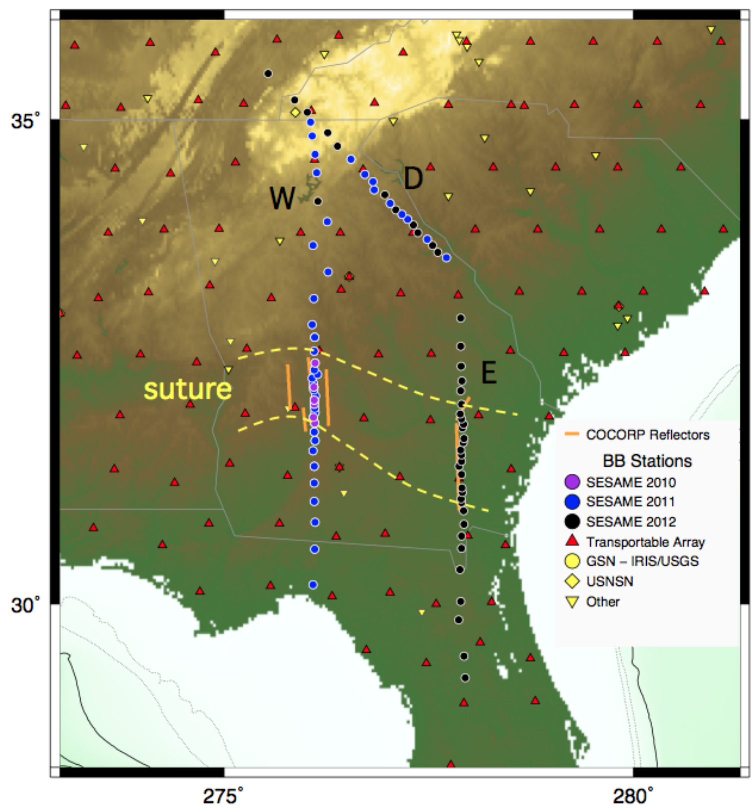
The Southeastern Suture of the Appalachian Margin Experiment (SESAME)

Julia G. MacDougall, Emily Hopper, Karen M. Fischer (Dept. of Geological Sciences, Brown University)
Robert B. Hawman, E. Horry Parker Jr. (Dept. of Geology, University of Georgia)
Lara S. Wagner (Dept. of Geological Sciences, University of North Carolina, Chapel Hill)

The goal of the Southeastern Suture of the Appalachian Margin Experiment (SESAME) is to better understand processes of continental accretion and rifting through imaging of crust and mantle structure in the southeastern U.S. Targets of particular interest are the Laurentia-Gondwana suture proposed in southern Georgia, adjacent regions of Mesozoic extension and magmatism, including the South Georgia Rift basin, and the architecture of southern Appalachian orogenic crust. SESAME comprises 85 broadband EarthScope Flexible Array stations deployed in two N-S lines that cross the proposed Laurentia-Gondwana suture (the W and E lines); a third line is oriented roughly normal to Appalachian crustal terranes from northern Georgia to eastern Tennessee (the D line). Stations were installed in three phases from 2010-2012, and will remain in the field until mid-2014.



Shear-wave splitting in SKS and SKKS phases recorded through October 2012 by stations on the SESAME W and D lines reveal the presence of significant anisotropy in the mantle. Splitting times range from 0.54 s to 1.95 s with a mean of 1.09 s. Near the Gulf Coast on the W line, fast polarizations are predominantly E-W, but rotate to a NE-NNE orientation at stations just south of the suture footprint at crustal depths (orange lines in map). At stations within the footprint of the suture, fast polarizations are predominantly ENE-NE but manifest significant scatter. North of the suture, fast directions remain ENE-NE but are more coherent, although local rotations to NNE azimuths are observed. In the future, shear-wave splitting measurements and azimuthal anisotropy from Rayleigh wave tomography will be modeled to constrain the distributions of anisotropy in the asthenosphere, mantle lithosphere and crust. However, fast polarization changes over short horizontal scales that have already been observed suggest that some of the anisotropy resides at lithospheric depths.

Preliminary Sp common conversion point images clearly delineate the base of the South Georgia Rift basin as an increase in shear velocity. At mantle depths, an Sp phase indicative of a decrease in velocity with depth is observed at a depth of 90-100 km beneath the northern W line in the mountains and at a depth of 60-70 km to the south of the suture. Interpretation of this phase is pending until constraints from surface wave tomography identify the approximate thickness of the lithosphere. However, if the discontinuity does represent the lithosphere-asthenophere boundary, the lithosphere is significantly thinner beneath the South Georgia Rift Basin. Hints of south-dipping mantle interfaces are also observed.