

Second critical endpoint between high-Mg andesite and aqueous fluids using X-ray radiography

Tatsuhiko Kawamoto[1]; Masami Kanzaki[2]; Kenji Mibe[3]; Kyoko Matsukage[4]; Keigo Sawai[5]; Yoshitsugu Furukawa[6]; Shigeaki Ono[7]

[1] Inst. for Geothermal Sciences, Kyoto Univ.; [2] ISEI, Okayama Univ.; [3] ERI, Univ. Tokyo; [4] Department of Environmental Science, Ibaraki Univ.; [5] Inst Geotherm Sci, Kyoto Univ; [6] Aso Volcano. Lab., Kyoto Univ.; [7] IFREE, JAMSTEC

<http://www.vgs.kyoto-u.ac.jp/japan/memberj/kawamotoj.htm>

Aqueous fluids dissolve significant amounts of silicates under high-temperature and high-pressure conditions. Silicate components dissolved in aqueous fluids coexisting with mantle peridotite change their major element chemistry from silicic at 1-2 GPa to peridotitic at 3 GPa and higher pressures (Ayers et al. 1997 EPSL; Stalder et al. 2001CMP; Mibe et al. 2002 GCA; Kawamoto et al 2004 Am Min). In the present study, we show direct observations of complete mixing between aqueous fluids and a calc-alkaline andesitic melt (61.5 weight percent SiO₂) at around 1 GPa by use of Bassett type externally heated diamond anvil cell (Bassett et al 1993, Rev Sci Instrum). Aqueous fluids and andesitic melts can mix completely in 2 - 3 GPa. Mibe et al. (2004 Fall Meeting) reported a possible second critical endpoint between aqueous fluids and a peridotitic melt at 3.6 ± 0.4 GPa by use of synchrotron X-ray radiography using multi-anvil type high-T and high-P apparatus at SPring-8. These experiments suggest that the slab-derived component can be under supercritical conditions. Whether the component has chemical characteristics like a partial melt or an aqueous fluid depends on temperature. In wedge mantle, such supercritical fluids can lose water by forming hydrous minerals as reactions with mantle minerals, and get rich in silicate components. In this case, those fluids can become gradually water-rich melts. Critical temperature, which is a boundary between two-fluids and a single supercritical fluid regions, increases as decreasing pressure (Shen and Keppeler, 1997 Nature; Bureau and Keppeler 2001 EPSL). Therefore, supercritical fluids separate into silicate melts and aqueous fluids along its migration to the surface. In this case, an elemental fractionation should occur between an aqueous fluid and a silicate melt.