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Probing the role of crustal fluids on seismicity by three-dimensional magnetotellurics: Case study from Armutlu Peninsula, NW Turkey

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Electromagnetic impedance and transfer function information derived from thirty-five magnetotelluric (MT) observation points were exploited to develop the electrical resistivity structure of Armutlu Peninsula, at the western part of the 1200-km-long dextral North Anatolian Fault, Turkey by means of three-dimensional numerical modeling. The most challenging step while performing the task was to overcome the influence of the highly conductive Marmara Sea due to its indented coast and varying bathymetry. Following several forward tests, this "coast effect" was surmounted by inserting fixed cells (with 0.3 Ωm) to the initial model with near-realistic geometry. The resulting models suggest that: (i) the aftershocks of the devastating 1999 İzmit Earthquake that occurred on the İzmit – Karamürsel and Yarımca – Yalova segments tend to follow a conductive – resistive boundary while concentrating on the resistive side. This resistive zone is continuous along the fault line although its depth varies spatially. In particular, the shallowing resistive zone is consistent with the tendency that the hypocenters of aftershocks start to concentrate on shallower depths towards the west. Such a disposition would indicate that seismic activity will be shallower in the further west towards İstanbul. (ii) The area is composed of two major strata; a shallow resistive layer with small surficial conductive patches, and a deep layer which has relatively larger conductive blocks aligned in a rather northeast-southwest direction. The former corresponds to a brittle zone and the latter shows a more ductile characteristic. Crustal stress accumulates only in the brittle zone and an aseismic flow occurs in the ductile zone. (iii) A spherical aftershock cluster in the western part of the study area corresponding a high-resistivity zone surrounded by a circular conductor, which is in good agreement with the presence of shallow hydrothermal activity.