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Water-triggered dissociation of iron-rich magnesium silicate in the deep lower mantle: implications for formation of UVLZs near the margins of LLSVPs via slab interaction

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Seismic observations indicate dense regions in the deep lower mantle such as large low shear velocity provinces (LLSVPs) and ultra-ow velocity zones (ULVZs) [1]. Enrichment of iron in Earth's lowermost mantle may explain these dense regions, with much more extents of iron in ULVZs than LLSVPs. Importantly, ULVZs are more likely to be found near LLSVPs boundaries [2]. Recently, Lai et al. observed strong waveform complexities at the northeastern edge of the Pacific LLSVP, suggesting that an ULVZ was formed near the inner edge of the LLSVP, potentially pushed by a subducted slab [3]. Subducted slabs have the potential to transport water (hydrogen) into the deep Earth. LLSVPs are thought to be consisted of Fe-rich bridgmanite and magnesiowüstite assemblage (e.g., [4]). We investigated chemical reaction between Fe-rich magnesium silicate ($(Mg_{0.6}Fe_{0.4})SiO_3$) and a limited water supply (hydrated silica) in a laser-heated diamond anvil cell under high pressure-temperature conditions, mimicking slab interaction with a LLSVP in the deep lower mantle. The phase assemblages were identified by high-pressure X-ray diffraction and transmission electron microscopy on recovered samples. We found that both Fe-rich $(Mg_{0.6}Fe_{0.4})SiO_3$ bridgmanite and post-perovskite react with a limited water supply at high temperatures, producing an Fe-rich compound with Fe# up to 0.95. Such an iron-rich compound could accumulate at the base of the lower mantle and may account for the origin of ULVZs near LLSVPs boundaries.

[1] Edward J. Garnero, Allen K. McNamara & Sang-Heon Shim (2016), *Nature Geoscience* 9, 481–489.

[2] Shule Yu & Edward J. Garnero (2018), *Geochemistry, Geophysics, Geosystems*19, 396–414.

[3] Voon Hui Lai, Don V. Helmberger, Vasilije V. Dobrosavljevic, Wenbo Wu, Daoyuan Sun, Jennifer M. Jackson & Michael Gurnis (2022), *Geochemistry, Geophysics, Geosystems* 23, 1–9.

[4] Susannah M. Dorfman, Farhang Nabiei, Charles-Edouard Boukaré, Vitali B. Prakapenka, Marco Cantoni, James Badro & Philippe Gillet, (2021), *Minerals* 11, 1–20.