Paper Number: 4221

New active-source seismic imaging of the Malawi (Nyasa) Rift from the SEGMeNT project

Shillington, D.J.[1], Scholz, C.A.[2], Accardo, N.J.[1], McCartney, T.[2], Gaherty, J.B.[1], Chindandali, P.R.[3], Kamihanda, G.[4], Trimhammer, P.[5], Wood, D.[2], Mtelala, K.[6], Gondwe, D.[3], Chilje, S.[3], Ebinger, C.J.[7], Nyblade, A.A.[8], Mbogoni, G.[4], Wambura, R.F.[6], Mruma, A.[4], Salima, J.[3]

[1]Lamont-Doherty Earth Observatory – Columbia University, Palisades, NY 10964, USA, djs@ldeo.columbia.edu
[2]Syracuse University, Syracuse, NY, USA
[3] Geological Survey of Malawi, Zomba, Malawi
[4] Geological Survey of Tanzania, Dodoma, Tanzania
[5]Aarhus University, Denmark
[6] University of Dar es Salaam, Dar es Salaam, Tanzania
[7] University of Rochester, Rochester, NY, USA
[8] Pennsylvania State University, University Park, PA, USA

Little is known about the controls on the initiation and development of magmatism and segmentation in young rift systems. The northern Lake Malawi (Nyasa) rift in the East African Rift System is an early stage rift exhibiting pronounced tectonic segmentation, which is defined in the upper crust by ~100-km-long border faults. Very little volcanism is associated with rifting; the only surface expression of magmatism occurs in an accommodation zone between segments to the north of the lake in the Rungwe Volcanic Province. The Study of Extension and maGmatism in Malawi aNd Tanzania (SEGMeNT) project is a multidisciplinary, multinational study that is acquiring a suite of geophysical, geological and geochemical data to characterize deformation and magmatism in the crust and mantle lithosphere along 2-3 segments of this rift.

As a part of the SEGMeNT project, we acquired seismic reflection and refraction data in Lake Malawi (Nyasa) in March-April 2015. Over 2000 km of seismic reflection data were acquired with a 500 to 2580 cu in air gun array from GEUS/Aarhus and a 500- to 1500-m-long seismic streamer from Syracuse University over a grid of lines across and along the northern and central basins. Air gun shots from MCS profiles and 1000 km of additional shooting with large shot intervals were also recorded on 27 short-period and 6 broadband lake bottom seismometers from Scripps Oceanographic Institute as a part of the Ocean Bottom Seismic Instrument Pool (OBSIP) as well as the 55-station onshore seismic array. The OBS were deployed along one 270-km-long strike line and two ~40- to 50-km-long dip lines.

We will present preliminary data and results from seismic reflection and refraction data acquired in the lake and their implications for crustal deformation within and between rift segments. Seismic reflection data image structures up to ~5-6 km below the lake bottom, including syntectonic sediments, intrabasinal faults and other complex horsts. Some intrabasinal faults in both the northern and central basins offset the youngest sediments, indicating that they are active. These include faults in the area of

the 2009 Karonga earthquakes. In the northern basin, intrabasinal faults are uniformly synthetic to the border fault, and fault spacing and fault throw decrease away from the border fault, as noted by previous studies. In the central basin, faulting patterns are significantly more complex. Velocity models created from seismic refraction data indicate significant variations in sediment thickness and velocity structure between and within the northern and central basins, as well as variations in crustal structure. We will discuss the implications of these new constraints on fault geometries and crustal structure for the distribution and style of extension in the Malawi (Nyasa) rift.