Theory of continental drift and plate tectonics pdf

Plate tectonics is the scientific theory that attempts to explain the movements of the Earth's lithosphere that have formed the landscape features we see across the globe today. By definition, the word "plate" in geologic terms means a large slab of solid rock. "Tectonics" is a part of the Greek root for "to build" and together the terms define how the Earth's surface is built up of moving plates. The theory of plate tectonics itself says that the Earth's lithosphere is made up individual plates that are broken down into over a dozen large and small pieces of solid rock. These fragmented plates ride next to each other on top of the Earth's more fluid lower mantle to create different types of plate boundaries that have shaped the Earth's landscape over millions of years. Plate tectonics grew out of a theory that was first developed in the early 20th century by the meteorologist Alfred Wegener. In 1912, Wegener noticed that the coastlines of the east coast of South America and the west coast of Africa seemed to fit together like a jigsaw puzzle. Further examination of the globe revealed that all of the Earth's continents fit together somehow and Wegener proposed an idea that all of the continents had at one time been connected in a single supercontinent called Pangaea. He believed that the continents gradually began to drift apart around 300 million years ago - this was his theory that became known as continental drift. The main problem with Wegener's initial theory was that he was unsure of how the continents moved apart from one another. Throughout his research to find a mechanism for continental drift, Wegener came across fossil evidence that gave support to his initial theory of Pangaea. In addition, he came up with ideas as to how continental drift worked in the building of the world's mountain ranges. Wegener claimed that the leading edges of the Earth's continents collided with each other as they moved, causing the land to bunch up and form mountain ranges. He used India moving into the Asian continent to form the Himalayas as an example. Eventually, Wegener came up with an idea that cited the Earth's rotation and its centrifugal force toward the equator as the mechanism for continental drift. He said that Pangaea started at the South Pole and the Earth's rotation eventually caused it to break up, sending the continents toward the equator. This idea was rejected by the scientific community and his theory of continental drift was dismissed as well. In 1929, Arthur Holmes, a British geologist, introduced a theory of thermal convection to explain the movement of the Earth's continents. He said that as a substance is heated its density decreases and it rises until it cools sufficiently to sink again. According to Holmes it was this heating and cooling cycle of the Earth's mantle that caused the continents to move. This idea gained very little attention at the time. By the 1960s, Holmes' idea began to gain more credibility as scientists increased their understanding of the ocean floor via mapping, discovered its mid-ocean ridges, and learned more about its age. In 1961 and 1962, scientists proposed the process of seafloor spreading caused by mantle convection to explain the movement of the Earth's continents and plate tectonics. Scientists today have a better understanding of the make-up of the tectonic plates, the driving forces of their movement, and the ways in which they interact with one another. A tectonic plate itself is defined as a rigid segment of the Earth's lithosphere that moves separately from those surrounding it. There are three main driving forces for the movement of the Earth's tectonic plates. They are mantle convection, gravity, and the Earth's rotation. Mantle convection is the most widely studied method of tectonic plate movement and it is very similar to the theory developed by Holmes in 1929. There are large convection currents of molten material in the Earth's upper mantle. As these currents transmit energy to the Earth's asthenosphere (the fluid portion of the Earth's lower mantle below the lithosphere), new lithospheric material is pushed up toward the Earth's crust. Evidence of this is shown at mid-ocean ridges where younger land is pushed up through the ridge, causing the older land to move out and away from the ridge, thus moving the tectonic plates. Gravity is a secondary driving force for the movement of the Earth's tectonic plates. At mid-ocean ridges, the elevation is higher than the surrounding ocean floor. As the convection currents within the Earth cause new lithospheric material to rise and spread away from the ridge, gravity causes the older material to sink toward the ocean floor and aid in the movement of the plates. The Earth's rotation is the final mechanism for the movement of the Earth's plates but it is minor in comparison to mantle convection and gravity. As the Earth's tectonic plates move, they interact in a number of different ways and form different types of plate boundaries. Divergent boundaries are where the plates move away from each other and new crust is created. Mid-ocean ridges are an example of divergent boundaries. Convergent boundaries are where the plates collide with one another and cause the subduction of one plate beneath the other. Transform boundaries are the final type of plate boundary and at these locations, no new crust is created and none is destroyed. Instead, the plates slide horizontally past one another. No matter the type of boundary, the movement of the Earth's tectonic plates is essential in the formation of the various landscape features we see across the globe today. There are seven major tectonic plates (North America, South America, Eurasia, Africa, Indo-Australian, Pacific, and Antarctica) as well as many smaller microplates such as the Juan de Fuca plate near the United States' state of Washington. To learn more about plate tectonics, visit the USGS website This Dynamic Earth: The Story of Plate Tectonics. If you're a fan of river cruising and slow travel, you'll love the latest travel-by-water trend to resurface: canal barges. Smaller than river cruise ships and often carrying just two passengers (though some can carry as many as 20), canal barges are all about exploring small towns and European villages along the waterways. And