The 6th Global-COE (24th GRC) International Frontier Seminar

March 3rd, 2009, from 17:00, at the room #101

Laboratory-based Interpretation of Upper-mantle Seismic Tomograms: Progress and Prospects

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During the past decade, torsional forced-oscillation techniques have been used intensively to probe the high-temperature viscoelastic behaviour of fine-grained synthetic polycrystalline olivine. The result has been substantial progress in understanding the grain-boundary processes responsible for the attenuation and associated shear modulus dispersion in such materials. We review the experimental dataset from the ANU and University of Wisconsin (UW) laboratories for fine-grained olivine polycrystals, derived from either natural or synthetic precursors, and for a dunite mylonite. The ANU data have been re-processed to correct for the newly documented influence of interfacial compliance as part of an updated assessment – with emphasis on the grain-size sensitivity of the viscoelastic relaxation and the influence of a small melt fraction. There is a striking *qualitative* similarity between the data obtained in the ANU laboratory and by Cooper and his colleagues at UW. *Quantitatively*, the reconstituted dunite specimens tested by Cooper et al. are consistently more lossy, and of correspondingly lower shear modulus, than the ANU melt-free specimens made from pure laboratory reagents by a solution-gelation process. This difference is plausibly attributed to the presence of a small melt fraction in the UW reconstituted dunites. Alternative strategies for description of the contrasting behaviour of genuinely melt-free and melt-bearing olivine are reviewed, and their differing seismological implications are addressed. Finally, we emphasise that the experimental work of the past decade has been focussed on grain-size sensitive viscoelastic relaxation attributed to grain-boundary sliding in essentially dry fine-grained polycrystals. Much more experimental work is required to provide a comprehensive picture of seismic wave dispersion and attenuation in the upper mantle. We highlight emerging opportunities for experimental studies of dislocation-mediated viscoelastic relaxation and the influence of water.

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Room 101, Kogi-to Bldg
Faculty of Science
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