Deep conductive structure of the Pacific NW derived from 3-D inversion of USArray Magnetotelluric data

Long period (10-20,000s) magnetotelluric (MT) data are being acquired in large footprints across the continental USA on a quasi-regular grid (nominal ~70 km spacing) as a part of the USArray component of EarthScope. These data are highly sensitive to fluids, melts, and other orogenic indicators, and thus provide a valuable complement to other observational components of EarthScope. Here we present and interpret results from 3D inversion of MT data from 325 sites acquired in 2006-2011 to provide a regional scale view of electrical resistivity from the middle crust to nearly the transition zone, covering a rectangular area from NW Washington to NW Colorado. Extensive areas of low resistivity are imaged in the lower crust and uppermost mantle beneath the extensional Basin and Range, High Lava Plains, and Snake River Plain provinces, most plausibly explained by underplated, hybridized magmas, and associated exsolved highly saline fluids. These pervasive low resistivity layers generally have a "streaky" appearance where lateral scale is similar to site spacing, and where the elongate zones of lowest resistivity tend to align with seismic fast-axes. This suggests that finer scale electrical anisotropy, most likely resulting from alignment of melt flow induced by slab roll-back , may be widespread in the uppermost mantle in this area. Thick sections of resistive lithosphere are found in the eastern and northeastern part of the domain, coinciding spatially with the Wyoming and Medicine Hat Cratons. Several deep conductive sutures bound these cratonic blocks; these most likely represent meta-sediments emplaced during ancient collisions. Oceanic lithosphere of the subducting Juan de Fuca and Gorda Plates beneath the Coast Ranges appears highly resistive. Other resistive zones in the northwestern part of the domain may represent relict oceanic lithosphere: the accreted "Siletzia" terrane beneath the Coast Ranges and Columbia Embayment, and a deep vertical resistive feature just to the east, spatially coincident with the seismically fast "slab curtain" beneath eastern Idaho interpreted by others as stranded Farallon lithosphere. Quasi-horizontal patches of low resistivity are common in the deep crust beneath the Cascade Volcanic Arc, typically extending into the near fore-arc region. These features likely represent fluids evolved from thermally induced breakdown of hydrate minerals in the down-going slab. In the backarc, low resistivities concentrate in "plumes" connecting into a deeper aesthenospheric layer to the east, consistent with subduction-driven upwelling of hot, probably hydrated (and possibly melting), aesthenospheric mantle. There is substantial heterogeneity along the arc, which may in part reflect flow control by more impenetrable upper mantle structure, relict from past subduction. East of the backarc, mantle resistivities are consistent with a thermal lithosphere only ~50-60 km thick in the active provinces of the west, increasing to around 200-250 km under the cratonic stable areas. Beneath the active region, aesthenospheric resistivities are near 100 Ωm above 150-200 km depth, consistent with laboratory results for dry olivine. Lower resistivities (15-20 Ωm) at greater depth require moderate hydration (~350 ppm). Resistivities are lower (< 10 Ωm) immediately beneath the stable cratons, suggesting either higher levels of hydration in these areas, especially east of the Rocky Mountain Front, or influence of poorly resolved structures outside our array.