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Transcript

Evidence for Plate Tectonics
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So in this episode, I'm going to go through the evidence that we've got for the theory of plate tectonics.

Now, plate tectonics is the universal and unifying theory that we have for many of the features that we have on our planet, including the shape and location of continents, and the location of mountains and all of that type of stuff. And if you don't know about plate tectonics, then please go and listen to the episode that I have already recorded about plate tectonics, to get an overview of what plate tectonics is all about. But for now, it's all about the evidence.

So probably the first thing that people noticed about our planet when good maps were available, was that some of the continents look like just by their shape that they fitted together like a jigsaw puzzle. And I know that lots of people have tried to take a map of the Earth, cut around the shorelines of all the continents and try to click them together and you get a rough fit. But it's not until you realize that the continents spread out under the ocean a little and you cut out around the continental shelf area, and then try to fit things together that you get a much better fit. Added to that is that you need to use a map that does not stretch out the continents. So as standard map that we have of the earth normally has the North Pole in the south pole, which are just points stretched out to form lines. So the very top of the map on those projections, has the North Pole as a line, and the very bottom of the map as the south point the South Pole as a line. And that distorts the shapes of the continents as you move from the equator towards the poles. So if you can use a projection, where the continents are not distorted, and you cut around the edge of the continental shelves, and then you try to put everything together, then you get a fairly good fit of all of the continents. In particular, it was really noticed that the continents on either side of the Atlantic Ocean really fit in well together. So South America fits really well into Africa, for example. And that fact alone started leading scientists of the day into thinking that the continents may have moved.

The next piece of evidence is somewhat related to that, because it was noticed that these continents have mountains that are located and they get disjointed by the ocean. But if you join the continents back together, like in the first part of evidence, you will find that the mountain chains all link up. And this followed by the age of the rocks on either sides of the oceans also link up when you put the continents back together. So there's mountains and fossils on either side of what is now the ocean basins, if you move the continents back together the ages of the rocks or link in together nicely as do the mountain ranges. So shapes of continents, the location of mountains, and the ages of rocks on either side of the ocean basins, all started to fall together to provide evidence that the continents may have moved.

Now I've just brushed over those few. But they were really the fundamental things that got people thinking that something strange was happening on our planet that moved land masses around. And it was from that evidence that people started looking for more scientific facts that they could use to try to see what was happening.

And one of the earliest pieces of data that they gathered was the location of earthquakes. Now fortunately, large earthquakes can be measured from many many miles away from where the earthquake took place. And in some parts of the world, including in Europe, there were people who were measuring earthquakes and locating them using the simple triangulation method from data that had been collected from three points. And the earthquake data, just the location of where earthquakes took place. If you plot them on the map of the globe, you will notice that they form bands around the planet. So 90% of the earthquakes take place along these bands or zones. We recognize these bands or zones now as the boundaries between the lithospheric plates of the planet. Now there are 10% of earthquakes that don't play take place on those boundaries. But that is further evidence that these huge slabs of rock are moving and in the process So moving build up stresses that are occasionally released as earthquakes. And we call those intraplate earthquakes.

Likewise, if we go and map the location of all of the volcanoes that are active on Earth, we find they also fall into bands or zones around our planet. The biggest being the Pacific Ring of Fire that I'm sure you've all heard about, where there are volcanoes all around the basin of the Pacific Ocean. And scientists now recognize that those volcanoes are related to subduction zones that are taking place where slabs of rock are being forced under continents, creating melting, and then the formation of these massive volcanoes.

So we have this zoning of earthquakes and volcanoes that are related to the boundaries of the tectonic plates. And that provides us great evidence for the plates actually moving.

If we go and have a look at those zones, where there's earthquakes and volcanoes, we also notice some other amazing features of the planet, like the deep ocean trenches. So when one tectonic plate is being forced under another, not only do we get lots of earthquakes there, but the bending of the plate that's been forced down under the other plate creates a very deep Ocean Trench, a big linear feature, as the plate gets forced down, that, in fact, are places where the ocean is the deepest on the planet, like the Marianas Trench, then onshore from the trenches, are the volcanoes, so they're obviously related. Another piece of evidence for plate tectonics takes place in the middle of some ocean basins, like in the Atlantic, where we find this great linear underwater Ridge, that is now called the Mid Atlantic ridge that runs right down the center of the Atlantic Ocean. And along that area, there are lots of shallow earthquakes, and lots of volcanism taking place. And we recognize this as a place where plates are moving apart from each other. And the evidence supports that.

Now, when rocks are collected from these mid ocean ridges, when they're close to the ridge, we noticed that they're incredibly young. Then as we move away from the ridge, the rocks get older and older. But there is a mirror image of those ages, with the ridge being the mirror. So on either side of the ridge, the rocks get progressively older as you move away from the ridge. And this is evidence that new crustal material is being added to a plate on either side of the ridge. So you move away from the ridge in either direction, and the rocks become older. We also noticed that those rocks contain magnetic minerals that show us where the location of the Earth's magnetic field was when they were formed. And again, there is a reflection along the mid ocean Ridge, a mirror image of those patterns from the ridge moving into the older rocks, again, evidence that we have spreading taking place at the mid ocean ridges.

And on land, if we go and look at rocks that form from the cooling of molten material, we can find those same magnetic minerals in them and find out where they were pointing when that rock formed. And by doing so, we can actually measure the motion of the continent over time. And this evidence is referred to as apparent polar wandering curves. Because originally we thought the Poles were moving in instead, it really was the continents were moving relative to the poles.

And the last piece of evidence is that we have these strange volcanoes that are located nowhere near the other zones of volcanoes. They're located way out in the middle of the Pacific Ocean, for example, like why are right in the middle of a continent like Yellowstone volcano. And we realize that what these volcanoes are, are hotspots that come deep from the mantle that burn a hole all the way through the overlying plates, no matter where or how the plates are moving. These hotspots leave a trace on the surface of the earth because as the hotspot burns through and the plate moves above it, new volcanoes are formed on the plate as the plate moves and we get a chain of volcanoes the active one being where the hotspot is now and Then older and older and older volcanoes are eroding away along the chain of where the plate has moved over the hotspot. And from this evidence, we can work out the direction and the speed, the plate is moving the speed because we can work out the distance between where rocks are collected of different age formed by the hotspot.

There's the evidence really in brief summary and you can find out more about many of these things by doing further research but shape of continents, earthquakes, volcanoes, age of the seafloor, the seafloor magnetic anomalies, the location of mountains and fossils on either side of the oceans, polar wandering curves, and hotspot volcanoes. They all provide us evidence for plate tectonics and the movement of the continents around our planet.