Rocks of the Blue Ridge & Piedmont: Region 1, con't

Along a line from northern Georgia to southwestern Virginia (with the line continuing into the Northeast) are small exposures of very unusual dark rocks called ophiolites (Figure 2.18). Ophiolites are made of former deep-sea sediment, oceanic crust and upper mantle material. The line of ophiolite exposures is located along the ancient suture between North America and the Iapetus Rocks of the Ordovician Taconic Mountains. These igneous rocks, which form the Ultramafic Belt, are mostly basalts, gabbros and peridotite. Peridotite, derived from the upper mantle, is commonly altered slightly through metamorphism to a greenish rock called serpentinite.

Ophiolites are recognized by their particular sequence of rocks that are not usually found at the surface. The sequence includes sedimentary rock from the ocean floor underlain by pillow basalts. As basaltic lava pours out of cracks in the oceanic crust, it cools very quickly in seawater and forms pillow-shaped masses of basalt. Beneath the pillow lavas are intrusions of gabbro. The lowest layer in the ophiolite sequence is composed of peridotite, a rock formed in the Earth's upper mantle and rarely seen at the surface. That these sequences are found far from the ocean today is evidence for the tectonic movements of the past.

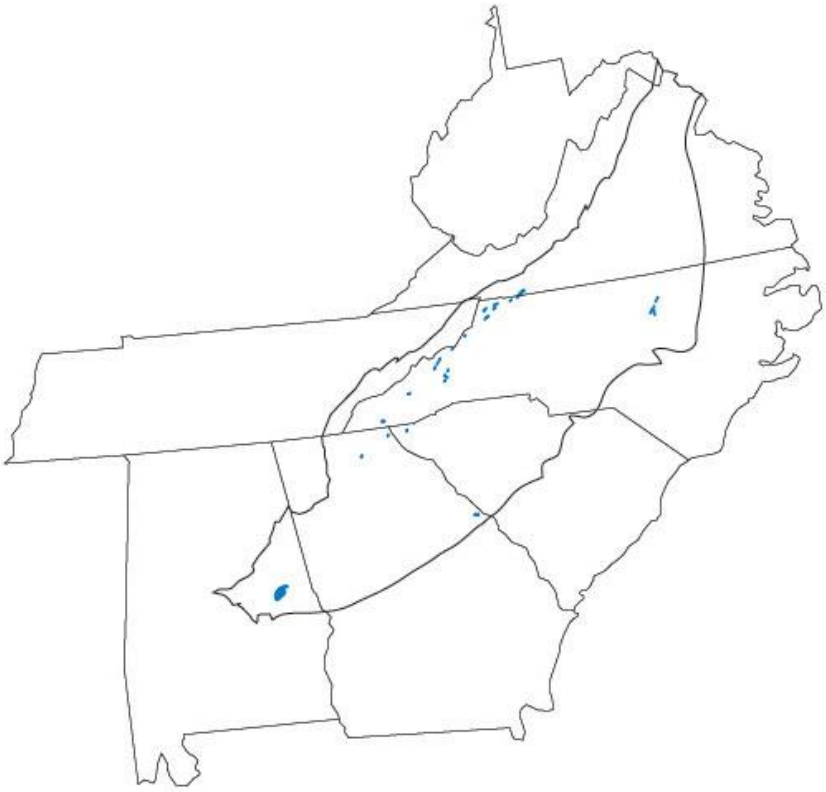


Figure 2.18: Ophiolite exposures along the ancient suture between North America and the Taconic volcanic

Ophiolites

When North America was on its collision course with the Taconic volcanic islands, the oceanic crust in between the continents was being pushed beneath the continental crust of the approaching North America. As the oceanic crust was subducted, some of the deep-sea sediments overlying the crust, the oceanic crust itself, and perhaps rock from the upper mantle, were scraped off the descending plate and did not get shoved back down into the mantle. Instead, the scraped off ophiolite was left stuck on the continental crust.

Subsequent erosion exposed this odd group of rocks that is so unlike the surrounding rock of the continental crust. The ophiolites are significant in the geology of the Southeast because they record the subduction of the oceanic plate beneath the Taconic volcanic islands as they collided with North America. Figure 2.19 by J. Houghton.

During and after the Taconic mountain building event, sediment continued to be deposited in the ocean basins then existing to the east and west of the Taconic Mountains, mixing with and then covering the limestone that had been building up along the margin of North America prior to mountain building.

