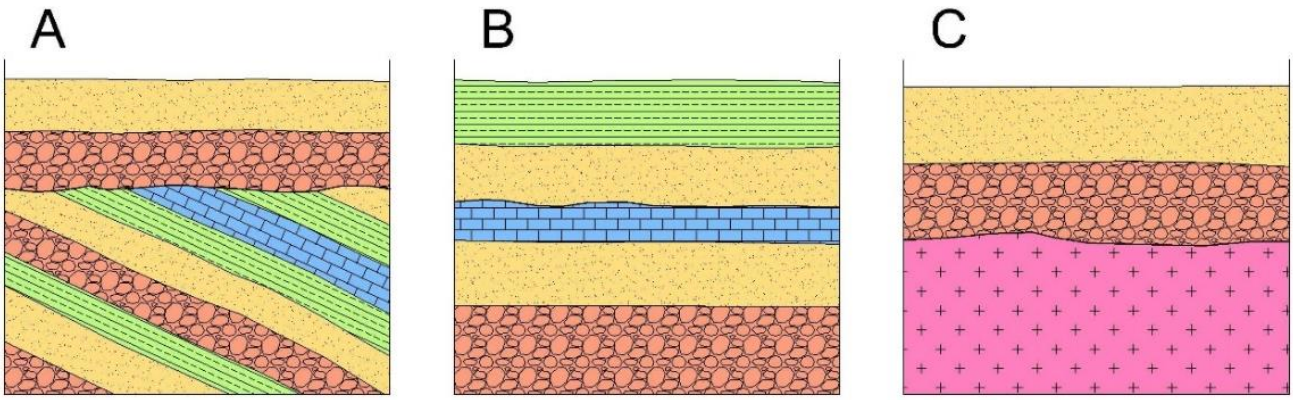
Special Explanation: What is an unconformity and what does it tell you?

Several types of events, such as metamorphism, can change rock formations that have already been formed. Rocks can be deformed by tilting of layers, folding, faulting, or fracturing, which all represent separate geologic events. Rock units can also be weathered and eroded, and these events represent times in which rock units were exposed at Earth's surface, or possibly, but less frequently, were eroded beneath the ocean. Weathering and erosion can cut into rocks by removal of weathered material, creating erosion surfaces, thereby destroying a part of the geologic record. This boundary represents a time gap in the geologic record, or a break in what is recorded by the rocks, known as an unconformity. Unconformities can also be the result of a period of non-deposition in a sedimentary rock sequence, when time is not represented by deposits. Technically, an **unconformity** is: **a surface that represents a break in time and is overlain by a sedimentary unit, lava flow, or pyroclastic volcanic deposit**.

Unconformities come in three fundamental types, which are shown in the figure below. An **angular unconformity** (Figure A below) occurs when sedimentary layers are tilted and eroded, and new sedimentary units are put down horizontally over the eroded sequence. The first sedimentary sequence was tilted and crosscut (partly removed) by erosion prior to deposition of the second horizontal sequence.

