Effects of water on density and seismic velocity of hydrous melts under crustal and upper mantle conditions

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Introduction

The density of the hydrous silicate melt plays key roles in various subduction zone magma processes. We present a new numerical model for the calculations of the density and the seismic velocity of hydrous silicate melts as a function of temperature, pressure, water concentration, and melt composition.

Model configuration and parameters

We optimize volumetric parameters of the H_2O end-member components in hydrous silicate melts, as well as *K'* of anhydrous silicate melts, using previously reported experimental results of density values of various hydrous melts. The parameter set optimized in this study is internally consistent with the parameter values for the properties of anhydrous silicate melt reported by [1, 2].

Results

The model developed in this study reproduces the experimentally determined densities of various hydrous melts, and can be used to calculate the relationships between pressures, temperatures, and water concentrations of hydrous melts (from basalt to rhyolite) at pressures of 0 to 4.29 GPa. Using the new parameter set, we investigate the effects of water content on the seismic velocity of hydrous melts. With the 5 wt% of water, *P*-wave velocity of silicate melt decreases by >10%. Based on the melt *P*-wave velocity, we demonstrate the effect of the melt water content on the seismic velocities of the partially molten regions of the subduction zones. The results show that the water content in silicate melt plays an important role in determining the seismic velocity structure of the partially molten rock.

[1] Lange & Carmichael (1987), *Geochim. Cosmochim. Acta*, **51**, 2931–2946. [2] Lange & Carmichael (1990), *Rev. Mineral. Geochem.,* **24**, 25–64