

GEO THERM supports East Africa - regional boundary conditions for geothermal energy use

The East African Rift Valley

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The 4000 km long and in average 60 km wide East African Rift System is visible from the moon. It is the largest crack in the continental crust on Earth and consists of two branches (Figure 1).



Figure 1 Simplified map of the East African Rift System

The eastern branch is extending from the southern Red Sea (Afar triangle) to Tanzania and the western branch is extending from Uganda to Mozambique. A much bigger volume of volcanic rocks were erupted in the eastern branch of the rift compared to the western branch (Figure 2). Most of the eastern rift belongs to Ethiopia and Kenya and therefore the highest numbers of active volcanoes and geothermal resources are found in these two countries.

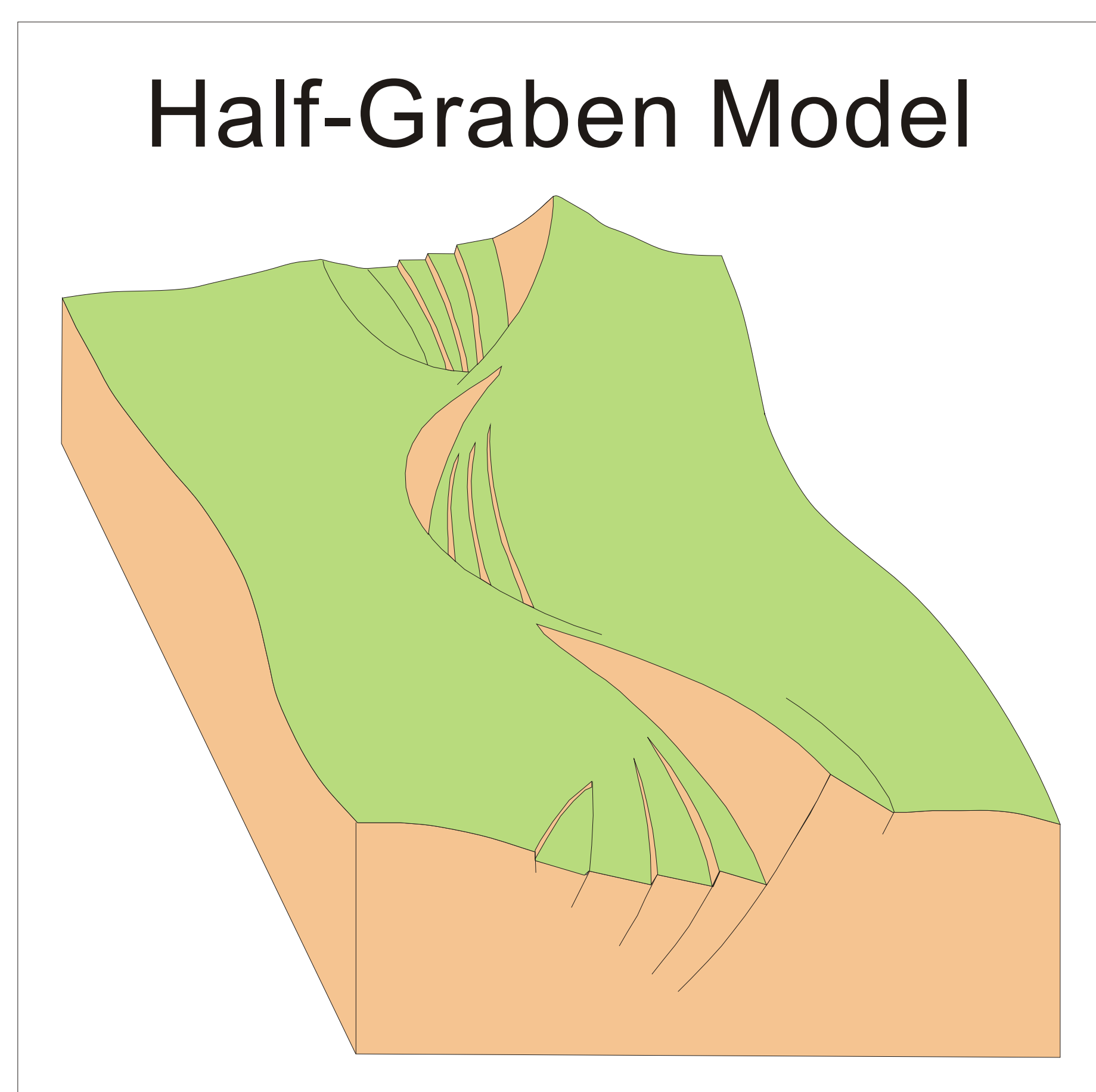


Figure 5 Schematic sketch of linked half-grabens

