CHEMICAL HETEROGENEITY IN THE MANTLE FROM ARRAY OBSERVATIONS OF SHORT PERIOD P, PDIFF AND THEIR CODA

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Abstract

I apply array processing techniques to study the slowness and coda of P/Pdiff for 1,371 shallow earthquakes (< 200 km) that occurred in Asia, South America, Tonga-Fiji, and Indonesia, and were recorded by the medium-aperture array, YKA, in Canada. The slowness analysis shows lateral variations in Earth structure at the base of the mantle across the north Pacific. I observe an Ultra-Low Velocity Zone (ULVZ) with up to 6% P velocity reduction in this region. The ULVZ can be explained as partial melt created by disaggregated mid-ocean ridge basalt (MORB) material that was subducted many millions of year ago beneath East Asia. It is currently being swept laterally towards the large, low shear velocity province (LLSVP) in the south-central Pacific by mantle convection currents. I also measure the coda decay rate (CDR) of the P/Pdiff energy. The radial variation of the CDR suggests that more fine-scale scatterers exist in the lowermost mantle compared to the mid-mantle. The CDR also has lateral variation, with the lowermost mantle beneath subduction regions having a smaller value (decays more slowly) than that corresponding to a nonsubduction region. The lateral variations of both the slowness and the CDRs at the base of the mantle support the hypothesis that mantle convection sweeps segregated subducted MORB laterally, due to the density and the melting temperature of the MORB, and it possibly accumulates to form the LLSVP. Synthetic simulations of Pdiff coda waves using a single scattering method also prefer the whole mantle scattering model with 1% dv/v in D". The synthetic tests also constrain other important properties of the lowermost mantle. A non-smooth CMB is indicated which leads to topographical scattering, and Qp for the lowermost mantle is estimated to be quite low at 150-250.