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Electrical Conductivity of H_2O-CO_2 rich-Melt in the Mantle and the construction of petrology-based conductivity profiles

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Electromagnetic data images mantle regions more conductive than that of dry olivine. There is no doubt that melt are thermodynamically stable and present in the LAB, but how they can impact on mantle electrical conductivity remains debated. In particular, petrological studies realized some 30 years ago have shown that peridotites exposed at the P-T-fO_2 conditions of the LAB produced H_2O and CO_2 rich-melts. But electrical conductivities of these melts are poorly known.

So we have been performed electrical conductivity experimentation in piston cylinder on H_2O-CO_2 rich melts. We have explored different melt compositions, from carbonated melts to basalts. We have determined the effect of chemical compositions and volatiles on these melts. The electrical conductivity measurements have shown that hydrous carbonated melts are very conductive, and the incorporation of basalt decreases the conductivity. With these new data, we have produced a semi-empirical law predicting the conductivity as a function of H_2O and CO_2 contents. Based on this law and the electrical conductivity of olivine, we have constructed 1D conductivity profiles. With these profiles, we discuss the effect of volatiles content (in the melt and in the mantle), melt fractions (mixing law and interconnection of the melt) and T-P on conductivity. And finally, we conclude that the electrical conductivities of the mantle is a powerful to track the fundamental process of mantle incipient melting, which is in turn narrowly associated to the cycling of H_2O and CO_2 in the upper mantle.