The 7th Global-COE (25th GRC) International Frontier Seminar

March 4th, 2009, from 17:00, at the room #101

Some Remaining Problems in the Mantle

Prof. Craig R. Bina

Department of Earth and Planetary Sciences, Northwestern University, USA

While much attention now is focused upon the lowermost mantle, near the core-mantle boundary, many interesting problems remain to be addressed in the shallower mantle. This talk will briefly review aspects of four of these remaining problems. At the base of the transition zone, recent measurements of the Clapeyron slope of the equilibrium between ringwoodite and the assemblage of silicate perovskite plus periclase have yielded values significantly smaller than earlier estimates. Can any subset of these values be simultaneously consistent with high-pressure experiments, calorimetry, and seismological observations of the 660-km discontinuity? At the top of the transition zone, a number of seismological observations have suggested the presence of a thin layer of melt atop the 410-km discontinuity, and such a melt layer has been interpreted to be a consequence of the presence of water in the upper part of the transition zone. Normally, chemical equilibrium between coexisting phases is maintained at any given depth, while equilibrium within a given phase across a finite depth range is not attained due to slow rates of solid-state diffusion. If water lowers such transport rates near the top of the transition zone, what might be the consequence for seismic velocities? In the lower mantle, observed scatterers of seismic energy often are attributed to subducted oceanic crustal material, where velocity perturbations of several percent suggest the presence of high-pressure phases of silica. However, free silica is unstable in contact with peridotite, as it reacts with ferropericlase to form silicate perovskite. Given measured diffusion coefficients under lower mantle conditions, at what length scales might free silica survive as metamorphic "armored relics" in subducted crust? In the upper mantle, low shear-wave velocities have been observed beneath the Ontong-Java plateau. These are not easily explained by thermal anomalies, as these regions do not exhibit high seismic attenuation. Can compositional anomalies, associated with high-pressure melt residues, explain both these seismic observations and xenolith mineralogy?

4 March 2009 17:00-18:00
Room 101, Kogi-to Bldg
Faculty of Science
Ehime University

Global COE
DEEP EARTH MINERALOGY
EHIME UNIVERSITY JASRI, UNIV.TOKYO, SBU

EHIME UNIVERSITY
GRC
GEODYNAMICS RESEARCH CENTER

Contact: T. Irifune
irifune@dpc.ehime-u.ac.jp
http://www.ehime-u.ac.jp/~grc