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Laboratory-based conductivity structure in the mantle transition zone

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Recent laboratory electrical conductivity measurements of the main mantle constituent minerals have refined the effect of water and iron content on electrical conductivity of high-pressure mantle phases. As a result, the laboratory-based conductivity-depth profile in the Earth's mantle is largely different from the previous model proposed by Xu et al. (2000), especially at the depth of the mantle transition zone. The electrical conductivity of the Earth's mantle is controlled by the coexistence of multiple mineral phases. Using these latest conductivity data of mantle minerals and geotherm model, the laboratory-based conductivity-depth profiles of a depth range from 200 to 800 km across the mantle transition zone have been constructed by the mixing models of composite materials assuming the pyrolitic composition. The calculated conductivity values increase from 10-2 S/m at 200 km depth to 100 S/m at 800 km depth. There should be no conductivity jump at the 410 km discontinuity is not obvious, which is striking difference from the previous model given by Xu et al. (2000), because modal proportion of majorite garnet gradually increases across this boundary, and conductivity values of olivine and wadsleyite are similar each other. Instead, Aa remarkable conductivity jump appears at the depth (520 km depth) of wadsleyite-ringwoodite transition with or without water in the transition zone. The present conductivity-depth profile in the transition zone agrees with thate 1-D conductivity-depth profile obtained from the geophysical observations beneath the Pacific, even if thein the case of the dry mantle transition zone is dry. In the mantle transition zone with the stagnant slab, tThe absolute conductivity values obtained from the conductivity profiles beneath the Philippine Sea and the northeastern China, where stagnant slabs exist, are too high to explain by the dry pyrolite model, especially in the stability field of wadsleyite. A presence of water in the transition zone minerals is required to explain suchthe high conductivity.