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Mantle transition zone beneath a normal seafloor in the northwestern Pacific: Electrical conductivity, seismic discontinuity, and water content

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We conducted a joint electromagnetic and seismic field experiment to probe water content reserved in the mantle transition zone (MTZ) beneath a normal seafloor around the Shatsky Rise in the northwestern Pacific. Specifically for the investigation of the MTZ structure, we developed new ocean bottom instruments for providing higher S/N ratio data and having higher mobility in field experiment than ever. We installed our state-of-the-art instruments in two arrays to the north and south of the Shatsky Rise for 5 years from 2010 to 2015. We first analyzed data obtained in our and previous studies to elucidate an electrical conductivity structure through the magnetotelluric and geomagnetic depth sounding methods and seismic discontinuity depths or thickness of the MTZ through the P-wave receiver function method. An electrical conductivity structure beneath two observational arrays is represented well by an average 1-D model beneath the northern Pacific. A MTZ thickness beneath the north array is thicker than a global average of MTZ thickness by 22 km, and that beneath the south array is similar to the average. For estimating water content in the MTZ, we implemented a series of forward modeling of the electromagnetic responses based on the average 1-D electrical conductivity model, temperature profiles of the MTZ involving temperature anomalies estimated from the MTZ thickness perturbations, and electrical conductivities of dry and hydrous MTZ materials (wadsleyite and ringwoodite). A result of the forward modeling indicates that the maximum water content in the MTZ beneath the north array is 0.5 wt.%.