

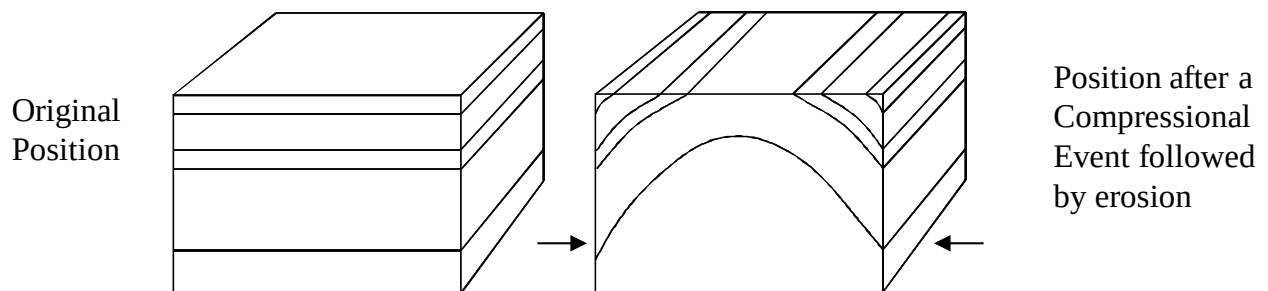
Physical Landscapes and the Geosphere (ACNA 4007)

Relative Ages of the Earth

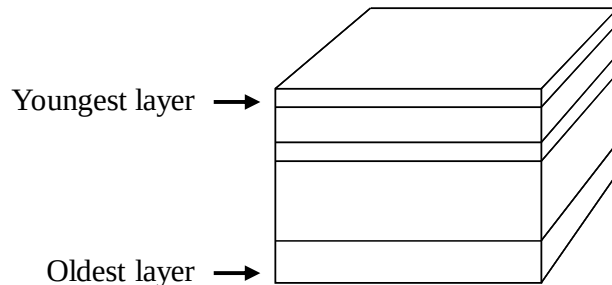
Relative Ages

The Earth was not always thought to be so ancient. The ability to assign an absolute age of 4.6 billion years to the Earth is a recent accomplishment. Before modern dating techniques existed, geologists were only able to give relative ages to the formational events of the Earth. They could only state whether an event happened before or after another event, but could not assign an actual date to its occurrence. Geologists developed a relative time scale using clues from the Earth and their knowledge of the five basic geologic principles:

1) Principle of Original Horizontality: The materials that make up sedimentary rocks are deposited in horizontal sheets which create layers, or strata, within the Earth. If these strata are not found to be horizontal, then some geologic event has caused them to be displaced from their original horizontal position.



2) Principle of Stratigraphic Superposition: In a sequence of strata that has not been disturbed by some geologic event, the layer on the bottom is the oldest and the layer at the top is the youngest. The bottom layer had to be there first for the other layers to be deposited on top of it.



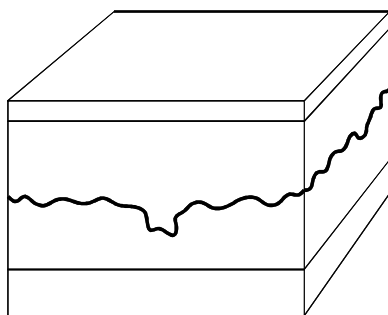
3) Principles of Unconformities - Most surfaces between adjacent strata or formations are *conformities*, meaning that rocks on both sides of these planar features formed in a continual sequence. An *unconformity* is a rock surface that represents a gap in the geologic record. It is like the pages of a book are missing. An unconformity can be a buried surface where there was a pause in sedimentation or a surface that was eroded before more sediment was deposited on top of it.

There are three kinds of unconformities (see figures below).

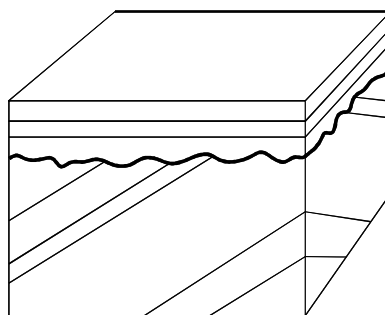
A **disconformity** is an unconformity between *parallel* strata or lava flows. Most disconformities are very irregular surfaces, and pieces of the underlying rock are often included in the strata above them.

