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Joint Inversion of Gravity and Magnetic Data in the Eastern Tennessee Seismic Zone

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The Eastern Tennessee Seismic Zone (ETSZ) is an intraplate continental region located in the eastern part of North America and constitutes, after the New Madrid Seismic Zone, the second most active region of the continent east of the Rocky Mountains. It consists of a NE-trending, 300 km long and 100 km wide, belt of diffuse seismicity and is characterized by relatively low magnitude earthquakes occurring at mid-crustal depths. As a consequence, the rupture never propagates up to the ground surface and no obvious relationship seems to exist between the earthquake distribution and the faults known from geological mapping. Yet, that distribution appears to be significantly correlated with seismic velocity variations inferred from body-wave tomography and with observed potential field anomalies, thus suggesting some control of the seismicity by geological contrasts at depth. Most of the earthquakes occur in the eastern part of the ETSZ and correspond to a negative magnetic anomaly zone, whereas the earthquakes occurring to the West appear to be correlated with a positive magnetic anomaly. The transition between these two zones is associated with a high gravity gradient and is also visible in the body-wave tomographic results. It coincides with the New York Alabama Lineament, a linear feature inferred from magnetic data and probably accounting for a crustal-scale tectonic structure of that region. In this work, we attempt to investigate the possible links between the seismic activity of the ETSZ and its crustal structure by means of potential field data modeling. We use the gravity and magnetic databases provided by USGS to invert for density and magnetic susceptibility variations within the crust. Information compiled from surface geology, available seismic profiles and well-log data, as well as recent 3D body-wave tomographic imaging results, is used to constrain the models prior to the inversion.