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Origin of the high conductivity layers in oceanic asthenosphere

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Origin of the high-conductivity layer (HCL) in oceanic asthenosphere is a key to understand mechanisms to allow smooth plate motion. Although it has been attributed to either partial melting or hydration, no definitive answer has been provided so far. We have compiled magnetotelluric studies in oceans to summarize the features of the oceanic HCL as follows. Firstly, HCL is observed about 80-100 km depth under juvenile plates, whereas no HCL is detected under mature plates. Secondly, the maximum conductivity of HCL is 3×10(-2) S/m near normal ridges, whereas larger magnitudes of HCL are observed near ridges with higher volatiles. The first point suggests that the mechanism for HCL is related to high temperature, which declines the hydration hypothesis because of the small activation energy of proton conduction. Moreover, the magnitudes of HCL cannot be explained consistently with conductivity of asthenosphere under the matured plates in view of the proton conduction. The magnitudes of the HCL near the normal ridges are explained by 0.1 % of partial melting of the DMM induced by trace amounts of volatiles. Not hydration but partial melting is thus essential in oceanic asthenosphere.