Laboratory 7 – Geologic Time

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(Name)

We will be exploring ideas behind the development of the **geological column**. The geological column is a general term that is used to describe the template behind which all geologic events are placed. The template begins about 4.6 billion years ago and ends in recent time. The basic idea behind the template is that Earth material can be subdivided into distinctive mappable subdivisions called lithostratigrahic units. Such units are based solely on their internal lithological aspects such as grain size, color, contained fossils, rock type, etc. Lithostratigraphic units can be combined in packages of Earth material that were on a global basis all deposited in the same interval of time. Such units are called time stratigraphic. In contrast, geologic time units represent the time that individual time stratigraphic units were deposited. But before we jump to far in to this topic let us stop and look at various ways that we can subdivide the geologic record.

Lithostratigraphic Units:
Lithostratigraphic units are units based solely on the composition and texture of a rock or sediment body. **Beds** are layers of Earth material that are greater than 1 cm in thickness. **Laminations** are like beds but are thinner than 1 cm. If we combine 2 or more beds we can form a **membe**r, and 2 or more members can be combined to form a **formation**. However, a formation is not required to contain members. Finally two or more formations make up a **grou**p and 2 or more groups make up a **supergroup**.

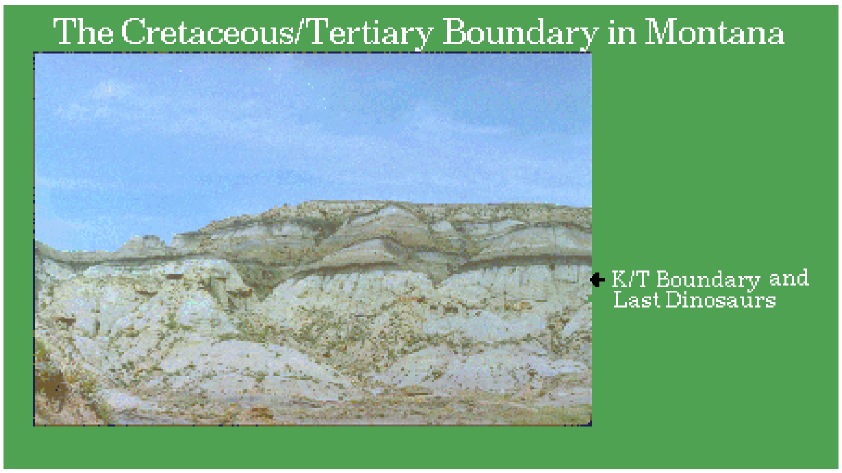
Time Stratigraphic Units:
Time stratigraphic units represent all of the rocks or sediments on planet Earth that were deposited during the same time interval. Time stratigraphic units in order of increasing duration of deposition include **stage**, **series**, **system**, e**rathem**, and **eonothem**. (see Geologic Time Scale below). An example of a time stratigraphic unit is the Cretaceous. We would say that "sediments containing dinosaur fossils belong to the Cretaceous system.

Geologic Time Units:
Geologic time units represent the time in which in a time stratigraphic unit was deposited (see Geologic Time Scale below). Geologic time units in order of increasing time interval include **age**, **epoch**, **period**, **era**, and **eon**. Geologic time units have the same names as time stratigraphic units, and, as a result, their differences are distinguished on the basis of context. For example, we would say that the Cretaceous system was deposited during the Cretaceous period.

The Geologic Time Scale of the Geological Society of America
Using the Geologic Time Scale provided below please answer all of the following questions.

1. An asteroid probably struck Earth about 65 million years ago. What periods and eras does this event separate?

2. Dinosaurs roamed planet Earth in the Mesozoic era, but some species, as for example birds, were wiped out by the asteroid event. How long did the Dinosaurs live (other than birds) during the Mesozoic?

