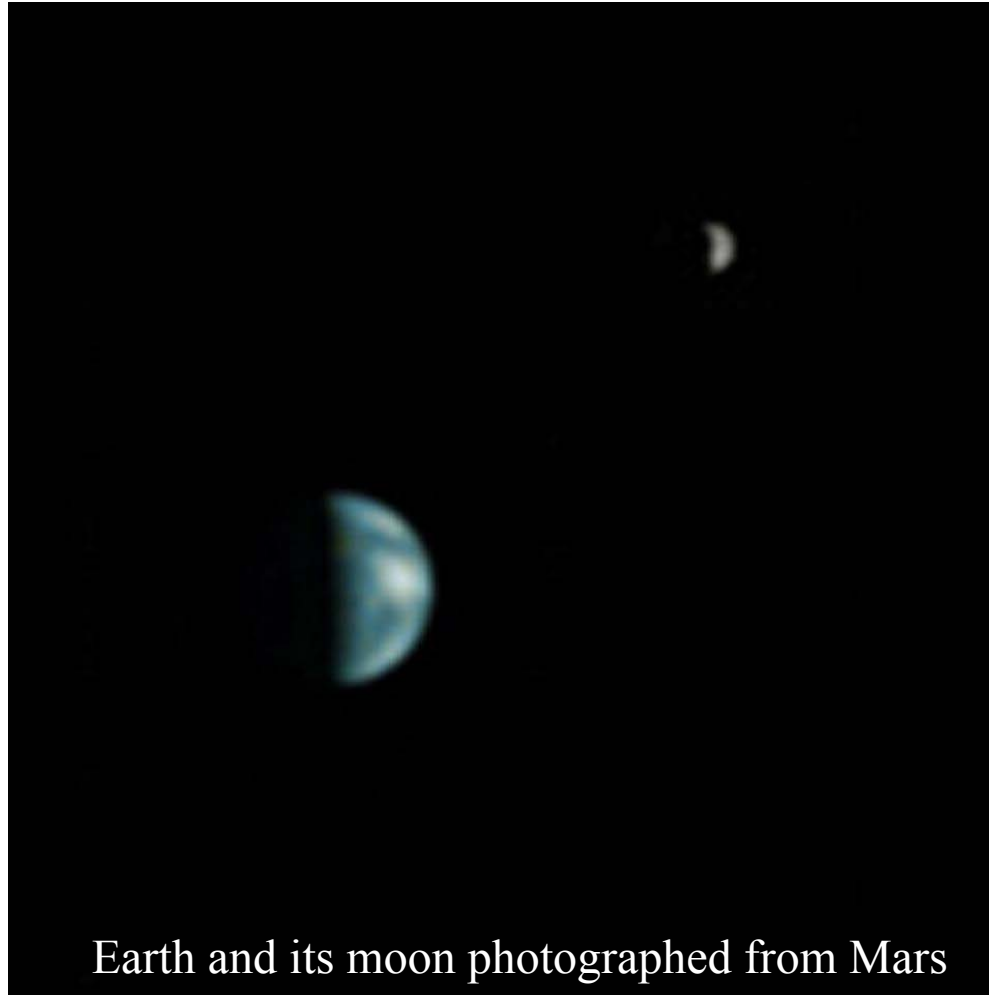


Welcome of EPS 50, Planet Earth



- 1) Organizational meeting and logistics
- 2) Earth Systems

Earth and Planetary Science 50: Planet Earth

Today: Course Logistics and Overview Lectures

Teaching Team:

Faculty: Douglas Dreger (Friday 1-3), and Michael Manga (T,TH: 11-11:30, 3:30-4)

GSIs: Ian Rose, Carolina Munoz, Shou Zhang, and David Mangiante

Today's program:

Is this the Right Class?

Scientific method

Approach to Understanding the Earth System

A little about our Research Interests

Course logistics

Are you in the right class ?

- (1) E&PS 50 is *the Gateway Course* into the 6 Majors of the EPS Department:
Geology, Geophysics, Atmospheric Science
Environmental Science, Marine Science, Planetary Science**
- (2) This class has an interdisciplinary focus for all students who need an introduction to earth processes: eg Biology, physics, chemistry, engineering, landscape architecture, environmental science, K-12 Single Subject science teachers, science writers, and those who will in fact *practice* earth science.**
- (3) This is also a class for those seeking a general earth science background to better understand the problems and issues we face in the ever increasing complexity of our world.**

What is geology?

- Science of studying Earth
- How planets are born
- How Earth evolves and *continues* to evolve
- How Earth works in a system of components with a delicate balance of conditions that sustain life
- How Earth resources formed that sustain life and support the human condition
- Exploring links between life and planets and origin of life

Geology is a Science

The scientific method: how we *think*, *prove* results and *communicate*

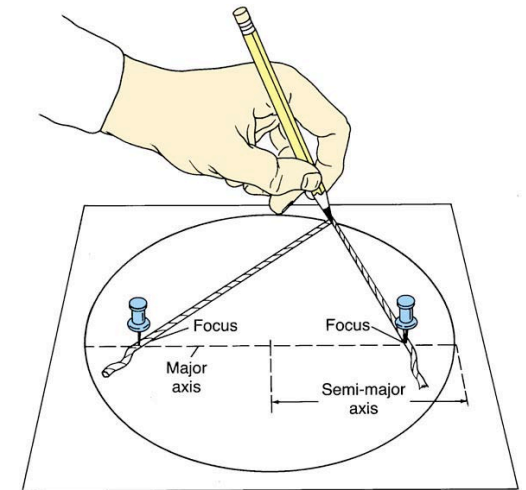
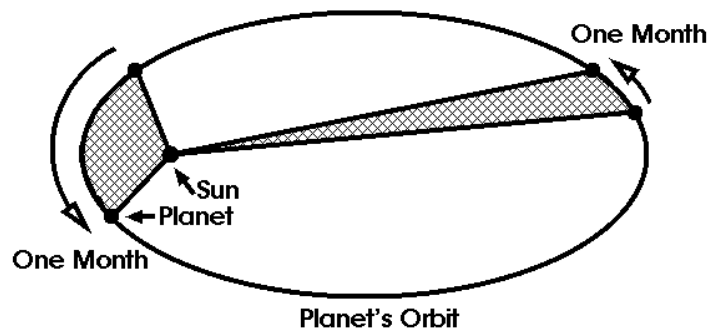
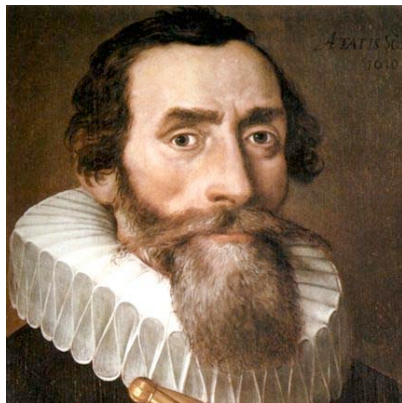
- Way of gathering and interpreting knowledge
- Figuring out what we *do not know* (organizing ignorance and estimating uncertainty)
- What needs to be learned; what is new
- A way to generate ideas
- Test with peer review
- Sharing results and ideas with scientists and the public
- Support national policy and education reform

How it works

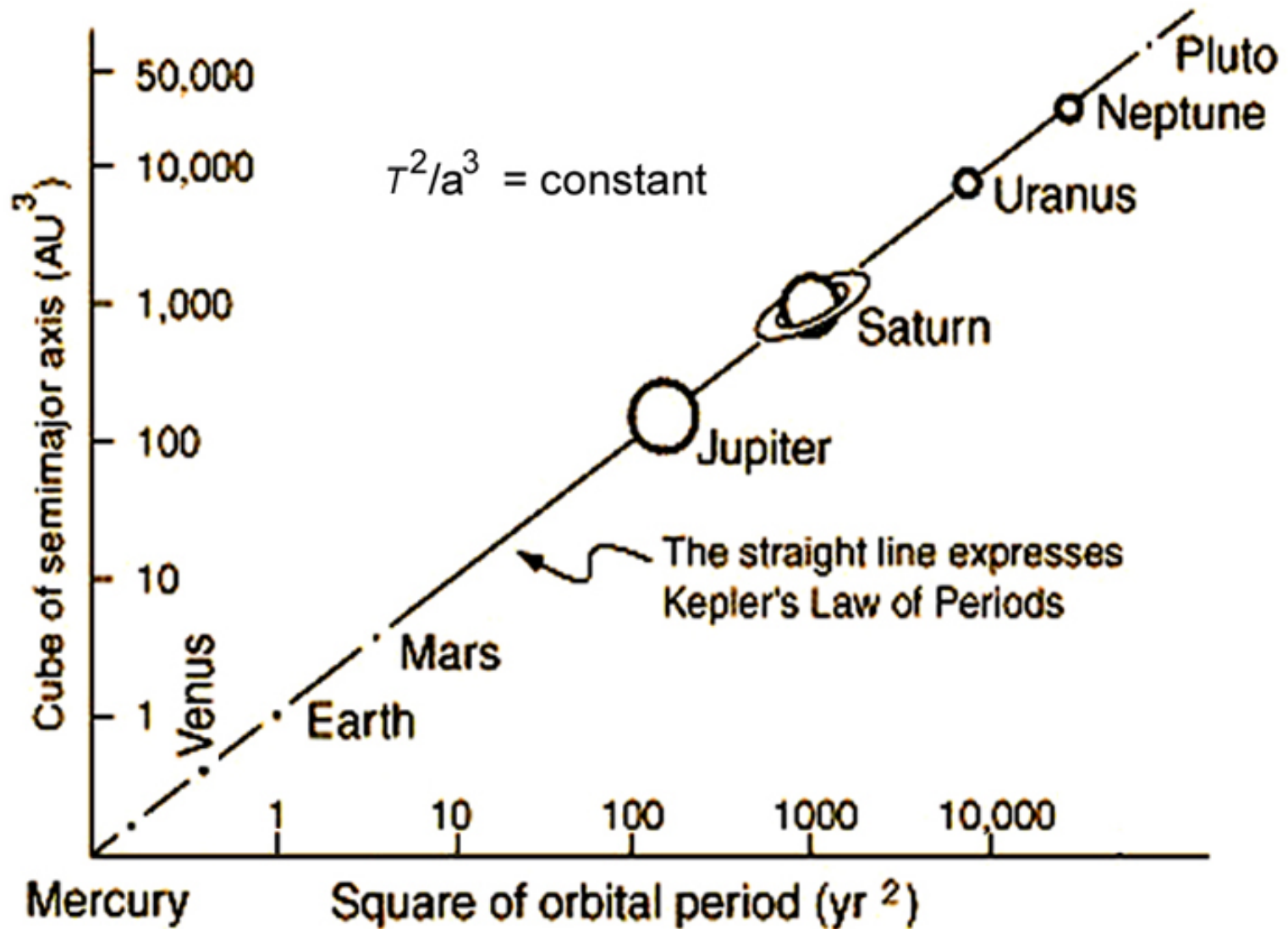
- **Hypothesis**: a tentative explanation based on data collected through observations, experiments and computation
- Present to community for criticism at conferences and in peer-reviewed journals
- Code of ethics: 1) acknowledge past work and contributions of others, 2) never falsify data, and 3) there is a scientific culture to support the renewal of science by teaching and working with engineers and policy makers
- **Theory**: a hypothesis that has survived repeated tests and challenges and has predictive capabilities

