Important Tectonic Questions in North Carolina

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North Carolina has a number of geologic features that are difficult to explain given its passive margin setting. The Blue Ridge Mountains are remarkable for their steep topography and surprisingly high elevations (Figure 1). While the last orogenic event is commonly believed to be the Alleghanian, evidence for more recent (Tertiary to present) uplift comes from the presence of east-west trending lineaments within the orogen in North Carolina (Hill & Stewart, 2012). Furthermore, data from the Appalachian Seismic Transect (AST) deployed across the North Carolina Blue Ridge in 2009 indicate the possible presence of an eclogitic root east of the Blue Ridge Escarpment that is not present beneath the higher elevations west of the escarpment (Wagner et al., 2012). This may suggest an ongoing isostatic explanation for the observed sharp topography (Gallen et al., 2013).

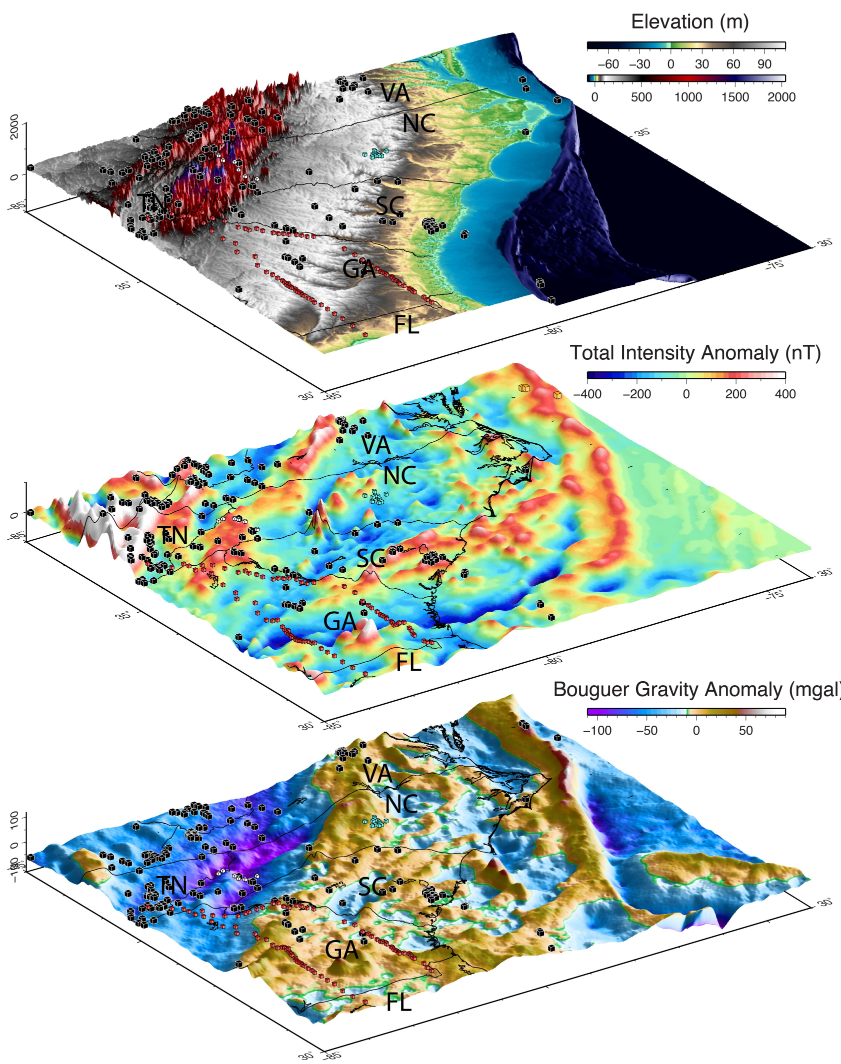

Figure 1: Maps of the southeastern U.S. showing topography, magnetic anomalies, and Bouguer gravity anomalies. Black cubes show locations of M > 3 earthquakes from the ISC catalog. Smaller cubes show station locations for recent and ongoing seismic deployments: Appalachian Seismic Transect (AST: white); South-Eastern Suture of the Appalachian Margin Experiment (SESAME: red); Pre-Hydrofracking Regional Assessment of Central Carolina Seismicity (PHRACCS): light blue)

The Blue Ridge Mountains are also the site of ongoing seismic activity, which, while not particularly destructive in modern times, is often felt and reported by residents. Aside from the mountains, however, the rest of North Carolina is notably aseismic, at least compared to adjacent South Carolina and Virginia (Figure 1). This difference in seismicity does not correspond to known geologic, geomagnetic, or gravity anomalies, and is not due to varying seismic station coverage. One possible explanation is that the ongoing seismicity in the Piedmont and coastal plains of South Carolina and Virginia are aftershocks of relatively recent large seismic events (e.g. the 1886 Charleston, SC earthquake). This might indicate that the observed lack of seismicity in North Carolina may only reflect the absence of such a large event in recent times. New data from the PHRACCS array in central North Carolina indicate that regional Triassic basin bounding faults are seismically active, but that the magnitudes of these events are currently very small. There is evidence for Quarternary tectonic activity within the coastal plains in both North and South Carolina from deflections of coastal rivers (Bartholomew and Rich, 2012) and from the Tertiary uplift of the Cape Fear Arch. Another possible explanation for the difference in seismicity between North Carolina and its neighbors could be the presence of thicker/stronger lithosphere beneath North Carolina (Mooney et al, 2012). Unfortunately, the regional lithospheric structure is not known. More data are needed to better understand the lithospheric scale structures across the southeastern United States to better understand passive margin tectonism and its potential for destructive seismicity.