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新燃岳 2011 年噴火のデイサイトメルトへの水の溶解度
Experimental determinations of water solubility in the Shinmoe-dake 2011 dacite melt to 150 MPa

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Water is the first dominant volatile within a volcano, and hence its solubility in a melt is fundamental to how explosive the eruption will be. Published solubility data for water are rather sparse, particularly for moderate SiO2 content melts, however. This has resulted in insufficient data coverage in composition space, rendering water solubility not to be precisely modeled if a melt is subject of partial crystallization (hence of composition change).

In this study, water solubility in dacite melt (68.3 wt% SiO2) was experimentally determined at 1000 degree C and 50-150 MPa in an internally heated pressure vessel. A groundmass separate of white-colored pumice from the 2011 eruption of Shinmoe-dake, Kirishima volcano group, was equilibrated with O-H fluid, and the water content in the quenched glass was determined by near-infrared spectroscopy. Oxidation-reduction state was controlled to near the Ni-NiO buffer, so that the O-H fluid was present as nearly pure H2O (more than 99 mol%). Temperature condition of 1000 degree C was desired since the water-saturated liquidus was experimentally located between 950 and 1000 degree C at the pressure range 50-150 MPa.

Experimental result shows that at 1000 degree C, the water solubility in the dacite melt monotonously increases with pressure, from 4.4 plus-minus 0.3 mol% (2.4 wt%) at 50 MPa through 6.0 plus-minus 0.3 mol% (3.3 wt%) at 100 MPa to 6.8 plus-minus 0.3 mol% (3.9 wt%) at 150 MPa. These values are practically the same as the previously published solubility data for water in rhyolite melts at 1000 degree C (4.2 mol% at 50 MPa, 6.3 mol% at 100 MPa; Yamashita, J. Petrol., 40, 1999). Thus, the water solubility was insensitive to the change of melt composition during groundmass crystallization in the Shinmoe-dake 2011 eruption. This would provide a rigorous petrological base for quantitatively modeling of degassing/explosive behavior in the Shinmoe-dake 2011 eruption as a continuum problem.

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