An **angular unconformity** is an unconformity between *nonparallel* strata.

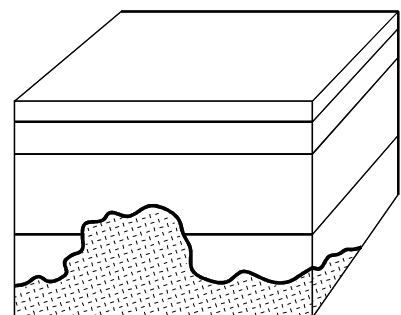
A **nonconformity** is an unconformity formed when stratified sedimentary rocks are deposited on eroded igneous or metamorphic rock.



Disconformity



Angular unconformity

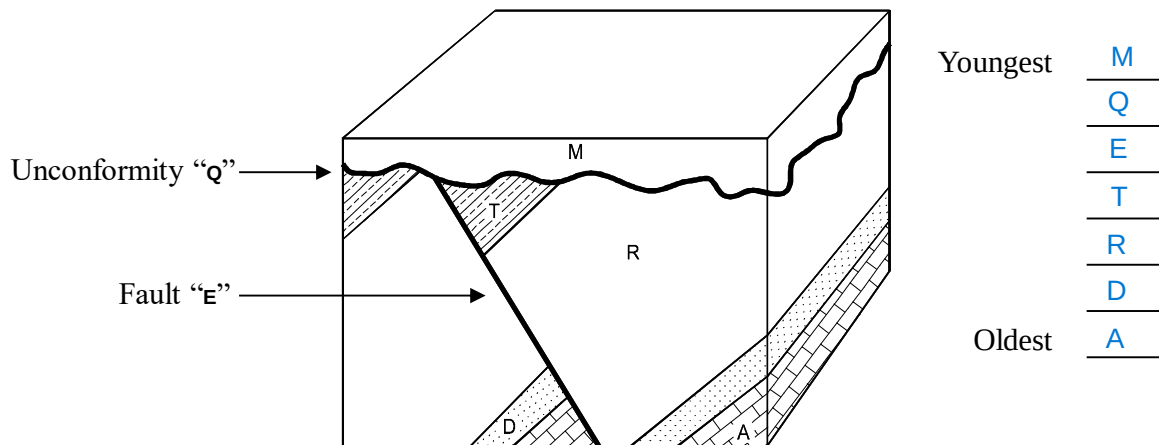


Nonconformity

Unconformities are represented by irregular-shaped, dark, thick lines.
Conformities are represented by straight, dark, thin lines.

3.a.) Relative Age of the Earth - Below and on the following pages, you will find block diagrams which represent pieces of the Earth's crust. Using what you have learned about geologic time, work through these relative-time exercises. Refer back to the *supplemental information* for details about each of the relative-time principles.

List the rock layers and geologic events in order from youngest to oldest and answer the following questions.

