University of Anbar

College of Science

Department of Applied Geology

Tectonics

Title of the lecture

Continental rifting and collision

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Continental rifting and collision

Continental rifting

A continental rifting is a linear belt in which continental lithosphere pulls apart Fig. 1. The lithosphere stretcher horizontally, so it thins vertically, much like a piece of taffy you pull between your fingers. Near the surface of the continent, where the crust is cold and brittle, the stretching causes rock to break and faults to develop. The faulting then makes blocks of rock slide down, and as a result leads to the formation of a low area that gradually becomes buried by sediment. Lower in the crust, where the rock is warmer and softer, stretching may take place in a plastic manner, without breaking the rock. The whole region that stretches is the rift.

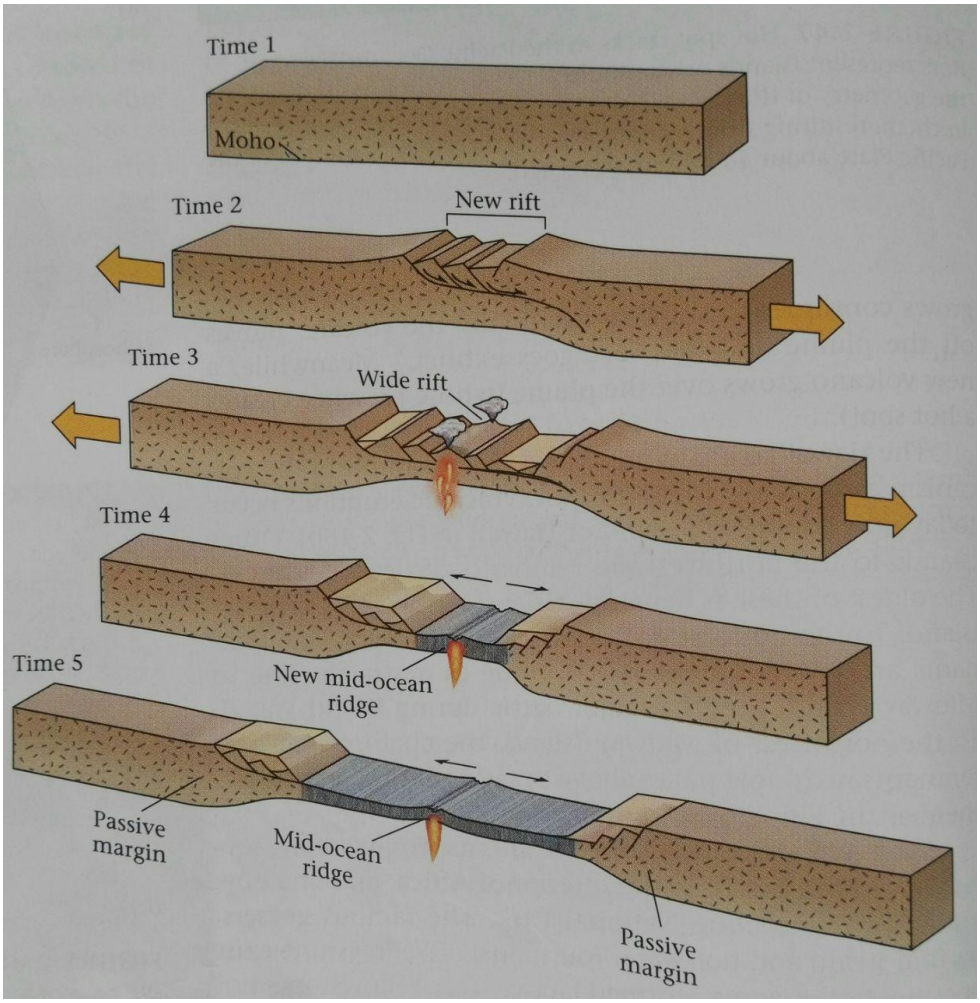

Fig. 1. A continent stretches during continental rifting.

At lithosphere thins, hot asthenosphere rises beneath the rift and partly melts. This molten rock erupts at volcanoes along the rift. If rifting continues for a long enough time, the continent breaks in two, a new mid-oceanic ridge forms, and sea floor spreading begins. The relict of the rift evolves into a passive margin. If the rifting stops before the continent splits in two. Then, the rift remains as a permanent scar in the crust, recognized by a belt of faults, volcanic rock, and a thick layer of sediment.

Good example of the rift today occurs in eastern Africa, which named East Africa Rift Fig. 2. It consists of a deep trough bordered on both sides by high cliffs that were made by faulting. Along the length of the rift, several major volcanoes smoke and fume; these include snow-crested Mt.

