Thermal conductivity anomaly in siderite across iron spin transition

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Prior studies have shown that a pressure-induced iron spin transition in siderite occurs around 40~55 GPa and the spatial distribution of the spin states within the siderite may be inhomogeneous. Here we combined diamond anvil cell with the ultrafast optical pump-probe method and Raman spectroscopy, which enables characterization of the fraction of low-spin state, to investigate the lattice thermal conductivity of siderite across the spin transition. We found that during the spin transition the thermal conductivity varies significantly with the fraction of low-spin state: the conductivity increases rapidly with the increasing fraction of low-spin and then suddenly drops as the spin transition almost completes. Such spin-transition-induced thermal conductivity anomaly may result in local inhomogeneous heat flux and temperature profile in the lower mantle if the siderite can be transported to about 1100 to 1500 km depth. A preliminary discussion on the fundamental mechanism of the anomalous thermal conductivity through spin transition will be presented.

Keywords: siderite, spin transition , thermal conductivity