HIGH-PRESSURE PHASE RELATIONS OF CA,NA-ALUMINOSILICATE, CAS PHASE, WITH IMPLICATION TO SHOCKED MARTIAN METEORITES

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Introduction: Ca,Na-aluminosilicate $(Ca_{1-x},Na_x)Al_{4-x}Si_{2+x}O_{11}$ named CAS phase, a high-pressure silicate with hexagonal barium-ferrite structure, was found in heavily shocked Martian meteorites by Beck et al. [1]. High pressure experiments demonstrated that the CAS phase was synthesized in high pressure mineral assemblages of anorthite [2] and oceanic sediments [3], and the CAS phase was also found as a liquidus phase in melting experiments of mid-oceanic ridge basalt [4]. We have examined high-pressure high-temperature phase relations of $CaAl_4Si_2O_{11}$ and those in the system $CaAl_4Si_2O_{11}$-$NaAl_3Si_3O_{11}$, using a multianvil press. We have also measured enthalpies of transitions involving $CaAl_4Si_2O_{11}$ CAS phase by high temperature calorimetry techniques, and have calculated the phase relations. The obtained high-pressure phase relations have been used to estimate the P,T conditions in shock processes which occurred in some shergottites.

Results and discussion: The experimental and calculated results indicate that $CaAl_4Si_2O_{11}$ CAS phase is stable at about 13-30 GPa at temperature above about 1200 ^oC. The stability field of the CAS phase is generally consistent with the experimental results in the compositions of anorthite, sediments and basalt, and would give basic constraints on the P, T conditions for the assemblages containing the natural CAS phases. Our preliminary phase relations in the system $CaAl_4Si_2O_{11}$-$NaAl_3Si_3O_{11}$ reveal that at 1600 ^oC $CaAl_4Si_2O_{11}$ CAS phase dissolves $NaAl_3Si_3O_{11}$ component up to about 50-60 mol% to form the CAS solid solution at about 23 GPa. Above the pressure, $NaAlSiO_4$-rich calcium ferrite coexists with the CAS solid solution with smaller amount of $NaAl_3Si_3O_{11}$ component. The synthesis of the CAS solid solution is consistent with the natural occurrence of the Ca,Na-CAS phases. In the phase relations, pressure interval where the single CAS phase is stable decreases with increasing the Na content. The phase relations suggest that the Ca,Na-CAS phases found by Beck et al. [1] in melt pockets of the shergottites were crystallized at pressure around 23±5 GPa at temperature higher than 1600 ^oC from the melt during the shock processes.

References: [1] Beck P. et al. 2004. Earth Planet. Sci. Lett., **219**, 1-12. [2] Gautron L. et al. 1996. Phys. Earth Planet. Int., **97**, 71-81. [3] Irifune T. et al. 1994. Earth Planet. Sci. Lett., **126**, 351-368. [4] Hirose K. and Fei Y. 2002. Geochim. Cosmochim. Acta, **66**, 2099-2108.