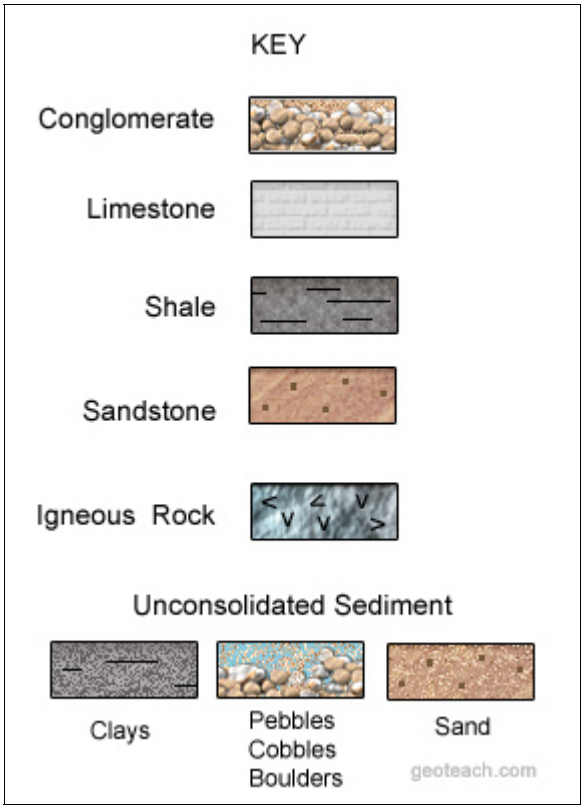
Relative Dating of Rock Sequences
Rocks Tell Their Stories

All that remains is for us to observe and infer their history.



The Key: Be sure to look at the key before observing the series of illustrations.
Notice that not only do symbols exist for sandstone, shale and conglomerate, but also for the loose sediments that will eventually lithify to become these rock types.

Look at the 2 illustrations in this lesson which show several horizontally layered sedimentary rock layers, igneous intrusions and faults. They have been numbered and lettered for ease of reference.

In this lesson we will tell the "story" of the rock sequences by observing certain characteristics:
1- The order in which the rock layers appear.
2- Erosional Surfaces
3- Unconformities

If you need help with the submergence , emergence and unconformity issues, go to **Submergence and Emergence of Rock Layers With Respect to Sea Level**, look at the illustrations and read the captions.

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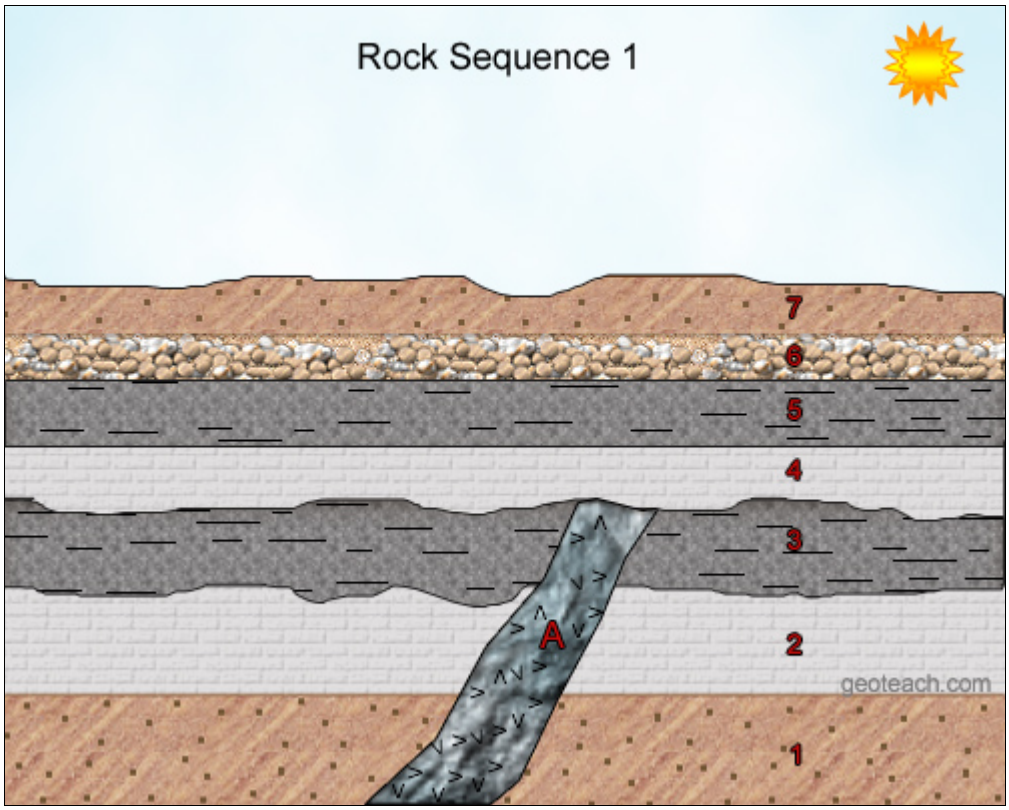
Let the Stories Begin!