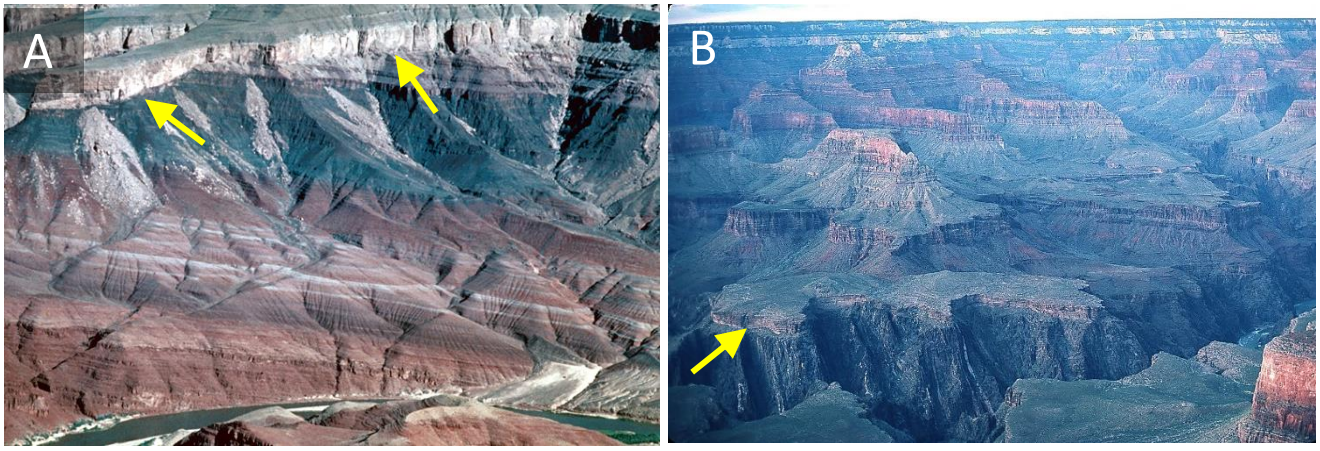


*An **unconformity** is a boundary that is overlain by a sedimentary rock unit or extrusive igneous rock unit (lava flow or pyroclastic volcanic deposit) and represents a significant time gap in the geologic record between the rock units above and below. There are three fundamental types of unconformities including: A) an **angular unconformity**, in which rocks below the unconformity were tilted and eroded prior to deposition of units above the unconformity; B) a **disconformity**, in which units above and below the unconformity (top of blue unit in figure B) have the same bedding orientation and there has been either erosion parallel to bedding or a period of non-deposition; and C) a **nonconformity** that separates intrusive igneous or metamorphic rock units below (pink unit on figure C) from sedimentary rock units deposited on them above. The rock units above the nonconformity could not be deposited until erosion exposed the igneous or metamorphic rock units at Earth's surface. In this case the igneous rock did not intrude the sediment above.*

A **disconformity** (Figure B above) is where there is missing time, but the sedimentary units above the unconformity have the same bedding orientation as units below. This can be due to erosion that is roughly parallel to the beds below, followed by burial of the erosion surface by more sediment or volcanic rocks with the same orientation. It can also be due to a period in which nothing was deposited, and when deposition resumed the bedding orientation was the same as prior to the interval of non-deposition. There was no tilting event as with an angular unconformity.

A **nonconformity** (Figure C above) is when an igneous or metamorphic rock unit is eroded and exposed at Earth's surface, and then sedimentary layers or extrusive igneous rocks are put down on the eroded surface. In the case of coarse-grained igneous or metamorphic rock units, the nonconformity represents a great amount of erosion. The coarse igneous and metamorphic rocks had to have formed deep beneath Earth's surface, and everything above these units was removed by erosion before sedimentary or volcanic layers could be laid down upon them at Earth's surface.

In the images below are examples of an angular unconformity and a nonconformity along a single surface known as The Great Unconformity in the Grand Canyon.



The Great Unconformity in the Grand Canyon that separates rocks of Precambrian age from the Cambrian Tapeats Sandstone above. A) In the eastern Grand Canyon, the Tapeats Sandstone rests on tilted units of the Grand Canyon Series at an angular unconformity (arrows). (Image from USGS photo library, med 00280.) B) In the western Grand Canyon, the Tapeats Sandstone sits on much older igneous and metamorphic rocks (arrow) at a nonconformity (image by Jack Ridge). In both cases, the Tapeats Sandstone forms a resistant bench that is capping older units.

The Great Unconformity on the Clear Creek Trail on the north side of the Grand Canyon. Image was taken near the right edge of image B above. The nonconformity separates the Zoaster Granite below, which is about 1.5 billion years old, from the Tapeats Sandstone above, which is about 540 million years old (image by Jack Ridge). The granite is weathered along this surface prior to deposition of the sandstone. The nonconformity can also be seen on the south side of the canyon at the tip of the arrow. The Tapeats Sandstone forms a prominent bench in the Grand Canyon.