Example: Discovering the law of gravitational attraction

- Early history: planets orbit the Earth (geocentric model)
- Copernicus (1473-1543): planets orbit sun, rotation of Earth explains motion of stars, stars are far away compared to planets
- Kepler (1571-1630): Three laws
 - 1) Planets move in elliptical orbits
 - 2) Planets sweeps out equal area in equal times
 - 3) Period = semi-major axis $^{3/2}$



3rd law: A test



- Newton explained (derived) these laws with conservation of angular momentum and $F=ma$ (significance: same laws that apply on Earth apply in the heavens! - physics is universal)



Predictive powers

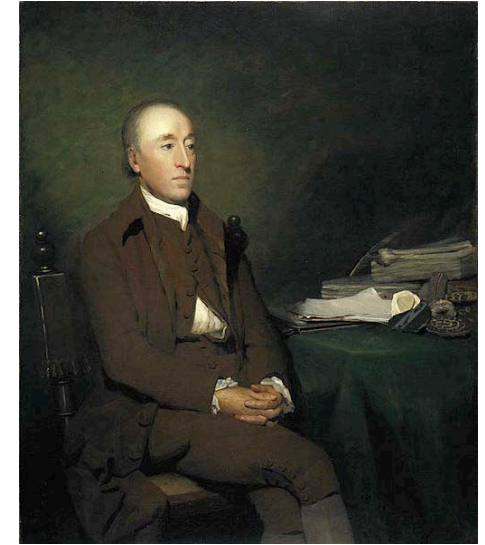
- 1841 John Adams predicted the existence of a yet unknown planet; 1846 Galle found it (Neptune)
- Applications: satellite, GPS, discovery of planets around other stars, evolution of the Universe

Observations → hypothesis tests → empirical law (Kepler) → physical law (Newton) → widespread applications

Assumptions affect how we interpret observations

James Hutton's (father of modern Geology, 1726-1797) principle of Uniformitarianism

- the present is key to the past
- processes we see today operated in the past

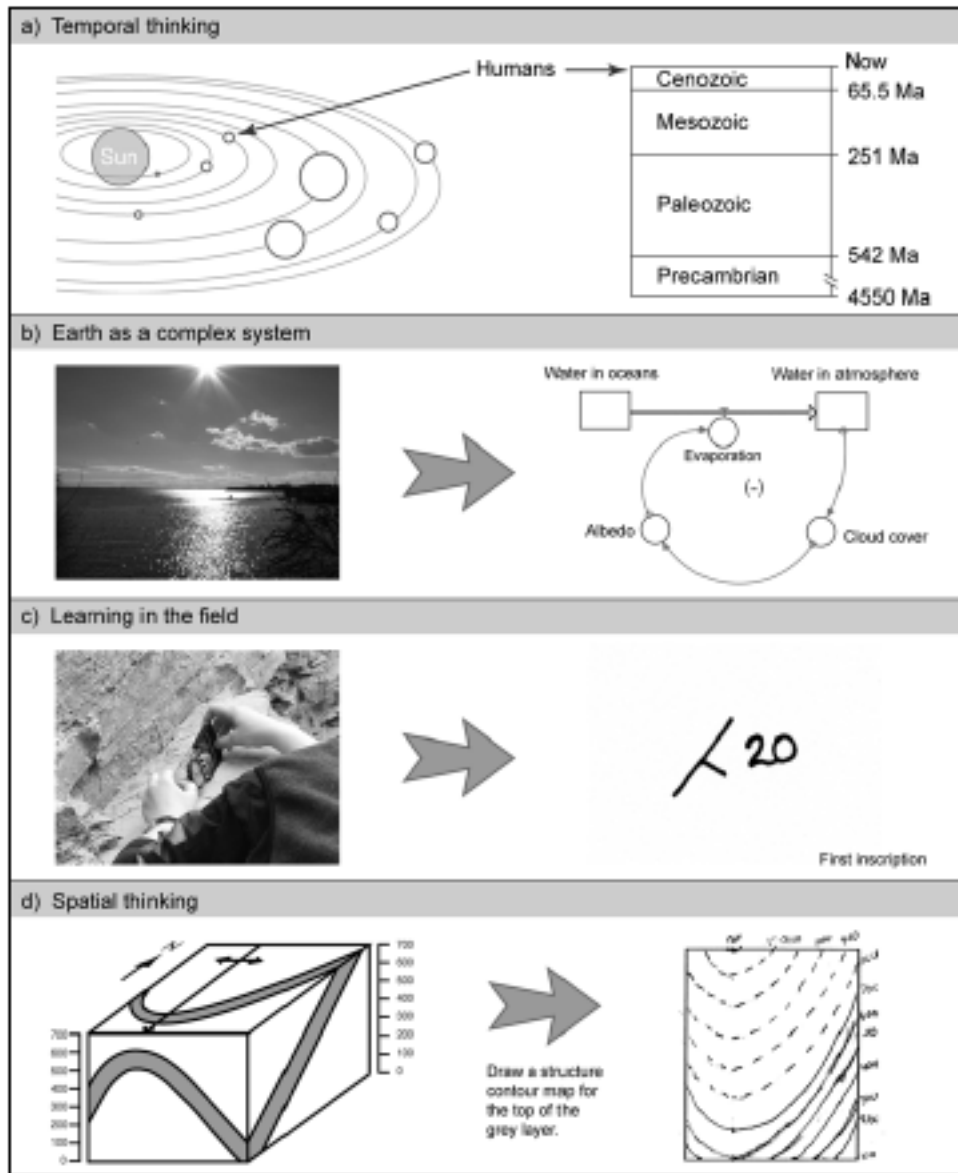


Too limiting: we now know that there are processes that are important that we have not seen

Nanoscale and space exploration may open new doors



How geoscientists think and learn



Time

Complex systems

Field

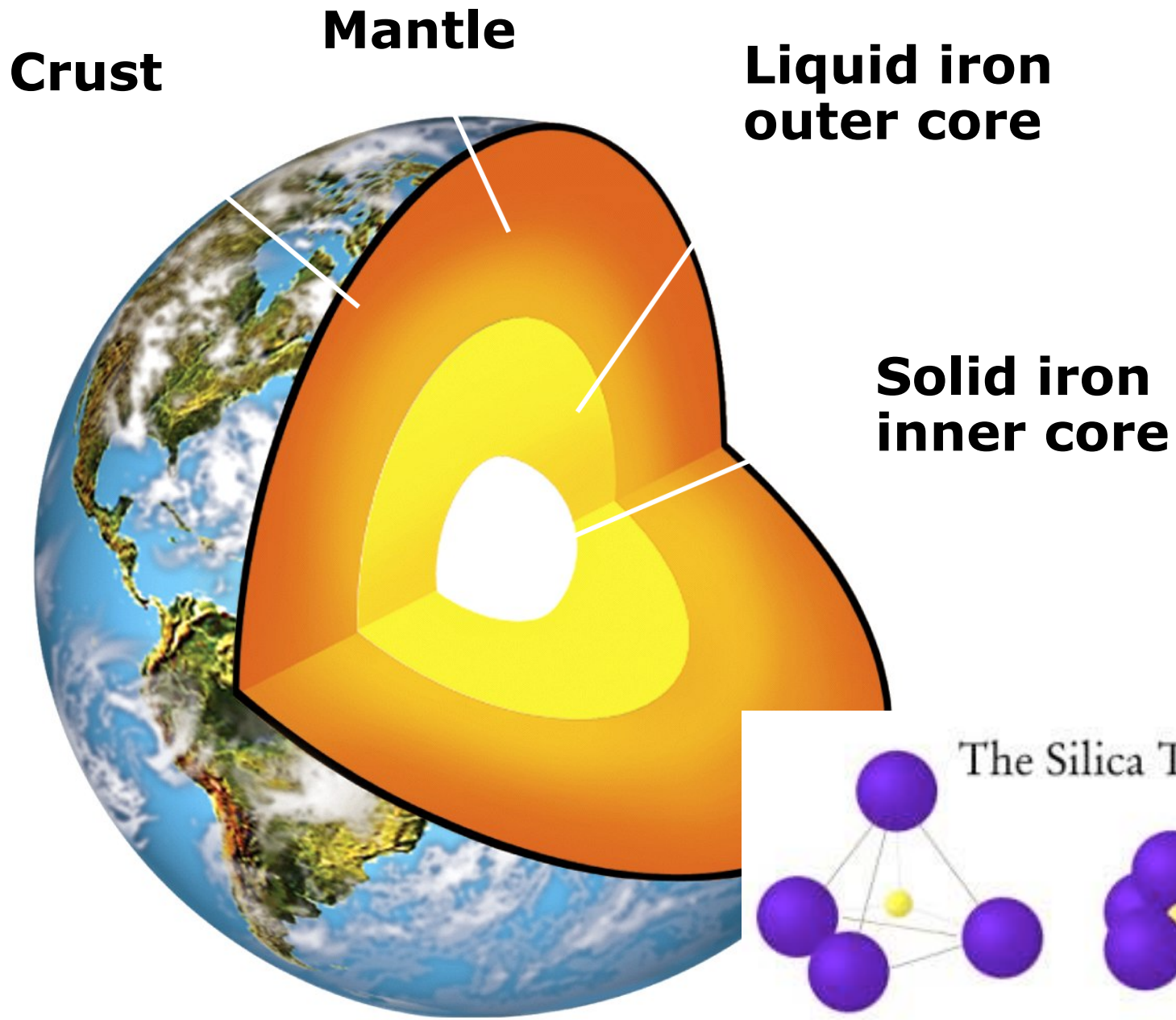
Space

Our Earth

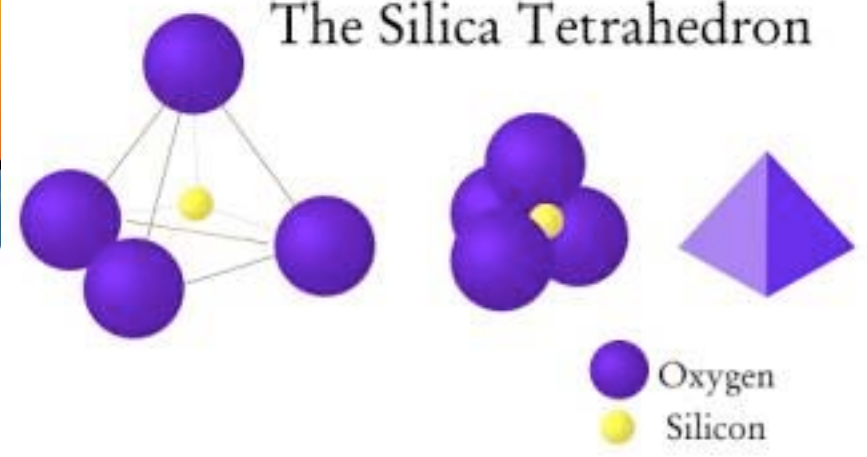
Two features of Earth

Tremendous range of **length scales** matter
(nanometers to 1000s of kilometers)

