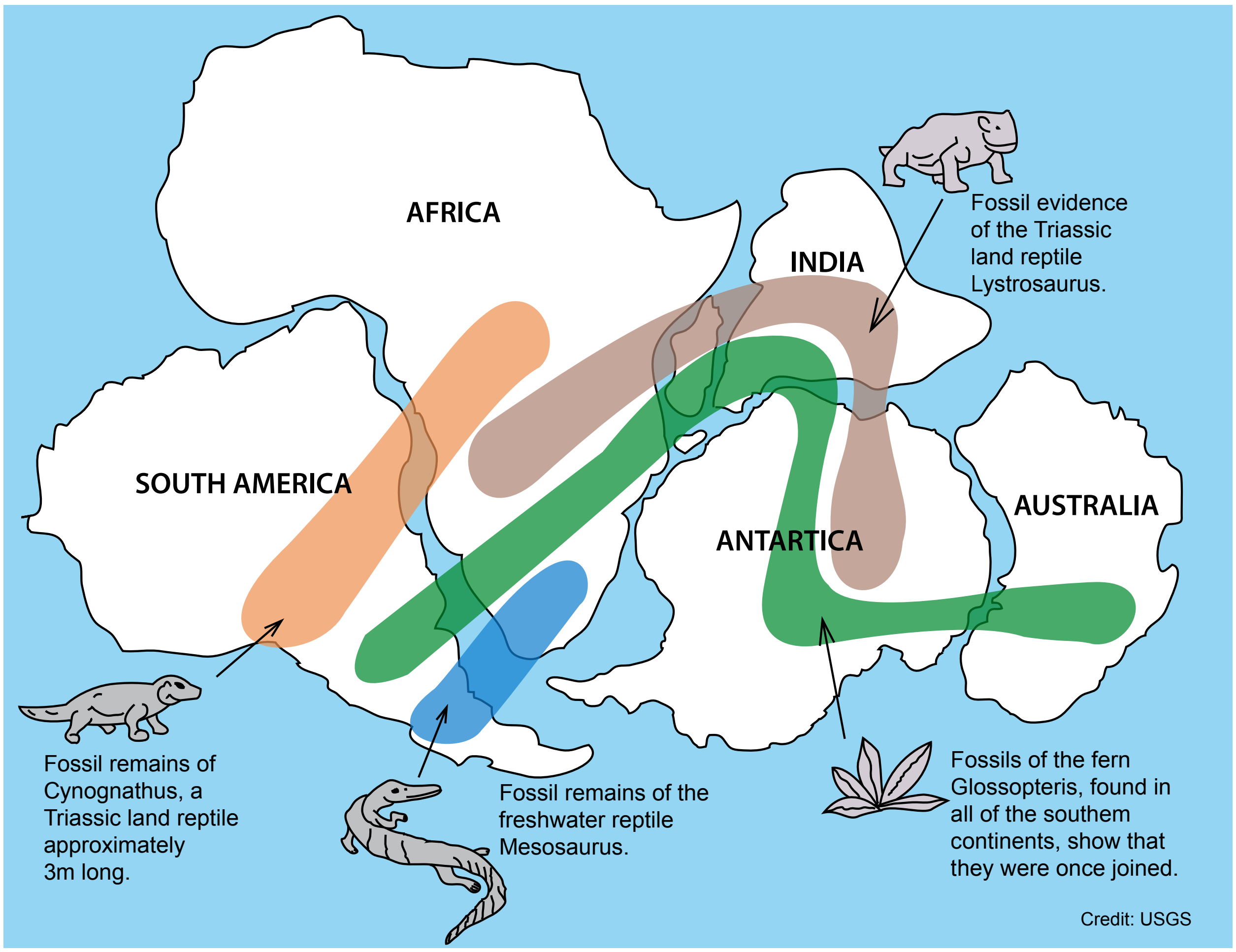
We have succeeded in taking this picture, and if you look at it you see a dot. That's here. That's home. That's us. On it, everyone you've ever heard of, everyone who ever lived, lived out their lives on a moot of dust suspended in a sunbeam.

