The Sedimentary and Paleoenvironmental History of Lake Magadi, Southern Kenya Rift: New Evidence from Drill Cores in the Axial Graben

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Lake Magadi, a saline, alkaline lake in the southern Kenya Rift, was cored to bedrock in June 2014 as part of the Hominin Sites and Paleolakes Drilling Project (HSPDP), which aims to provide a high-resolution paleoenvironmental context for human evolution in East Africa. The cores (1A, B and C: total depth 137 m; 2A, total depth: 198 m), which are composed mainly of zeolitic mud, chert, trona, and carbonate, contain a Pleistocene and Holocene record of closed-basin paleoenvironments and paleoclimate in a tectonically active rift basin. The trachyte basement, 0.8–1.4 Ma, is overlain sharply by carbonate grainstone with gastropods, ostracodes, and coated grains, indicating a period with freshwater lakes during the early stages of the Magadi Basin. The overlying sediments are thin bedded to laminated, greenish lacustrine muds and silts, with interlayered bedded and nodular cherts, and silicified mudstone. The diverse suite of chemical sediments (zeolites, chert, magadiite, and trona) indicates alkaline saline lake conditions for most of the history of the Magadi Basin. Frequent saline and anoxic conditions are implied by the lack of fossils and bioturbation, and black organic muds. Pyrite, which is common in the lower parts of the cores, shows that reducing conditions commonly developed in the lake and sediments. Although airfall and redeposited tephra are widespread in exposed Pleistocene sediments, few tuffs are distinctive in the lake cores, implying that most volcaniclastic grains have been altered to zeolites. Coarse siliciclastic sediments include thin matrix-supported conglomerates that appear to be subaqueous debris flow deposits, and rare sand and gravel intervals that indicate periods of subaerial exposure. Soft sediment deformation and microfaulting are common in the Magadi sediments. Evaporite layers, decimetres thick, alternate with interbedded organic-rich muds in the upper ~60 m of core 2A. They confirm that the most arid period at Lake Magadi was the Holocene and provide potential for obtaining a high-resolution Holocene paleoclimate record. Syndepositional dissolution surfaces in the uppermost trona beds indicate dilute floodwaters mixing into a shallow saline lake. 142 Future research will attempt to establish a chronology from bulk radiocarbon, Uranium-series dating of cherts, optically stimulated luminescence, paleomagnetism, and Ar-Ar dating of tephra. Comparison of the Lake Magadi lacustrine record with that from the nearby Koora Plain cores will help to resolve whether lake level and paleoenvironmental changes in southern Kenya were driven primarily by climate or by local or regional tectonic factors in the East African Rift.