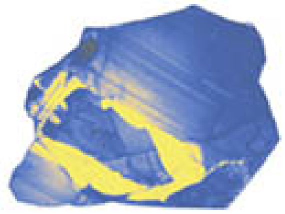


Source; http://www.ucmp.berkeley.edu/mesozoic/mesozoic.html

3. The largest mass extinctions to have affected planet Earth occurred about 245 million years ago. At this time ~50% of marine invertebrate families and over 75% of terrestrial vertebrate families went extinct. On the Geologic Time Scale what eons does this event separate? What periods does this event separate?

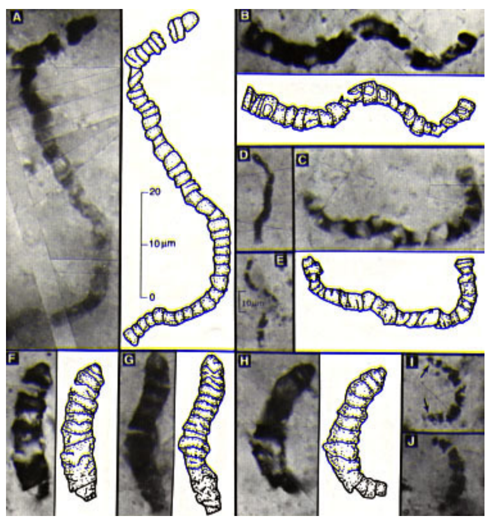
4. Between about 10,000 years ago and 1.8 million years ago large parts of our planet was covered with ice. What epoch does this correspond too?

5. The oldest mineral dated on our planet is from west Australia. It is a zircon and has an age of 4.4 billion years. What eon did the crystal grow in?



Cathodoluminescence image of 4.4 b.y. old zircon.
Source: http://www.geology.wisc.edu/zircon/Earliest%20Piece/Earliest.html

6. Between about 3.4 and 3.5 billion years ago prokaryotes developed on our planet. Prokaryotes are single celled organisms that lack a nucleus. The earliest forms of prokaryotes were anaerobic bacteria that did not require oxygen. Prokaryotes are about 1000th the size of a grain of sand. Blue-green algae or cyanobacteria also evolved in this general time frame (~3.5 billion years ago). Cyanobacteria are also prokaryotes but photosynthesize, i.e., they convert the suns energy into food, and then give off oxygen. Cyanobacteria are represented by stromatolites, hump-like mats that grew in shallow tropical waters. What eon did prokaryotes develop in?



Cyanobacteria, North Pole, Australia. Source:
http://www.astrobiology.ucla.edu/ESS116/L15/1515%20Apex%20Chert.jpg

Stromatolite – Source:
http://www.paleoportal.org/time_space/state.php?state_id=10&period_id=17

