In situ observation of complete miscibility between andesitic melts and H2O fluids using an externally heated diamond anvil cell.

Tatsuhiko Kawamoto[1], Kyoko Matsukage[2]

[1] Inst. for Geothermal Sciences, Kyoto Univ., [2] Institute for Geothermal Sciences, Kyoto Univ.

http://www.vgs.kyoto-u.ac.jp/InetHome/kawamoto/

The direct measurement of melts at high temperature and pressure conditions is desirable. Based on chemistry of partial melts of H2O-saturated mantle peridotite, we have suggested structures of hydrous melts should change drastically with an increasing pressure (Kawamoto and Holloway 1997 Science). For direct observations of magmas at high temperature and pressure conditions, Bassett's type externally heated DAC can be one of ideal tools because of its easy temperature control within a few degree C in a range to 1050 degree C (Bassett et al., 1992 Rev Sci Inst). FTIR microscopy with this DAC is used to understand complete miscibility between H2O-rich melts and silicate-rich H2O fluids and also temperature dependence of OH/H2O abundances in aluminosilicates and felsic magmas .

Knowledge of structures of magmas is important to model the evolution of the earth's interior. Much efforts had been made to understand structure of magmas by measuring properties of glasses quenched from high temperature and pressure conditions. Properties of silicates melts have been found to be different from those of quenched glasses (Stebbins et al, ed., 1995, Reviews of Mineralogy, 32). Therefore, the direct measurement of melts at high temperature and pressure conditions is desirable. Based on chemistry of partial melts of H2O-saturated mantle peridotite, we have suggested structures of hydrous melts should change drastically with an increasing pressure (Kawamoto and Holloway 1997 Science). For direct observations of magmas at high temperature and pressure conditions, Bassett's type externally heated DAC can be one of ideal tools because of its easy temperature control within a few degree C in a range to 1050 degree C (Bassett et al., 1992 Rev Sci Inst). FTIR microscopy with this DAC is used to understand complete miscibility between H2O-rich melts and silicate-rich H2O fluids and also temperature dependence of OH/H2O abundances in aluminosilicates and felsic magmas (Shen and Keppler 1995 Nature, Bureau and Keppler 1999 Earth Planet Sci Lett). A series of experiments of complete miscibility in H2O and an island arc andesite has been conducted in our laboratory. So, let's do this business with magmas relevant to mantle conditions. It is revealed that there is a difficulty to conduct experiments in mafic systems such as enstatite MgSiO3, diopside CaMgSi2O6, wollastonite CaSiO3, natural basalt, and high Mg andesites. When the glasses of those mafic compositions are heated with water in DAC, crystallization of pyroxene or amphibole takes place quickly at around 500 degree C. The crystals do not remelt and no melt of the system itself can be obtained in a temperature range to 1050 degree C. In order to obtain melts of these chemical compositions, higher temperature DAC should be used. Above 1050 degree C, diamond surfaces quickly transform to graphite. Internal heating method (cf., Saxena et al., 1999, Am Mineral), which is able to heat samples uniformly and leave diamonds less hot, can be a better tool to investigate the mafic melts.