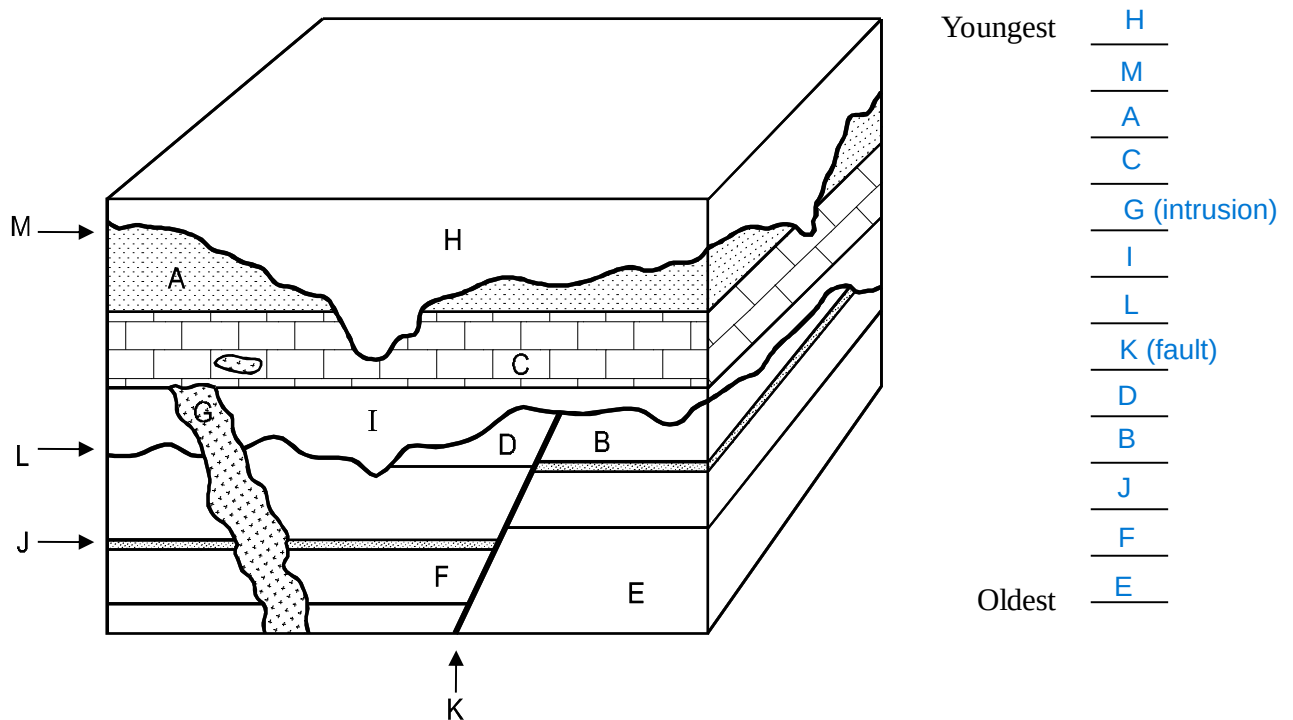


What type of unconformity is "Q"? Angular Unconformity

Which is older, the fault or the unconformity? The fault is older

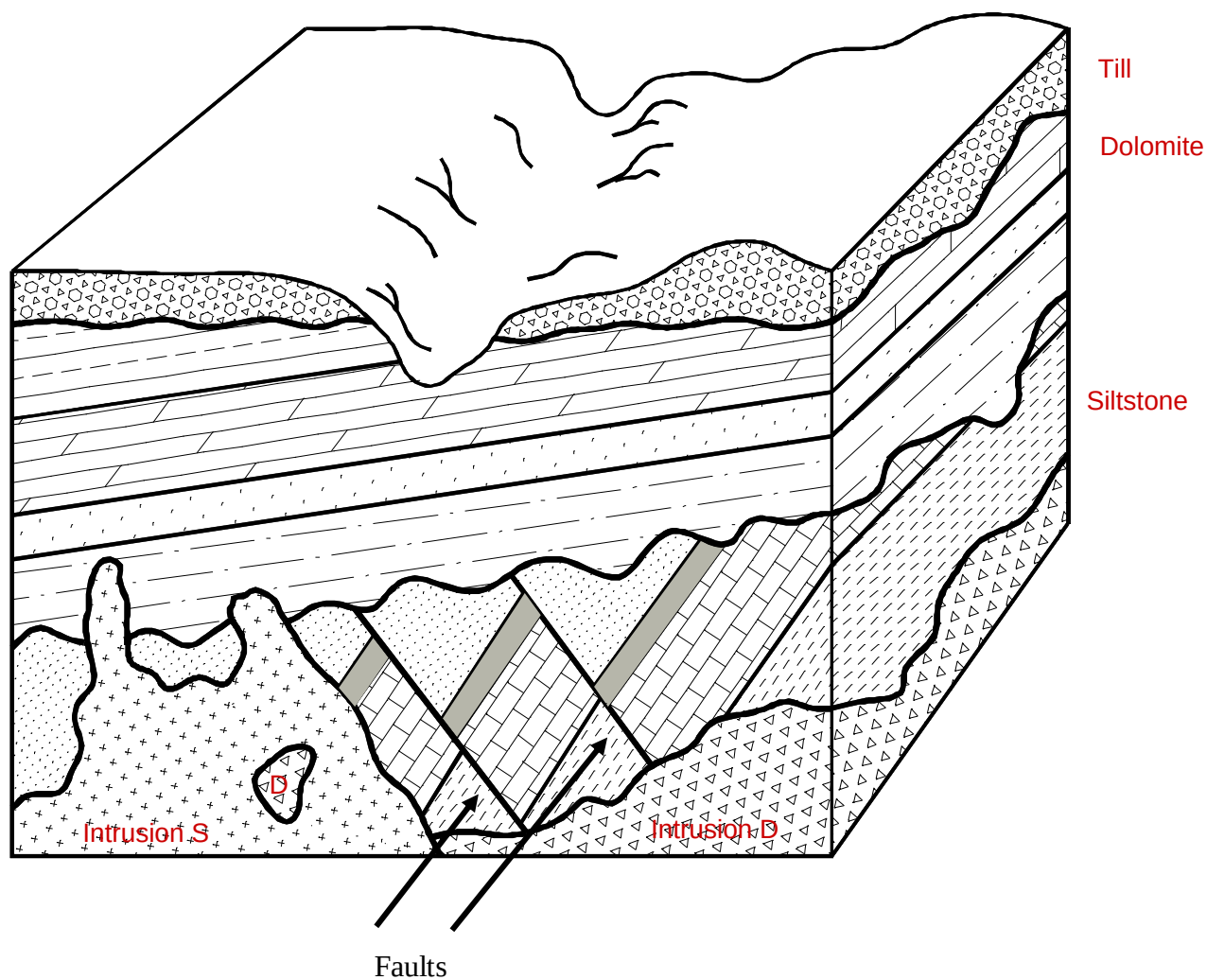
According to which principle? Principle of unconformities

3.b.) Relative Age of the Earth - List the rock layers and events by relative age from youngest to oldest.



- Which is older (occurred first) fault "K" or deposition of strata "B" ? B is older (occurred first)
- What principle did you apply to answer question 1? Cross cutting relationships
- What type of unconformity occurs between the igneous intrusion "G" (a dike) and strata "C" ? Non conformity
- Which is older "G" or "C" ? G
- What principle did you apply to answer question 4? Components (Principle of inclusions)
- Explain, in a couple of sentences, what the age relationship is between "G" and "K".
G is a dike intrusion and it extends into layer I. The feature labelled 'K' is a fault, and it does not extend into layer I. Therefore, we know that K is older than I as I layer was deposited after the fault occurred. The dike (intrusion G) extends past the fault past layer I so we know layer I had to have existed for the intrusion to intrude into that layer. Therefore, G is younger than K.
- Which strata is younger, (most recent), "E" or "F" ? F is more recent
- What principle did you apply to answer question 7? Principle of Original Horizontality

