Introduction to Biology. Lecture 3

Alexey Shipunov

Minot State University

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Outline

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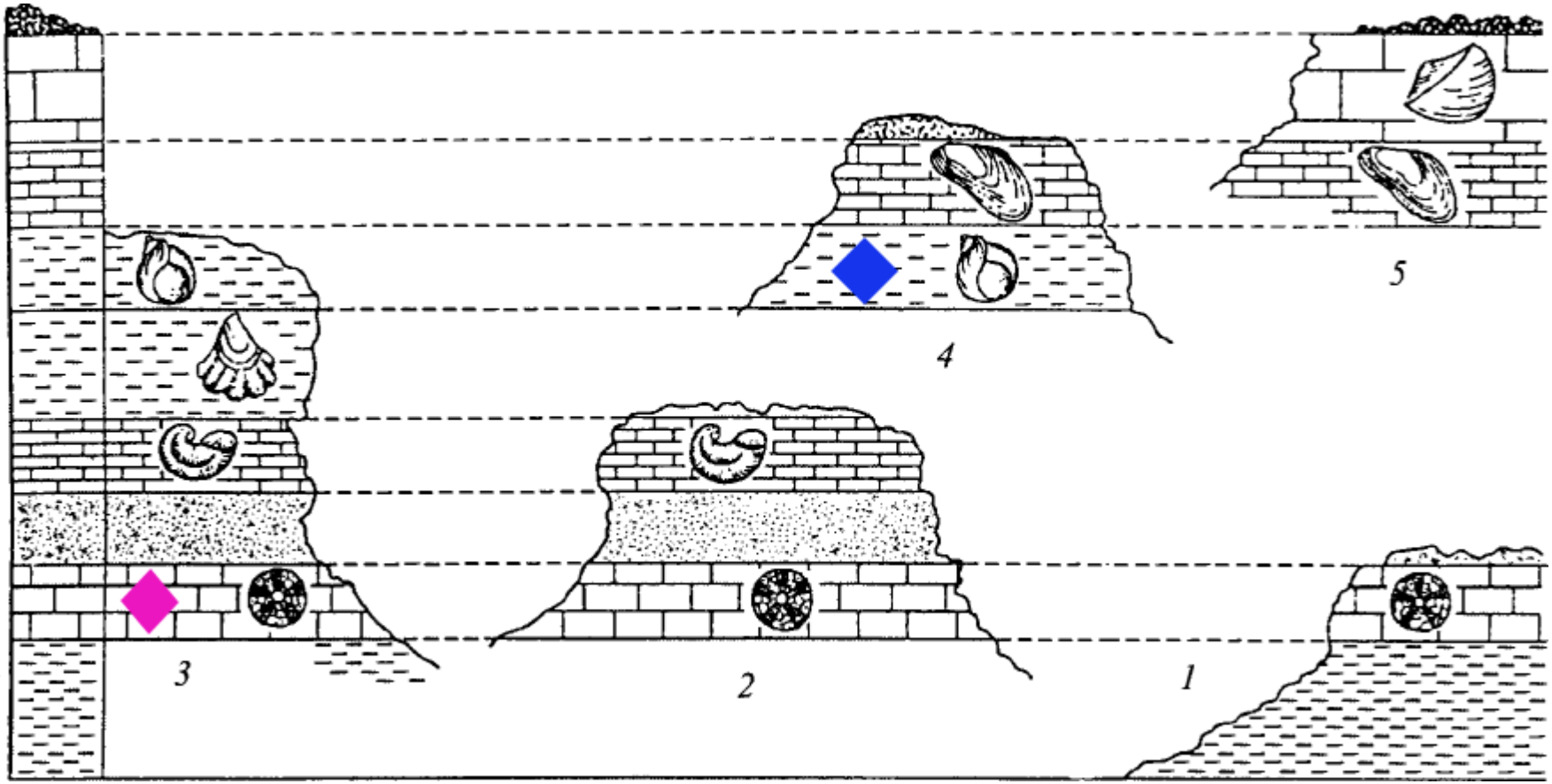
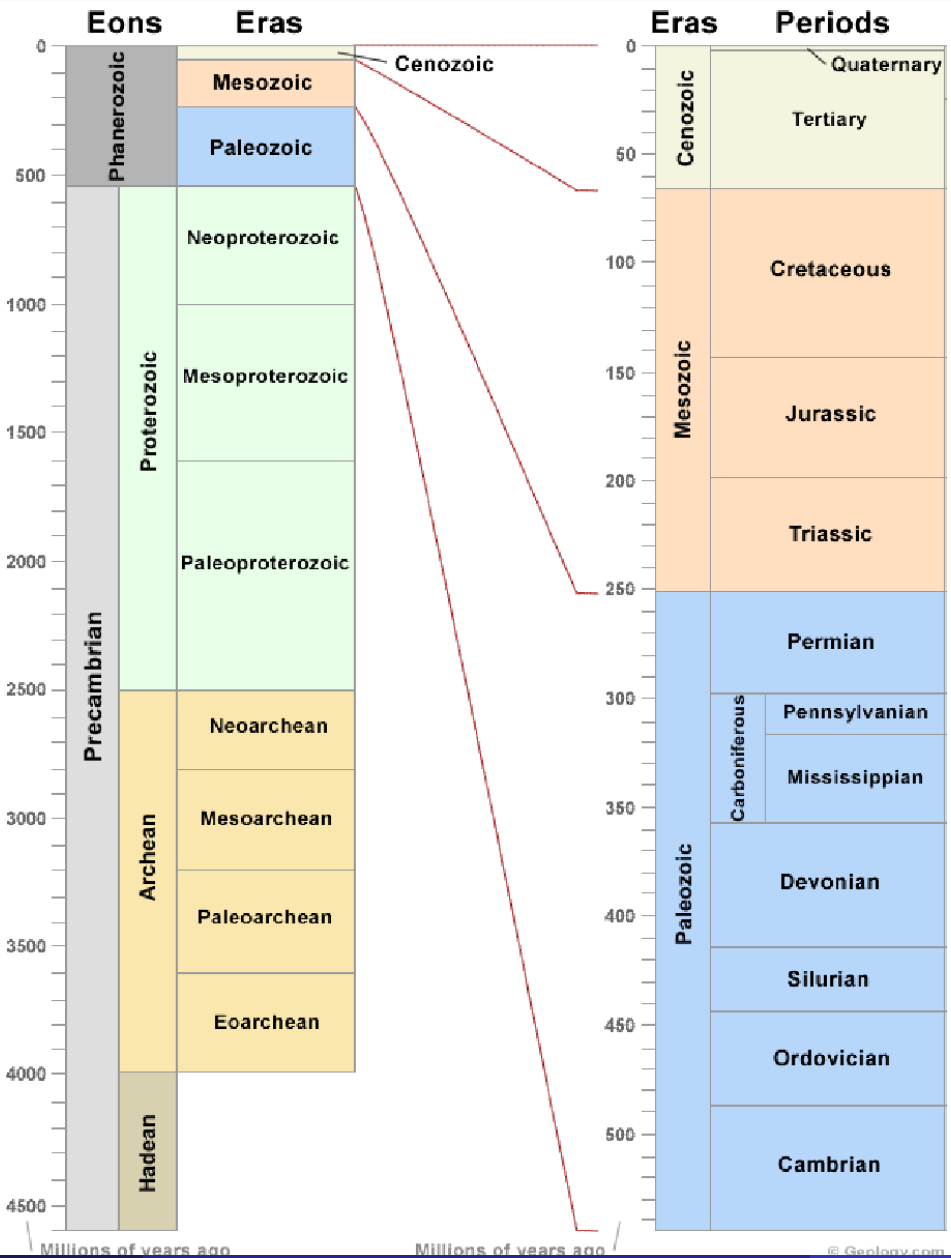
Stratigraphy and radioactivity works together



