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Wedge mantle anisotropy and geometry of serpentine sealed cracks

mitsuhiro toriumi[1]

[1] Univ.Tokyo

The seismic anisotropy of the wedge mantle has been determined to display contrasting two types by Nakajima et al. (2006). The wedge mantle under island arc appears fast s-wave orientation normal to the trench axis but that under the forearc does pararell to the trench axis. Many authors consider the model of CPO of olivine responcible for seismic anisotropy derived from plastic flow of the upper mantle. However, there are some reasons for alternative models of upper mantle anisotropy: one is that the temperature of the uppermost mantle near the slab is too low for olivine to deform plastically and secondly wet condition makes the upper mantle to hydrate and form abundant serpentine.On the other hand, peridotite masses are frequently serpentinized by antigorite, chrysotile and lizardite. The modes of occurrence of those serpentine minerals can be classified into three types: one is the replacement from grain boundary of olivine, second is the transgranular replacement by radial antigorite tabular grains, and third is sealed crack occupied by serpentine. The former two types make isotropic texture of replacement from olivine to serpentine but the latter one shows strong anisotropy of distribution of serpentine. Then, the seismic anisotropy is remarkably large in the case of sealed crack type serpentinization. Further, it is very important that seismic anisotropy derived from sealed serpentine cracks can be predicted by the instantaneous stress orientation in the frontal wedge mantle.