



The 1st Breakup: *ancient rifting*

Following Grenville Mountain building, the North American plate began to break away from the other continental plates because of **tensional** forces in the Late Precambrian and early Cambrian. A series of cracks in the crust formed,

Precambrian rift basins

Rift basins that formed in the crust when the continental plates were pulling apart during the Precambrian have played an important role in the geologic makeup, shape, structure and sedimentary deposits of the Southeast. Many basins formed during this time into which sediment was deposited in the Precambrian and throughout later mountain building events. The Cincinnati Arch, a structural feature that stretches through Ohio, Kentucky, and Tennessee, was originally a rift basin. In the Cambrian, the rift basin was uplifted and became an arch. The Nashville and Jessamine Domes of Tennessee and Kentucky are bumps along the Cincinnati Arch.

Not all of the cracks broke completely across the continent. Instead, many rifts became **basins** when crustal blocks slid downward along the cracks in the crust (Figure 1.8). These basins filled with sediment, as well as lava that welled up through the cracks in the crust. A few of the larger rifts grew and actually split chunks off the margin of North America. One of these chunks of land, named the **Piedmont Terrane**, continued to move away from North America for millions of years, becoming a large offshore island like modern Madagascar (Figure 1.9).

During the erosion of the Grenville Mountains in the late Precambrian and early Cambrian, the geography of the world looked nothing like it does today (Fig-

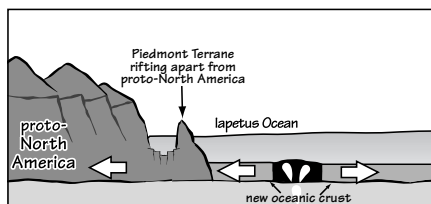


Figure 1.9: A Precambrian cross-section showing the Grenville belt of ocean floor sediment being squeezed between proto-North America and Rodinia.

known as **rifts**. The continents finally split apart completely at a major rift that eventually was flooded by ocean water. This ocean is called the **Iapetus** (or **Proto-Atlantic**) because several hundred million years later the modern Atlantic Ocean opened up in a similar way in a similar position relative to modern day North America and Europe.

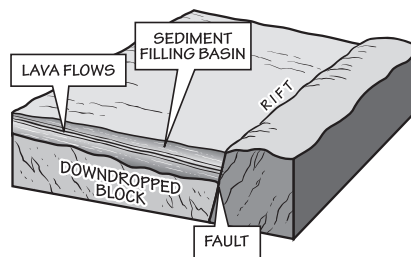


Figure 1.8: A typical rift basin, filled with sediment and lava flows.

Tension refers to objects (such as plates) pulling in opposite directions, unlike compressional force in which two objects are colliding as they are pushed together.

Rifts are cracks in the crust, which can be caused by tensional stress as a landmass breaks apart into separate plates. If you hold a Snickers candy bar at both ends and slowly pull it apart into two pieces, you will notice a series of cracks (“**rifts**”) in the chocolate. At a major rift near the middle, the candy bar will break apart completely. The way that the candy bar breaks is analogous to how the continental plate separated in the Precambrian to form the Iapetus Ocean.)

The **Proto-Atlantic** is also known as the **Iapetus Ocean**. In Greek Mythology, Iapetus was the father of Atlantis.

Basins are depressions in the Earth’s crust produced by subsidence.

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



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

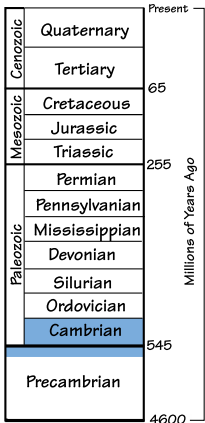




Geologic History

During this period the Earth experienced the most extreme glaciations in its history, with ice sheets developed in the tropics between about 750 and 560 million years ago. The end of rifting and the break up of Rodinia roughly corresponds to the end of the glaciations, the rise of sea level, and the Cambrian Explosion of organisms.

Carbonate rocks include limestone and dolostone, formed by the accumulation of calcium carbonate (CaCO₃) shells and outer skeletons from aquatic organisms, such as corals, clams, snails, bryozoans and brachiopods. These organisms thrive in warm, shallow waters common to tropical areas. It is not surprising that modern carbonates are observed forming in places such as the Florida Keys and the Bahamas.



ure 1.10). North America was experiencing a warm climate because it was positioned near the Equator, with today's east coast facing south. Sediment was eroding from the Grenville Mountains into oceans on either side of the mountain range. As sediment was deposited in the newly formed Iapetus Ocean, the edge of North America became a broad, flat shelf.

The Iapetus Ocean continued to widen during the Cambrian period. Because marine fossils are found on most continents in Cambrian-age rocks, scientists think that sea level was very high worldwide. Warm, shallow seas covered most of the Southeast. Near the end of the Cambrian, as the supply of mud and sand decreased from the worn-down Grenville Mountains, **carbonate rocks** were deposited in the Iapetus Ocean. The carbonate rocks were widely deposited atop the Grenville sediment on the shelf along the margin of North America (Figure 1.11).

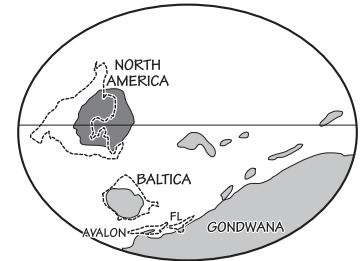


Figure 1.10: Cambrian: 500 million years ago. Shaded areas represent land that was above water. Figure by J. Houghton, after C. Scotese, Paleomap Project, 2000.

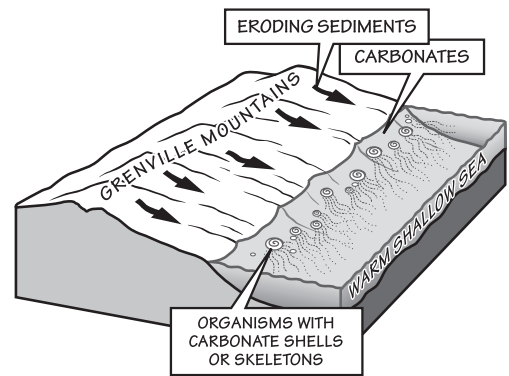


Figure 1.11.: Carbonate rocks formed in the proto-Atlantic Ocean along the margin of the continent. Figure by J. Houghton.

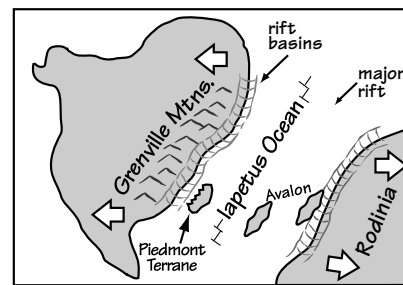


Figure 1.12: Ancient Rifting

- North America breaks away from the supercontinent
- Rifts form in crust from tension of plates moving apart
- Piedmont Terrane breaks off North America
- At a major rift, North America completely breaks away
- Iapetus Ocean floods the major rift