Geological scale (variant 2)



Where we are?
Basic principles of science

Principle of actuality

- Charles Lyell (1830)
- “The present is the key to the past”

Occam's razor

- Father William of Ockham (ca. 1300)
- "Plurality must never be posited without necessity"

Science as falsification

- Karl Popper (1963)
- “If something cannot be proved wrong, then it is meaningless”

Example of non-falsifiable hypothesis: Russel's teapot

... If I were to suggest that between the Earth and Mars there is a china teapot revolving about the sun in an elliptical orbit, nobody would be able to disprove my assertion provided I were careful to add that the teapot is too small to be revealed even by our most powerful telescopes.
(Bertrand Russel, 1952)

Null and alternative hypotheses

- Ronald Fisher (1935)
- Null: nothing happened; alternative: something happened
- Normally, we are able only to reject one of them and therefore **fail-to-reject** (not “support”!) the other

Basic science principles

- Actuality
- Occam's razor
- Falsification
- Hypothesis testing

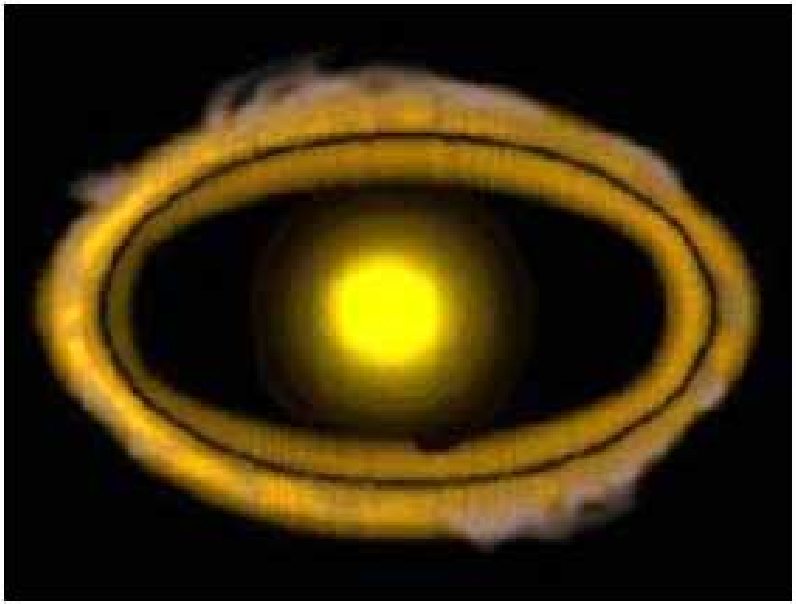
Origin of Earth. Basic Chemistry

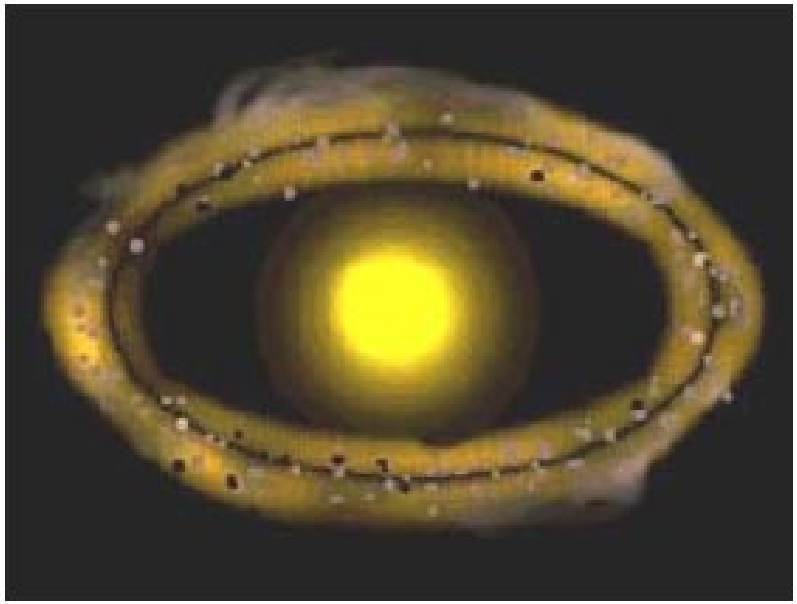
Origin of Earth

Nebula theory: cold Earth

- Pierre-Simon Laplace (1796): Earth originated from a “dust cloud”
- When cloud started to rotate around the Sun, the differentiation into planets started