Tremendous range of **time scales** matter
(seconds to billions of years)



The Silica Tetrahedron



Overview of geologic time

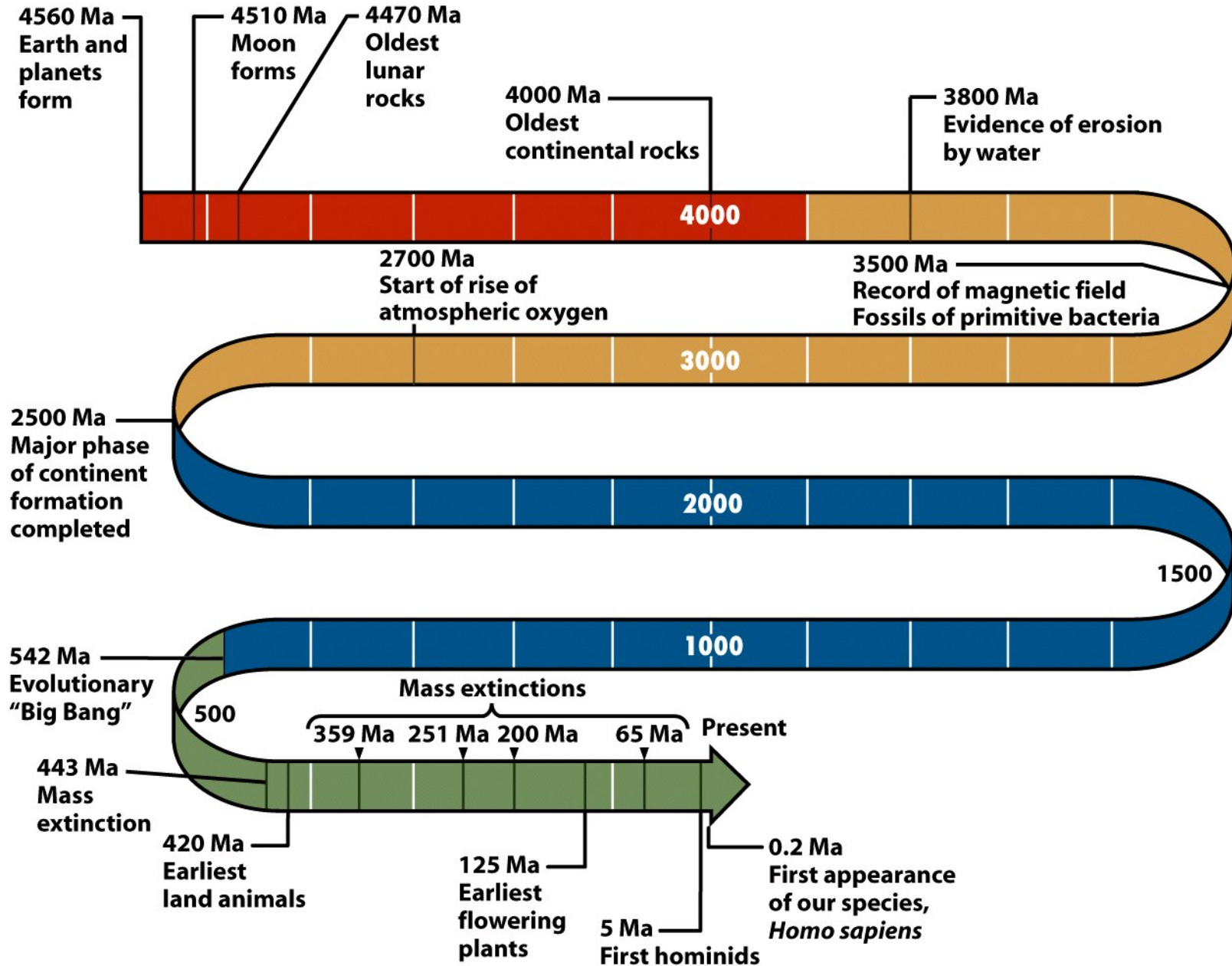


Figure 1-13
Understanding Earth, Fifth Edition
 © 2007 W.H. Freeman and Company

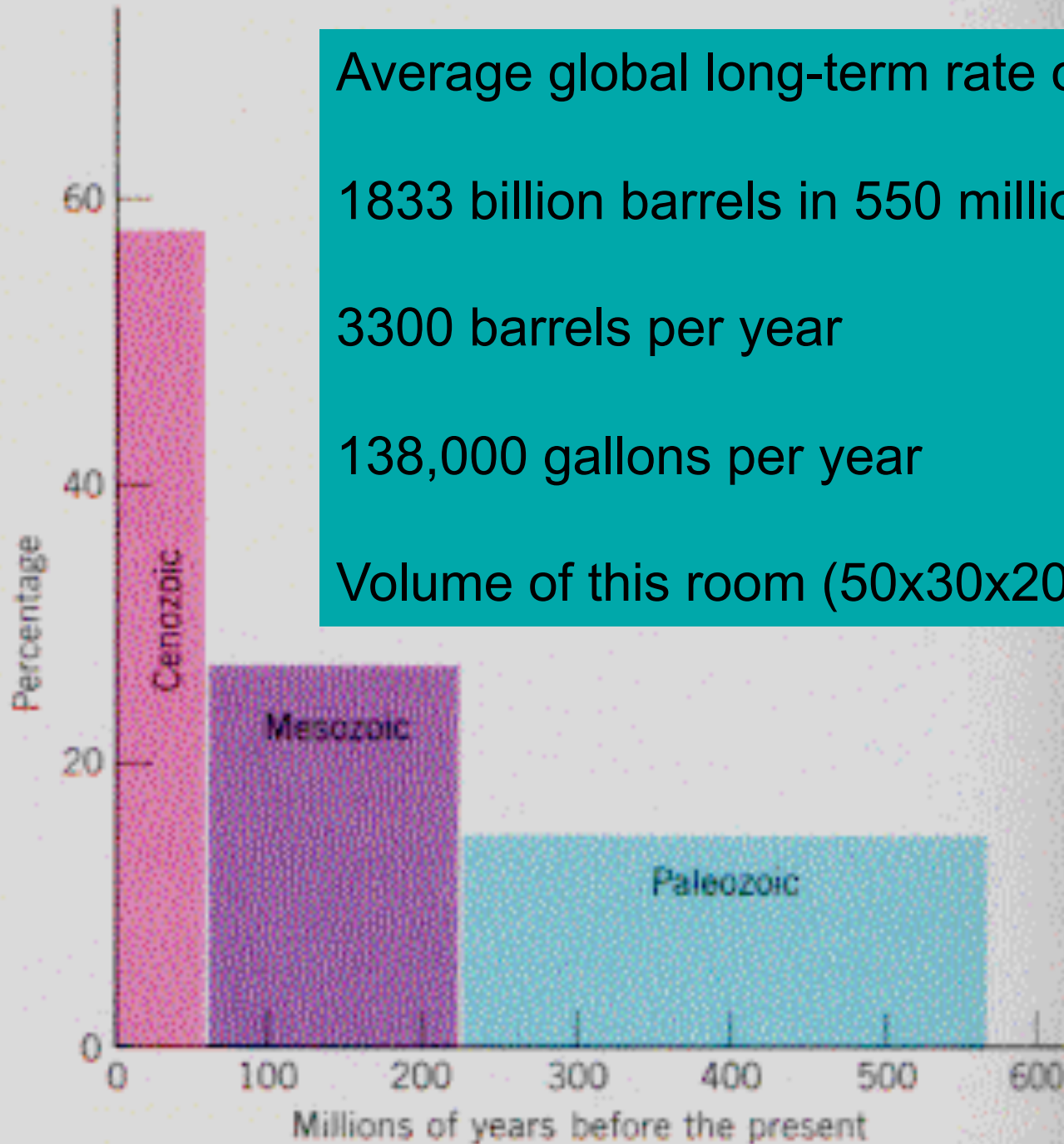
Average global long-term rate of oil formation:

1833 billion barrels in 550 million years

3300 barrels per year

138,000 gallons per year

Volume of this room (50x30x20')=220,000 gallons!



Some perspective

Global Oil Usage

82×10^6 barrels/day =

3.4×10^9 gallons/day =

~2 hours of Niagara falls!!

*From EIA-DOE (Energy
Information Agency)



