# Ultralow-velocity zones possibly explained by light element-enriched iron compounds

*Liang Yuan[1], Eiji Ohtani[1], Xiang Wu[2], Shengxuan Huang[3], Daijo Ikuta[1], Tatsuya Sakamaki[1], Seiji Kamada[1], Hiroshi Fukui[4,5], Satoshi Tsutsui[6], Hiroshi Uchiyama[6], Daisuke Ishikawa[5,6], Naohisa Hirao[6], Alfred Q. R. Baron[5]

1. Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan, 2. State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan 430074, China, 3. Key Laboratory of Orogenic Belts and Crustal Evolution, MOE, Peking University and School of Earth and Space Sciences, Peking University, Beijing 100871, China, 4. Center for Novel Material Science under Multi-Extreme Conditions, Graduate School of Material Science, University of Hyogo, Hyogo 678-1297, Japan, 5. Materials Dynamics Laboratory, RIKEN SPring-8 Center, Hyogo 679-5148, Japan, 6. Japan Synchrotron Radiation Research Institute (JASRI), SPring-8, Hyogo, 679-5198, Japan

The core–mantle boundary (CMB) is the most fundamental chemical discontinuity in the Earth. Recent experiments showed that, when water meets iron at the CMB, hydrogen-bearing iron peroxide $FeO_2H_x$ can be produced. The results indicate that water can interact with iron metal very differently than it does on the surface of the earth. Seismic waves speeds in this hydrogen bearing iron peroxide are much slower compared with lower-mantle silicate solid phases, and therefore it may help explain the seismic anomalies at the CMB.

Given the steep geothermal gradient across the CMB, the hydrogen-bearing iron peroxide $FeO_2H_x$ likely undergoes high-temperature decomposition into anhydrous iron oxides (e.g., $Fe_2O_3$) and fluids. We measured the sound velocity of $Fe_2O_3$ post-perovskite (ppv) through inelastic X-ray scattering up to 132 GPa and 1,800 K, relevant to the lowermost mantle. Combined with first-principles investigations, we are able to show that $Fe_2O_3$ ppv has very low sound velocities and strong anisotropy with respect to lower-mantle silicates. Therefore, both hydrogen-bearing iron peroxide $FeO_2H_x$ and post-perovskite $Fe_2O_3$ are candidate phases for ultralow-velocity zones at the CMB.

Funding acknowledgment: This work was supported by the JSPS Japanese–German Graduate Externship.

Keywords: Core–mantle boundary, Ultralow-velocity zones, Light elements, Iron compounds

 