Rocks of the Blue Ridge & Piedmont: Region 1

The Blue Ridge and Piedmont are distinct areas within the Southeast, but share similar types of crystalline igneous and metamorphic rocks (Figure 2.5). The border between the Blue Ridge and Piedmont provinces is often considered the Brevard Fault Zone. The rocks have been crushed and ground by the tremendous pressure of thrusting along the fault zone, creating "cataclastic" rocks (Figure 2.6). The Blue Ridge rocks are the spine of the Appalachian Mountain chain, forming the western part of its crystalline core, whereas the Piedmont rocks form the foothills of the mountains, and include the eastern part of the Appalachian Mountains' crystalline core. Most of the ancient Blue Ridge rocks are related to the geological events of the Precambrian and Cambrian periods, from the Grenville mountain building to the Cambrian rift basins. Most of the Piedmont rocks actually formed somewhere other than North America and were attached to the side of the continent in a patchwork of volcanic islands, fragments of land and former ocean bottom sediments.

Figure 2.5: The Blue Ridge and Piedmont.

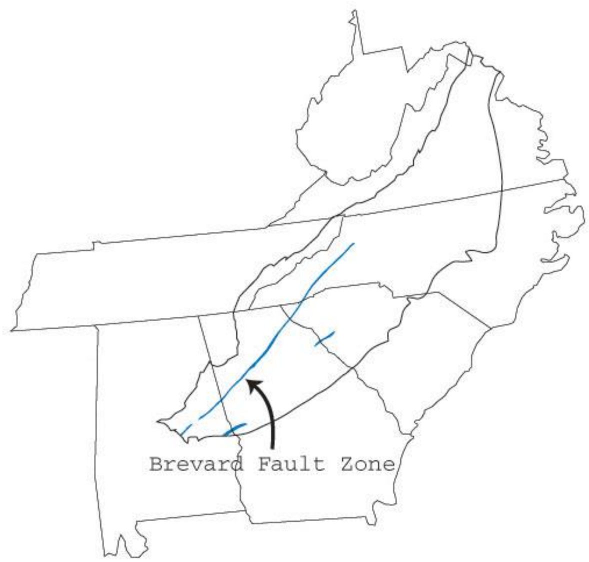


Figure 2.6: Cataclastic rocks along the Brevard Fault Zone and other faults where the rocks have been crushed by faulting pressure.

Many Piedmont rocks are metamorphosed to varying degrees and it is commonly difficult to determine their origin or determine when they formed (Figure 2.7). The Piedmont has two basic divisions: the Iapetus Rocks (also known as the Inner Piedmont) which include the sediments deposited in the ancient Iapetus Ocean, the Taconic volcanic islands (including the “Piedmont Terrane”) and sediments shed from the volcanic islands; and the Avalon Rocks (also known as the Outer Piedmont), recording the distinctive rocks of the Avalon microcontinent and sediment in the adjacent ocean basins.

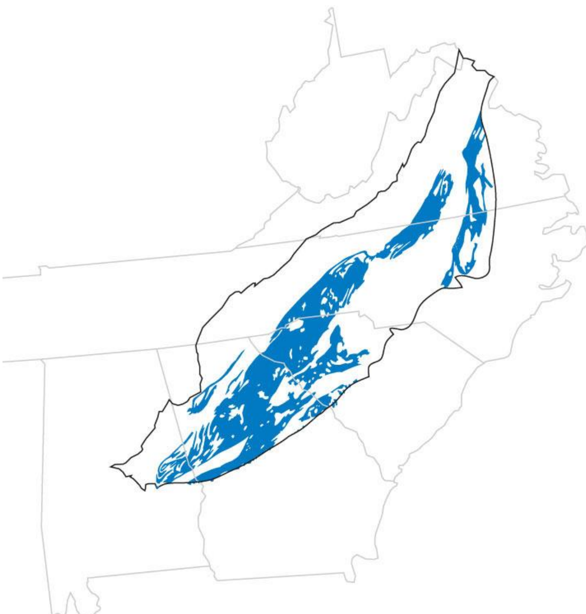
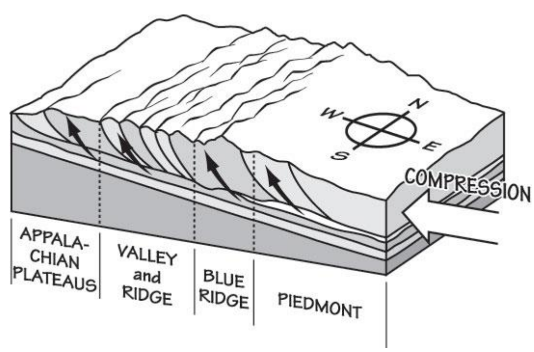


Figure 2.7: Blue Ridge and Piedmont rocks which are metamorphosed to a degree that is difficult to differentiate their origin or when they formed.

During the Paleozoic mountain building event the Blue Ridge and Piedmont Region was compressed into folds, faulted, intruded by magma, sheared, uplifted, and metamorphosed. Both the Blue Ridge and Piedmont were pushed over one hundred miles west, telescoping into a series of folded, thrusted crustal sheets. The Piedmont was thrust over the Blue Ridge, and the Blue Ridge was thrust over the rocks further west (Figure 2.8). In some areas of the Blue Ridge and Piedmont, ancient Grenville basement rock is exposed in windows where the overthrust Piedmont rocks have eroded away. Elsewhere Grenville rocks are buried deep beneath the Earth’s surface (hence the term “basement.”)

Figure 2.8: The crust was "telescoped" by the compressional forces of the Paleozoic mountain-building events. Slices of crust were thrust over each other, stacking like a deck of cards.

