*American Mineralogist, Volume 109, pages 482–487, 2024*

# Thermal conductivity of aluminous garnets in Earth's deep interior

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## Abstract

Aluminous garnets [$(Mg,Fe,Ca)_3Al_2(SiO_4)_3$] are a key mineral group in Earth's interior. Their thermal conductivity with relevant chemical compositions and at high-pressure-temperature (*P-T*) conditions plays a crucial role in affecting the thermal states of pyrolytic mantle and subducted basaltic crust over the depth range they are present. Using ultrafast optical pump-probe spectroscopy combined with an externally-heated diamond-anvil cell, we have precisely determined the high-*P-T* thermal conductivity of aluminous garnets, including pyrope, grossular, and pyrope-almandine solid solution. We find that the variable chemical composition has minor effects on the thermal conductivity of these garnets over the *P-T* range studied. Combined with previous results, we provide new depth-dependent thermal conductivity profiles for a pyrolytic mantle and a subducted basaltic crust. These results significantly benefit geodynamics simulations and advance our understanding of the thermal structure and evolution dynamics in Earth's upper mantle and transition zone. In addition, as garnets are also a key, useful material family for modern technology, our results on the thermal property of natural garnets also shed light on the novel design of optical and electronic devices based on various synthetic nonsilicate garnets.

**Keywords:** High pressure, thermal conductivity, garnet, geodynamics