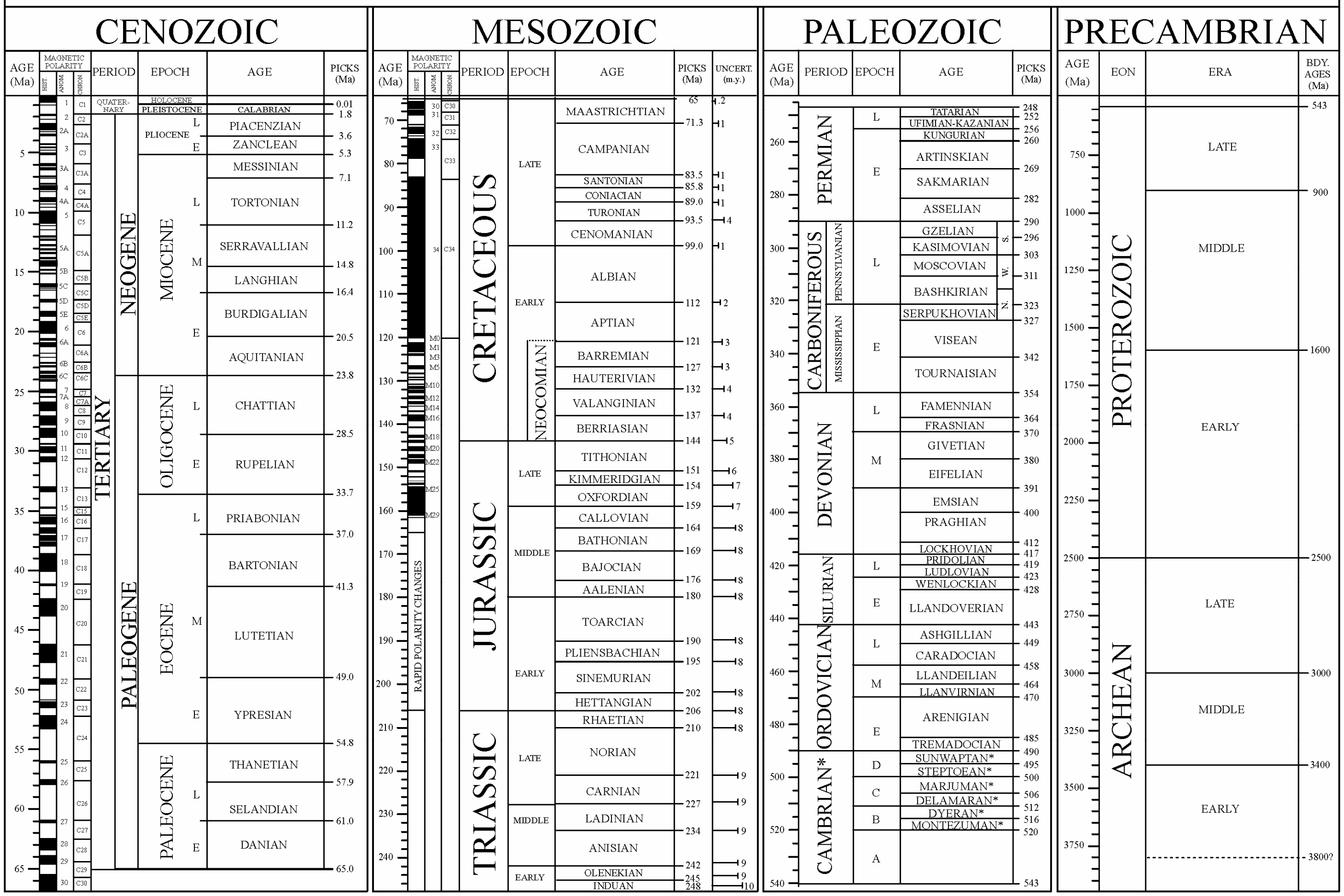
7. From about 2.5 – 2.0 billion years ago the cyanobacteria evolve rapidly and the Earths atmosphere becomes progressively more oxygenated. What eon did the cyanobacteria explosion occur in? What eon did the eukaryotes evolve in?

8. At about 1.5 billion years ago eukaryotes, single-celled organisms with a nucleus developed. The development of eukaryotes led eventually to the development of the famous soft bodied (without shells or hard parts) Ediacarian fauna (metazoans, i.e., multi-celled animals) ~600-700 million years ago. These consist of animals like jelly fish and worms. What eon did the Ediacarian fauna live in?

9. Animals with exoskeletons and shells appear for the first time in the Cambrian period. A common example is the trilobite. What is the maximum age of rocks that you would expect to find the remains of such animals?

The Cambrian trilobite *Olenellus* - Source: http://www.westernta.com/WTA.htm

1999 GEOLOGIC TIME SCALE



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*International ages have not been established. These are regional (Laurentian) only. Boundary Picks were based on dating techniques and fossil records as of 1999. Paleomagnetic attributions have errors, Please ignore the paleomagnetic scale.

Sources for nomenclature and ages: Primarily from Gradstein, F., and Ogg, J., 1996, Episodes, v. 19, nos. 1 & 2; Gradstein, F., et al., 1995, SEPM Special Pub. 54, p. 95–128; Berggren, W. A., et al., 1995, SEPM Special Pub. 54, p. 129–212; Cambrian and basal Ordovician ages adapted from Landing, E., 1998, Canadian Journal of Earth Sciences, v. 35, p. 329–338; and Davidek, K., et al., 1998, Geological Magazine, v. 135, p. 305–309. Cambrian age names from Palmer, A. R., 1998, Canadian Journal of Earth Sciences, v. 35, p. 323–328.

