Spin transition and thermal conductivity anisotropy of siderite under high pressure

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Deep carbon cycle plays an important role in controlling the distribution of carbon between Earth’s surface and interior. The subduction slabs transport the carbonates on seafloor into Earth’s interior. Most of the carbons could be trapped in Earth’s interior, and carbons recycled to the ground surface are rare. According to recent studies, Fe-bearing carbonates, for instance siderite, have been considered to be potential carbon hosting minerals inside the Earth’s interior. Previous studies showed that the distribution of Fe-bearing carbonates in mantle is difficult to be detected by seismic observation due to their low concentration, yet there is strong elastic anisotropy in Fe-bearing carbonate which could be a potential diagnostic feature. In addition to their intrinsic elastic anisotropy, spin transition of Fe driven by extremely high pressure is another factor that could change the physical properties of siderite. For instance, the volume of siderite collapses sharply across spin transition and bulk modulus changes. However, thermal conductivity, which could control the thermal structure in Earth’s interior and is related to the elastic properties of Fe-bearing carbonates, remains rarely studied. In this work, we study the vibrational spectrum and thermal conductivity of siderite along a-axis and c-axis form ambient condition to 65GPa under room temperature by Raman spectroscopy and Time-domain thermoreflectance combined with diamond anvil cell techniques. We found that the range of spin transition is 46GPa~52GPa, which is similar to previous studies, suggesting that iron concentration in siderite has minor effect on the pressure range of spin transition. Preliminary results show that the thermal conductivity of siderite along a-axis decreases across spin transition.

Keywords: siderite, spin transition , thermal conductivity

