

The Pliocene Hadar Formation in the Context of Global Climate Patterns & Variability

Christopher J. Campisano^{1,2},

Craig S. Feibel^{1,3}

¹ Department of Anthropology, Rutgers University, New Brunswick, NJ 08901-1414, USA

² Human Origins Program, Smithsonian - National Museum of Natural History, Washington, DC 20013-7012, USA

³ Department of Geological Sciences, Rutgers University, Piscataway, NJ 08854-8066, USA

Central to the debate surrounding global climate change and Plio-Pleistocene hominin evolution is the degree to which large-scale climate patterns influence low-latitude continental ecosystems and how these global influences can be distinguished from regional volcano-tectonic events and local environmental effects. If global climate is a major influence, are the geologic records of hominin-bearing deposits of sufficient resolution to record such changes?

Additionally, once the various environmental factors are isolated, can they be properly compared to trends or events in the hominin fossil or archaeological record? As resolving the issue of global climate change and hominin evolution will require multiple lines of evidence from localities spread across space and time, it is first necessary to address these questions at the scale of individual basins. The Pliocene Hadar Formation of Ethiopia preserves a record of hominin paleoenvironments from roughly 3.5 to 2.3 Ma at a temporal resolution relevant to evolutionary change within hominins and other taxa. This study integrates the high-resolution sedimentological and paleontological record at Hadar with climate proxies such as marine core isotope, dust, and sapropel records.

Consistent cycling observed both between and within fluvial and lacustrine depositional environments prior to 2.9 Ma at Hadar appears to be predominantly climatic in nature. However, a significant change in depositional facies after 2.9 Ma to sequences dominated by conglomerate cut-and-fill cycles indicates a strong tectonic signature related to regional developments in the Main Ethiopian Rift. Marine paleoclimate proxy records provide an important context for the reinterpretation of terrestrial paleoenvironmental reconstructions. However, the extent to which the influences of short-term global climate change can be recognized and subsequently incorporated into the East African record must be carefully evaluated. While specific events seen in marine proxy records may have parallels in the Hadar environmental archive, it may be more useful to look for correlations to the larger patterns of regional and global climate change and variability than at any one particular event. For example, periods of relatively high-amplitude climate oscillations between 3.15 and 2.95 Ma may be linked to noted morphological changes within the Hadar australopithecine lineage and a significant increase in more arid adapted mammalian taxa. Similarly, the dominant lacustrine phase at Hadar ca. 3.3 Ma coincides with the least variable period in numerous climate proxy records and is coeval with a very distinct and significant long-term period of low dust percentage in circa-Africa marine cores.