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There are five basic principles that are used to subdivide Earth material into events of variable relative duration. These five principles are:
Principle of Original Horizontality
Principle of Superposition
Principle of Lateral Continuity
Principle of Faunal Succession
Principle of Cross Cutting Relationships

Your instructor will lead you through a 3D view of the above basic priniplesl using the attached block diagrams and clay models. Make sure that you bring your color pencils.

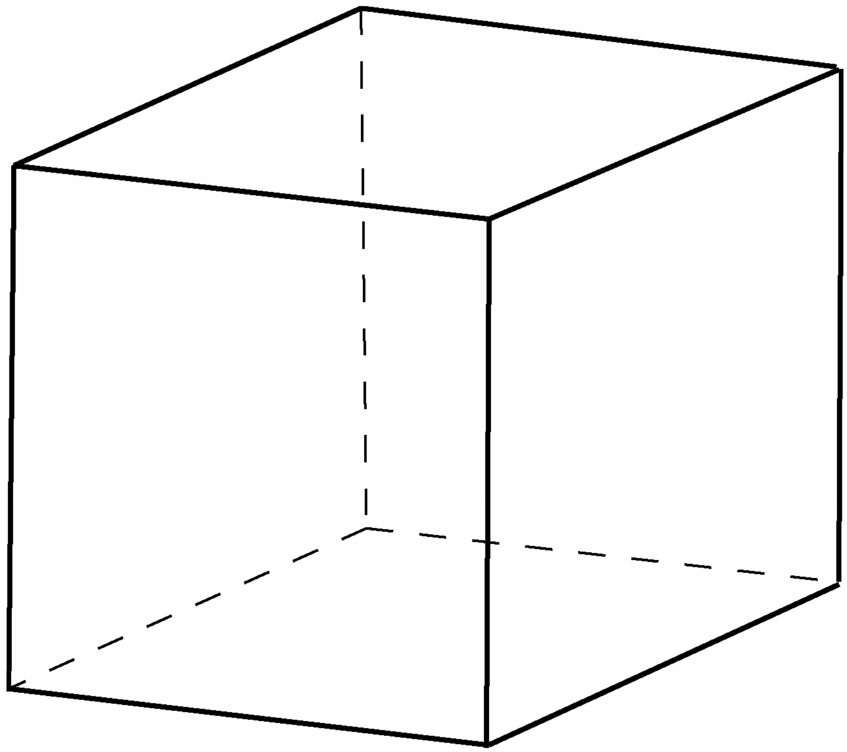
The 5 principles listed above can be used to understand **unconformities** which *are surfaces of non-deposition or erosion and mass wasting*. There are three types of unconformity that we will discuss:
Angular Unconformity
Nonconformity
Disconformity.

Your instructor will lead you through a 3D view of the above material using the attached block diagrams, photographs, and clay models. Make sure that you bring your color pencils.

An angular unconformity between flat lying sediments above and tilted sediments below. Can you pick out the surface of unconformity?

A nonconformity between Precambrian rocks (gneiss) below and flat lying Miocene sedimentary rocks above. Can you pick out the surface of nonconformity?
Source of photo: 3dparks.wr.usgs.gov/joshuatree/images/e90.jpg

Your instructor will lead you through a 3D view of the above material using the attached block diagrams and clay models. Make sure that you bring your color pencils.



