Influence of Tectonic Processes on the Climates of the East African Rift System

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Introduction:

Eastern Africa is home to one of the most studied examples of a continental rifting environment on earth, The East African Rift System. The East African Rift Valley stretches over 3,000 km from the Gulf of Aden in the north towards Zimbabwe in the south, traversing through the higher elevation Ethiopian and Kenyan Domes (**Fig. 1**). The rift system separates the Nubian Plate to the west from the Somali Plate to the east. The rift can be further broken down into the Eastern Branch (~40 Ma) and Western Branch (~12 Ma). This region is extremely biodiverse and is said to be "the cradle of mankind". Understanding the tectonic processes that have shaped this region can help us to better understand how and why we see the current distribution of climates there.

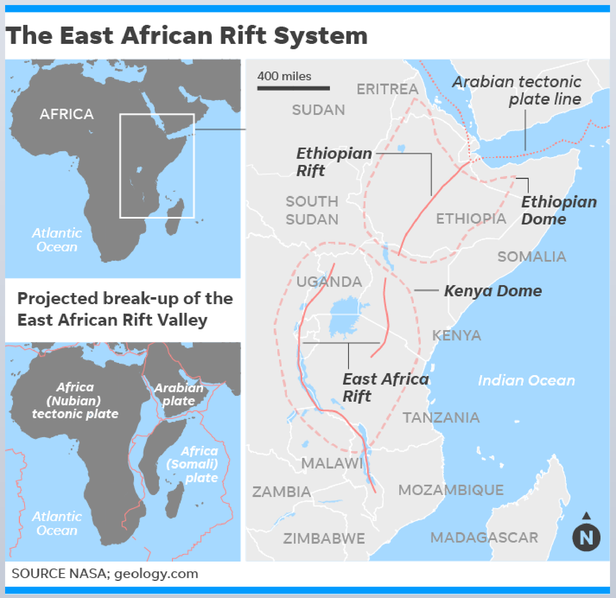

Figure 1: A map of the East African Rift System showing the locations of the major structures (rifts, domes, and plates) and a map showing what the projected breakup would look like.

Goals/Objectives:

-To provide credible, science-based research regarding the tectonic processes that have/are occurring throughout Eastern Africa.

-Educate students about what factors influences regional climates.

-To understand the relationship between tectonics and regional climates.

Results:

Based on the research done, The East African Rift System has a major impact on the regional climates of Africa (**Fig. 2**). The uplifted highlands, such as the Ethiopian Highlands are home to a lusher and more vegetated landscape than the adjacent lower elevation areas. The lower elevation areas tend to be more arid climates ranging from savannahs to barren deserts. These range of climates are directly related to the tectonic process of rifting, which is occurring throughout Eastern Africa. Another factor that influences the climate of this region are the prevailing westerly winds coming off the Indian Ocean, which carry precipitation.

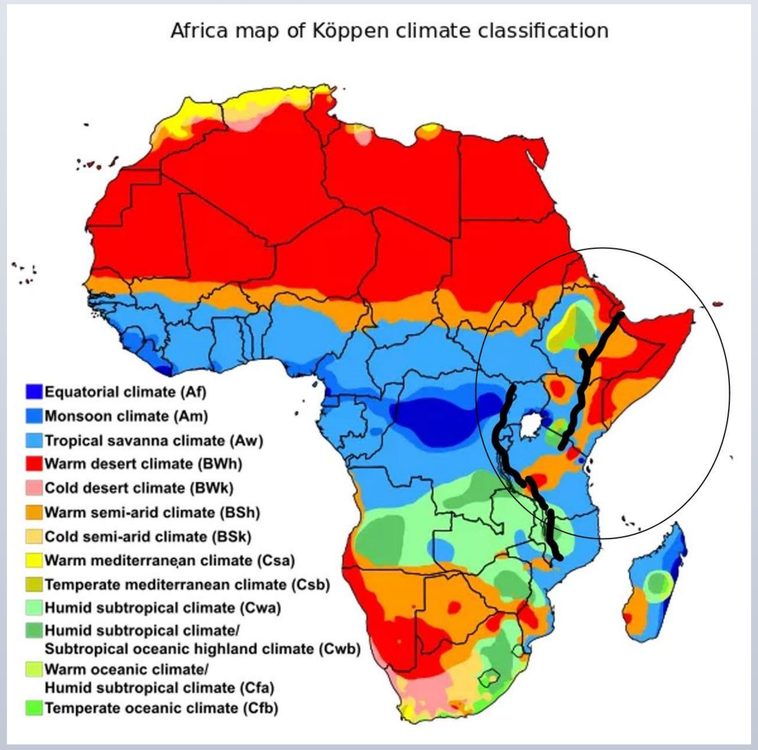

Figure 2: A climate classification map of Africa by Koppen. Eastern Africa and the EARS are shown within the ellipse.