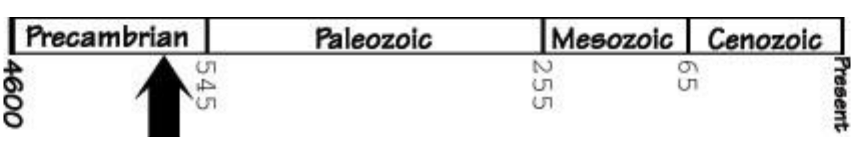


Most commonly, older rock layers were thrust over top of younger rock layers. Erosion has removed part of the overthrust crust (of older rocks) in some areas of the Piedmont and Blue Ridge, exposing the younger buried rock beneath. These “windows” (or fensters) allow us to look through to the younger rocks below the overthrust rocks (Figure 2.9). Older rock on top of younger rock is the exception to a general rule in geology, the Law of Superposition: younger rocks are usually found above older ones. The exception to the rule only happens when folding overturns rocks or when older rocks are thrust on top of younger ones. How do geologists figure out whether the youngest is on top? If the rock has been overturned in a giant fold, clues such as mud cracks or fossils on the bottom of a layer of sedimentary rock may suggest the rock is upside down. Thrust faults may have fossils or unique rock components out of the order they normally occur in every other known locality. Often it is necessary to determine which layers are older by looking at the overall structural geology of the region or using radiometric dating.

Figure 2.9: Outstanding geologic windows of the Southeast.

The Blue Ridge and Piedmont Region was at the center of the mountain building events throughout the Paleozoic and many of the rocks were originally formed deep below the surface as cooling magma. Thus, it should be no surprise that this region is highly metamorphosed (especially the Blue Ridge and inner Piedmont). The uplifting, folding and faulting of the mountain building activities exposed the ancient metamorphosed Blue Ridge rocks, which are the core of the mountain range. The inner Piedmont closest to the Blue Ridge is also highly metamorphosed, having been nearly at the center of the continental collisions. The outer Piedmont is more variably metamorphosed. The only sedimentary rocks or sediments within the Blue Ridge and Piedmont region are modern (Quaternary age) deposits from rivers and streams, and rift basin deposits, which formed during the Triassic and Jurassic periods when the ancient supercontinent of Pangea split apart.

Precambrian Rocks



The Blue Ridge is dominated by Precambrian rocks, including rocks from more than one billion years ago associated with the Grenville mountain building event, and late Precambrian rocks associated with proto-North America breaking away from a supercontinent. Precambrian rocks are also sometimes found in the Piedmont where overthrust layers were eroded to expose the ancient bedrock.

The oldest rocks in the Blue Ridge and Piedmont Region are known as Grenville Basement, which is composed of highly metamorphosed igneous and sedimentary rocks that were formed during the Precambrian Grenville mountain building event more than one billion years ago. Grenville-aged rocks were originally sandstone, shale and limestone deposited in a warm, shallow ocean along the eastern margin of proto-North America (the Grenville Belt). These are the oldest rocks found at the surface in the Southeast (Figure 2.11). As the Precambrian supercontinent formed, the sedimentary rocks of the Grenville Belt were squeezed and pushed up onto the margin of proto-North America, forming the Grenville Mountains. Due to the intensity of the squeezing, the sedimentary rocks were metamorphosed. The sedimentary rock sandstone became the metamorphic rocks quartzite, gneiss or schist; limestone became marble; and shale became gneiss and schist.

During Grenville mountain building, magma created by friction between the converging plates rose up into the overlying crust. Some blobs of magma rose high enough to push through the overlying sedimentary rocks, but remained well below the surface. The blobs eventually cooled and crystallized, forming igneous rocks such as granite, anorthosite and, less commonly, gabbro. As the Grenville Orogeny continued, the cooled igneous blobs and the sedimentary rocks of the Grenville Belt were later buried under as much as 30 kilometers of sedimentary cover! With that much crust overhead, the pressure and temperature on the buried rocks was extremely high, causing further metamorphism.

For millions of years following the Grenville mountain-building event, the Grenville rocks were worn down and buried by layers of sedimentary rock. Grenville-age rocks are present in many other parts of the Southeast besides the Blue Ridge, but are generally deeply buried by younger overlying sedimentary rocks. The Precambrian rock is visible at the surface in the Blue Ridge and Piedmont region only because of intense thrusting and subsequent erosion of the area during the Paleozoic mountain building events (especially the Alleghanian), which uplifted layers of rock that were once buried beneath many kilometers of crust.

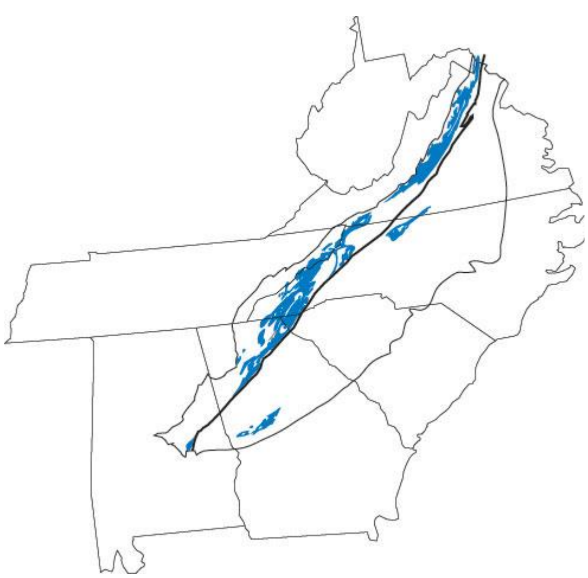


Figure 2.11: Precambrian Grenville basement rock of the Blue Ridge and Piedmont Region. These are the oldest rocks at the surface in the Southeast.

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