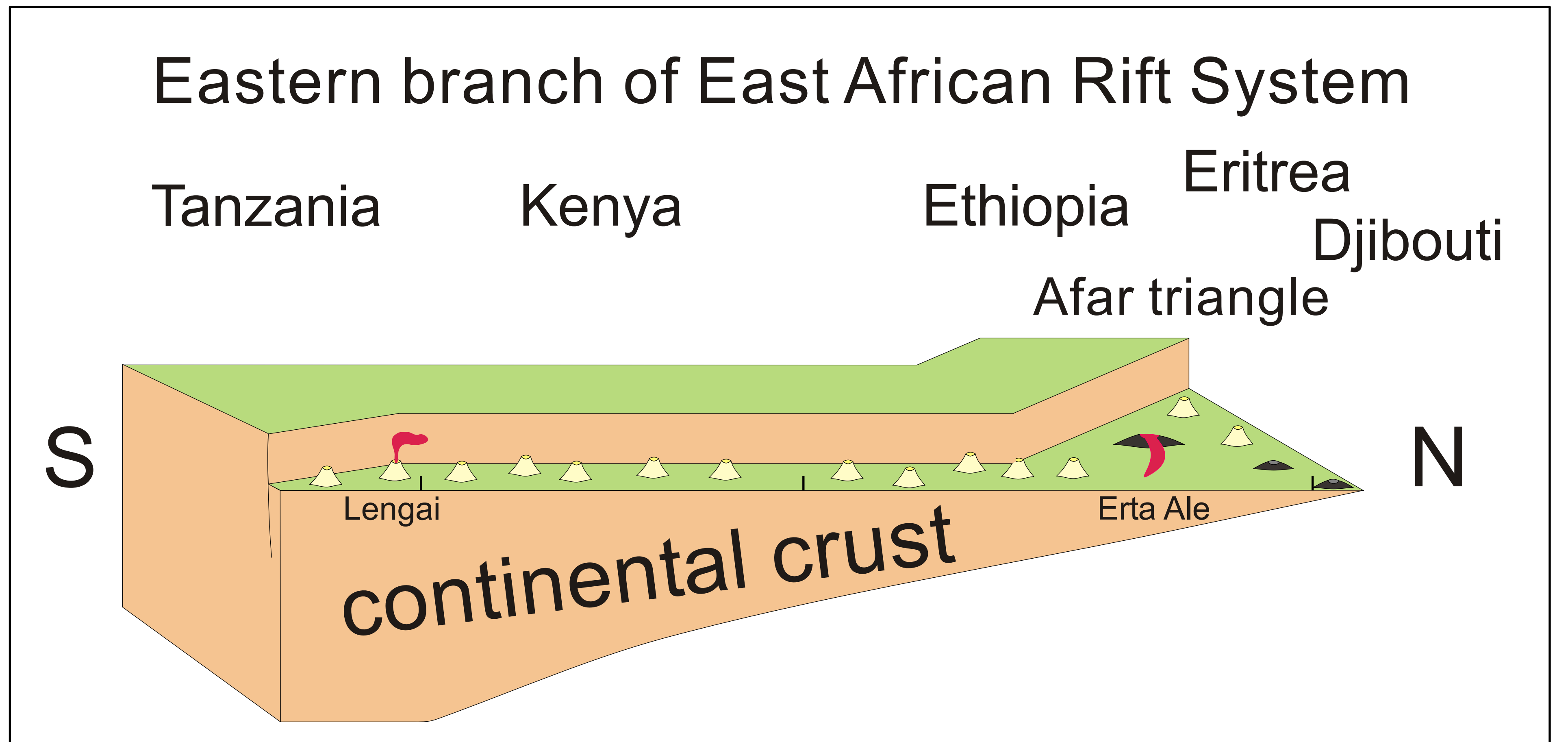


Figure 3 Schematic sketch of eastern rift with central volcanoes and changing thickness of the continental crust

The continental crust of the eastern rift area (Figure 3) thickens from North (Afar triangle) to South (Tanzania) and the amount of dilatation and age of rifting decreases in the same direction (Figure 4).

Rifting started 30 million years ago in the Afar region (dilatation of continental crust up to 60 km), xx Ma ago in northern Kenya (dilatation 35-40 km), 12 Ma ago in central Kenya (dilatation 5-10 km) and less than 5 Ma ago in northern Tanzania (dilatation less than 5 km). The continental crust is composed of units different in age, composition, thickness, rigidity etc. and the rift mainly follows pre-existing zones of weakness along contacts between these units. The rift is not a symmetrical structure because it consists mainly of linked half-grabens (Figure 5).

