In situ Raman spectroscopy of water-bearing calcium aluminosilicate melts during high temperature and high pressure diamond cell experiments

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Water is key to volcanic eruptions. Dissolved in magmas, it profoundly affects their rheology and thermodynamic properties, hence influencing mass and heat transfers in the inner Earth. Near surface, it exsolves in bubbles, and thus participates in building a rapidly expanding gas phase that feeds the volcanic jets involved in explosive eruptions. Despite such importance, water environment in magmas remains not well known. Most data are acquired on glasses, which structure is only representative of that of the melt at the glass transition temperature, usually very far from volcanic temperatures. To circumvent such caveat, *in situ* experiments, e.g. in hydrothermal diamond anvil cells, can be performed. However, most published data concern alkali-bearing aluminosilicate melts because of their generally low liquidus temperatures. While such melts are important for granitic systems, they are not representative of the alkaline-earth rich magmas involved in ocean ridge basaltic and subduction andesitic volcanisms.

In this study, we present new Raman spectroscopy data on Ca aluminosilicate melts with a quartz-wollastonie-anorthite eutectic composition, a simplified analogue for andesite melts. We first improved the knowledge of water speciation for this composition by performing water-saturated piston-cylinder experiments. This allowed determining water solubility in such melt composition up to 2 GPa. Then, we conducted hydrothermal diamond cell experiments between 300 and 1100 °C and 0.2 and 1.5 GPa. Raman spectra of the melts and aqueous fluids were acquired. The data confirm that most of the water should be considered as present as OH groups at high temperatures. Variations in water speciation are accompanied by modifications of the equilibrium between the different tetrahedral entities building the skeleton of the melt. Together with existing data, obtain results highlight the role of metal cations on influencing water environment in magmas.