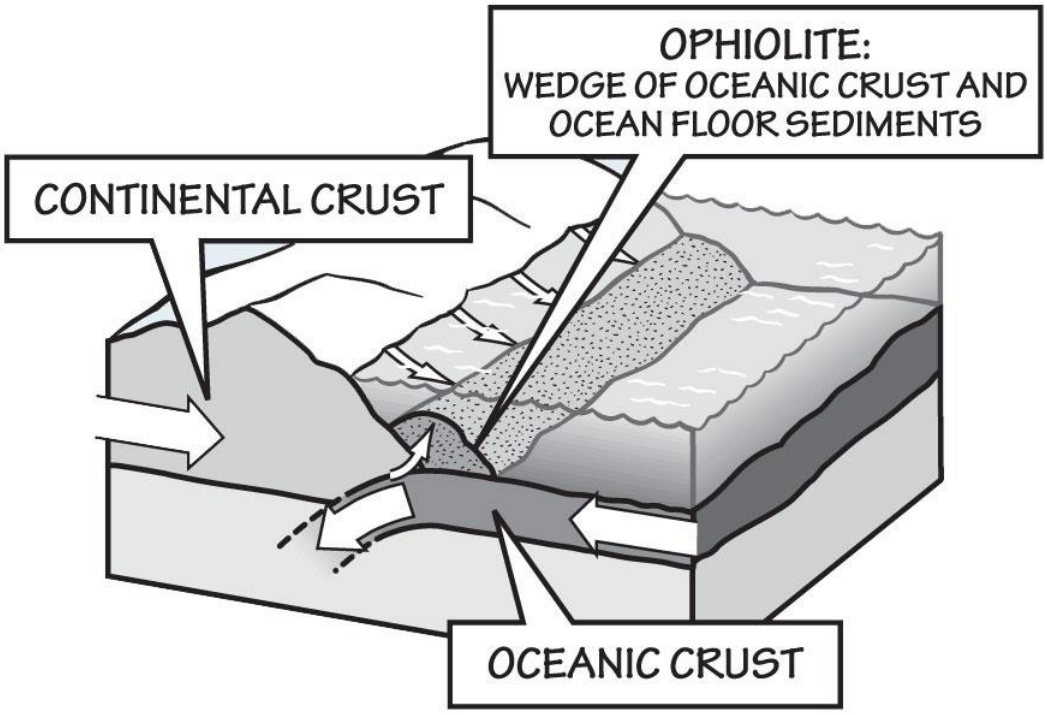


Figure 2.19

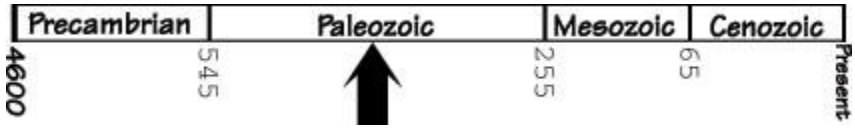
Light vs. Dark Igneous Rocks: clues to ancient chemistry!

Dark-colored igneous rocks generally come from either mantle magma or melting oceanic crust at a subduction zone, and are called “mafic” (meaning dark). Oceanic crust is dark, dense and rich in iron and magnesium. The dark color originates from the iron and magnesium, and a correspondingly low percentage of silica. Dark igneous rocks include basalt and gabbro.

Light-colored rocks are formed from continental crust that is melted from the pressure of overlying rock or friction from colliding plates. Continental crust derived sediments may also melt to form light-colored igneous rocks. Light-colored igneous rocks are very rich in silica and lack significant amounts of iron and magnesium, and include rocks such as granite.

The abundance of silica relative to iron and magnesium, and resulting internal structures of minerals, makes light-colored igneous rocks less dense than oceanic crust. Thus, continental crust, with a density of 2.7 g/cm3, is rarely subducted when plates collide because it is too buoyant to be pulled under. Oceanic crust, with a density of 3.2 g/cm3, is more easily pulled under an approaching plate.

Devonian Rocks



During the late Devonian, the Outer Piedmont Avalon Rocks were attached to the margin of North America. The Avalon Rocks include the Avalon microcontinent (made up of volcanic sediment, sandstone, mudstone, and intrusions) and the surrounding ocean basin sediment (made up of mud, ash, and sand) on either side of the microcontinent. In the collision with North America, the Avalon rocks underwent varying degrees of metamorphism depending on how close the rocks were to the center of the collision. Marine sediment became argillite, slate, gneiss, schist, phyllite, and quartzite; and preexisting intrusions were metamorphosed to amphibolite, greenstone, serpentinite, metagabbro, and metabasalt.

The Carolina Slate Belt stretches over 600 miles from Georgia to Virginia. Located in the outer Piedmont, the belt is a weak to moderately metamorphosed section of the Avalon Rocks. The slate belt includes argillite, slate, schist and phyllite and has significant gold deposits (Figure 2.20). The collision of the Avalon Rocks also resulted in igneous intrusions throughout the Piedmont, similar to Ordovician and earlier intrusions (Figure 2.21). Some of these intrusions formed pegmatites.

Figure 2.20: The Carolina Slate Belt.

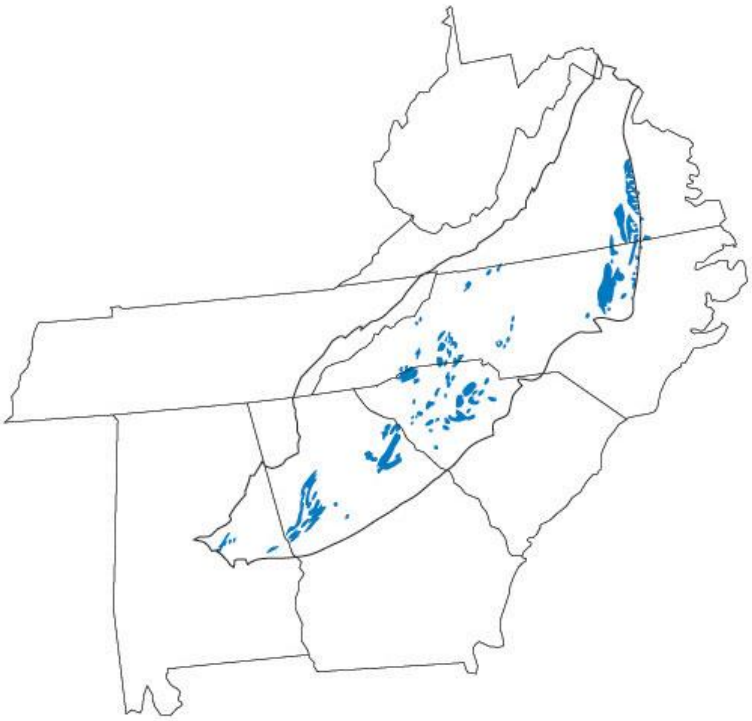


Figure 2.21: Igneous intrusions associated with the Devonian Acadian mountain-building event.

Picconi, J. E. 2003. The Teacher-Friendly Guide to the Geology of the Southeastern U.S. Paleontological Research Institution, Ithaca, NY.

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