while the concept is far from new, canal barge cruising is getting a facelift — and a fast-track ticket into the travel zeitgeist — in 2022, when Abercrombie & Kent launches luxury canal barge cruises in Europe. Abercrombie & Kent's take on canal barging taps into travelers' interest in slowing down and taking in quieter, European destinations outside of the major cities . That's why their canal barges will sail through the Loire Valley and the canals of Burgundy and Champagne. Beyond France, these barges will also take travelers on luxe adventures in Germany, Italy, England, Ireland, Belgium, Holland, and Scotland. Instead of road tripping, and constantly bouncing to new hotel rooms, canal barge cruising gives you a consistent home base as you travel through under-the-radar villages and dock right outside must-visit pubs, wineries, and restaurants. Courtesy of Abercrombie & Kent In terms of what you'll get on the A & K canal barges when they launch next year, here's the rundown. These barges come with gourmet meals, prepared by onboard chefs who source local ingredients as much as possible. They'll curate wine pairings for lunch and dinner, and all food and beverage are included in the trips. Any entry fees to local attractions are also covered in your charter costs. Courtesy of Abercrombie & Kent Bargers (yes, that's the term we're going with) can charter the entire vessel; For example, traveling in Strasbourg's Roi Soleil along the Canal du Midi requires a six-person barge and charters start at $33,900 for seven days. On a more grandiose scale, you can charter a 20-guest canal barge in Venice starting at $79,000 for seven days. However, you don't have to rent out an entire barge — travelers can instead book on an intimate, curated trip instead. There are options to sail the Burgundy canal with only 11 other guests for $5,590 per person. Thanks for your feedback! When you visit the site, Dotdash Meredith and its partners may store or retrieve information on your browser, mostly in the form of cookies. Cookies collect information about your preferences and your devices and are used to make the site work as you expect it to, to understand how you interact with the site, and to show advertisements that are targeted to your interests. You can find out more about our use, change your default settings, and withdraw your consent at any time with effect for the future by visiting Cookies Settings, which can also be found in the footer of the site. You probably know that the Earth's crust is broken up into huge tectonic plates that slide under, over and past each other, slowly building mountains, forming new oceans and triggering earthquakes. But do you know how long all of that has been going on?Scientists aren't really sure, either.Now, after studying ancient rocks in southern West Greenland, one team of researchers says that modern plate tectonics, with its subduction zones, spreading centers, earthquakes and all the other features we're familiar with, probably started about 3.2 billion years ago (the Earth is about 4.6 billion years old). Before that, a much different set of processes shaped the Earth's surface, the researchers say."There have been several very different views on when modern-like plate tectonics started," said Tomas Naeraa, a researcher at the Geological Survey of Denmark and Greenland who led the study. "It was clear from our data that there was a transition 3.2 billion years ago, and rocks formed after that could be related to plate tectonic processes."Ancient rocks in GreenlandWhen and how plate tectonics started is a key question among geologists. Some researchers think it started more than 4 billion years ago, and others say it started only about 1 billion years ago. That's a big range, and the uncertainty stems from the fact that it's simply hard to find well-preserved ancient rocks.To find rock samples for this study, Naeraa went to Greenland."Southern West Greenland contains the best preserved, and some of the oldest examples, of crustal rocks known on Earth," Naeraa told OurAmazingPlanet. "This makes the area excellent for studying geological processes during the earliest history of Earth."The oldest rocks in Greenland range from 3.9 billion to 2.5 billion years old, which meant Naeraa's team could analyze rock samples spanning a huge range of ages. [Images: Greenland's Dramatic Landscape]They measured hafnium isotopes — atoms of the same element that have different numbers of neutrons in their nuclei — in the rocks to figure out how long each sample had been part of the Earth's crust. As rocks on the surface are melted and recycled, the proportions of hafnium isotopes change. The hafnium patterns in the older rocks, those that are more than 3.2 billion years old, are different from the patterns in younger rocks, Naeraa found.Plumes before subductionThe different isotope patterns likely arose because plate tectonics kicked in around that time, Naeraa said.Before then, vertical plumes of very hot magma in the mantle probably brought material straight up to the surface of the Earth to form the first bits of continental crust, he said. Today, the Hawaiian Islands are forming above a similar mantle plume.Gradually — between about 3.5 and 3.2 billion years ago — the Earth's interior began to run low on heat-generating radioactive elements, the mantle cooled down and there were fewer hot magma plumes. Stable convection cells formed in the mantle and started driving plate movements and subduction, and plate tectonics began to shape the Earth's surface, the researchers believe.Since then, most new crust has made its way to the surface of the Earth at spreading centers and subduction zones, Naeraa said. One example is the Mariana subduction zone, where the Mariana island arc has formed, and the Mariana Trench — the deepest spot in the ocean — is located.What it boils down to, Naeraa said, is that the early Earth was a very different place from the planet we know today."Plate tectonics as we know it on Earth today is not a good model for understanding processes in the Earth's earliest history," Naeraa said.His team's findings were published May 31 in the journal Nature.Follow OurAmazingPlanet for the latest in Earth science and exploration news on Twitter @OAPlanet. We're also on Facebook and Google+.

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