Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PPS05-10 Room:203 Time:May 25 13:45-14:00

High-pressure phase relations in FeCr2O4 with implications to post-spinel phases in shocked meteorites

AKAOGI, Masaki[1*], Shouichi Tsukamoto[1], KOJITANI, Hiroshi[1]

[1]Gakushuin University, Faculty of Science

Studies on natural high-pressure minerals in shocked meteorites may provide valuable information on shock events of the meteorites, as well as mineralogy and dynamics of the Earth's deep mantle. High-pressure polymorphs of FeCr2O4-rich chromite were found in a shocked chondrite by Chen et al. (2003a, b). The polymorphs have structures of calcium-ferrite (CaFe2O4) type and calcium-titanate (CaTi2O4) type, the latter of which was named xieite. However, the high-pressure stability relations in FeCr2O4 have not yet been well clarified.

In this study, we have examined the phase relations in FeCr2O4 to apply the results for evaluation of pressure-temperature conditions of formation of the natural FeCr2O4-rich high-pressure polymorphs in the shocked meteorite. The high-pressure experiments were carried out up to about 27 GPa and 1800 oC, using a multianvil high-pressure apparatus. The quenched samples were examined by microfocus and powder X-ray diffractometers, and the compositions were analyzed by a scanning electron microscope with an energy-dispersive X-ray spectrometer.

Above about 14 GPa, FeCr2O4 chromite with the spinel structure dissociates into an assemblage of a new Fe2Cr2O5 phase and Cr2O3 with corundum structure. The new Fe2Cr2O5 phase has the same structure as a high-pressure form of Mg2Al2O5 found recently by high-pressure experiments in MgAl2O4 (Enomoto et al., 2009, Kojitani et al., 2010). The two phases combine at 16-19 GPa into the FeCr2O4 polymorph with the calcium-ferrite structure below about 1300 oC, while they combine into the other polymorph with the calcium-titanate structure above about 1300 oC. Both of the calcium-ferrite and calcium-titanate phases are stable up to at least 27 GPa. These results suggest that the natural FeCr2O4-rich calcium-ferrite and calcium-titanate were formed at pressure above 19 GPa at temperature below and above 1300 oC, respectively, during the shock event. This is generally consistent with the texture observation of the two FeCr2O4 polymorphs in the shocked meteorite.

Keywords: meteorite, shock compression, FeCr2O4, post-spinel, high pressure