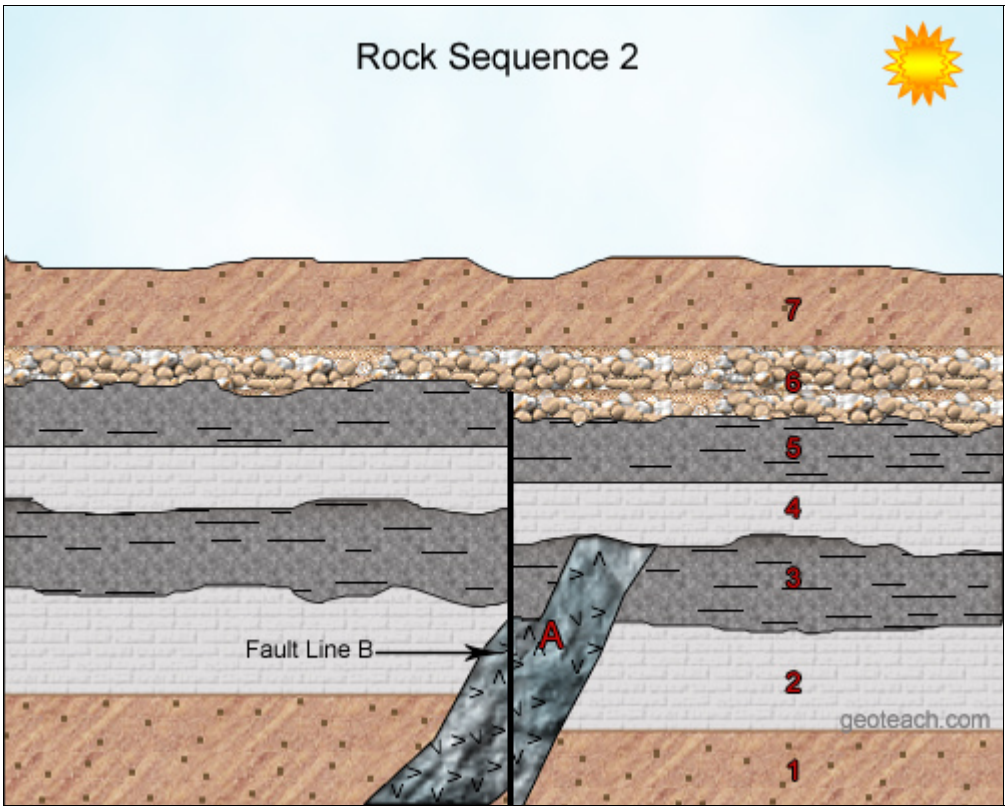


This is the "story" for Rock Sequence 1:

1- Submergence followed by Deposition and the Formation of layers 1 and 2 (the sandstone and limestone).
2- Emergence and Erosion of layer 2 (limestone).
3- Submergence followed by Deposition and the Formation of layer 3, (the shale) producing an unconformity with layer 2 (limestone). The unconformity is evidenced by the wavy, eroded top surface of a rock layer.
4- Igneous Intrusion A with resulting Contact Metamorphism of layers 1, 2 and 3 (the sandstone, limestone and shale).
5- Emergence and Erosion of layer 3 (shale) and Igneous Intrusion A.
6- Submergence followed by Deposition and the Formation of layers 4, 5, 6 and 7 (the limestone, shale, conglomerate and sandstone) producing an unconformity with layer 3 (the shale) and with Igneous Intrusion A.
7- Emergence and Present-day Erosion of layer 7 (sandstone).

