

Anagenesis as a test of the relationship between environmental change and human evolution, with a focus on *Australopithecus*

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Hypotheses that seek to explain events in human evolution by reference to environmental change may focus on several levels: 1) macroevolutionary patterns (e.g., overall diversity in the hominin clade); 2) species origination and extinction; 3) within-species (anagenetic) change or geographic variation; 4) and the evolution of individual features or behaviors. Each of these levels of analysis requires a different theoretical framework and encounters different types of sampling problems in the fossil record.

In this brief talk I will focus on patterns of anagenetic change in hominin evolution. To the extent that such trends can be demonstrated, they offer powerful tests of hypotheses that link evolutionary events to climate change, mainly because morphological change can be localized to a particular time and region. In other words, the context is more precise than that available for individual species origination or extinction events. Moreover, patterns of anagenetic change are in many ways analogous to clinal models of geographic variation within species, which have been demonstrated in some cases to correlate with climatic variation.

Several possible examples of anagenetic change exist in hominins. The *Australopithecus afarensis* lineage is among the most clearly documented, mainly because of the sample size and the precision of the chronological record (Lockwood et al., 2000). Furthermore, trends observed in *A. afarensis* probably extend back to *A. anamensis* (Leakey et al., 1995; Kimbel et al., in review). During the relevant period of time – 3.0-3.5 Mya if we focus exclusively on *A. afarensis*, or 3.0-4.2 Mya if we consider the entire *A. afarensis*-*A. anamensis* lineage – the reconstructed environments in eastern Africa vary in a nondirectional manner, and periodicity of climate change remains consistent. In other words, there is no obvious environmental explanation for the anagenetic trend. Bonnefille et al. (2004) have concluded from the environmental variation at Hadar that *A. afarensis* may have been adapted to diverse habitats, but in any event the morphological change within the species begs explanation. Further work on this and similar cases may shed light on the extent to which evolutionary change in hominins occurs in the absence of directional climate change.

References

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