



Mountain Building Part II: the Taconic Mountains

During the early part of the **Ordovician** period, about 470 million years ago, the Iapetus Ocean began to close as the continental plates came together again. The **Gondwana** plate moved towards the Southeast region, while the **Baltica** plate

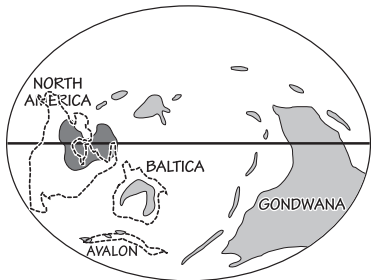


Figure 1.6: Ordovician: 458 million years ago. Shaded areas represent land that was above water. Figure by J. Houghton, after C. Scotese, Paleomap Project, 2000.

approached what is now New England, eastern Canada and Greenland (Figure 1.13). Though neither Gondwana nor Baltica collided with North America until several hundred million years later, the initial convergence of the plates caused changes in the appearance of the margin of North America. As the plates converged, a subduction zone formed at the edge of the North American plate where Iapetus oceanic crust was forced under the Pied-

mont Terrane (Figure 1.14). The intense heat and pressure caused by the colliding plates melted crust and created a string of **volcanic islands** along the subduction zone.

Volcanic Islands

Volcanic islands are common at subduction zones between colliding oceanic plates. As the plates smash together, one plate is pulled under the other (or subducted). The friction between the plates generates enough heat and pressure to melt some of the crust. The molten rock rises upwards through the crust and creates a string of volcanoes along the edge of the plate. The Piedmont Terrane, a chunk of land rifted off the Southeast during the late Precambrian, also became a site of island volcanism at the edge of the subduction zone.

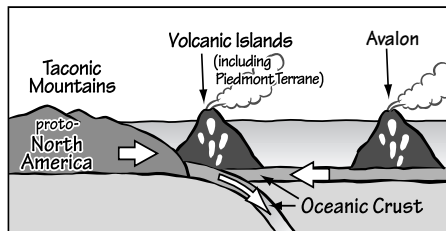


Figure 1.14: An Ordovician cross-section showing volcanic islands forming at a subduction zone between the converging plates of North America and Africa (part of Gondwana.)

melted into magma. The **magma** migrated upward through the crust and in some places broke through the crust as lava to form Piedmont Terrane volcanoes. The volcanic islands drew closer and closer to North America as the oceanic crust was subducted beneath the North American plate. Eventually the islands were pushed onto the margin of North America. The carbonate rocks that had been deposited in

In the Northeast, the Iapetus Ocean began to close during the middle **Ordovician**; in the Southeast, the Iapetus Ocean began closing during the early **Ordovician**.

Ancient continents

It has taken millions of years for the continents to take on the shapes we see today. To simplify ancient geography, geologists have given names to the proto-continents to distinguish them from their modern counterparts: **proto-Europe** (Northern Europe without Ireland and Scotland) is known as **Baltica**; proto-North America is known as **Laurentia**; and Proto-Africa was part of a group of continents known as **Gondwana** (Africa, Australia, India and South America)

The Aleutian Islands are a modern example of **volcanic islands** forming at a subduction zone.

Magma is molten rock below the surface of the Earth. When the molten rock breaks through the surface it is called lava.

Cenozoic	Quaternary	65	Millions of Years Ago
	Tertiary		
Mesozoic	Cretaceous	255	
	Jurassic		
	Triassic		
	Permian		
Paleozoic	Pennsylvanian	545	
	Mississippian		
	Devonian		
	Silurian		
	Ordovician		
Precambrian	Cambrian	4600	
	Precambrian		





Geologic History

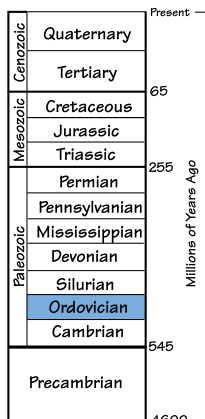
The **Iapetus Rocks** includes the volcanic islands formed at the subduction zone off the coast of North America, the volcanic Piedmont Terrane, and the sediment of the Iapetus Ocean bottom. The Iapetus Rocks form the Inner Piedmont of the Southeast.



see **Rocks**, p. ___ for more on the Inner Piedmont..

An **orogeny** is a mountain-building event (like the formation of the Taconic or Grenville Mountains) caused by colliding plates and compression of the edge of the continents. Orogeny is derived from the Greek word, 'oro,' meaning mountain.

Other **basins** formed at this time in the Southeast from the compression forces of Taconic mountain building, including the Black Warrior Basin of northwest Alabama and northeast Mississippi. These basins filled with sediment from the eroding mountains.



the Iapetus Ocean through the Cambrian were squeezed and pushed ahead of the volcanic islands up onto the margin of the continent, along with deeper water silts, sands and clays, and volcanic remnants such as ash, cooled lava and magma intrusions (Figure 1.15).

