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Oblique rifting, drainage evolution, and lacustrine sedimentation in the East African Rift: implications for paleoclimate research

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For most of their structural evolution the Kenya and Malawi rifts have been controlled by an E-W oriented position of Shmin. However, fault kinematic data, orientations of eruptive centers and dyke systems, caldera elongations, borehole breakouts, and earthquake focal-mechanisms document that the extension direction has rotated to its present-day NW-SE to WNW-ESE orientation during the Pleistocene. This appears to be related to a reorganization of the tectonic stress field in East Africa, although the ultimate nature of this change is still unknown. The change in the extension direction has had a profound impact on the generation of new fault arrays, the oblique reactivation of older rift-bounding structures, and possibly the triggering of destructive earthquakes.

In the Malawi Rift, the kinematic change has caused oblique normal and strike-slip faulting. In Kenya, the new extension direction results in oblique normal faulting at the rift margins and a new left- and right-stepping pattern of young zones of extension in the central and northern Kenya rifts, respectively. The NNE striking normal fault zones bound smaller sub-basins within the larger rift segments. Kinematically, the transfer between these smaller extensional basins is either accomplished by closely spaced normal faults or obliquely striking fault zones with combined strike-slip and normal faulting. The combination of active tectonism, volcanism and tectonically controlled drainage reorganization has resulted in a plethora of sedimentary environments associated with the sub-basins in the Kenya Rift that constitute ideal archives for past climatic conditions.

Because of the ongoing tectonic processes in this environment, however, variations in

lake-level and water chemistry are not solely explicable with climate change. For example, in the Central Kenya Rift Lake Naivasha is characterized by freshwater. During the Quaternary it has often expanded and overflowed into the presently alkaline Lake Nakuru basin. Both lakes are adjacent to each other and are fundamentally influenced by the tectonically controlled contributing area and topographically influenced precipitation patterns. In this scenario sufficient runoff reaches Lake Naivasha, whereas adjacent basins are starved of moisture, causing alkalinity. The recent setting of these lakes underscores the need for integrated geomorphic, structural and paleo-ecological studies in attempts to unravel the climatic history of East Africa.