Seismological structure of the Earth's core: Implications for geomagnetism

Satoru Tanaka[1]

[1] IFREE/JAMSTEC

I overview recent progress of seismological studies on the Earth's core and the core-mantle boundary (CMB). The interesting topics raised by classical seismological data have been updated by using modern data and new discoveries are also achieved. Enduaring accumulation of both analog and digital seismograms makes it possible to reveal the features of the Earth's central part. Moreover, recent broadband seicmic observations change qualitative and quantitavie perspective of the seismological core studies.

The CMB, especially the base of the mantle, is recognized as a chemical and thermal boundary layer that acts as a plume root and a slab graveyard. Seismological studies have revealed heterogeneity and anisotropy at the base of the mantle. Moreover, free oscillation studies indicate that the density at the base of the mantle is larger than that of the lower mantle. Iron inclusion is one of interpretaion for such heavy material and its content has serios effects on the geomagnetic field. The recent discovery that post-perovskite phase is denser than perovskite will intersect the previous point of view.

In the outer core, stably stratified layer or thin sediment at the top of the core has been discussed. The structure of the core surfacce will be critical for understanding geodynamo and secular variation of geomagnetic field. Accumulation of modern broadband seismograms invokes a new trial of this issue. Regional and global analyses of seismic waves support the existence of a low P-wave velocity layer with 50-100 km thickness in the outermost core. Although the existence of a thin layer (2-10 km thickness) is examined by using dense seismic arrays, a global scale studies has not been fully studied.

Since geodynamo energy is partly maintained by inner core growth, inner core structure has been investigated. Inner core anisotropy is a widely accepted concept. However, its fine structure has been under debate. Hemispherical structure and radial variation of inner core anisotropy are questioned by seismologists who mainly analyze the ISC travel-time catalog, whereas many seismolgogists analysing waveforms support the hypothesis. Inner core super-rotaion is the most interesting topic in this decade. The most recent estimate of the rotation rate is approximately 0.1 degree/year that is a detection limit from the available data set at the present time and is remarkably smaller than the past largest estimation of 3 degree/year.