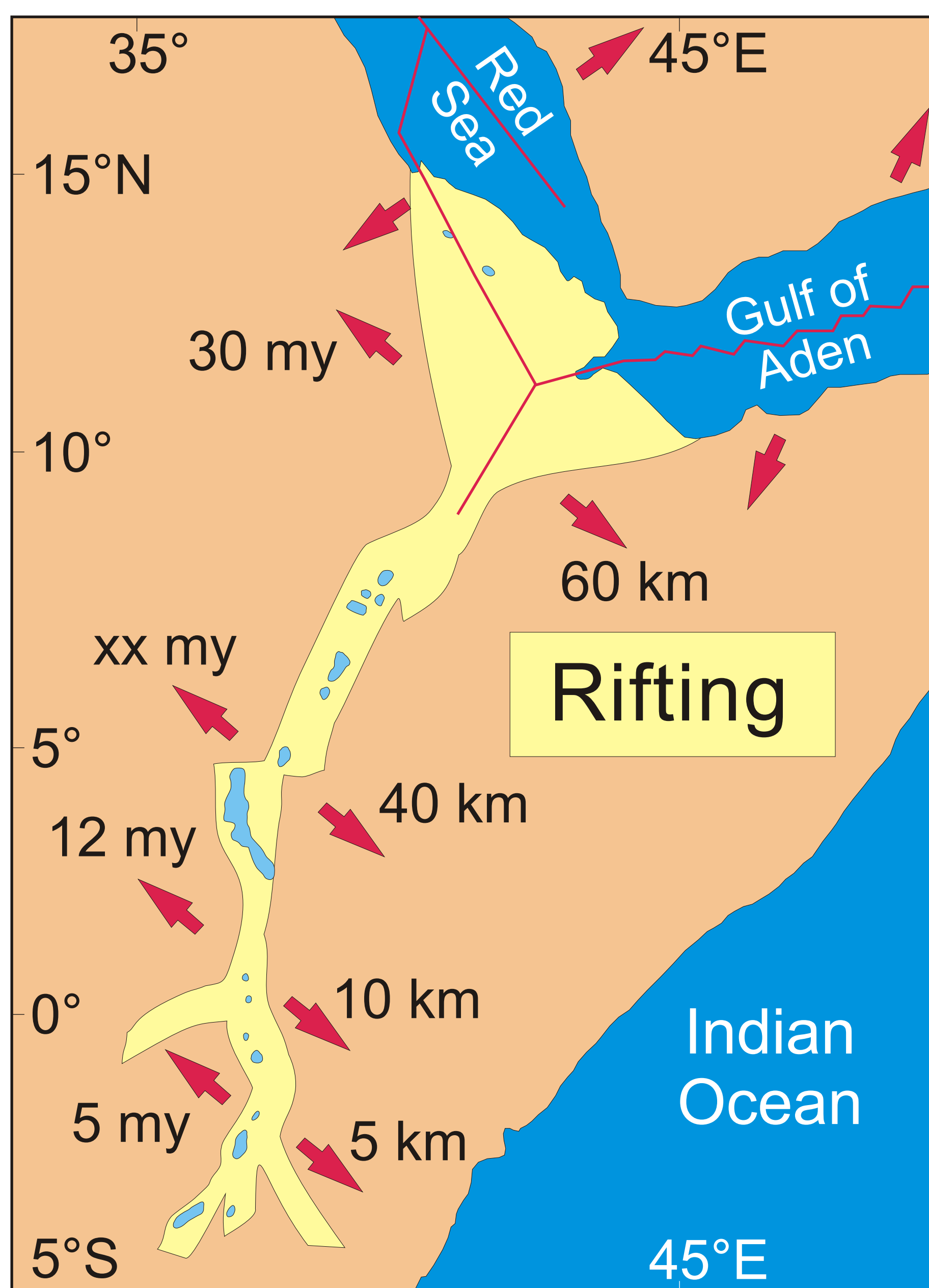


Figure 4 Maximum extension of continental crust, age of initial rifting in million years before present and triple junction formed by Red Sea, Gulf of Aden and East African Rift System

Rifting of the eastern branch with a rate of millimetre per year is caused by uprising mantle plumes. These plumes are transporting melts and heat to the earth surface and bulge the continental crust. If the tensional forces exceed the breaking strength of the up-warped crustal rocks cracks occur (i.e. the tension is released by earthquakes) leading to a Y-shaped triple junction at the spherical earth surface (Figure 4).