Earth system

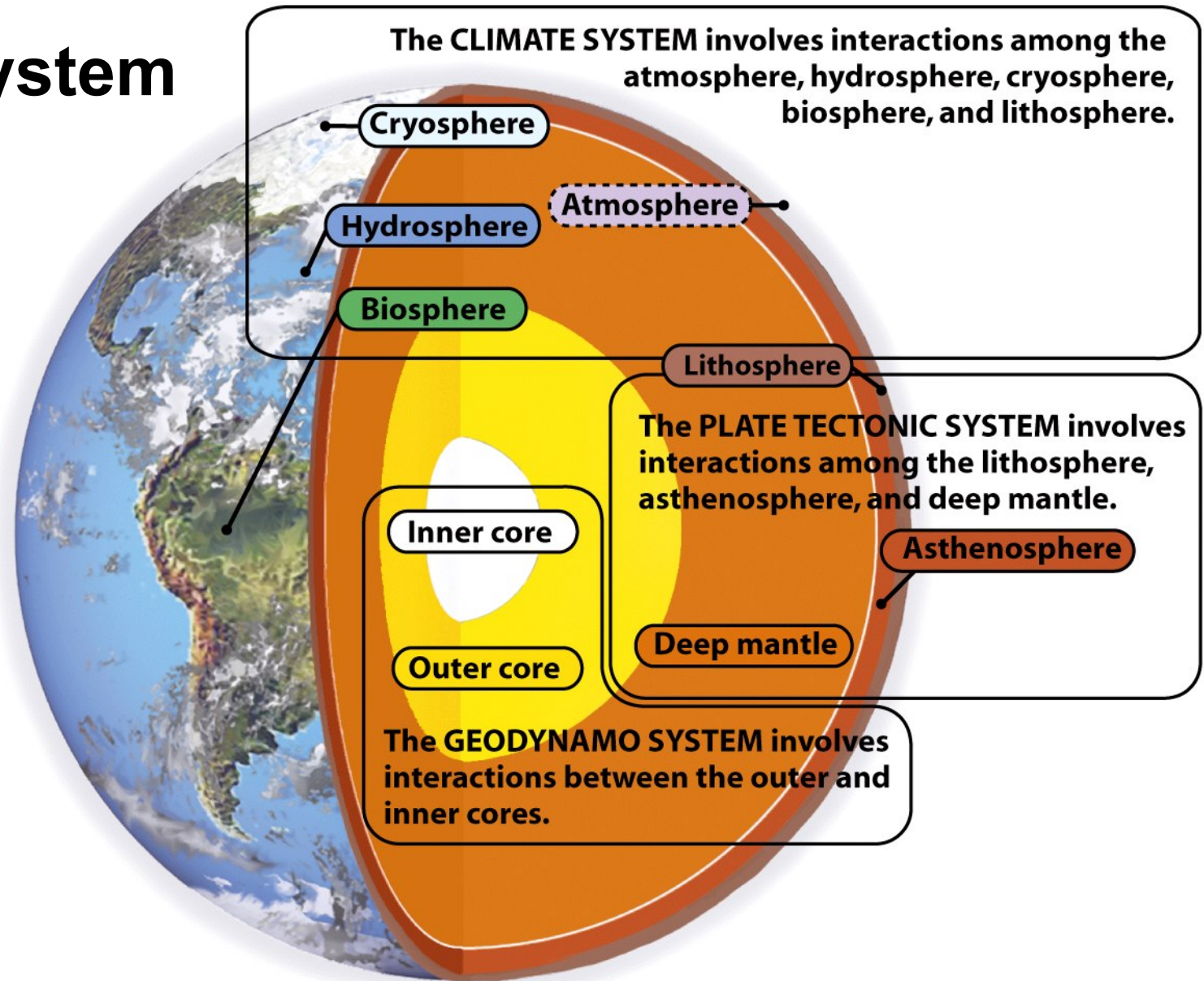
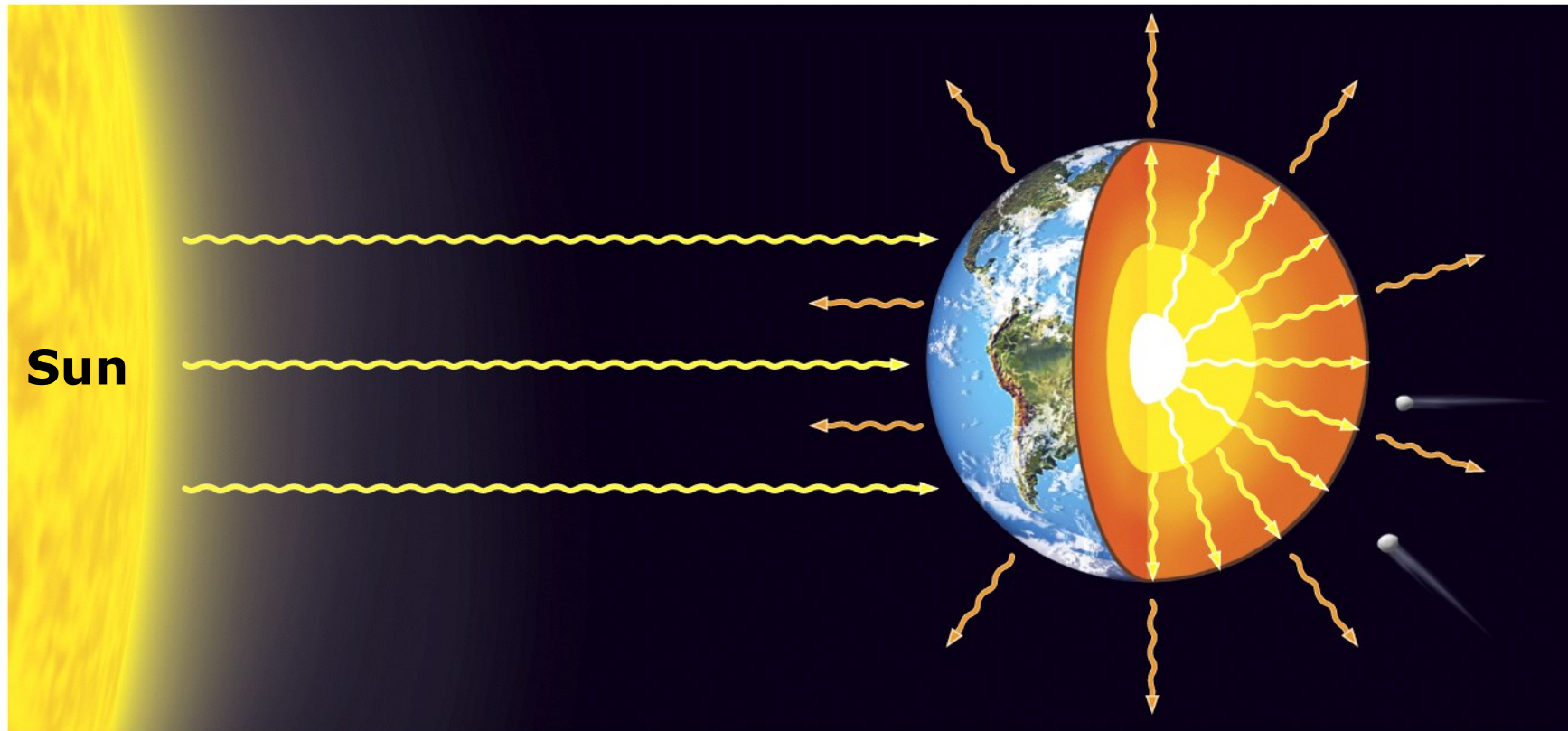


Figure 1-10 part 1
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Earth is an open system

- It exchanges mass and energy with the rest of the cosmos

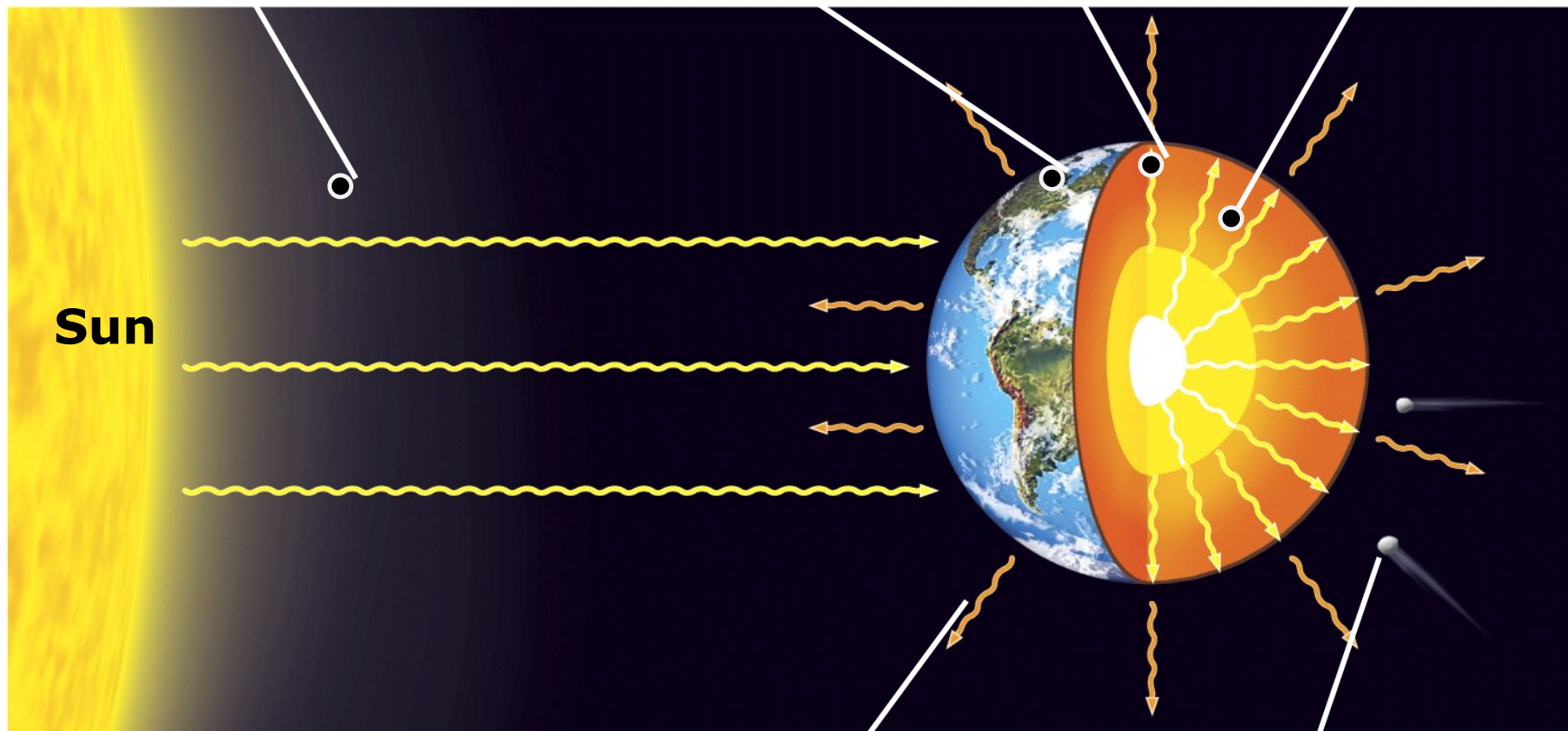


The Sun drives Earth's external engine.

Solar energy is responsible for our climate and weather.

Earth's internal engine is powered by trapped heat...

...and radioactivity in its interior.



Heat radiating from Earth balances solar input and heat from interior.

Meteors move mass from the cosmos to Earth.

