Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SIT042-19 Room: 101 Time: May 25 15:48-16:03

Post perovskite is weaker than perovskite by experiment and simulation

David Dobson[1*], Simon Hunt[1], Michael Ammann[1], John Brodholt[1], Donald Weidner[2], Li Li[2], Nico Walte[3]

[1]Earth Sciences, UCL, [2]MPI, Stony Brook, [3]BGI, Universitaet Bayreuth

The D double prime region at the core-mantle boundary of the Earth is thought to contain iron- and aluminium-bearing magnesium silicate in the calcium iridate structure. This recently discovered post-perovskite phase has been invoked to explain many of the anomalous seismic properties of D double prime. Recent studies suggest that the lowermost mantle is rheologicaly distinct from the overlying perovskite-dominated mantle, however no studies of post-perovskite rheology have been reported to date. Here we present results of laboratory studies aimed at measuring the strength of the low-pressure analogue phase calcium iridate as it transforms from perovskite to post-perovskite. Experiments were performed in pure shear geometry using d-DIA presses and real-time X-radiographic imaging of strain; further, quenching, experiments are consistent with the in situ results. The results suggest that perovskite is at least 5 times stronger than post perovskite and there is a further weakening by a factor of two which occurs during the transformation; these are minimum estimates of the weakening. These results are support results from ab initio simulations of chemical diffusivity in MgSiO3 perovskite and post perovskite, which we also report here. If, as seems likely, a similar weakening occurs in lower mantle magnesium-silicate compositions this would have significant implications for the base of the lower mantle.

Keywords: D'', post perovskite, rheology, HPHT experiments, atomistic simulations