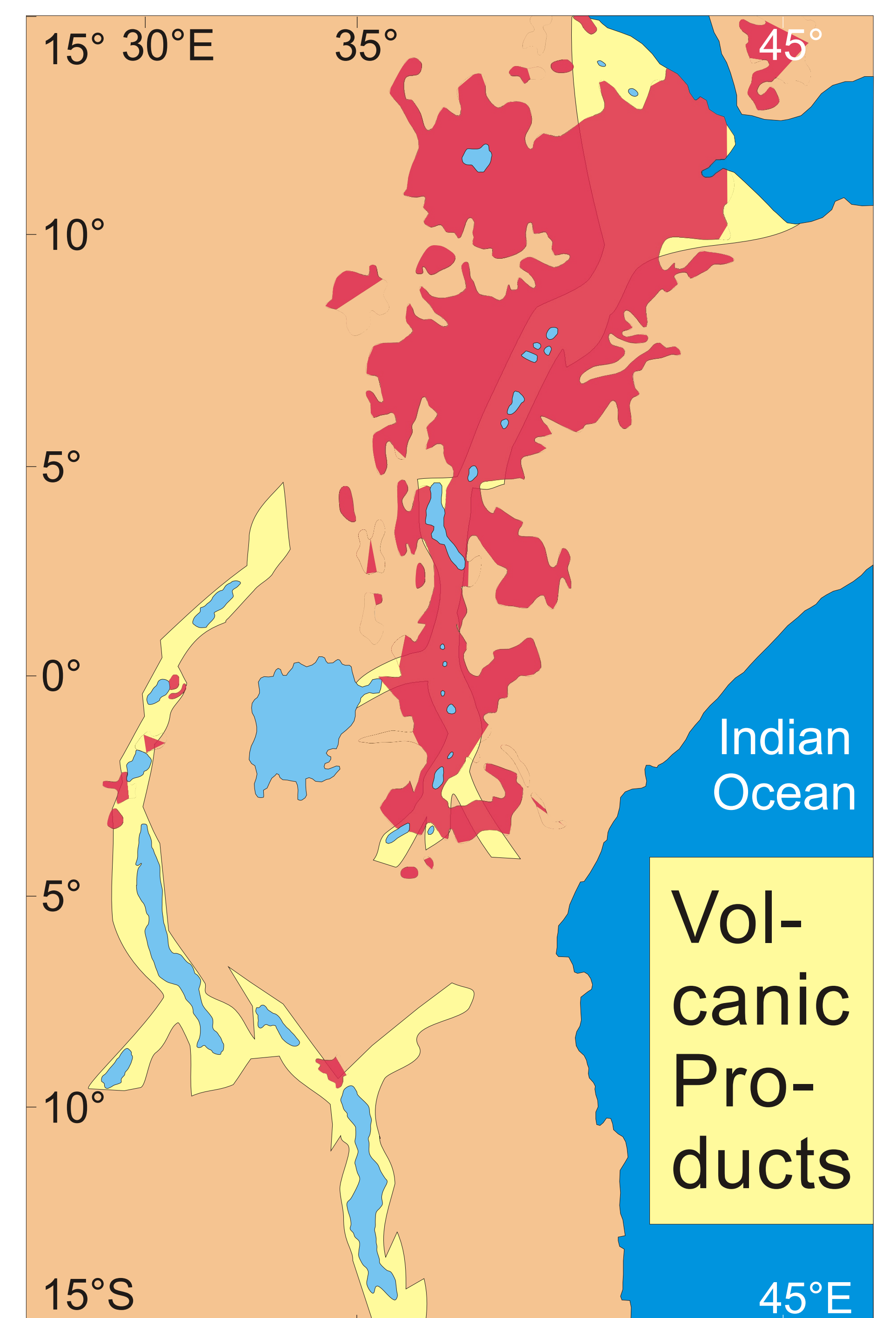


Figure 2 Difference in volcanic activity in the two branches of the East African Rift System

Two arms of the triple junction will open to an ocean by forming new oceanic crust and the third arm will be a "failed rift". The Red Sea and the Gulf of Aden are the two new oceanic arms spreading with a rate of centimetre per year and the rift valley is the remaining third arm which will never open to an ocean. Therefore it is most unlikely that East Africa will be split off from the rest of the African continent like it happened to Madagascar 165 million years ago..