The climate system

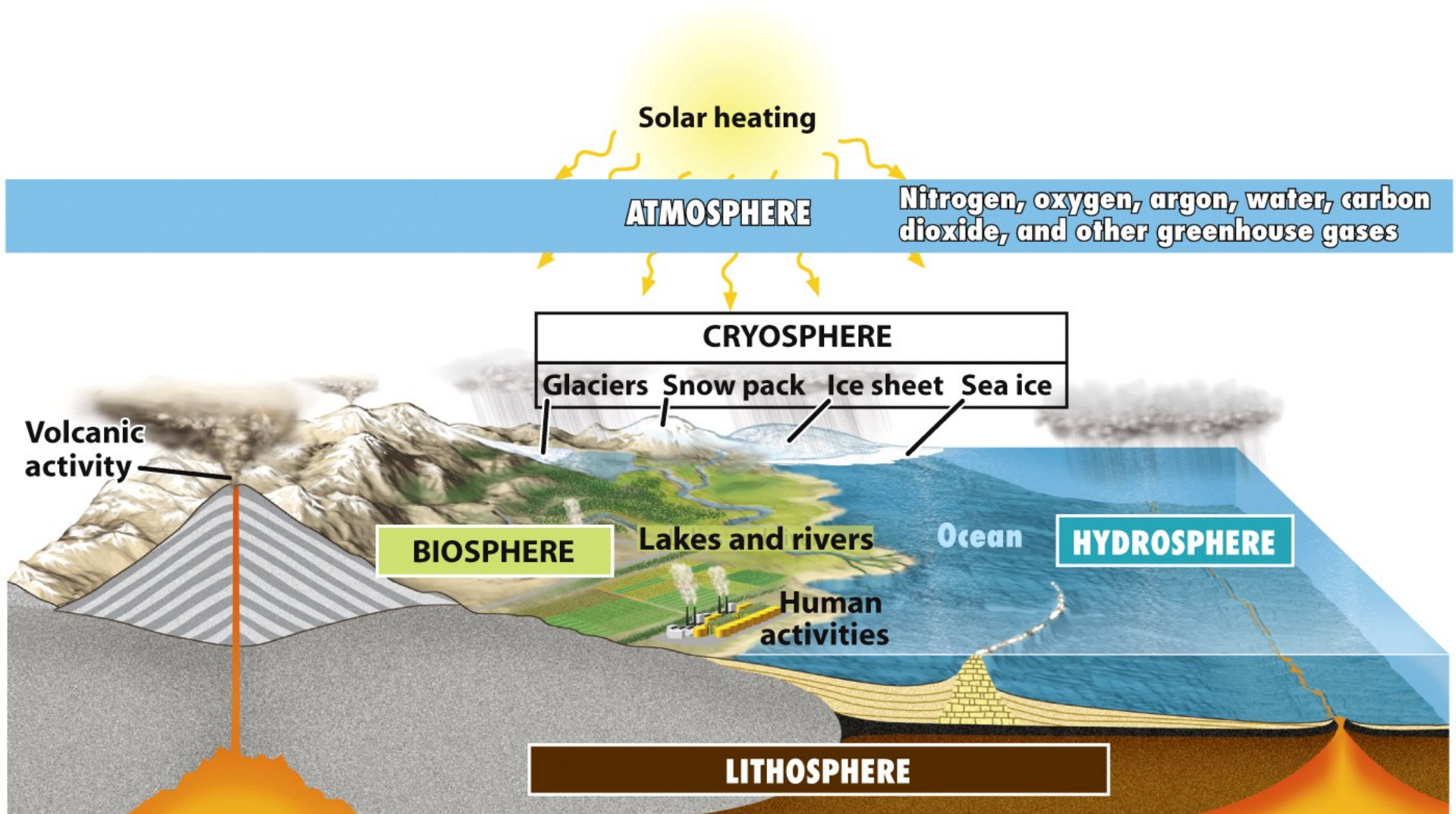


Figure 15-1
Understanding Earth, Fifth Edition
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Convection causes hot water to rise...

...where it cools, moves laterally, sinks,...

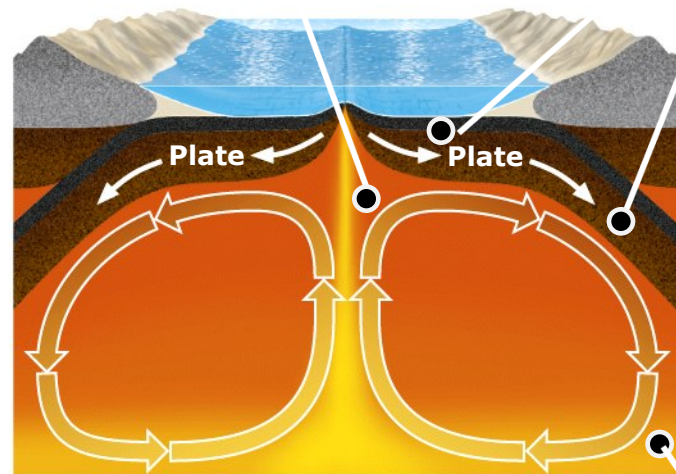


...warms, and rises again.

The plate tectonics system:
how does the heat energy inside the Earth move and thus affect the earth's plates?

Hot matter from the mantle rises,...

...causing plates to form and diverge.



Where plates converge, a cooled plate is dragged under...

...sinks, warms, and rises again.

The geodynamo system: rapid motion of the liquid outer core sets up electrical current causing Earth's magnetic field

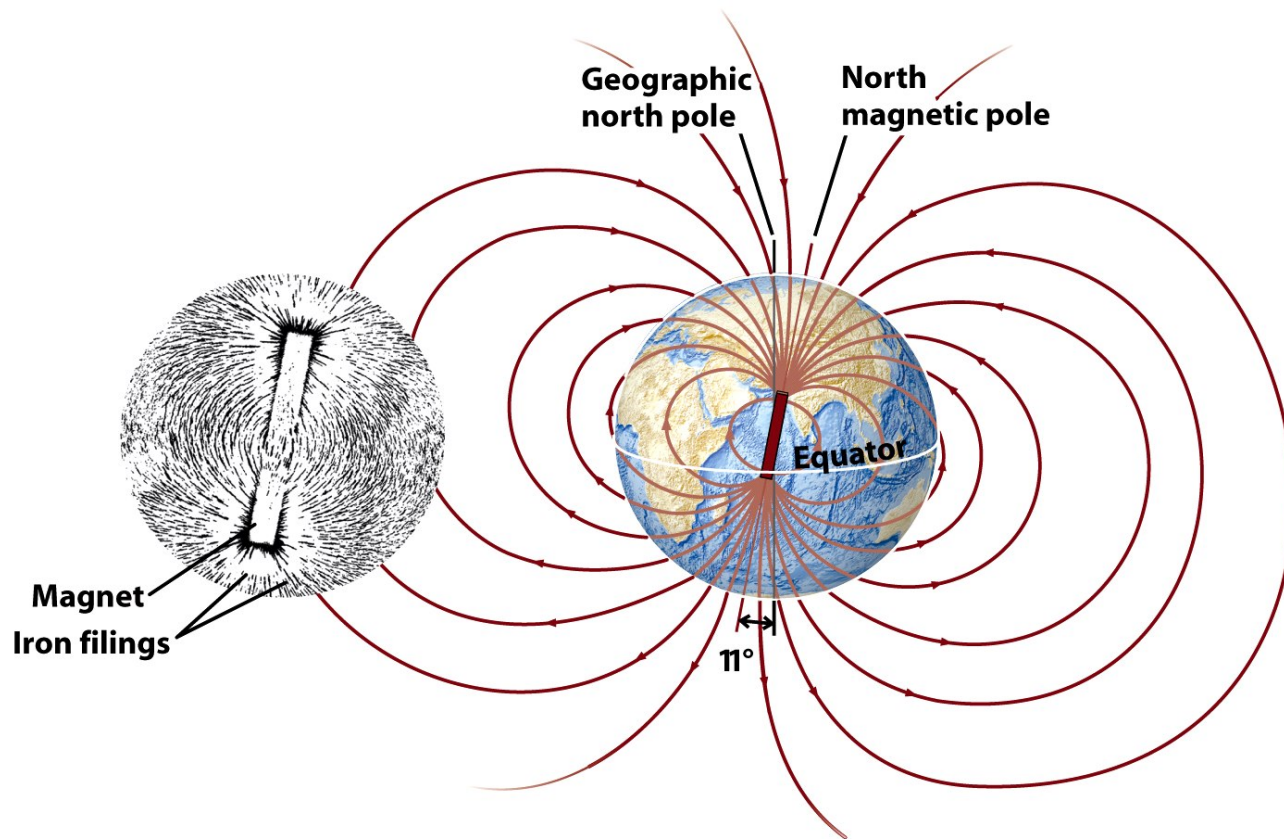
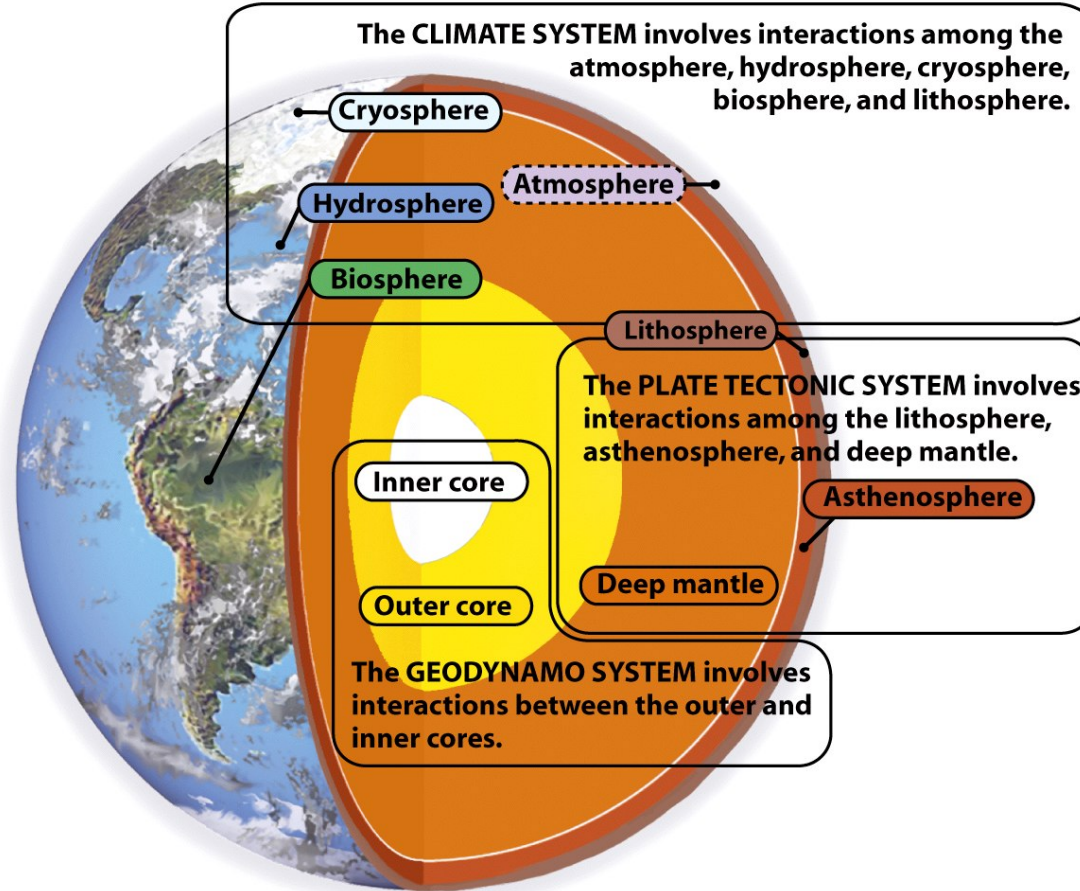


Figure 1-12
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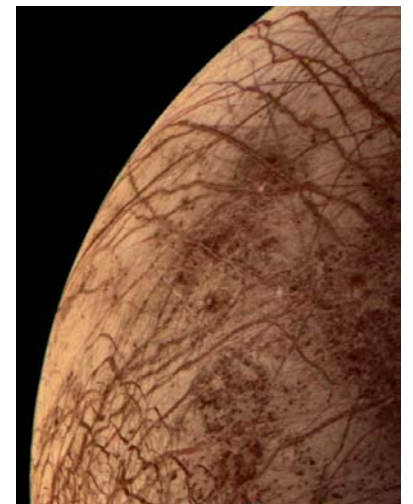
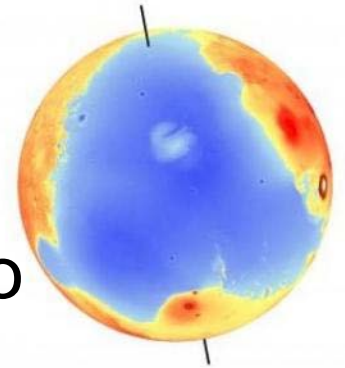
Earth system

Which part of the Earth system does not influence life (and your life) on Earth?



