Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28657

The role of water on LLSVP dynamics from the perspective of bridgmanite grain size

YIFU LYU[1], **HONGZHAN FEI**[1], AMRITA CHAKRABORTI[2], YAN YANG[1], FANG XU[1], DR. BAOHUA ZHANG SR., PHD[1], PROF. QUN-KE XIA, PHD[1] AND TOMOO KATSURA[2]

[1]School of Earth Sciences, Zhejiang University
[2]Bayerisches Geoinstitut, University of Bayreuth

Large Low-Shear-Velocity Provinces (LLSVPs), stabilized at the base of the lower mantle for at least 540 Myr [1,2], play a critical role in lower mantle dynamics. However, the origin of their long-term stability remains unclear, as the thermal buoyancy [3] of LLSVPs should reduce their viscosity and thus accelerate convective destruction. Here we quantitatively determined the effect of water on the grain growth kinetics of bridgmanite, the dominant mineral in the lower mantle, through high pressure and high temperature multi-anvil experiments. Our results show that even very tiny amount of water significantly enhances the grain growth rate. This water-induced coarsening of bridgmanite enables LLSVPs to develop larger grain sizes and consequently higher viscosity than the surrounding mantle despite of their relatively high temperatures, which accounts for the long-term stability of LLSVPs.

[1] Torsvik, T.H. et al., Nature 466, 352–355 (2010).
[2] McNamara A.K., Tectonophysics 760, 199–220 (2019).
[3] Deng, X. et al., PNAS 120, e2220178120 (2023).