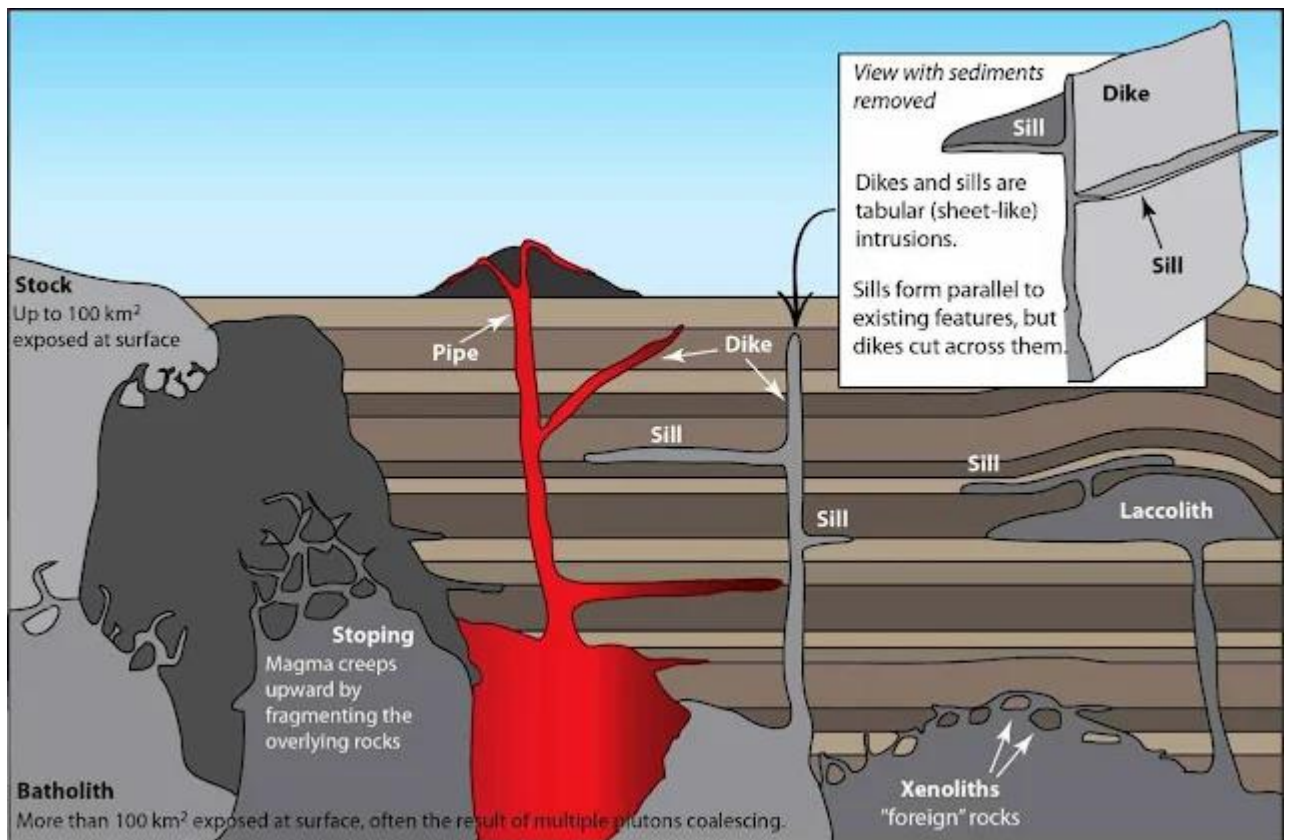
3.c.) Relative Age of the Earth - Answer the questions on the following page relating to this block diagram



Intrusion (D)		Limestone		Ss (G)		Claystone	
Intrusion (S)		Shale		Ss (R)		Siltstone	
Dolomite		Ash Bed		Till			

1. What type of unconformity occurs between the till and the dolomite? Angular unconformity
2. Which intrusion occurred first **D** or **S** ? D
3. Explain your answer to question 2.
Intrusion D is included in intrusion S, and therefore had to exist first. Intrusion S contains fragments of D. Owing to the Principle of Inclusions (or sometimes known as components), we know that any rock fragment that is included in a rock must be older than the rock in which they are included.
4. What type of unconformity occurs between the siltstone and intrusion **D** ? Nonconformity
5. Which is younger, the limestone or the sandstone (Ss) **R** . Sandstone
6. According to which principle? Original Horizontality / Superposition
7. How many different unconformities can you identify? 3
8. Which rock unit was formed first, the claystone or the shale? Claystone
9. Which principle did you apply in question 9? Question 8... Principle of Superposition
10. List rock units/events from youngest to oldest

youngest	<u>Till</u>
	<u>Shale</u>
	<u>Dolomite</u>
	<u>Ss (G)</u>
	<u>Claystone</u>
	<u>Intrusion S</u>
	<u>Faults</u>
	<u>Ss (R)</u>
	<u>Ash Bed</u>
	<u>Limestone</u>
	<u>Siltstone</u>
	oldest



Examples of Intrusive Igneous Rocks