The compressibility of partial molar volume of H_2O in mamga

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Background

As an important component of magmas, H_2O shows significant influence on their physical and chemical properties. Especially, water effect on the density of magmas need to be understood because density is one of the most important properties and it controls the depth of density-crossover between magma and surrounding rock, and the gravitational stability. In order to investigate the density of hydrous magma, the partial molar volume of H_2O (V_{H2O}) and its pressure- and temperature-dependences are essential. Here, I'd like to show isothermal compression curve of V_{H2O} in magma by compiling previous works.

Results

Depending on target experimental conditions, several techniques, such as X-ray absorption method and sink-float method, have been used for density measurements of hydrous magma. These techniques have provided knowledge on the density of hydrous magmas and V_{H2O} over wide temperature, pressure and composition ranges. Summarizing P-T-V_{H2O} data, I introduce the compression curve by fitting to Vinet equation of state. The compressibility of V_{H2O} is divided into three pressure regions: 1) high compressibility region below 0.5 GPa; 2) intermediate region between 0.5 GPa and 5 GPa; 3) low compressibility region above 5 GPa. Although H_2O is one of the most compressible oxides in the magma under lower pressure conditions, the compressibility contrast between V_{H2O} and partial molar volume of other oxides reduces with pressure. The change in water effect on the magma density can result in a change in the magma mobility in the Earth's interior. Quantitative understanding of the mobility is a help to explain the origin of geophysical anomaly.