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Imaging the deep roots of the Dead Sea Fault and the San Andreas Fault with magnetotelluric measurements

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Continental transform faults separate plates of lithosphere but it is still debatable if these faults cut rigid blocks as narrow shear zones or if the lower crust decouples and deforms continuously over a wide area. Electrical conductivity images from the brittle crust show some similarities but also marked differences between the Dead Sea Fault (DST) and the San Andreas Fault (SAF). In particular, the DST does not exhibit a fault zone conductor in the brittle crust but acts as a barrier to cross-fault fluid transport due to an impermeable fault seal, a lithological contrast across the fault, or some combination of the two. The very narrow, meter-scale damage zone at the DST could be a result of a faulting mechanism where strain is extremely localized, apparently over long periods of time. A regional scale geophysical transect across the DST in Jordan and Israel reveals a narrow, approximately 3-5 km wide, sub-vertical zone of high electrical conductivity penetrating the lithosphere to a depth of at least 30 km. This image strongly suggests that the DST may be spatially confined even in the ductile lower crust. MT studies of the SAF have generally focused on the geometry and nature of the upper crustal fault. We give details of a new magnetotelluric experiment designed to investigate the SAF at Parkfield on the scale of the entire crust and upper mantle.