

## Electrical conductivities of carbonates in the subducted slab

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The behavior of carbonate minerals under high pressures is important in our understanding of the geochemical cycle of carbon in the deep mantle. Magnesium and calcium carbonate minerals dominate the Earth's interior. Magnesite,  $\text{MgCO}_3$ , is a naturally occurring carbonate mineral and is stable over a wide range of pressure and temperature. In contrast, calcium carbonate ( $\text{CaCO}_3$ ) occurs in three structural forms: calcite, aragonite, and vaterite. Calcite is stable under ambient conditions, and adopts several different modifications (calcite I-V), whereas aragonite is thermodynamically stable at high pressures and high temperature corresponding to the upper mantle conditions. Dolomite ( $\text{MgCaC}_2\text{O}_6$ ) is stable up to the mantle pressures. Therefore, the behavior of magnesite, aragonite, and dolomite are important for an understanding of the circulation of carbon from the crust to the upper mantle. Recent advances in geophysical observations have allowed to map the electrical conductivity of the Earth's mantle. Electrical conductivity measurements on carbonates at high pressures and high temperatures can contribute towards an estimation of the distribution of carbonate rocks in the deep mantle. In this study, we have determined the electrical conductivities of three carbonates up to 6 GPa and 1000 K using in situ complex impedance spectroscopy in a multi-anvil high-pressure apparatus. These measurements allowed us to quantify the effects of pressure, temperature, and chemical composition. The electrical conductivity of magnesite increased with increasing pressure. The activation enthalpy also increased with increasing pressure. The effect of pressure was interpreted as being the activation volume in the Arrhenius equation. 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 [1]. In the case of aragonite, a decrease in the electrical conductivity with increasing pressure was observed. The calculated activation enthalpy increased with increasing pressure. The positive activation volume observed in this study suggests that ionic conduction is the dominant mechanism over the pressure and temperature range investigated [2]. The electrical conductivity of aragonite was higher than that of magnesite. The electrical conductivity of dolomite was similar to the value of magnesite. According to our data, the electrical conductivities of carbonates can be described as a function of pressure, temperature, and chemical composition. Our new data can contribute to interpret the electrical conductivity map of the Earth's interior.

[1] Mibe & Ono (2011) *Physica B*, 406, 2018-2020.

[2] Ono & Mibe (2013) *Eur. J. Mineral.* (in press).

Keywords: Electrical conductivity, Carbonate, Slab, High pressure experiment