Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PPS22-09 Room:415 Time:May 1 11:30-11:45

Formation processes of silica polymorphs in lunar meteorites

KAYAMA, Masahiro[1*] ; TOMIOKA, Naotaka[2] ; SEKINE, Toshimori[1] ; GöTZE, Jens[3] ; NISHIDO, Hirotsugu[5] ; OHTANI, Eiji[4] ; MIYAHARA, Masaaki[1] ; OZAWA, Shin[4]

[1]Department of Earth and Planetary Systems Science, Graduate School of Science, Hiroshima University, [2]Institute for Study of the Earth's Interior, Okayama University, [3]Department of Mineralogy, TU Bergakademie Freiberg, [4]Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University, [5]Depertment of Biosphere-Geosphere Science, Okayama University of Science

Asteroid and meteorite collisions lead to formation of impact craters and thick regoliths on the Moon and also contribute to revolution of the Earth, e.g. Giant impact, the late heavy bombardments and the origin of life. Although lunar meteorites and Apollo samples have experienced such impact events during the ejection from the lunar surface or formation of immense basin, they were believed to contain few high-pressure mineral because of the volatilization during collision in the high vacuum (Papike 1998; Lucey et al., 2006). Recently, Ohtani et al. (2011) and Miyahara et al. (2013) discovered high-pressure silica polymorphs (coesite, stishovite and seifertite) in lunar meteorites, Asuka-881757 and NWA4734. Their existences provide constraints on the shock condition and give us valuable information on impact history on the Moon and the Earth.

The shock condition of meteorites has been estimated based on the pressure-temperature phase diagram obtained from high-pressure experiments using shock gun, multi-anvil press and diamond anvil cell (DAC) for various types of minerals including in silica polymorphs. There have been many investigations of the high-pressure experiments for quartz and amorphous silica glass, but not for the other polymorphs, regardless of dominant occurrence of cristobalite and tridymite in lunar meteorites. Since the transition pressure to high-pressure phase depends on a type of starting material (Kubo et al. 2012; Bläβ, 2013), it is necessary for understanding the detailed impact history of the Moon to conduct the high-pressure experiments for various types of silica polymorphs.

In this study, silica polymorphs in various types of lunar meteorites (anorthositic breccia, basalt, and gabbro and basalt clast-dominated breccia) were described using Raman spectroscopy, Scanning and Transmission Electron Microscope and X-ray diffraction analysis and the obtained results were compared with the data of high-pressure experiments for various types of silica polymorphs to clarify the phase transition process, interpret the formation process on the Moon and constrain shock pressure and temperature that the lunar meteorites have experienced.

Keywords: Lunar meteorite, Silica polymorph, High-pressure mineral, Collision, Shock experiment, Static compression experiment