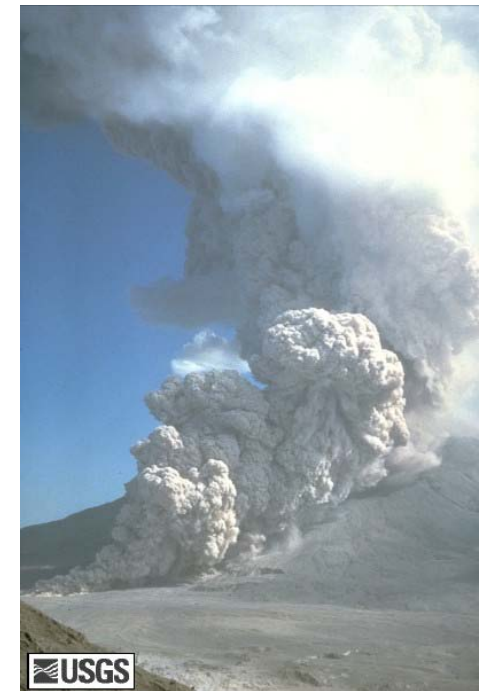
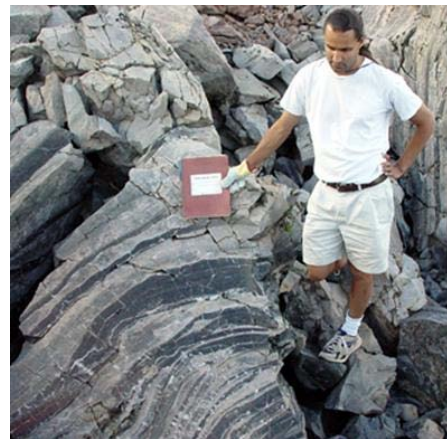
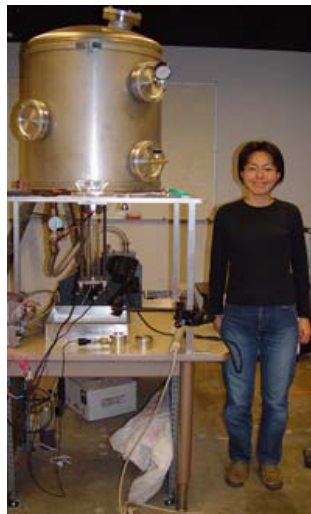
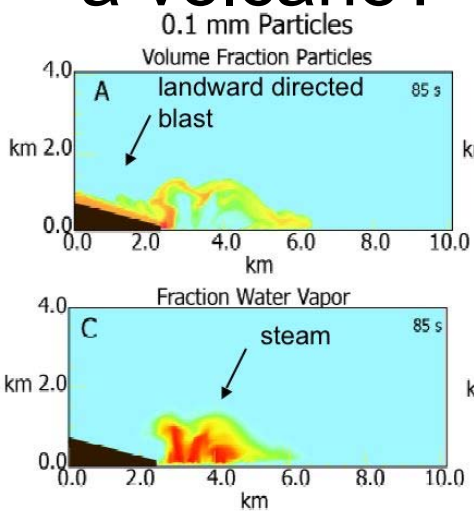
Planetary structure and evolution

- Why does Earth have plate tectonics? (and not its sister planet Venus)
- Why is Mars still volcanically active?
- What caused the death of the Martian dynamo (magnetic field)?
- Were there large oceans on Mars?
- What caused large floods on Mars?
- What processes created tectonic features on Europa?
- Is it possible erupt water on icy satellites?



Volcanology

- Why do volcanoes erupt in so many different ways?
- What processes control the dynamics of pyroclastic flows?
- Why are there supervolcanoes?
- What causes magma to be focused at a volcano?



Hydrology

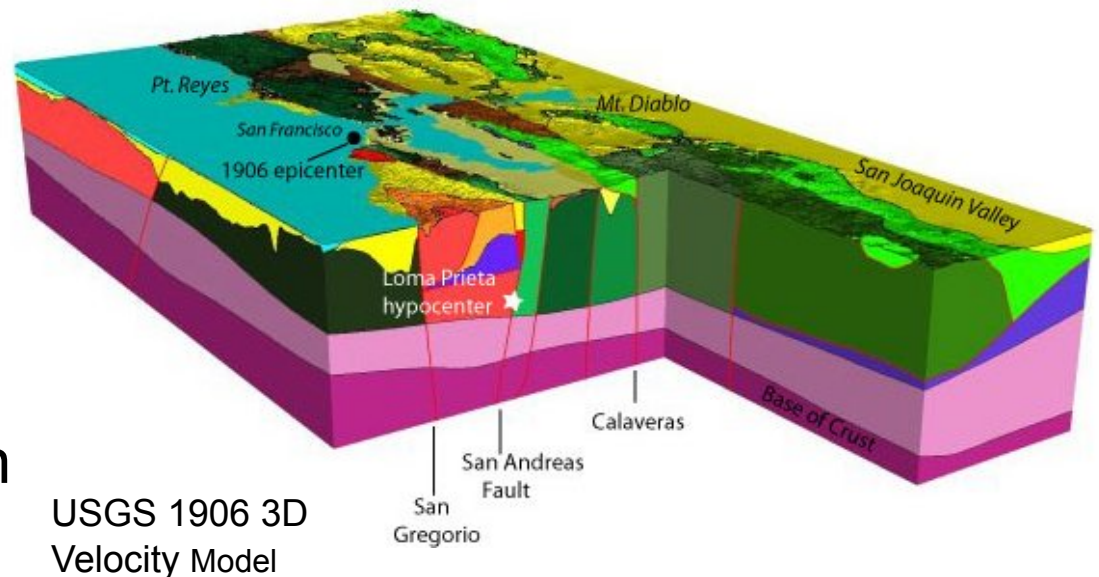
- How do earthquakes affect groundwater flow? (and vice versa)
- Using springs to learn about subsurface geology



Earthquake Hazards



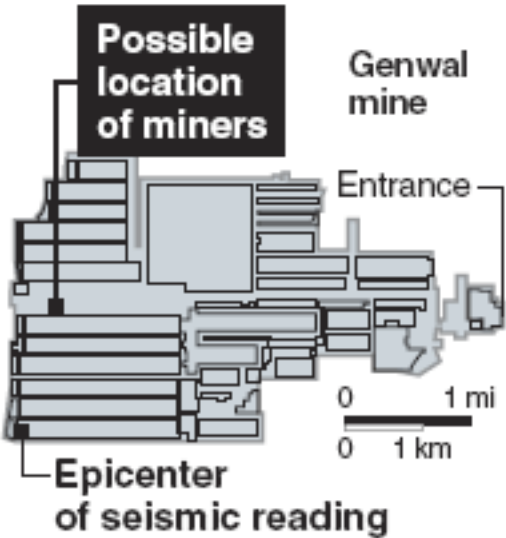
- Can we predict earthquakes?
- Where are earthquake faults located?
- What controls the strength of seismic shaking?



Ground Motion Simulation

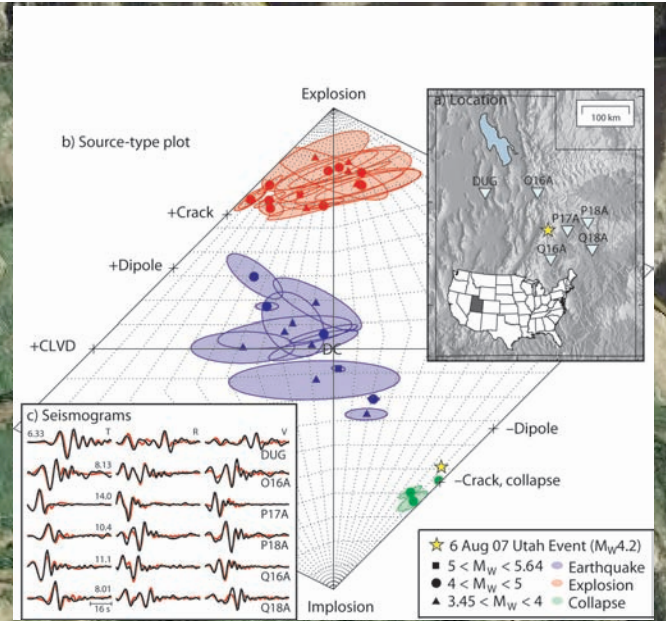
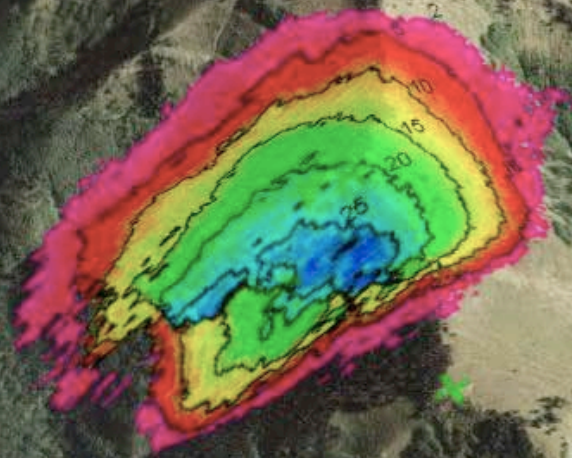
Miners trapped

Six miners were trapped after the Genwal mine reported a "cave-in" at 3:50 a.m. MDT, an hour after a magnitude 3.9 seismic reading.



