Essay for Pan-African Approaches to Teaching Geoscience Workshop

The Intersection between Paleoclimate and Human Origins

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If I had a chance to try teaching at the intersection between Africa and Earth Science, one of the topics I would most look forward to learning about and then teaching would be the relationship between climate and the evolution of humans and our hominin ancestors over the last 8 million years.

This topic is inherently interesting, and is the subject of cutting edge research. But in addition, I think that guiding students to reflect on and discuss this topic has broader values for society, on two quite different dimensions. The first dimension has to do with building bridges between people of different ethnic and racial heritage. Realizing that all humans have descended from the same founding population, and that that founding population was in Africa, may help in some small way to mitigate the feeling of otherness towards other groups. The second dimension has to do with helping to build acceptance of the ideas that (a) humans can impact the climate and (b) that changes in climate are hugely consequential for humans. And finally, this topic allows the development of many important geoscience habits of mind, including spatial thinking and temporal thinking.

Here are some basic elements of the story, with some thoughts about teaching opportunities. I am not an expert in this field, but I did enough reading to convince myself that this would be a great topic for a Pan-African curriculum. Collaboration with an expert in the field would be important.

The hominin line diverged from the ancestors of our chimpanzee cousins between 6 and 8 million years ago. Since that time, there have been two main temporal trends in Earth's climate: a gradual decrease in temperature and a fairly sudden increase in volatility (climate fluctuations). These trends are both discernable to the novice eye in plots of oxygen isotope ratios in planktonic microfossils in ocean sediments (a proxy for ocean water temperature and global ice volume). Working with this data affords an opportunity to explore how geoscientists can know about the past, even though there were no scientific instruments and no one collecting data back then.

In relating climate to human evolution, an older idea, the savannah hypothesis, drew a link between the drying out of Africa and the early evolution of human ancestors. From the late Miocene through the Pliocene, eastern Africa became drier. Proponents of this hypothesis infer that this change favored bipedalism, which in turn freed hands for tool-making and tool-using.

A newer idea is the variability selection hypothesis. In general, the period of human evolution was a time of dramatic variability in climate, with rapid shifts between warmer and colder, between arid and moist. Climate fluctuations meant variability in food resources, and also in parasites, predators and other dangers. According to the variability selection hypothesis, volatile climate favored species that were able to adapt to change. Humans were not physically endowed with great survival traits, but they were perhaps the most adaptable mammal ever to walk the Earth. Brain size increased slowly from 4 million

years ago onward. Then, as climate fluctuations became more extreme (beginning around 800,000 ybp) the rate of increase of brain size speeded up. Larger brains were evolutionarily favored at times of climate volatility because they allowed hominins to process and store information, to plan ahead, and to solve abstract problems.

Sources:

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