Folding, thrust faulting, uplifting, and intrusions occurred along the margin of the continent as the **Iapetus Rocks**, including the volcanic islands, Piedmont Terrane and Iapetus Ocean sediment were thrust onto the side of North America. The intense pressure of the colliding plates and addition of the Iapetus Rocks caused another mountain chain to form in

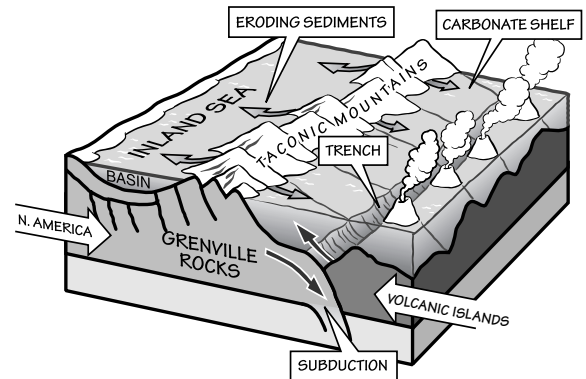


Figure 1.15: Volcanic islands formed where the plates were forced together as the Iapetus Ocean closed. The compression crumpled the crust to form the Taconic Mountains and a shallow inland sea. Figure by J. Houghton.

place of the worn-away Grenville Mountains. This mountain-building event is called the Taconic **Orogeny**. The Iapetus Rocks, including the string of offshore island volcanoes and associated ocean basin sediment from the Taconic mountain building event, added the inner region of the Piedmont to the Southeast. The Taconic Mountains extended from present-day New England to Alabama.

The compression induced by the collision of the Iapetus Rocks with North America caused a downwarp in the crust to the west of the Taconic Mountains, creating the Appalachian **Basin**. This sagging crust was flooded by a broad, shallow inland ocean and filled with sediment from the eroding Taconic Mountains. As

Basins...and then basins!

Downwarped crust resulting from mountain building plate collisions in the Paleozoic formed the Appalachian, Black Warrior, and Illinois Basins (Figure 1.16). Not all basins are caused by converging plates, though. Some basins form when plates are diverging, such as the Precambrian rift basins and Triassic-Jurassic rift basins. In these cases, the crust is not downwarped, but rather blocks of crust slide down faults created by the rifting crust (Figure 1.17).

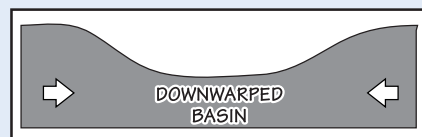


Figure 1.16

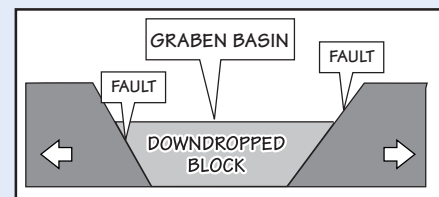


Figure 1.17





sediment was eroded from the western side of the Taconic Mountains, *delta* deposits formed a wedge of sediment spreading away from the mountains along a shoreline which extended from Virginia to Alabama (Figure 1.18). Some of the delta sediment settled in the shallow inland sea, gradually filling the basin. Sediment was also being eroded and deposited east of the Taconic Mountains into the Iapetus Ocean, which continued to narrow as the North America, Baltica, and Gondwana plates converged. Eventually, the Taconic Mountains eroded away to only the inner core, as had the Grenville Mountains previously.

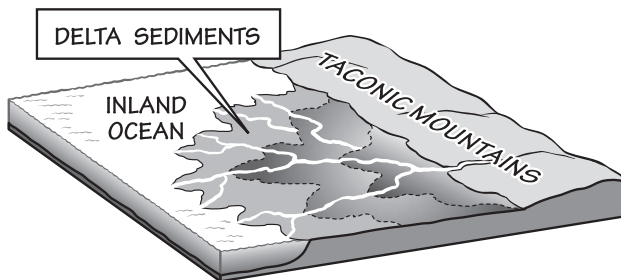


Figure 1.18: Delta deposits formed along the eroding Taconic Mountains into the Inland Sea. Figure by J. Houghton.

A **delta** forms as sediment is eroded from mountains and transported downward by streams. Deltas typically form a wedge-shaped deposit as sediment fans out across the lower elevations.

The Mississippi Delta is a modern delta that is dumping sediment from the Mississippi River into the Gulf of Mexico.

The string of volcanic islands collided with eastern North America in stages, similar to closing a pair of scissors. In the Southeast the collision occurred millions of years earlier than in the Northeast. The volcanic islands converged on North America like a hinge that closed first in the Southeast and later in the Northeast. When the volcanic islands finally collided with the Northeast in the middle Ordovician, the sediment eroded from the northeastern Taconic Mountains spread as far south as Tennessee. The sediment reflects the later, more northerly pulse of the Taconic mountain building event.

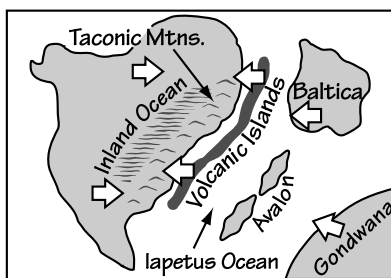


Figure 1.19: Taconic Mountain Building

-Volcanic islands and Iapetus Ocean sediment (together making up the Iapetus Rocks) collide with North America

-Crust is depressed west of Taconic Mountains to form basin

-An inland sea floods basin; delta deposits form

Cenozoic	Quaternary	Present
	Tertiary	
Mesozoic	Cretaceous	65
	Jurassic	
	Triassic	
	Permian	
Paleozoic	Pennsylvanian	255
	Mississippian	
	Devonian	
	Silurian	
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	Cambrian	
Precambrian		545
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