THE GEODYNAMICS SEMINAR № 642



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Venue: Meeting Room #486
Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords
1. Martian lower mantle
2. Fe-rich Ringwoodite
3. Seismic velocities



Elastic wave velocities of Fe-rich ringwoodite at high P–T and implications for the Martian deep mantle

The Martian mantle is believed to be richer in iron than peridotite rocks constituting the Earth's upper mantle while mantle areotherms are hotter than average mantle geotherms at equivalent depth. Based on these assumptions, high pressure phase relation studies proposed the Martian lowermost mantle to be mostly constituted of Fe# ~34 ringwoodite (Rw) and majorite. Seismic observations from NASA's InSight Mars lander have however since then provided further constraints on the velocity structure of Mars' interior suggesting the existence of Fe-rich (~30 wt.% FeO) silicate melt layer or partially molten regions, above the Martian core-mantle boundary (CMB). Melting experiments on Martian mantle composition have also showed that Rw coexisting with Fe-rich silicate melt is likely to be depleted in iron (Fe# 26) compared to Rw (Fe# 34) in experiments with no melt. Interpreting these results in term of velocities remains however difficult because of limited elasticity data on Rw with Fe# > 10 at pressures and temperatures relevant to the deep Martian interior. In this study, we measured P- and S-wave velocities of $(Mg_{0.74}Fe_{0.26})_2SiO_4$ Rw (Fe# 26) up to 23 GPa and 1300 K by combining ultrasonic interferometry, X-ray diffraction and imaging techniques at the beamline BL04B1 in SPring-8. Our measured Vp and Vs are consistent with previous studies, standing right in between those of Rw with San Carlos composition (Fe# 10) and Rw (Fe# 34) reported by Li et al. (GRL 2026). Using this new elasticity dataset we discuss the composition and structure of the Martian lowermost mantle based on a comparison with InSight's seismic data.

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