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Electrical conductivity measurement of $MgCO_3$ up to 6 GPa and 1000 K

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Magnesite, $MgCO_3$, is a naturally occurring carbonate mineral and is stable over a wide range of pressure and temperature. It is known that magnesite is one of the important host phases of carbon in the Earth's deep interior. A knowledge of how magnesite's electrical properties vary as a function of pressure and temperature will be important in interpreting the observed electrical conductivity map of the Earth's interior. We, therefore, measured the electrical conductivity of polycrystalline magnesite at pressures 3-6 GPa at high temperatures using complex impedance spectroscopy in a multi-anvil high-pressure apparatus. Synthetic powdered magnesite ($MgCO_3$)(purity > 99.5%) was used as the starting material. The measured electrical conductivity increased with increasing pressure. The activation enthalpy calculated in the temperature range 650-1000 K also increased with increasing pressure. The effect of pressure was interpreted as being the activation volume in the Arrhenius equation, and the fitted data gave an activation energy and volume of 1.76 $\pm$ 0.03 eV and -3.95 $\pm$ 0.78 cm^3/mole, respectively. The negative activation volume and relatively large activation energy observed in this study suggests that the hopping of large polarons is the dominant mechanism for the electrical conductivity over the pressure and temperature range investigated.