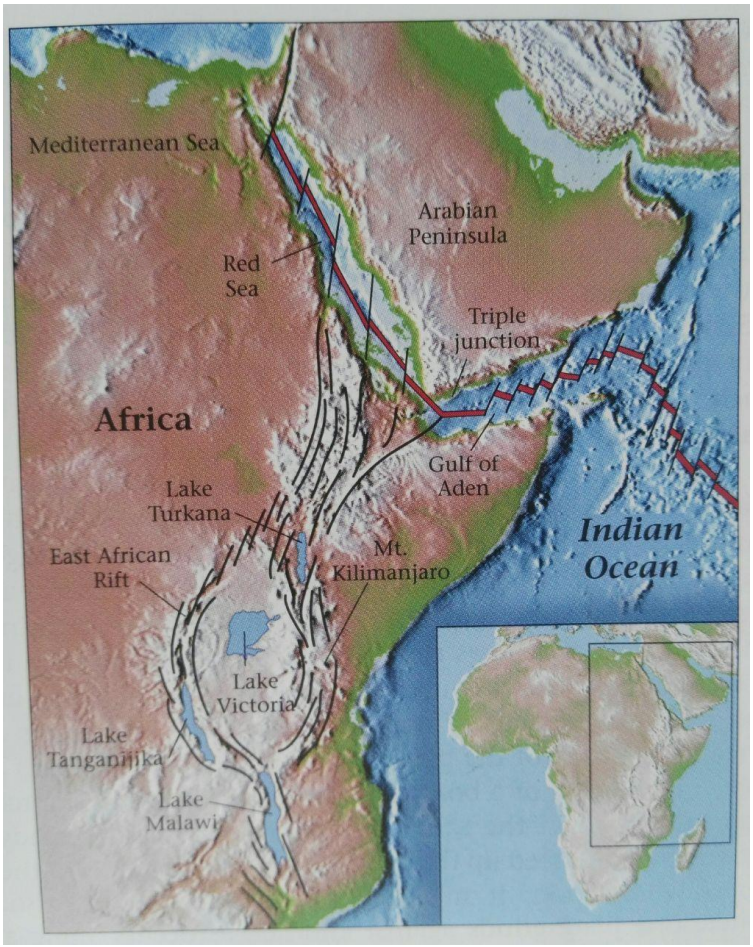

Fig. 2. If the East Africa Rift were to continue growing, part of Africa would break off, forming a continental fragment. Note that the East Africa Rift intersects the Red Sea and the Gulf of Aden at a triple junction.

Another major rift, known as the Basin and Range Province. Here, movement on numerous faults tilted blocks of crust to form narrow mountain ranges, while sediment that eroded from the blocks filled the adjacent basins (the low areas between the ranges).

Collision

Continental lithosphere, unlike oceanic lithosphere, is too buoyant to subduct. So, when Indian collide with Asia, due to the subduction consumed the ocean between India and Asia, the attached ocean plate broke off and sank down into the deep mantle. But India pushed hard into Asia, squashing the rocks and sediment that once lay between the two continents into 8 km high welt that we know as the Himalayan Mountains. During the process, not only did the surface of the eart here rise in this mountain belt, but the crust become thicker. Generally, the crust beneath a mountain range is 60-70 km thick, about twice the thickness of normal continental crust.

Geologists refer to the process of two buoyant pieces of lithosphere converging and smashing together as collision Fig. 3. Some collisions involve two continents, some involve continent and an island arc. When a collision is complete, the convergent plate boundary that once existed between the two colliding pieces ceases to exist. Collisions yield some of the most mountains on the planet, such as the Himalayas and the Alps. They also yielded major mountain ranges in the past, for example Appalachian Mountains in the eastern United States were created as a consequence of the three collisions. After the last one, a collision between Africa and North America around 280 million years ago, North America became part of Pangaea supercontinent. The rifting apart of Pangaea later formed the Atlantic Ocean.

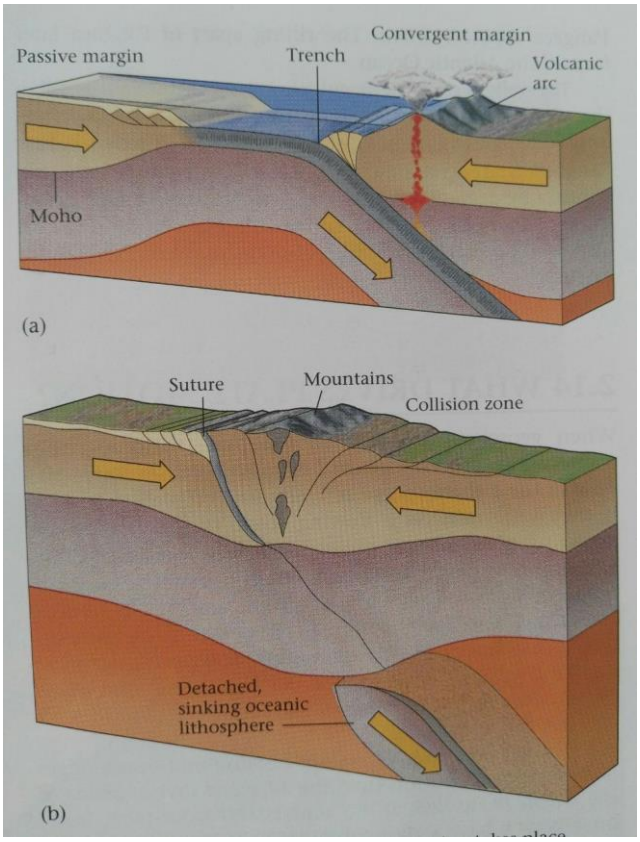

Fig. 3. (a) Before a continental collision takes place; subduction consumes an oceanic plate until it collides with another plate. Here, a passive continental margin collides with a continental volcanic arc. (b) After the collision, the oceanic plate detaches and sinks into the mantle. Rock caught in the collision zone gets broken, bend, squashes and forms a mountain range.

The reference

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