Methods:

-Reading scholarly scientific articles/papers.

-Examining both topographic and climate maps of Africa.

-Researching regional weather patterns, such as precipitation amounts and wind patterns.

Conclusions:

The tectonic process of rifting has greatly altered the landscape (**Fig. 3**) of Eastern Africa since the initiation of volcanism ~40 Ma and to the onset of rifting ~25 Ma. Some of this alteration was to the topography of the region which as previously discussed has certain climates associated with certain elevations. The topography of a region in turn controls wind patterns and the amount of precipitation in that region. Rifting has also created rift related lakes which have a huge influence on the surrounding climate. The East African Rift System is the main contributor in the distribution of the regional climates of eastern Africa.

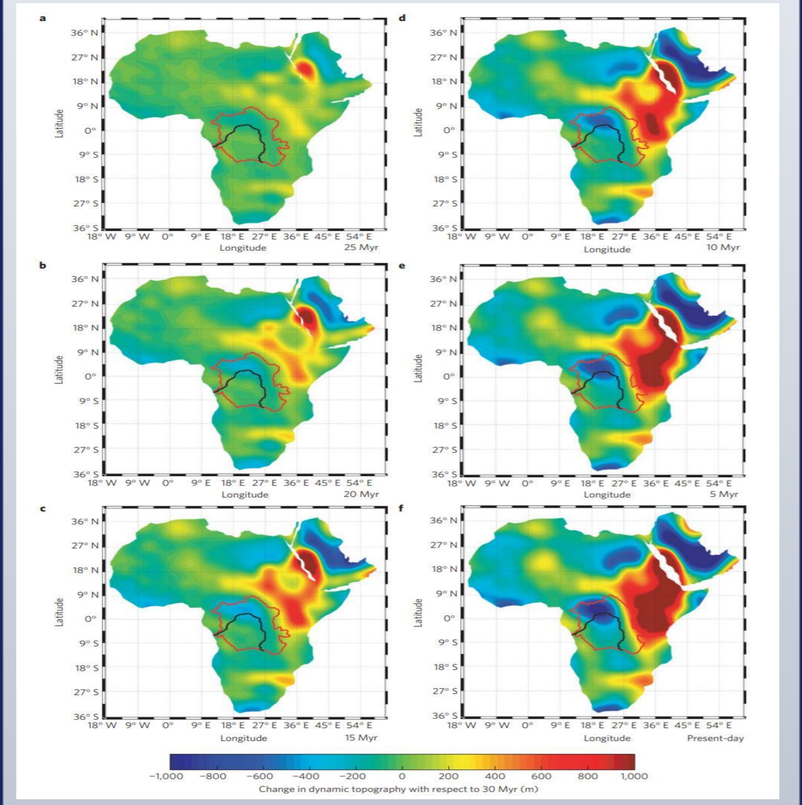

Figure 3: A model showing the evolution of the topography of Africa and the East African Rift System over the past 25 Ma. (**a: 25 Ma, b: 20 Ma, c: 15 Ma, d: 10 Ma, e: 5 Ma, f: present day**)

References Cited:

Maslin, M. A., Brierley, C. M., Milner, A. M., Shultz, S., Trauth. M. H., Wilson, K. E., 2014, East African climate pulses and early human evolution, Quaternary Science Reviews, v. 101, p. 1-17

Prömmel, K., Cubasch, U., Kaspar, F., 2013, A regional climate model study of the impact of tectonic and orbital forcing on African precipitation and vegetation, Palaeogeography, Palaeoclimatology, Palaeoecology, v. 369, p. 154-162

Chorowicz, J., 2005, The East African rift system, Journal of African Earth Sciences, v. 43, Issues 1–3, p. 379-410

Ring, U., 2014, The East African Rift System, Australian Journal of Earth Science, v. 107/1, p. 132-146

Couvreur, T., Dauby, G., (2020) "Tectonics, Climate and The Diversification of the Tropical African Terrestrial Flora and Fauna" *John Wiley & Sons Ltd of Cambridge Philosophical Society.*