Carl Sagan

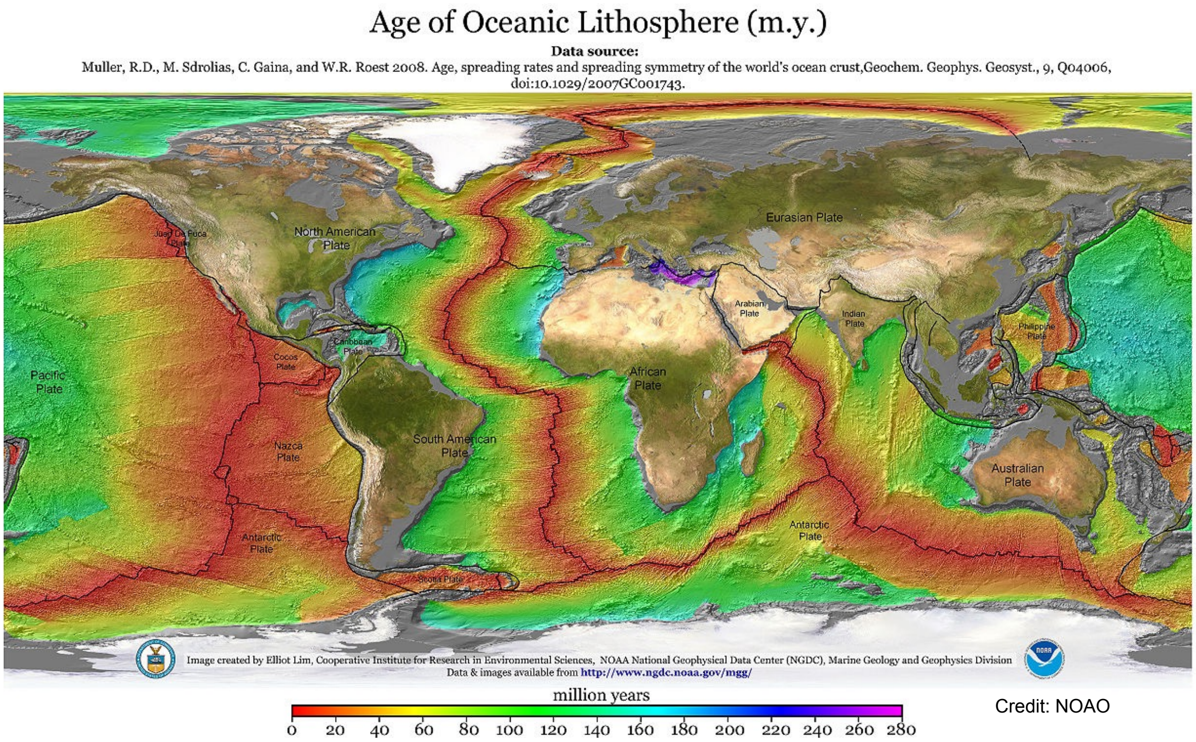
Third Rock From The Sun

Hi there, Astronomy 111. In this module we'll tour the geology of the Earth and summarize the history of the terrestrial planets.



Evidence for plate tectonics includes the jigsaw puzzle game, as illustrated above. If you just take the continents, you notice that they kind of fit together. You can piece them together in one giant super continent, named Pangaea, which likely existed 200 - 300 million years ago. And it subsequently broke up.

More convincing, if you you go to the coasts of, say western Africa and eastern South America, you find the same kind of minerals on both coasts and the same kind of freshwater reptile fossils. This suggests rather strongly that two were much closer together in the past than they were today.



