Understanding of low velocity anomaly in the asthenosphere inferred from elastic wave velocity measurement of partially molten rocks

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The low velocity anomaly at the top of asthenosphere is one of important seismological features, and expected to be formed by carbon dioxide (CO_2)-induced partial melting of mantle rock. For better constraint on the melt fraction and distribution in the low-velocity zone, a comparison between experimental velocity and geophysical observation is a straightforward approach. Here we have measured the elastic wave velocity of olivine + carbonate melt using in-situ ultrasonic technique under conditions relevant to the top of asthenosphere. Both of compressional (V_P) and shear (V_S) wave velocities became smaller with increasing the volume fraction of melt in the sample, and we found quantitatively the velocity attenuation as a function of melt fraction. Comparing with the low-velocity zone, we succeeded in understanding a suitable amount of melt in the asthenosphere. The presence of magmas below the lithosphere could serve as a lubricant for the dynamics of plate tectonics and be a magma source of petit-spot volcanoes located at the outer rise of the oceanic plate.

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