Question: How does one know when the Igneous Intrusion entered the rock layers?
Answer: Since it passes through layers 1, 2 and 3 then those layers had to be in place before the igneous event occurred.
We know that the intrusion entered the layers *BEFORE* the deposition of layer 4 because the top of it is eroded along with the "shale layer 3".

Question: Why is layer 4 (limestone) not listed as having been metamorphosed by the igneous intrusion?
Answer: Layer 4 was not formed when the intrusive event took place.



This is the "story" for Rock Sequence 2:

1- Submergence followed by Deposition and the Formation of layers 1 and 2 (the sandstone and limestone).
2- Emergence and Erosion of layer 2 (limestone).
3- Submergence followed by Deposition and the Formation of layer 3, (the shale) producing an unconformity with layer 2 (limestone). The unconformity is evidenced by the wavy, eroded top surface of a rock layer.
4- Igneous Intrusion A with resulting Contact Metamorphism of layers 1, 2 and 3 (the sandstone, limestone and shale).
5- Emergence and Erosion of layer 3 (shale) and Igneous Intrusion A.
6- Submergence followed by Deposition and the Formation of layers 4 and 5 (the limestone and shale) producing an unconformity with layer 3 (the shale) and with Igneous Intrusion A.
7- Faulting of layers 1, 2, 3, 4, 5 and igneous intrusion A.
8- Submergence followed by Deposition and the Formation of layers 6 and 7, (the conglomerate and sandstone) producing an unconformity with layer 5 (shale).
9- Emergence and Present-day Erosion of layer 7 (sandstone).

Question: How does one know when the faulting occurred?
Answer: The fault affected layers 1-5 and the igneous intrusion because they are displaced (offset). It did not affect any layers above #5. Therefore, the faulting had to occur *after* the formation of 1-5 and also *after* the igneous event but *before* the final deposition and formation of the uppermost layers 6 and 7.

Take Note! A few rules apply when considering the relative ages of rock layers, i.e., which layer is oldest and which is youngest. Before telling the history of this illustration, one must keep the following laws and principles in mind:

Concerning Rocks:
Principle of Original Horizontality: Nicholas Steno (1638-1686) stated that sedimentary rock layers form in the horizontal position. Any deviation from this horizontality indicates that the rocks were later disturbed, (for example, by crustal movement).
Law of Superposition: The principle that the oldest rock layers are at the bottom of a rock sequence with younger rock layers deposited on top of them. This can be considered a rule that applies in all situations, except where overturning of rock layers and/or extreme deformation has occurred.
Law of Inclusions: Fragments of rock inside a larger rock are older than the matrix surrounding them. This includes country rock that was ripped apart by the force of intruding magma and which ended up inside the cooling and crystallizing igneous material. It also includes rock fragments that compose a larger sedimentary rock. Example: conglomerate.
Intrusions: Igneous Intrusions are younger than the rocks into which they have intruded.
Law of Faunal Succession: Maintains that different rock strata of different ages, contain individualized fossils of flora (plant) and fauna (animal life), and that worldwide these fossils succeed each other in a predictable order. For example, a dinosaur fossil will not be found in the same rock layer as an early hominid (human) fossil. Therefore, fossils are of great importance and assistance in placing rock layers in proper order, even those layers that have been disturbed and severely overturned.

Concerning Events:
Faults: Faults are younger than the rocks they have faulted and/or displaced.
Tilting: The event of tilting is younger than the rocks that are titled and displaced.
Folding: The event of folding is younger than the rocks that are folded.
Metamorphism with resulting Contact Metamorphis of preexisting rocks: The metamorphic event came after the rocks that have been metamorphosed. Any rocks changed by contact metamorphism had to be their before they were changed.
Erosion: Erosional Events are younger than the rocks that are eroded.