Geophysical Research Abstracts, Vol. 9, 05221, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05221

Reconstruction of the local climate record in Plio-Pleistocene deposits at Koobi Fora (Kenya) improves age control of hominin fossils

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Climate and habitat change are considered to be important driving factors for hominin evolution. However, at present it is not always possible to establish reliable high-resolution temporal relationships between climatic and evolutionary events in a continental setting, particularly beyond the range of C14 dating. In the Plio-Pleistocene deposits of the Turkana Basin, age control at timescales relevant for evolution (1-10 ky) cannot always be achieved by employing the present method of stratigraphic scaling between radiometrically dated tuffs and astronomically tuned paleomagnetic reversals. To address these issues, we reconstruct the local climate record preserved in Plio-Pleistocene sediments of paleolake Lorenyang (precursor of Lake Turkana) at Koobi Fora, using strontium (Sr) isotope ratios as a robust novel proxy for climate change.

The Sr isotope ratio of Lake Lorenyang shells, ostracods, fish bones etc. record the Sr isotopic composition of well-mixed lake waters consisting for the most part of Omo river water draining Ethiopian Traps flood basalts (with Sr isotope ratio of $\sim$ 0.704), and for a small part of local rivers draining a mixed lithology including Pan-African metamorphics (with Sr isotope ratio $>$ 0.710). Changing monsoonal rainfall patterns driven by orbital forcing determine the proportion of Omo water, relative to local rivers, flowing into the lake. Thus, during periods with strong monsoons the Sr isotope ratios of Lake Lorenyang biogenic carbonates and apatites are relatively low (ca. 0.7048), and during periods with weak monsoons the Sr isotope ratios are rela-

tively high (ca. 0.7053). We have systematically sampled every meter in a composite continuous section of 190 m between ca. 2-1.7 Ma in Area 102 at Koobi Fora, and by washing and sieving obtain well-preserved carbonates and apatites suitable for precise determination of Sr isotope ratios. Employing this proxy approach we reconstruct a climate curve reflecting Milankovitch cyclicity, and containing stratigraphic anchor points such as the well-dated KBS Tuff at 1.87 Ma and the top of the Olduvai subchron at 1.78 Ma. By tuning this terrestrial record against the marine climate record (eg from the Arabian Sea; DeMenocal, 1995) we can assign an astronomically tuned age to each of the inflexion points of the wet-dry cycles in our study interval. Our tuning approach strongly improves age control of hominin fossils. As a consequence, we gain insight in the temporal relationships between local climatic-environmental change and fossil occurrences, which allows testing of hypotheses on climate change and hominin evolution.