Paleogene flood basalt stratigraphy in East Africa

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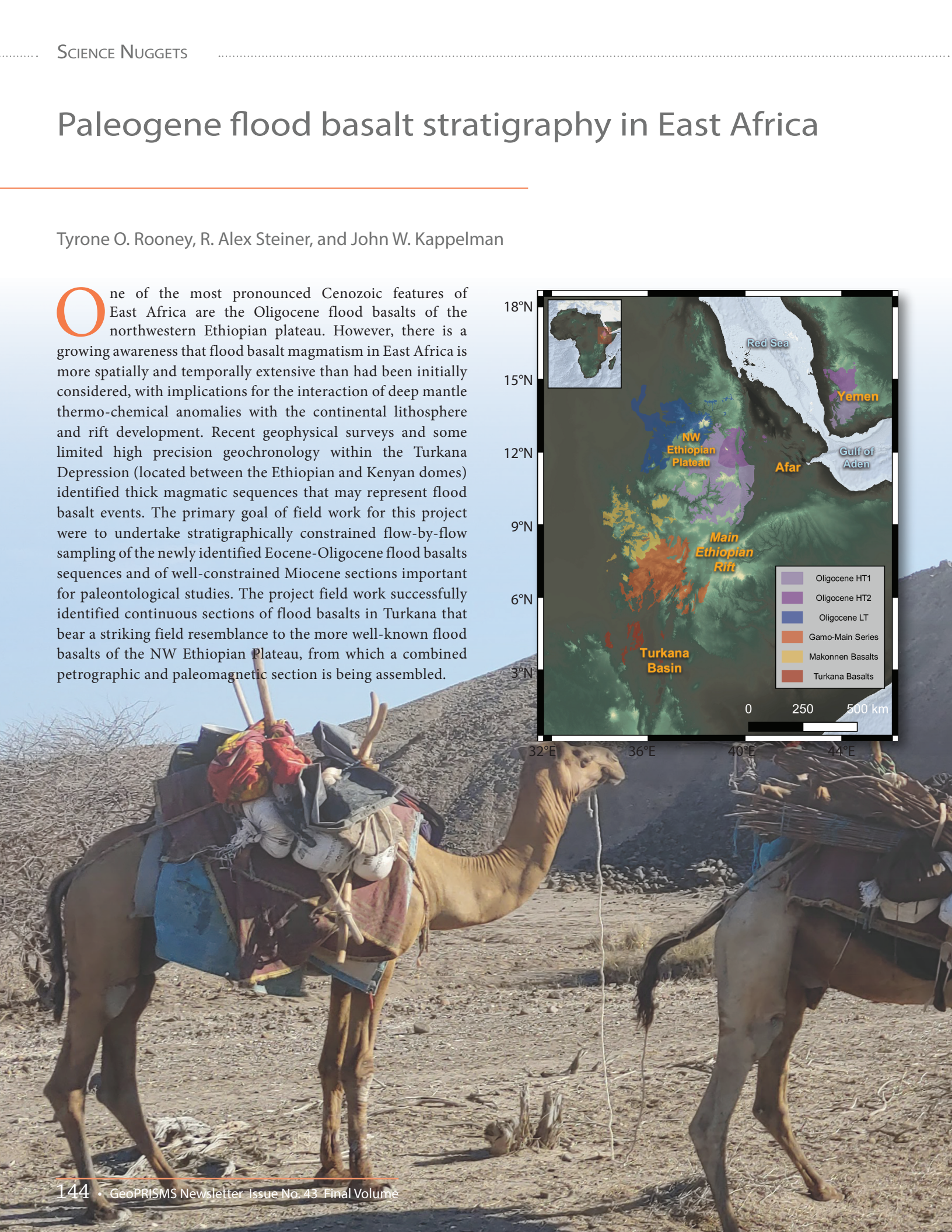
One of the most pronounced Cenozoic features of East Africa are the Oligocene flood basalts of the northwestern Ethiopian plateau. However, there is a growing awareness that flood basalt magmatism in East Africa is more spatially and temporally extensive than had been initially considered, with implications for the interaction of deep mantle thermo-chemical anomalies with the continental lithosphere and rift development. Recent geophysical surveys and some limited high precision geochronology within the Turkana Depression (located between the Ethiopian and Kenyan domes) identified thick magmatic sequences that may represent flood basalt events. The primary goal of field work for this project were to undertake stratigraphically constrained flow-by-flow sampling of the newly identified Eocene-Oligocene flood basalts sequences and of well-constrained Miocene sections important for paleontological studies. The project field work successfully identified continuous sections of flood basalts in Turkana that bear a striking field resemblance to the more well-known flood basalts of the NW Ethiopian Plateau, from which a combined petrographic and paleomagnetic section is being assembled.



