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A collapsed orogen from the crust to the core: An Earthscope target

Susan Beck[1]: beck@geo.arizona.edu
Matthew Fouch[2]: fouch@asu.edu
Mihai Ducea[1]: ducea@geo.arizona.edu
Edward Garnero[2]: garnero@asu.edu
George Zandt[1]: zandt@geo.arizona.edu
Clement Chase[1]: chase@geo.arizona.edu

[1]Department of Geosciences, University of Arizona, Tucson, AZ 85721

[2] Department of Geological Sciences, Arizona State University, Tempe, AZ 85287

The Southern Basin and Range (SBR) and transition to the Colorado Plateau (CP) provide a natural laboratory to study the evolution of a collapsed orogen using a combination of broadband seismology, gravity/geoid, and crustal and upper mantle xenoliths. Within the past 40 Myr the region has evolved from an Andean type subduction margin to a highly extended terrane with associated volcanism. This region of tectonic North America can provide important clues regarding lithospheric and crustal evolution processes. Fundamental questions we can address from the crust to core include: Are there fundamental differences in crustal structure between the SBR and CP? Is there a remnant stretching fabric in the crust? What is the nature of the lower crust and is it decoupled from the upper crust during the process of extension? What is the architecture of the upper mantle beneath the SBR and CP and does it reflect old or new lithospheric boundaries? Is there a lithospheric keel beneath the CP? Does asthenospheric mantle flow exist in the region? Does the mantle transition zone reflect lateral temperature variations? Are remnants of the Farallon plate still sinking into the lower mantle? Are there discontinuities in the lower mantle? What is the nature of the core-mantle boundary structure? Large suites of xenoliths from the SBR and CP provide a direct sampling of the lower crust and upper mantle and can provide constraints on composition, water content, and temperature through time. In general, petrologic studies indicate a more heterogeneous upper mantle than seismological studies, signifying a need for more detailed information to resolve these discrepancies. A broadband flexible seismic array coupled with the EarthScope USArray footprint will yield an unprecedented image combining tomography, receiver function, and anisotropy techniques from the crust to the core. The integration of results from the xenolith data and the new seismic data, particularly seismic velocity, attenuation, and scattering, will supply the information necessary to place key constraints on the evolution of the crust and mantle. Additionally, the ideal distance from South American deep earthquakes will enable analyses of unprecedented detail of the deepest mantle and core-mantle boundary structure. Stations in the region are ideally located for travel time and shear wave splitting studies of core-reflected ScS waves, with the aim of fine scale resolution of D" heterogeneity, anisotropy, and discontinuity structure beneath Central America and the Caribbean, as well as mid-lower mantle slab signatures detected in tomography. The SBR-CP structure is most certainly 3-D so our future work will entail using and developing 2-D and 3-D wave propagation methods to combine tomography, discontinuity structure, and anisotropy studies to go beyond current 1-D models with this high quality data set.