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Presentation of the Mineralogical Society of America Award for 2011 to Motohiko Murakami

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Over the past decade or so, it has become increasingly common to hear the phrase "transformative science" in various contexts. In reality, the number of scientific results that are truly transformative are relatively few. (After all, how often can our fields be transformed?) Today, it is my pleasure to be introducing Motohiko Murakami, a young scientist whose work has fundamentally changed the way we think of the Earth's lower mantle, and especially the few hundred kilometers just above the core-mantle boundary: the D″ region.

In 2004, Motohiko published a paper with his Ph.D. thesis advisor Kei Hirose, N. Sata, and Y. Ohishi showing convincing proof that $MgSiO_3$-perovskite transforms to a new "post-perovskite" phase under pressure-temperature conditions corresponding to those just above the core-mantle boundary. The D″ region had long been known to be seismically anomalous, displaying an array of puzzling features including a seismic discontinuity, remarkable heterogeneity, and a host of other as yet unexplained characteristics. The work of Murakami and co-workers showed clear evidence of a phase transition in magnesium silicate perovskite (the major component of Earth's lower mantle) that could explain the D″ discontinuity. Aside from providing a plausible explanation for a pervasive feature of the core-mantle boundary region, the perovskite–post-perovskite transition presented a means of measuring the temperature just above the core-mantle interface. The initial work of Murakami and others on post-perovskite instantly stimulated a surge of both experimental and theoretical follow-up studies that continues to this day. Aside from Motohiko's groundbreaking work on $MgSiO_3$ post-perovskite, his early Ph.D. period included research on the water content of the lower mantle, lower mantle phase transitions of SiO_2 to $CaCl_2$ and α-PbO_2-structured phases (crucial for determining the buoyancy forces in slabs in the lower mantle), and phase transitions in FeO.

I first met Motohiko in about 2005 when he came to my laboratory to learn Brillouin scattering and to investigate the sound velocities in minerals at high pressures. This was a new field for him, but it quickly became apparent that Motohiko was a rather quick study, and it was a very productive period. He was also a joy for everyone in the Illinois mineral physics research group to interact with. His notable achievements from this period included making the first sound velocity measurements at megabar pressures by Brillouin scattering on samples of $MgSiO_3$ perovskite and post-perovskite, giving evidence for a silica-enriched lower mantle composition. He also participated in some of the initial measurements on a COMPRES project to interface Brillouin with synchrotron X-ray measurements at the GSECARS beamline of the Advanced Photon Source. After his initial stay at Illinois, he designed and built a state-of-the-art Brillouin scattering facility at the SPring-8 synchrotron in Japan, doing it with astonishing speed. In our later joint work, he was the first to break the 2 megabar mark in sound velocity measurements on SiO_2 and $MgSiO_3$ glasses, showing evidence for an amorphous-amorphous phase transition in these analogs for silicate melts. More recently, as an Associate Professor at Tohoku University, Motohiko has made some groundbreaking measurements on the velocities of Earth materials at simultaneous high-pressure high-temperature conditions with laser heating.

Motohiko Murakami is a remarkably talented scientist with unusual abilities. He has been extraordinarily productive for someone of his age and has already had a very profound, indeed transformative, effect on the way we view the Earth's interior. Members of the Society, Presidents Bish and Hochella, it is my pleasure to present to you the 2011 MSA Award winner, Motohiko Murakami.

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