On the coexistence of high-Mg andesites and ultramafic volcanic rocks

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In order to understand the origin of magmas in the hydrous upper mantle, we have been investigating the phase relation and compositions of phases in the system peridotite-H_2O. Using X-ray radiography technique together with Kawai-type multi-anvil high-pressure apparatus (SPEED-1500, SPring-8, Japan), the second critical endpoint in the peridotite-H_2O system was determined to be at around 3.8 GPa and 1000 ºC (corresponding to a depth of ~ 110 km) [1]. It is possible that two fluid phases (i.e., aqueous fluid and hydrous silicate melt) coexist up to 3.8 GPa. Above 3.8 GPa, however, hydrous silicate melt and aqueous fluid in upper mantle becomes indistinguishable from each other and the melting temperature of hydrous mantle peridotite can no longer be defined beyond this critical condition. Using the quenched recovered samples obtained by Mibe et al. [1], chemical compositions of aqueous fluid, silicate melt, and supercritical fluid magma in the vicinity of second critical endpoint were determined by the electron microprobe analyzer. In the run at 3.6 GPa, the composition of aqueous fluid was high-Mg andesitic, whereas the composition of hydrous silicate melt was komatiitic. Our experimental results indicate that high-Mg andesitic magma and komatiitic magma can be generated at the same time as the liquid-fluid immiscibility near the second critical endpoint in the peridotite-H_2O system. Some natural examples on the coexistence of high-Mg andesites and ultramafic volcanic rocks from various tectonic settings and locations around the world will also be presented.
[1] Mibe, K., M. Kanzaki, T. Kawamoto, K. N. Matsukage, Y. Fei, and S. Ono (2007), Second critical endpoint in the peridotite-H_2O system, J. Geophys. Res., 112, B03201, doi:10.1029/2005JB004125.

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