Principle of Superposition
Principle of Lateral Continuity
Principle of Faunal Succession

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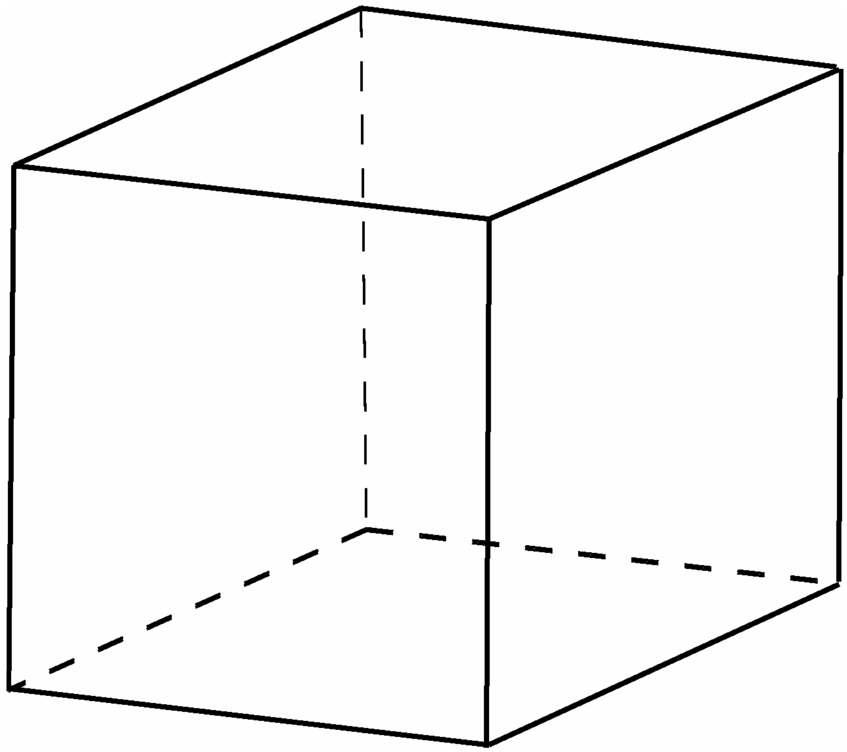

Angular Unconformity

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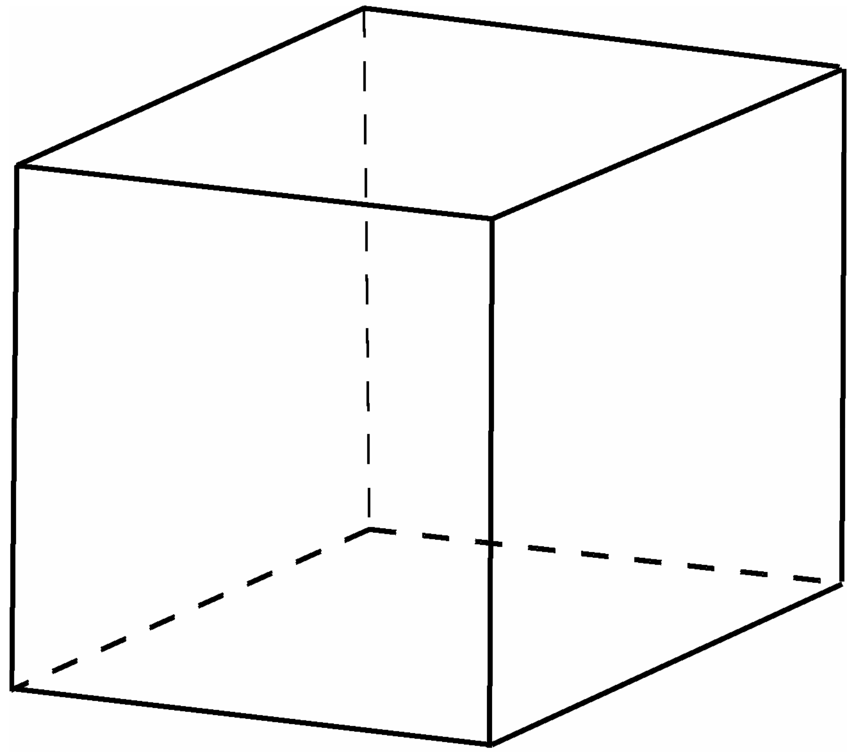

