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Correlation between crustal high conductivity zones and seismic activity and the role of carbon during shear

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The electrical conductivity of the lower crust is anomalously high in many locations around the world. Well interconnected grain boundary carbon not only has the potential for increasing the electrical conductivity of the rock, but would also be expected to reduce its shear strength. We report field and laboratory measurements consistent with deep carbon-bearing rocks causing observed high conductivities and crustal weaknesses associated with increased seismicity. The field data indicate a correlation between the depths to a zone of high electrical conductivity observed in Transdanubia in Hungary, earthquake focal depths, and zones of high seismic attenuation. The laboratory triaxial deformation experiments show progressive shearing of a fracture in carbon-bearing rock can result in a weaker more electrically conductive fracture. We propose that smearing of carbon during shear reduces friction and makes further shearing easier as well as increasing the electrical connectivity along the fracture plane. These results provide strong evidence for the role of carbon at depth in both electrical conduction and seismo-tectonics, explaining the correlation between mid-crustal high reflectivities and high conductivities observed at many locations worldwide.