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Electromagnetic constraints on a melting region beneath the central Mariana back-arc spreading ridge

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An electrical resistivity profile across the central Mariana subduction system shows high resistivities in the region of upper mantle beneath the back-arc spreading ridge where melt is supposed to exist. The question arises as to why the 2D magnetotelluric (MT) experiment failed to image the melt at the place where seismic attenuation structures showed a signature of the melt but seismic velocity structures did not strongly show it. We have run forward models that test possible melt geometries that are consistent with other observations from the region, and that we use to place upper bounds on the possible extent of melt beneath the spreading center. The tests are carried out by examining the differences in MT response between a starting 2D model which is essentially the result of inversion of data from the region and models with 3D melt bodies superimposed on this background starting model. If differences in the predicted MT responses are above a threshold level determined by the uncertainties in the field data, then we argue that such a feature should be resolvable and therefore is not compatible with our data. Features which do not greatly perturb the MT responses, within the error, could be considered acceptable. The tests with the across-strike real data profile and an along-strike hypothetical data profile show that perturbations in the off-diagonal elements of the MT response behave similarly in both profiles, and that weak signals from melt bodies in diagonal elements of the MT response may not be detected within the observational error. Taking into accounting melting regions suggested by other geophysical studies, as well as the likely effects of melt focusing, the most likely melt region has a pyramid shape and a resistivity of 100 Ohm-m, whose value is close to a dry olivine on mantle adiabat and could indicate the interconnected silicate melt of ˜1%-0.1%. In contrast to the superfast spreading southern East Pacific Rise, the 3D melt region with a modest detectable melt supply suggests that buoyant mantle upwelling is the dominant process beneath the slow-spreading central Mariana back-arc spreading ridge.