Nonconformity

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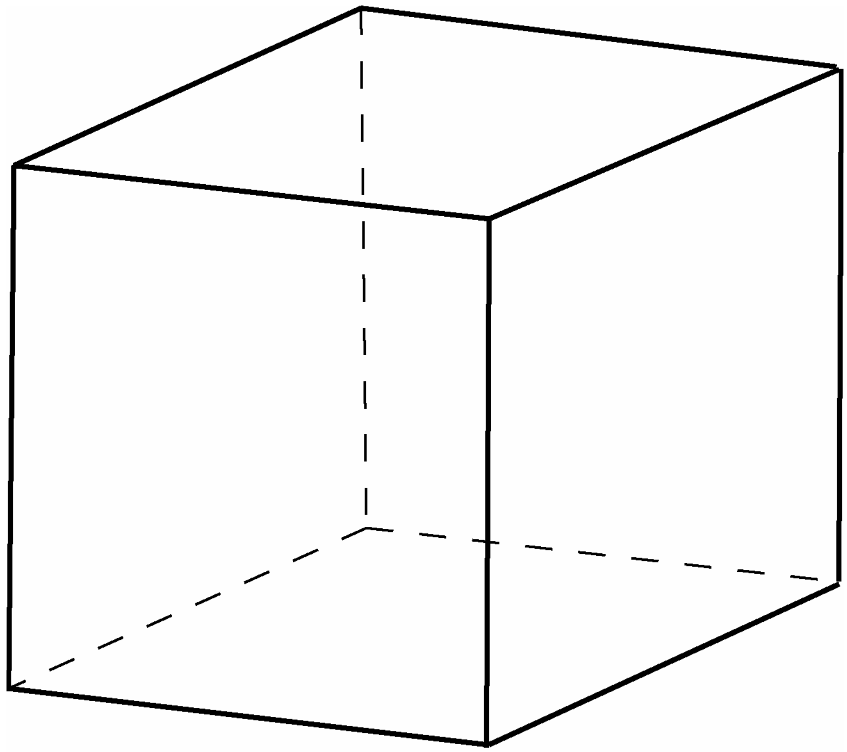

Disconformity

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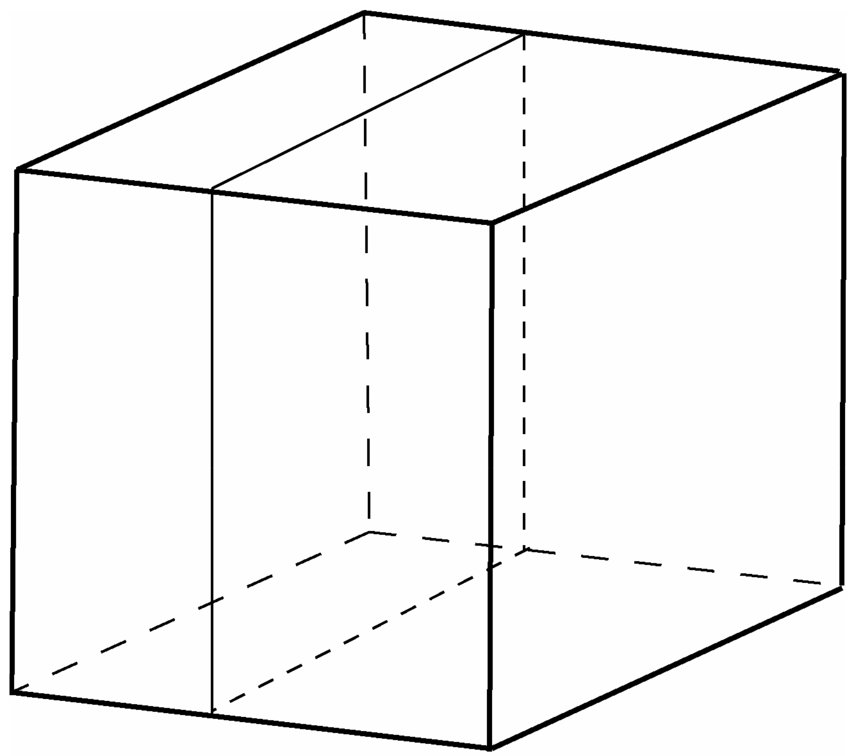

Principle of Cross-cutting Relationships

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