Our study locales in West Turkana hold great significance for studies of mammalian and especially primate evolution. Some of the sections that we are studying contain the earliest evidence for the origin and evolution of Old World monkeys and apes, but the ages are not tightly constrained. This fossil record also documents the major Oligo-Miocene dispersal event that introduced Eurasian taxa to Africa, thus modernizing the faunal composition of the continent, along with the extinction of many taxa from the archaic fauna. Our work will better constrain the dates of these important events and in doing so, facilitate testing of the various hypotheses thought to be responsible for these important changes.

We are currently combining petrographic, geochemical, geochronologic, and paleomagnetic data on Eocene-Oligocene and Miocene basalt sections to explore the temporal evolution of magmatism in this important region. Ongoing work examines the evolution of the magmatic systems that produce flood basalt lavas by novel interpretation of crystal compositions within the context of geochemical modelling of open magmatic systems. Tentative results suggest these techniques can establish timescales of magma residence within the crust and contribute to models of flood basalt magma generation, storage, homogenization, and eruption.

Using the well-constrained section we have developed in Turkana, and equivalent sections of flood basalts in Southern Ethiopia and the northwest Ethiopian Plateau, we seek to link these disparate magmatic systems by characterizing a spatially distributed suite of Eocene-Oligocene lavas that extend from the Kenyan border to the boundary of the flood basalts of the northwestern Ethiopian Plateau. Collectively, we hope that our observations will provide new insights into the distribution of thermo-chemically anomalous material in the East African upper mantle derived from the African Large Low Shear Velocity Province during the initial stages of lithospheric destabilization and subsequent Cenozoic rifting. ■

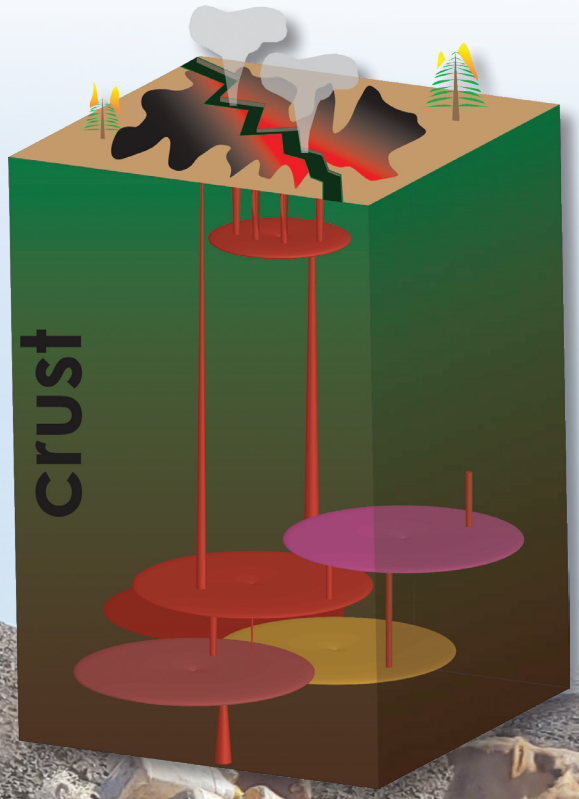


Figure 1 (left page). Map showing the distribution of the Eocene and Oligocene flood basalt provinces in East Africa. LT and HT represent Low Ti and High Ti basalts respectively.

Figure 2 (right). Schematic figure showing a hypothetical trans-crustal magmatic plumbing system of a continental flood basalt.