Investigating Magma-Poor Rifting Processes along the northern Western Branch of the East African Rift System using Geodesy and Geodynamics

Asenath Kwagalakwe (asenathk@vt.edu)[1], D. Sarah Stamps[1], John Naliboff[2], Rob L. Evans[3], Estella Atekwana[4], Emmanuel Njinju[4], Michael Taylor[5], Hillary Mwongyera[5], Andrew B. Katumwehe[6], Peter H. Barry[3], John Mary Kiberu[7], Albert Kabanda [8], Fred Tugume[9], Joseph Nyago[9], Joan Nakajigo[7]

Institutions: [1] Virginia Tech; [2] New Mexico Institute of Mining and Technology; [3] Woods Hole Oceanographic Institution; [4] University of California, Davis; [5] University of Kansas; [6] Midwestern State University; [7] Makerere University; [8] Northwestern University; [9] Department of Geology Survey and Mines, Uganda.

The northern Western Branch of the East African Rift System (EARS) consists of two segments, the magma-rich segment and the magma-poor segment. The magma-poor segment is found in the western and northwestern regions of Uganda, whereas the magma-rich segment is located in the southwestern region of Uganda. In this study, we investigate magma-poor rifting processes using mantle convection and lithospheric dynamics code ASPECT and GNSS (GPS) measurements. Our study has three main objectives: First, we investigate sources of melt below the lithosphere by modeling melt generation and lithospheric modulated convection. Results from this study indicate melt is unlikely to be the weakening mechanism for the magma-poor segment. Second, in our ongoing work, we investigate the role of pre-existing structures in the initiation of magma-poor rifting segments through comparisons between predicted (modeled) and observed fault offsets. Fault locations are constrained by observed fault traces and assumed average dips, which are parameterized in the Geodynamic World Builder (GWB) software package. The GWB mesh-independent representation of the faults provides the initial conditions for the ASPECT simulations, which achieve high resolutions in the faults using adaptive mesh refinement. Future work will focus on constraining the kinematics of the northern Western Branch using GNSS (GPS) data and block kinematic modeling with the TDEFNODE software. This research will help advance our understanding of magma-poor continental rifting processes.

Figure: Map showing the location of the study site. The plate boundaries are shown as a red dashed line. Earthquakes from the National Earthquake Information Center catalog from the years 2000 to 2022 are shown as small white stars, triangles and diamonds. Holocene volcanoes are red triangles. Major faults in the region are represented by black, red, magenta, blue, brown, and gray lines. BF = Bunia Fault; BWF = Bwamba Fault; TF = Tonya Fault; TBF = North Toro Bunyoro Fault; RWF = Rwimi- Wasa Fault; GF = George Fault.