Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SIT03-10 会場:106 時間:5 月 25 日 16:45-17:00

Phase relations of MgSiO3-Al2O3 system in Earth's lower mantle
Phase relations of MgSiO3-Al2O3 system in Earth's lower mantle

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Abstract
Aluminum oxide (Al_2O_3) is present in about 4˜5 mol% for the Earth's mantle compositions, e.g., pyrolite, piclogite and chondrite (Ringwood, 1966; Sun, 1982; Anderson, 1989; Irifune et al. 1986, 2007). In the Earth's uppermost parts of lower mantle conditions, the Al_2O_3 is accommodated mainly in bridgmanite (Irifune 1994), which is the most abundant mineral phase in this region (Ringwood 1975). The $MgSiO_3$-Al_2O_3 system is a basis system to understand lower mantle phase equilibria in a more complex composition. Phase relations of $MgSiO_3$-Al_2O_3 system have since been extensively studied using the multi-anvil apparatus with tungsten carbide anvils from upper mantle to the uppermost parts of lower mantle conditions (Irifune 1986, 1996; Kubo et al. 2000; Hirose et al. 2001; Akaogi et al. 2002), and also further constructed by theoretical calculation (Panero et al. 2006; Tsuchiya et al. 2008). The phase relation of $MgSiO_3$-Al_2O_3, especially toward the Al_2O_3-rich side, in the lower mantle conditions is still relatively limited. Recent technique development of sintered diamond anvils in multi-anvils apparatus allow us to achieve the high pressures and high temperatures conditions of Earth's middle lower mantle(Tange et al. 2008, 2009; Irifune et al. 2010; Ito et al. 2010; Nishi et al. 2013; Yamazaki et al. 2014). Here, we further extend the phase relations of $MgSiO_3$-Al_2O_3 system between 31 GPa and 45 GPa at 2000 K using multi-anvil apparatus with sintered diamond anvils. Aluminum oxide solubility in bridgmanite is increasing with increasing pressure and temperature. These results can further confirmed previous experimental studies on the same system and pyrolite composition (Irifune et al. 1994, 1996, 2010), and the entire inventory of Al_2O_3 in pyrolite can be accommodated in bridgmanite in Earth's lower mantle.

キーワード: Aluminum oxide, bridgmanite, lower mantle, sintered diamond technique, phase relation
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