Evidence suggesting crustal fluids beneath earthquake source regions

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Electrical resistivity is highly sensitive not only to the temperature and bulk composition of rocks, but also to the presence and connectivity of melt, volatiles, and aqueous fluids. A great deal of effort has been made using MT soundings to obtain information on subsurface electrical conductivity anomalies around seismically active regions in subduction zones. Strike-slip intraplate earthquakes such as the 1997 Kagoshima (M6.6), the 2000 western Tottori (M7.3) earthquakes, tend to occur near the boundaries between conductive and resistive crust, generally resistive side. Rheological heterogeneities driven by aqueous fluids in the crust would produce strain concentrations within resistive crust due to anelastic deformation under strike-slip fault type stress. In the case of the 2011 Hamadori swarm earthquakes, which are thought to be triggered the 2011 Tohoku-Oki earthquake, an anomalous conductor with a width of 20 km has been detected below the seismic source region, extending down to the base of the crust. The swarm activity is likely caused by increased pore pressure, within resistive crust, as a result of fracturing stimulation. Assuming that aqueous fluids produce the low-electrical resistivity, the plausible explanations for the generation of fluids are limited to the following: (1) sediment porosity reduction and from smectite-illite and opal-quartz reactions in the subducting deep-sea sediments, (2) metamorphism of fore-arc basin sediments, sedimentary and/or volcanic rocks detached from the plate or (3) dehydration reactions in the subducted oceanic crust and/or hydrated mantle below the fore-arc mantle wedge.

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