**Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.**

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## Ocean drilling confirms continental drift

*The Ocean Drilling Ship Resolution spent over 25 years drilling into the ocean floor for scientific purposes in order to better understand the history of the Earth and the ocean basins.*

The theory of plate tectonics, or the concept that the surface of the Earth consists of a number of large rigid plates that move around relative to one another, generating earthquakes in the process, was proposed in 1968, the same year that the Deep-Sea Drilling Program launched its maiden voyage. Timing was ideal as the ability to sample the sediment and rocks of the seafloor provided a unique opportunity to test much of what the theory had proposed.

Plate tectonics evolved from the old idea of continental drift, and also a newer idea put forth in 1963 known as sea-floor spreading. Continental drift dates back to the early 1900's, and grew initially from something that virtually all school kids appreciate today, that the coasts of South America and Africa fit together like a jigsaw puzzle. While other geological and fossil evidence accumulated over the 20$^{th}$ century supporting the idea that South America and Africa, as well as Antarctica, Australia and even India, were at one time joined as a large super

continent named Pangea, scientists really didn't have a process or mechanism capable of moving entire continents around on the earth's surface. This was troubling, and most geologists in the first half of the last century weren't at all ready to accept this idea.

Sea floor spreading was put forth in 1963 as a mechanism to explain the drifting of the continents. It was postulated that new ocean floor was created at the world-encircling ocean ridges, the Mid-Atlantic Ridge, being one example. As hot molten magma from deep within the earth rose towards the seafloor, it cooled and solidified, forming new oceanic crust. It was then carried laterally away from the ridge crest by a thick conveyor belt of deeper crustal material. This conveyor belt was envisioned to operate much like the way an old window shade is pulled down or rolled out. One important difference was that you can pull down a window shade very quickly, but the seafloor was thought to be spreading at rates of only an inch or two per year.

If this idea was correct, then as the volcanic rock that formed the seafloor was carried further from the crest of the ocean ridge on this conveyor belt, it should be getting progressively older. In addition, the marine sediments that were slowly accumulating on the seafloor should be progressively older and thicker the farther we got away from the center of the Mid-Atlantic Ridge.

Something remarkable was discovered as the drilling ship began to bore into the ocean floor as it first crossed the Atlantic Ocean. The cores of sediment and rock that were brought back on board ship and analyzed, and then later dated by oceanographers and geologists, revealed that the sediments were very thin right at the crest of the Mid-Atlantic Ridge and the underlying volcanic rock was very young. Cores taken progressively farther from the ridge crest, as the ship headed for the coastline of North America or Europe, showed thicker and thicker deposits of marine sediment, with older and older fossils. When the core penetrated the volcanic rock beneath the sediments and this rock was radiometrically dated, it was also found to be progressively older moving farther from the ridge crest. These deep cores confirmed the theory that the sea floor was in fact spreading laterally from the middle of the Atlantic Ocean and continents had been slowly drifting apart. The oldest rocks that have been recovered from the Atlantic Ocean floor are about 180 million years old, and have been recovered on opposite sides of the ocean, off the east coast of the United States and off the west coast of North Africa. By knowing the age of these volcanic rocks, and their distance from the ridge crest, where they originally formed, we can determine how fast the sea floor has been spreading over the past 180 million years. This turns out to be about an

inch per year or about the rate at which your fingernails grow. While this rate of ocean floor spreading seems very slow, over the past 180 million years it has been fast enough to completely open the Atlantic Ocean and separate and transport the continents on either side to their present locations.