

# Mineralogical and chemical composition of the Ultra-Low Velocity Zones

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Ultra-Low Velocity Zones (ULVZs) are seismic anomalies that lay on top of the Core Mantle Boundary characterized by a large decrease in seismic wave velocities and an increase in density with regards to PREM [1]. They represent small bodies (a few tens of km in height and around a hundred kilometres in length) sometimes spatially associated with the Large Low Shear Wave Provinces [2].

The decrease in wave velocity is substantial and is most drastic in the case of shear waves (Vs), up to 30% lower than PREM [1]. This massive decrease has given rise to the idea of melt being present inside the Ultra-Low Velocity Zones [1].

We study (Mg,Fe)SiO<sub>3</sub> melts using first principles calculations. We use our results together with available literature data [3-6] on Bridgmanite and Mg-Wüstite to build a three phase mixing model that fits all the seismic observations for the Ultra-Low Velocity Zones.

Our results prove that an iron rich melt mixed with Bridgmanite slightly enriched in iron can explain the fastest Vs values observed in the ULVZs. Higher decrease in Vs requires an increase in the iron content of the solids. Thus, our model is the first three phase model that explains in a quantitative manner the composition of the Ultra-Low Velocity Zones.

[1] Rost et al. (2006) *J. Geophys. Res.* **111**, B09310. [2] Frost and Rost (2014) *Earth Planet. Sci. Lett.* **403**, 380-392. [3] Caracas & Cohen (2005) *Geoph. Monog. Series* **174**. [4] Marton et al. (2001) *J. Geophys. Res.* **106**, 8615-8627 [5] Oganov et al. (2001) *EPSL* **185**, 555-560 [6] Crowhurst et al. (2008) *Science* **319**, 451