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Are the crustal and mantle conductive zones isotropic or anisotropic?

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Abstract

One of the significant problems of modern deep magnetotellurics is the recognition of anisotropy in the crustal and mantle conductive zones. In the paper we perform numerical experiment comparing several 2D models of crustal and mantle isotropic and anisotropic prismatic conductors. Anisotropy is modeled by alternating horizontal or vertical thin layers of different resistivities (the vertical layers are parallel to the prism strike). Using these models, we examine conditions under which the magnetotelluric and magnetovariational response functions distinguish between isotropy and anisotropy. The resolution of MT and MV studies depends on the sediments conductance, lithosphere resistance and deep conductor width. Calculations show that the most favorable conditions for anisotropy studies are observed in the active regions characterized by small sediments conductance (10-20 S) and moderate lithosphere resistance (10^8 Ohm·m^2). However, in the stable regions, where sediments conductance exceeds 50-100 S and the lithosphere resistance comes up to 10^9 Ohm·m^2, the crustal and mantle anisotropic and isotropic conductors manifest themselves in the equivalent magnetotelluric and magnetovariational functions, which cannot distinguish between anisotropy and isotropy and admit both the interpretations.

Key words: magnetotellurics, anisotropy, Earth's crust, lithosphere, asthenosphere, mantle.