Zeolitic Alteration in Saline, Alkaline Paleolake Basins in the Southern Kenya Rift Based on Analysis of Minerals from Koora Plain (ODP) and Lake Magadi (HSPDP) Core Samples

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To understand environmental and climate change in East Africa over the past several hundred thousand years and the possible impact of that change on human evolution and stone technology, we analyzed lacustrine sediments from two adjacent basins in the southern Kenya Rift. X-ray diffraction analysis of core samples obtained during the Olorgesailie Drilling Project (ODP) in the Koora Plain and the Hominin Sites and Paleolakes Drilling Project (HSPDP) at Lake Magadi have revealed distinct zeolite assemblages in each basin. Zeolites form from the alteration of volcaniclastic material (e.g., tephra, tuff) in saline, alkaline waters, such as those found in lakes of the southern Kenya Rift. Given the proximity of the Koora Plain to Lake Magadi (~15 km), one could argue that their climatic and tectonic histories should be closely linked. The mineralogy and geochemistry of each basin, however, appear to be distinctly different. Abundant authigenic zeolites throughout the core at Lake Magadi suggest it was a closed basin lake for most of its history, perhaps recharged primarily by hot springs at the lake margin as in the modern environment. In contrast, the Koora Plain paleolake experienced fresh phases suggestive of an open basin, when diatomaceous silts and diatomites accumulated, and saline periods indicated by saline diatoms and zeolitic facies in closed basin settings. The dominant zeolites in the ODP core from the Koora Plain are analcime and phillipsite, with pronounced zeolitic zones alternating with zones of other authigenic minerals such as low Mg-calcite. The most common zeolite in the Lake Magadi cores is erionite, although other zeolites such as analcime, chabazite, clinoptilolite, and phillipsite are also present. Erionite found in the Magadi cores is formed mainly by the reaction of trachytic glass + H2O, with subsequent zeolite phases forming by erionite reacting with additional cations (e.g., erionite + Na+ ◊ analcime) or tuffs reacting with the saline, alkaline waters. The Lake Magadi core contains virtually no recognizable volcaniclastics, implying that the tuffs were all altered to zeolites, whereas the ODP core has relatively abundant volcanic material. The preservation of tuffs in the ODP core indicates periods of freshwater paleolake conditions, while the lack of preservation of 174 volcaniclastics in the Magadi core suggests persistent saline, alkaline conditions, with the exception of a freshwater phase during the initial basin formation. These data provide insight into paleoclimate and tectonic history in the southern Kenya Rift during the late Pleistocene and Holocene, which will aid our understanding of the relationship between environmental and climate change and hominin evolution.