Pilot study: Deep electrical structure of the Rio Grande Rift to constrain extent and mechanisms of rifting

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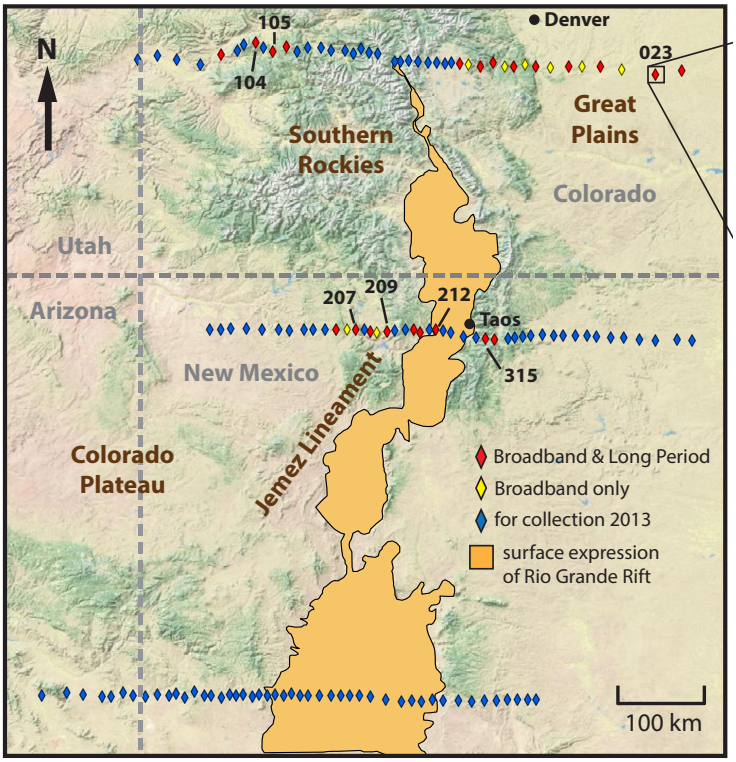
A wideband and long period magnetotelluric pilot experiment is underway across the Rio Grande Rift in Colorado and New Mexico in order to provide constraints on the thermal and rheological state of the lithosphere beneath this region of intra-continental extension. Important questions about continental rifting remain unresolved, including the role of magmatism, volatiles and inherited lithospheric structure in the initiation and development of rifting. Recent seismic imaging studies show thinned crust and low seismic wavespeeds in the upper mantle beneath the Rio Grande Rift. New and ongoing geodetic work confirms the low strain-rate environment of the region and shows surprisingly uniform deformation over an area far wider than the rift's physiographic expression. Electrical conductivity models from this experiment will provide information complementary to seismic studies and can be used to determine the relative contributions of thermal and compositional heterogeneity in the crust and upper mantle to the process of continental extension. The magnetotelluric pilot experiment will include three transects across northern, central, and southern segments of the rift. A comparison of results from these segments will be used to examine along strike variation in the spatial extent of rift-associated modification of the lithosphere. The need for an expanded or modified array design will also be assessed as part of the pilot experiment.

The first phase of this experiment began in summer 2012 with the collection of magnetotelluric (MT) data at 30 locations along the northern and central portions of the rift, including sites in the Great Plains, the Colorado Front Range, the Rocky Mountains, the Taos Plateau and the Sangre de Cristo Mountains. Preliminary data assessment shows high quality signal down to periods of at least 10 000 s, which is believed to correspond to upper mantle depths in this region of high upper-crustal conductivity. Although sparse station coverage limits the ability to justify 2D inverse modeling at this stage, 1D forward modeling has been successful at recovering robust electrical structure in the crust. A notably example of this is the identification of a mid- to upper-crustal conductor beneath the western slope of the Rocky Mountains. The second phase of this experiment will take place in summer 2013 with the collection of magnetotelluric data at approximately 80 sites along the southern and central segments of the rift in New Mexico.



The first phase of data collection involved the recruitment and training of 20 volunteer field assistants, including nine undergraduate students. This summer we will again rely on undergraduate assistance, including a dedicated IRIS intern as well as several students recruited from the geology and physics departments of the University of Colorado at Boulder and the Colorado School of Mines. Continued funding for this pilot experiment is provided by an Earthscope EAGER grant.

Rio Grande Rift MT Pilot Experiment Station Coverage

Data will be collected across three 500 km-long, E-W profiles straddling the rift axis. Nominal station spacing of 7-15 km will require ~48 stations per line. Broadband MT data will be collected at each site, long period MT data at every other. Red and yellow diamonds correspond to data collected in 2012; blue are planned site locations. Physiographic regions of interest labeled in brown.