

EXTENDED ABSTRACT

SEISMIC ARRAY EVIDENCE OF LATERAL VARIATIONS IN THE LOWER MANTLE

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Two classes of array data have been used in exploring lateral variations in the mantle: (1) slowness vector anomalies of primary body waves; and (2) scattered waves. Large-scale inhomogeneities in the lower mantle and near the source region have been inferred from array slowness anomalies, with estimates of linear dimensions varying from more than 1000 to 200 km or less. The existence of such deep-seated structure has been supported by other data (i.e. travel times), yet the source of the array anomalies themselves has been debated lately. A comparison of slowness anomalies at the NORSAR and LASA arrays, with anomalies at seismic networks in the same regions (Scandinavia and Montana) does not confirm the array slowness anomalies (Vermeulen and Doornbos, 1977). Network data from events in Central America (to Fennoscandia) and in the northern part of the Bonin arc (to Montana) do reveal $dT/d\Delta$ anomalies, but their source is unrelated to the slowness anomalies observed at NORSAR and LASA. The network anomalies point to lateral inhomogeneity in the deep mantle (from Central American events) and near the source region of the northern Bonin arc.

Scattered waves, in particular those emerging as PKIKP precursors, have been analysed at NORSAR and the UKAEA arrays. They are diagnostic of small-scale (10–30 km) inhomogeneities in the deep mantle and/or the core–mantle boundary (CMB). For many of the data, a slightly rough CMB provides a simple explanation. Theoretical work has led to the conclusion that both a slightly rough CMB (radial variations up to a few hundred metre), and a slightly heterogeneous lower mantle (relative variations in physical

parameters up to a few per cent) produce the energy level that is observed in most of the PKP precursors (Doornbos, 1978). For some data groups at NORSAR, the simultaneous explanation of other characteristics like travel time and slowness vector, by scattering in an otherwise standard earth model, may require heterogeneity (which may not be small) well above CMB (up to about 600 km), and/or large-scale lateral variations in the amount of heterogeneity (Doornbos, 1976). Such large scale variations have been confirmed in a comparison of UKAEA precursor data and those at NORSAR (van den Berg et al., 1978). Precursors at the different arrays have sampled different regions of the lower mantle and CMB. This leads to the mapping of relatively “smooth” regions (beneath the southern Sandwich Islands and Central North America, from Yellowknife array data), and “rough” regions (beneath the Fiji Islands and Fennoscandia, from NORSAR data).

References

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