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Seismic evidence for melting within the oceanic asthenosphere

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The seismic low velocity zone (LVZ) of the upper mantle is usually associated with a low-viscosity asthenosphere that plays an important role for the dynamics of plate tectonics. However its origin remains enigmatic, some authors attributing the reduction in seismic velocity to a small amount of partial melt, other suggesting that it may originate entirely from the properties of solid peridotite close to its solidus or from anelastic relaxation caused by elastically accommodated grain boundary sliding. Observations of shear attenuation provide additional constraints to unravel the origin of the LVZ. Here, we report global observations of a significant amount of partial melt within the LVZ from the simultaneous interpretation of global shear attenuation and velocity models. Our observations are compatible with a model of partially molten asthenosphere consisting of horizontal melt-rich layers embedded in melt-less mantle. The seismic observations suggest that this model has a global character.