THE GEODYNAMICS SEMINAR № 608

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1. Thermal conductivity
2. Bridgmanite
3. Ferropericlase

Effect of iron on the lattice thermal conductivity of lower mantle minerals: implications for mantle dynamics

The presence of iron within the Earth's mantle exerts a profound influence on its physical and chemical characteristics. Of particular significance is its impact on thermal conductivity, a fundamental factor governing heat transport within the Earth's interior and thereby influencing the evolution of its thermal, chemical, geological, and magnetic states. Despite its pivotal role, the precise influence of iron on the thermal conductivity of mantle materials remains elusive. Bridgmanite and ferropericlase, constituting over 90% of the lower mantle, exert substantial control over its thermal structure and dynamics. Seismological investigations have hinted at heterogeneities in iron distribution and thermal states within the lower mantle, suggesting an intrinsic connection. Understanding the genesis, evolution, and nature of the chemically and thermally heterogeneous lower mantle necessitates a thorough comprehension of the impact of iron on the absolute value, pressure dependence, and temperature dependence of thermal conductivities within bridgmanite and ferropericlase.

To probe iron's influence on the thermal properties of these lower mantle phases, we simultaneously determined the thermal conductivity (λ) and diffusivity (κ) of bridgmanite and ferropericlase by combining a multi-anvil high-pressure experimental technique and pulse heating method. Thermal properties of bridgmanite with three different iron contents (X_{Fe} = 0, 0.03 and 0.1) and ferropericlase with six different Fe contents (X_{Fe} = 0.03, 0.05, 0.1, 0.2, 0.3 and 0.5) were measured up to 24 GPa and 1200 K in a Kawai type multi-anvil press. The experiment results suggest disparate responses of bridgmanite and ferropericlase to iron incorporation in heat transport properties. In this seminar, I will present our experimental results and delve into the potential distinct roles of these major minerals in the lower mantle's thermal evolution, which may also contribute to the heterogeneity of the lower mantle thermal state.

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