Precessional climatic signal in the Plio-Pliestocene Chemeron Formation, Central Kenya Rift

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The Chemeron Formation (4.5–1.6 Ma) is exposed within the Tugen Hills, a tilted horst block within the central Kenya Rift. The formation typically consists of fluviolacustrine and alluvial fan sediments, with volcaniclastic interbeds. Near the Barsemoi River, the formation includes a series of five prominent diatomite beds (2.7–2.5 Ma) intercalated in the terrigineous sequence. The diatomite units, up to 12m thick, document intermittent, significant lake systems within the axial portion of the rift.

$^{40}Ar/^{39}Ar$ dating of anorthoclase-bearing tephra horizons within the section permit precise determination of chronometric tie points to evaluate the sedimentation history of the sequence. Sedimentation rates are remarkably linear through the sequence that includes the diatomite horizons. By interpolation, we are able to estimate the absolute ages of the individual lakes (as represented by the diatomites). The regular temporal spacing of the lake sequence (ca. 25 ka periodicity) matches very well with the periodicity of the Earth's precessional curve for this interval. Given that there is a 1:1 match of diatomites to precessional peaks for five successive precessional cycles, we deem it highly probably that the lake systems are a climatic response to changes in insolation accompanying precession of the Earth, rather than a response to tectonism.

The Gauss/Matuyama paleomagnetic transition occurs just above one of the diatomites of this precessional sequence. This relationship to a paleomagnetic boundary allows us to compare the phase relationship of a wet period in the central Kenya Rift to the Mediterranean sapropel record; they appear to be in phase to within one quarter of a precessional cycle, if published astronomical ages for paleomagnetic boundaries can be relied upon.

Quartz hydration dating: A new mineral geochronological technique

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New Geochronological Technique for Direct Dating of Minerals

The new Quartz Hydration Dating (QHD) technique relies on the phenomenon of water diffusion into quartz leading to the formation of a hydration layer that can be measured by a hydrogen profiling technique, based on the resonant reaction $^{1}H(^{15}N,\alpha\gamma)^{12}C$, and diffusivity data connecting the layer thickness with the hydration time.

We have obtained such data by induced-hydration experiments in the temperature range 60 to 200 °C and derived a general equation for calculating diffusion coefficients which was validated by results from dated artifacts. The main factors influencing the diffusivity are temperature, the crystallographic orientation, measured as the angle between surface of hydration and crystal c-axis, and initial H content of the quartz.

The effective time range of QHD is 100 ya to over 100 kya. The error of age determination is 35%, but may be reduced to 20% by controlling for material variability. QHD is applicable to single-crystal specimens and aggregates of single crystals. QHD serves as an example of silicate mineral dating. A range of geological applications is discussed.

Reference

J.E. Ericson, O. Dersch, F. Rauch. (2004). Quartz Hydration Dating. J. Arch. Sci., **31**, 883-902.