SOURCES: ESRI; USGS

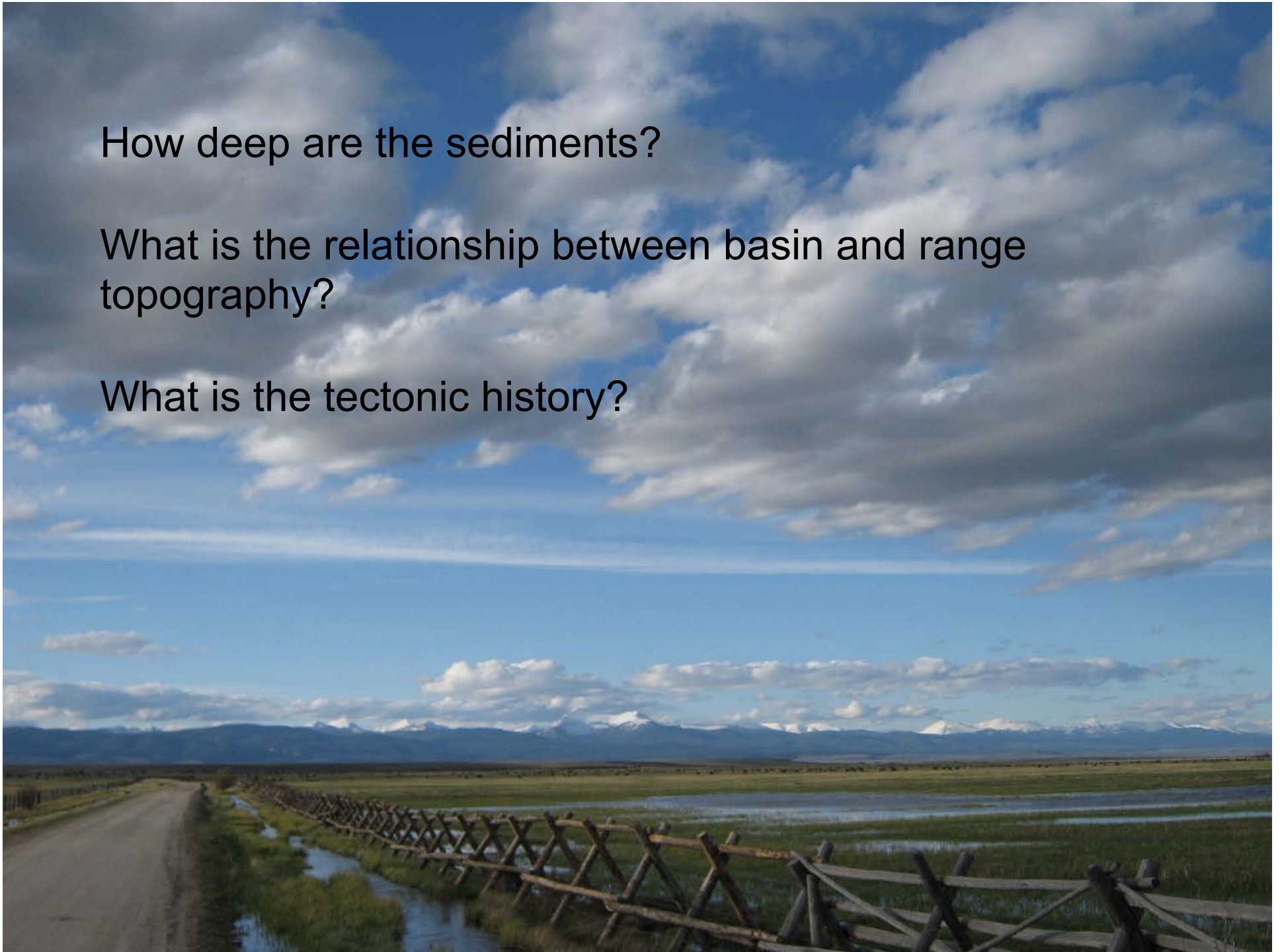
AP



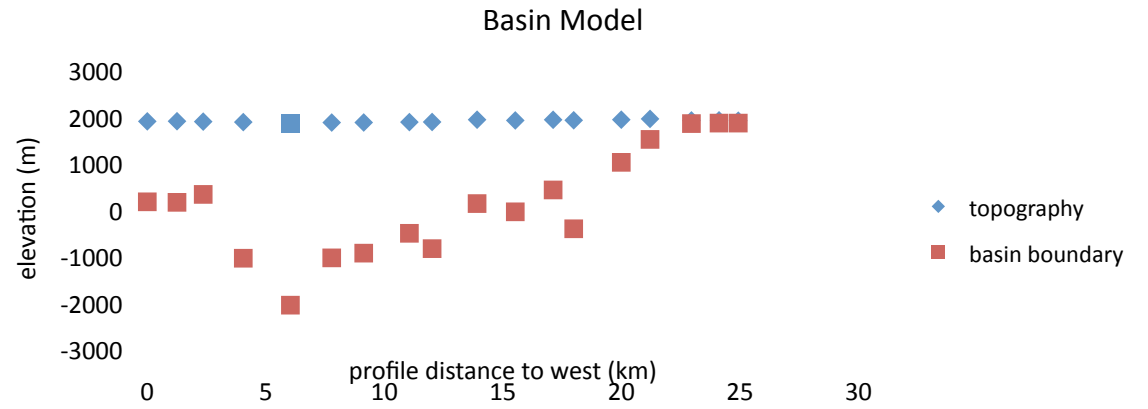
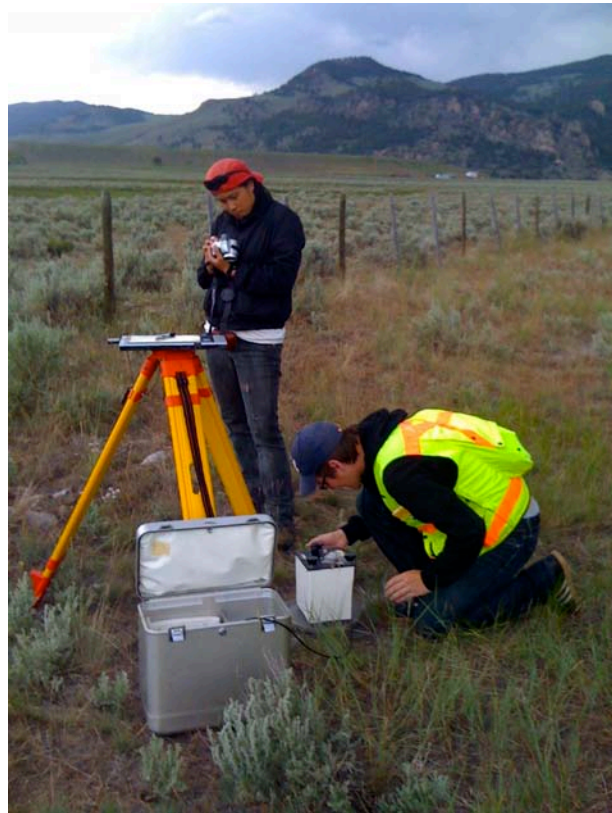
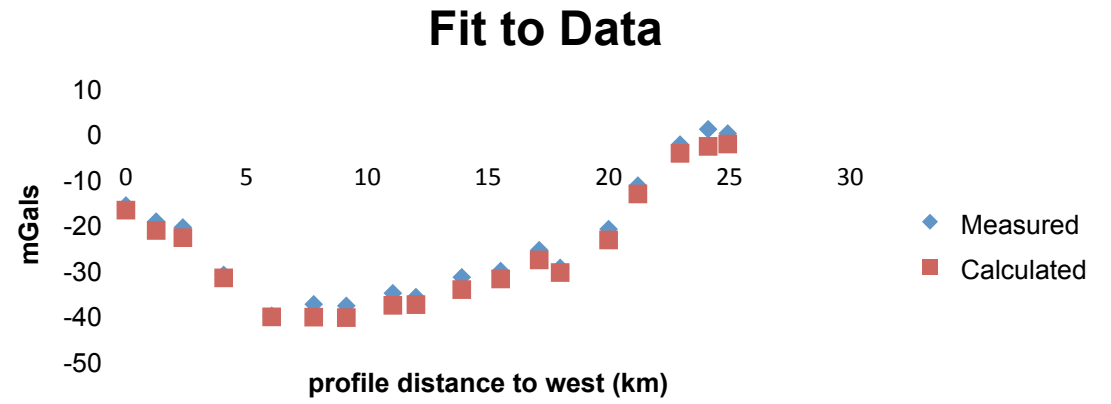
How deep are the sediments?

What is the relationship between basin and range topography?

What is the tectonic history?







EPS050

PLANET EARTH

the Web

on

<http://www.seismo.berkeley.edu/~dreger/EPS050>

- Lecture, reading & lab schedule!
- Announcements and updates
- Information on how and when to reach us
- Lecture notes, handouts and exam study questions
- Relevant material available on the Internet
- Grading policy
- For handouts: user: [eps050](#) password: [quakes](#)

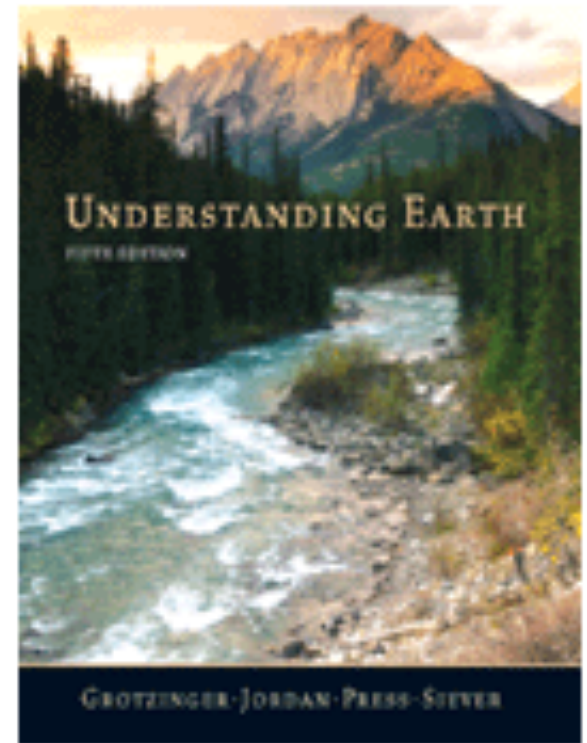
You have to use web page
to get essential and up-to-date information

The Book –Understanding Earth

5th or 6th editions (Grotzinger, Jordan, Press and Siever, or Grotzinger and Jordan)