Nebula: first and second steps





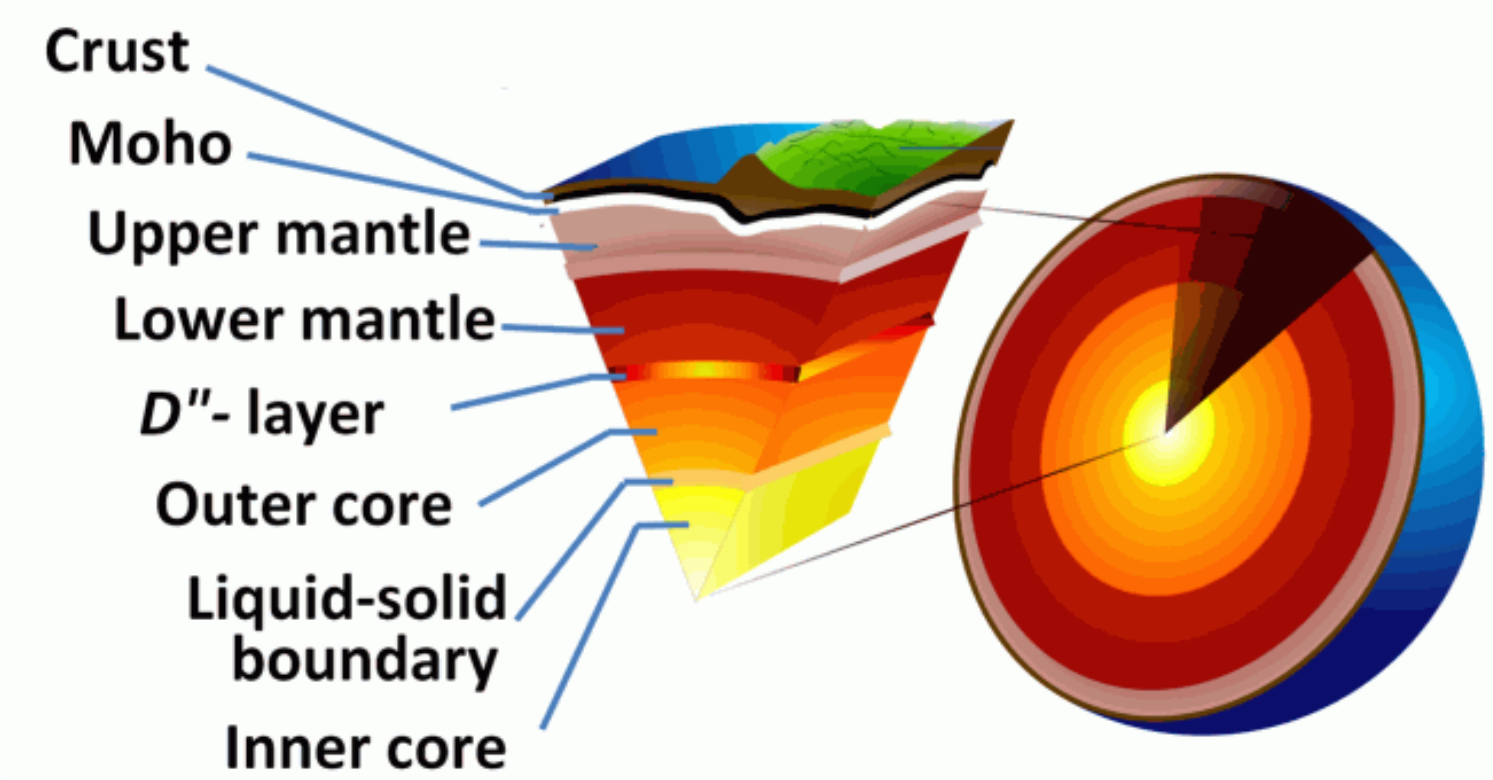
Heating: differentiation of depths

- “Heavy” elements went to the Earth center, light elements—to the surface
- The energy of this movings came out as warmth, and Earth melted (partly)

Structure of Earth

- Now, Earth is spheric drop of extremely viscous and heavy “liquid”
- This drop is structured into several layers. Most important are: crust, mantle and core.

The section of Earth



Atmosphere and hydrosphere

- The differentiation of Earth body finally resulted in developing of lighter gas layer on the surface (primary atmosphere), initially very thin and relatively cold ($\approx 15^{o}$C)
- Therefore, water vapor were condensed into primary ocean (primary hydrosphere)

Chemistry of atmosphere and hydrosphere

- According to the principle of actuality, it should be close to today's volcanic gases
- 15% of CO_2, plus CH_4 (methane), NH_3 (ammonia), H_2S, SO_2 and different "acidic smokes" like HCl

Origin of Earth. Basic Chemistry

Very basics of chemistry

Very basics of chemistry

- Atoms
  - Protons
  - Neutrons
  - Electrons
- Atomic weight
- Isotopes
- Elements and periodic table
- Chemical bonds
- Valence
- Molecules
- Molecular weight

Summary

- Geological time is calculated on the basis of both relative (stratigraphy) and absolute (radioactivity) methods
- Science is based on the principles of actuality, falsification, Occam's razor, and hypothesis testing

For Further Reading

Structure of the Earth. Wikipedia.
`http://en.wikipedia.org/wiki/Structure_of_the_Earth`

Atom. Wikipedia.
`http://en.wikipedia.org/wiki/Atom` (until “Identification”).