

## **Effect of melt content and the melt texture on sound wave velocity and electrical conductivity**

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The geophysical observations of elevated electrical conductivity (EC) and reduced seismic wave velocity (SWV) have long been discussed in conjunctions with partial melting in the Earth's asthenosphere. Alternative mechanisms based on solid state processes, such as anelastic relaxation and hydrogen diffusion in mantle minerals have also been proposed. However, the recent finding of young alkali basalt (< 10 Ma) on the 135 million-year-old Pacific-plate provides strong physical evidences for the partial melting at the top of the asthenosphere.

Various experimental techniques have been used to constrain the melt fraction in the asthenosphere low velocity zone (LVZ) reported at depth of 70-220 km. Geochemical and petrological constrains suggest low degree melting (less than 1 %) in the asthenosphere, while laboratory based EC and SWV measurements suggest melt fractions ranging from 0.1 to 10 %. Moreover, the comparison between geophysical observations and laboratory measurements of EC and SWV also yields contradicting estimations of the melt fraction, highlighting potential disagreements between EC and SWV techniques.

In this study we aimed at investigating the effect of melt fraction and the melt texture, key parameters governing the magnitude and the style of seismic velocity and electrical conductivity variations. We performed simultaneous sound wave velocity and electrical conductivity measurements on mixtures of San Carlos olivine and natural mid oceanic ridge basalt (MORB) at 2.5 GPa and up to 1650 K. This critical improvement enables us to understand how seismic and electrical measurements responses to melt volume fractions and the evolution of melt interconnectivity with time in a partially molten sample.

With our results, we were able to determine the potential limitations associated with laboratory based electrical conductivity and seismic wave velocity measurements for estimation of the melt fraction. Overall, the seismic velocity measurements appear more appropriate method to determine the melt fraction in a partially molten system. Based on our results, the geophysical anomalies observed in the LVZ of the asthenosphere can be explained with 0.3 to 0.8 vol. % of MORB-like melt.