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Tectonic and geochemical controls on soil edaphic variability in the southern Kenya Rift, implications for early hominin land use

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We have studied the importance of geological and soil edaphic factors for the location and duration of inhabitance of hominin sites in the southern Kenya Rift, East Africa. Using examples from the Lake Magadi-Olorgesailie region, we demonstrate that field mapping and analytical techniques derived from geology and soil science can provide important information for research in early hominin migration and land use.

The Lake Magadi-Olorgesailie region is located in the center of the ~60-km wide rift floor and characterized by a complex network of sub-parallel, nearly vertical, fault escarpments. The largest area of the rift floor is covered by trachyte flows, while other volcanic rocks including basalts, phonolites and carbonatites are located around Mt. Olorgesailie, Mt. Esayeti, Mt. Suswa and Singaraini. The Mid Pleistocene Olorgesailie site is famous for an unusual abundance of hominin artefacts, fossil mammals and palaeoenvironmental indicators, preserved in sediments spanning ~1.2 to <0.4 Ma and has been the subject of wide-ranging and intensive studies on hominins and their archeology. Other important hominin sites in the region are located in the Koora Graben, and in the vicinity of Lake Magadi.

We have analyzed the chemical composition of a large number of geological and soil samples in the southern Kenya Rift, in order to understand the control of geochemical and tectonic processes on the release and distribution of vital soil nutrients.

Results show that in the study region volcanic, tectonic and related pedogenic processes created a complex suite of landscape features potentially advantageous for human habitation. Analysis of soil samples from the main volcanic and metamorphic rocks as well as from sedimentary deposits shows that soil edaphic properties are closely correlated with the chemical composition of the parent materials and that deficiencies of soil nutrients are reflected in the mineralogy of the volcanic rocks. Particularly, deficient levels of calcium are sourced in the lack of calcium-bearing minerals in soils developed on trachytic rocks. Further, we show that soil nutrient distributions correlate with the relief created by tectonic faulting. We observed a significant increase of the concentrations of Ca, Mg, P in soils, with proximity to active normal faults.

We suggest that the combination of complex terrain and patchy nutrient distributions created narrow migration corridors potentially exploited by animals and the humans who hunted them. Our study implies that tectonics, geology and related soil edaphics have been important drivers for human habitation and strategic land use. Knowledge of these processes and their impact on past human-landscape interactions contributes to a broader understanding of how landscapes influenced hominin behavior and subsistence strategies in prehistoric time.