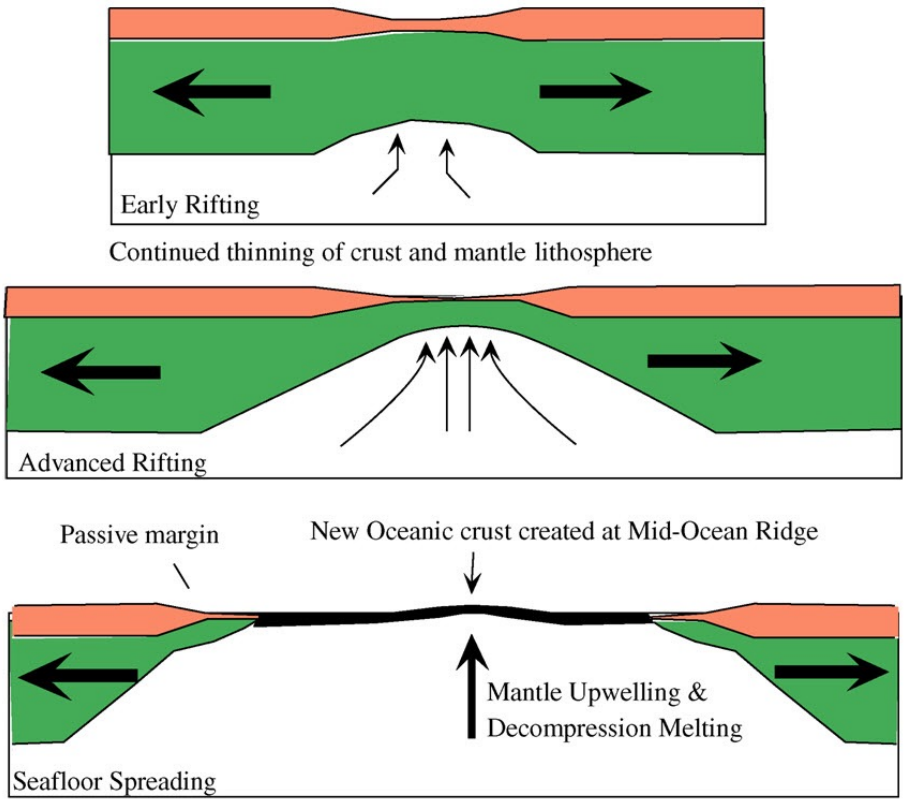
Credit: NOAO

Evidence for plate tectonics also includes the creation of new crust from seafloor spreading, for example, the mid-Atlantic Ridge, one of the deepest parts in the Atlantic Ocean. You might imagine there would be composition differences between the sea floor and the continental crust. And you'd be right because the stuff coming up from the sea floor coming up has a slightly different isotopic composition than what you find on the continents. So you can see evidence for different ages of material. This is what the age map above is showing. Red is young, purple is old. The sea floor at known plate boundaries is undeniably younger.

Of course in these techo days, you can measure plate motion directly with GPS. The typical speeds are about 5 cm per year. Some slower, some faster, but of that order. All the plates are in constant motion. That's why the continental crust looked much different in the past and will look much different in the future.

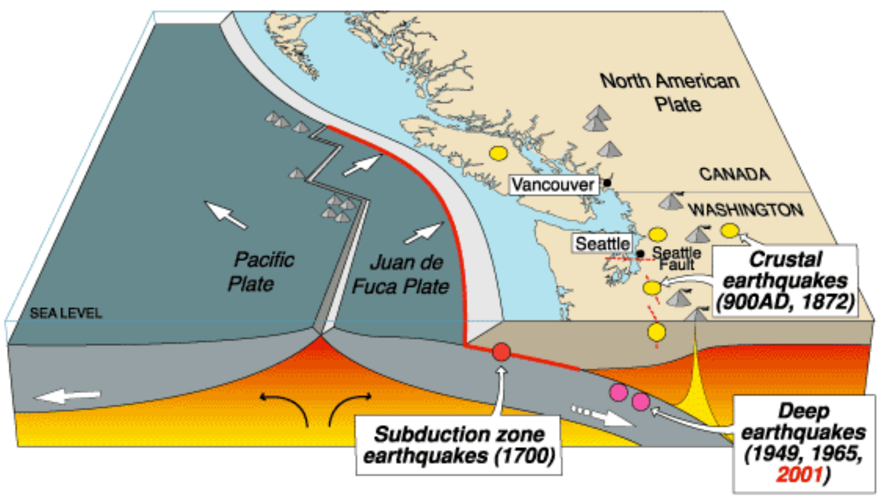
Plate tectonics explains much of Earth's geology, including seafloor spreading and subduction. The illustration below shows the thinning of the lithosphere as plates are pulled apart. As you spread out, you're making new crust, you're making new sea floor in these spreading out regions. The mid-Atlantic ridge, is a good example. The Atlantic Ocean is getting larger.

The illustration below also shows a subduction zone, where one plate dives beneath another plate, back into the Earth's mantle so to speak. The example shown is the subduction of the Juan de Fuca plate diving under the North American plate along the western US - Canada border. Such subduction causes earthquakes and volcanoes - the ring of fire we explored earlier.



Credit:Wikipedia
Creative Commons

Cascadia earthquake sources



	Source	Affected area	Max. Size	Recurrence
🔴	Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
🟣	Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
🟡	Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

Earth repaves itself 100 million years or so. The movement of the plates has radically changed Earth's surface appearance many times in the past. And will continue to do so in the future.

Finally, were the geologic properties of the terrestrial planets destiny? Seems that way. The fundamental properties of size, distance from the Sun, and rate of rotation drive the internal processes, surface properties, and as we shall see, the atmospheric properties. These are all quantities you get at birth. Whatever size you got, whatever you're rotating, whatever your distance from the Sun, that's what got. Ii's pretty much going to determine a planet’s fate.

Earth, like all the other planets, was hit by the era of of heavy bombardment early in the solar system’s formation. But it still has a thin lithosphere because of its size. It's still volcanically and tectonically active. That’s what the bar graph below shows. Contrast this with Mercury, avery small planet. It lost its heat relatively quickly and thus continues to retain features from the era of a heavy bombardment.

Thanks! Bye Bye.