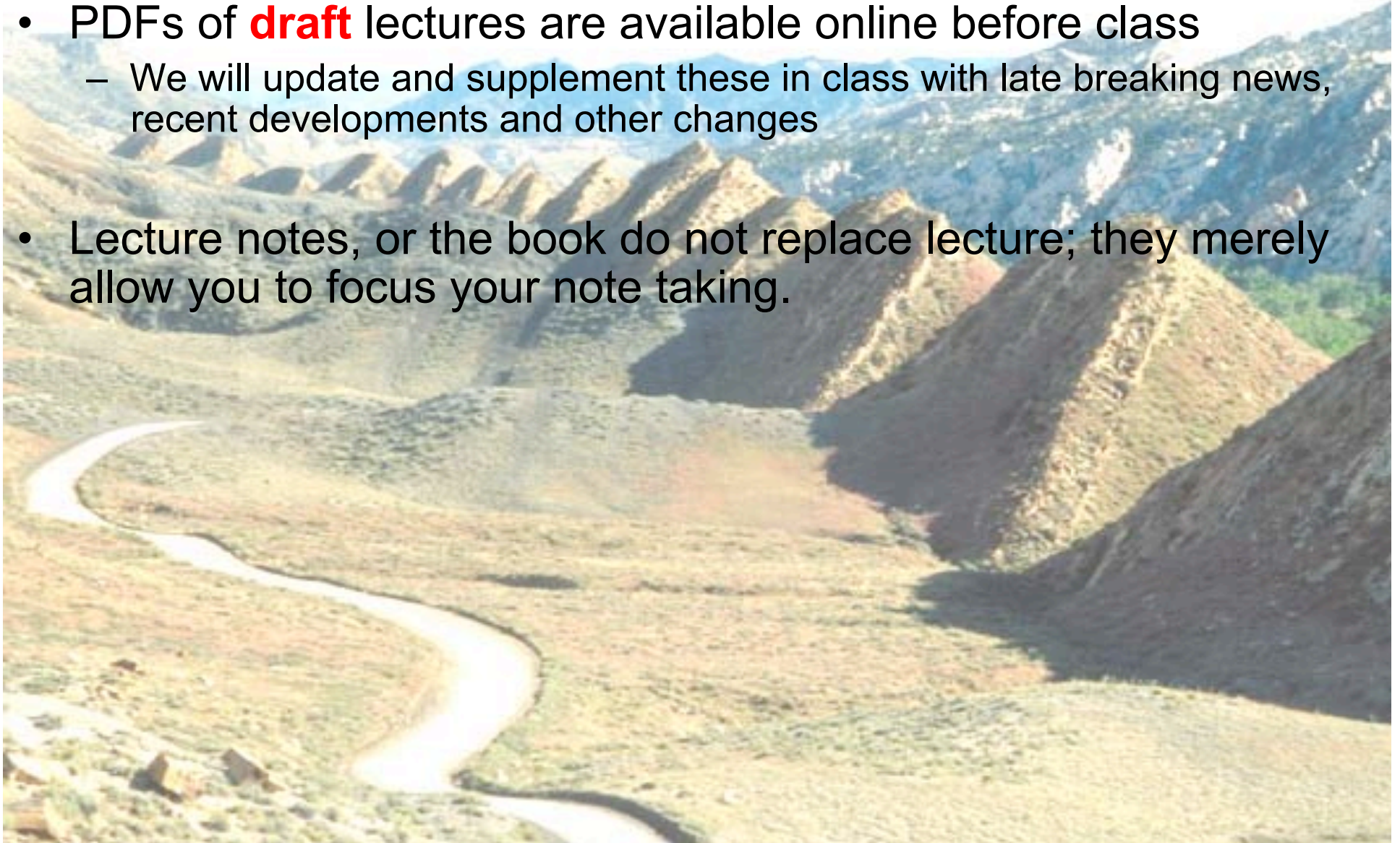
- Lectures follow book but have additional relevant material - order slightly different
- Active Reading: Use the exercises and thought problems at end of chapters to see if you grasped the material
- Use the resources made available on CD and the book's own web page!
- Question information and ask questions

[Textbook: Understanding Earth 5E](#)



EPS 50 Lecture Notes

- PDFs of **draft** lectures are available online before class
 - We will update and supplement these in class with late breaking news, recent developments and other changes
- Lecture notes, or the book do not replace lecture; they merely allow you to focus your note taking.



EPS 50 Field Trips

Geology and Tectonic History of the SF Bay Area

- Field trip 1 (Saturday, September 24):
- Field trip 2 (Sunday, September 25):

Count for 10 % of your grade

- Rain or Shine -> Bring rain gear and sturdy shoes
- Let us know about special requirements etc.
- Sign up sheets will be available at next week's lecture

EPS 50 Lab Exercises

- Your GSIs Ian Rose, Carolina Munoz, Shou Zhang, and David Mangiante
- Solve problems and gain hands-on experience and basic skills
- Identify Rocks and put them into geologic context
- Read and interpret maps
- Locate earthquakes and discuss seismic hazard
- Learn about surface processes and the landscapes they produce on Earth & Mars

Relies on your active participation and interactions with your GSIs

Lab Organization

- Sign up for one of four sections (101-104)
- Labs due at the beginning of the following week's lab
 - We will have weekly meetings with the GSIs to check lab progress
- Can switch to another lab section **once**, with permission by your GSI
- Your worst lab will not count in your final lab grade

EPS - 050 Exams

- Midterm I: Oct. 4, 2011: Lecture 1-9, Labs 1-4
- Midterm II: Nov. 1, 2011: Lecture 10-18, Labs 5-7
- Final Exam: [Exam Week](#)
 - Focus on comprehensive short answer questions covering whole semester
- The exams cover book, lectures, field trips, and labs, but are closed-book
- You are allowed a single letter-sized “cheat sheet” with any notes you would like to have available at each of the exams

EPS - 050 Grades

- It is important to participate in this class with questions in lectures and discussions on the field trips and labs.

- This class is not an easy grade, it takes real study and time.

- Your final course grades will be computed as follows:

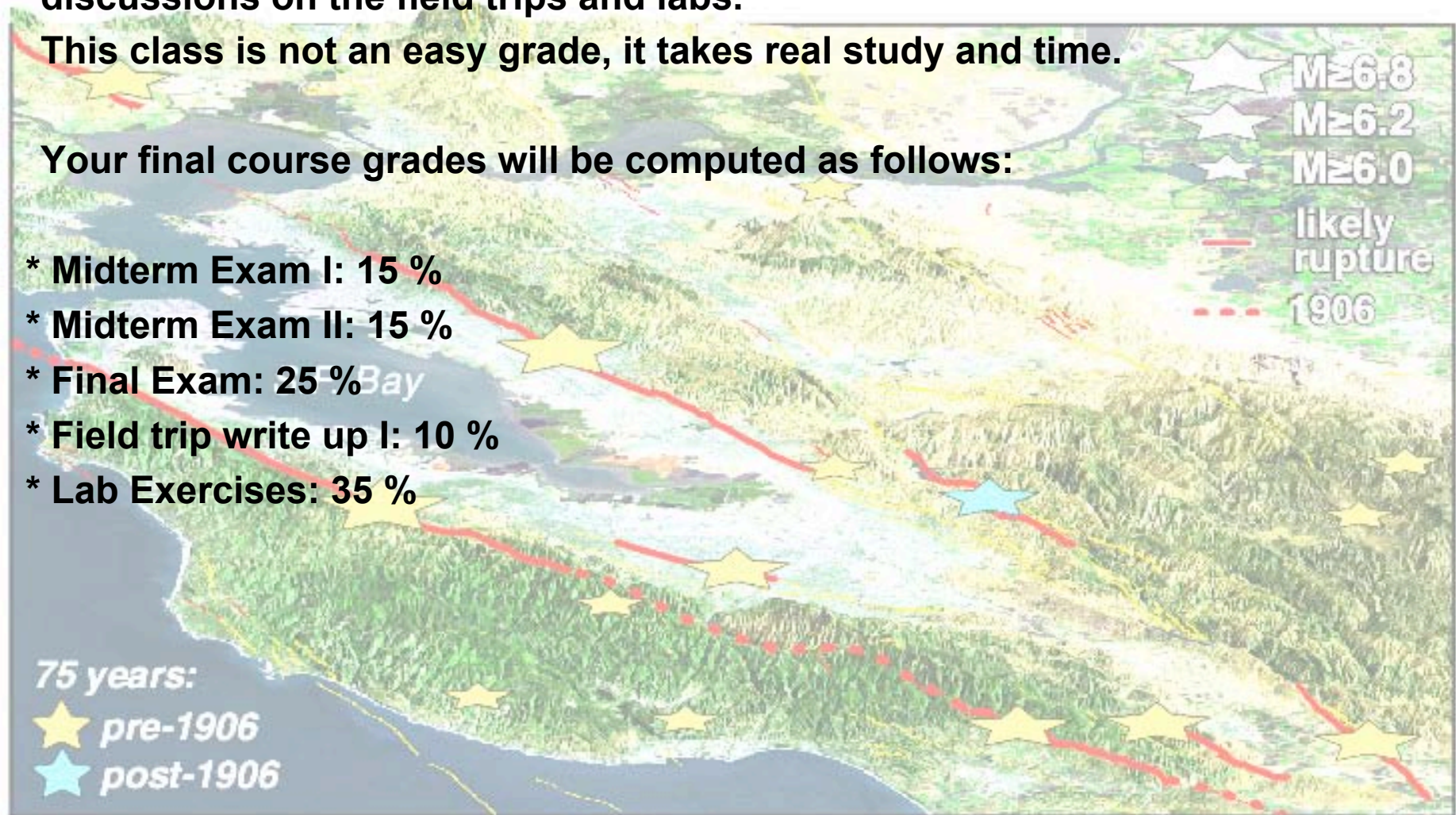
* Midterm Exam I: 15 %

* Midterm Exam II: 15 %

* Final Exam: 25 %

* Field trip write up I: 10 %

* Lab Exercises: 35 %



Participation

- We strongly encourage your participation in lecture, labs, fieldtrips, and outside of the classroom
- Please participate by:
 - Geology in the news discussion
 - Contributing to end-of-lecture Q&A
 - Active involvement during labs

Contact us ...

- We are available via e-mail, during office hours, and have an open-door policy
 - Questions
 - Suggestions
 - Your Planet Earth news
 - Ideas for analogies
 - Ideas for in-class demonstrations



First Assignment

- Labs will begin in two weeks (Sept. 5)
 - Attending labs is required and factors substantially in the final grade (more importantly, gives you a chance to learn and appreciate material)
- First reading assignment Chapters 1 & 2

Question to think about

- How would Earth, and life on Earth, be different if our moon did not exist?



(should our moon be part of the Earth System?)

Massive groundwater depletion in India

Rodell et al., *Nature* 460, Aug 20 (2009)

