Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS003-08 Room:202 Time:May 26 16:45-17:15

Approach to asteroidal impacts by static high-pressure experiments

Naotaka Tomioka[1]*

[1]ISEI, Okayama University

Impact event is one of the important processes for accretion and evolution of the planetary system. The event is recorded in petrographic features such as deformation, recrystallization, melting, and phase transformations of meteoritic minerals. Shock pressures in meteorites have been estimated only on the basis of shock recovery experiments [1]. However, the shock pressure duration should be significantly different between laboratory shock and natural shock because the pressure duration in shock compression is proportional to the size of target materials. In the case of laboratory shock experiments, the target size and pressure duration are 10^{-3} m and 10^{-6} seconds, respectively. The large parent bodies of chondrites result in much longer timescales for shock pressures resulting from natural impact compared with laboratory shock experiments. In fact, several researchers claimed that the peak pressure of natural impact persists from tens of milliseconds to several seconds in terms of the ultrahigh-pressure mineralogy and cation-diffusion profiles in shock-induced veins [2-4]. Therefore, if the kinetics of phase transformations are sluggish enough relative to the timescale of shock experiments, shock pressures of heavily shocked meteorites could be overestimated.

As an attempt to reevaluate the present shock-pressure scale, we focused on the formation pressure of diaplectic feldspar glass that is called maskelynite in heavily shocked meteorites. Static compression experiments of albitic plagioclase (Ab_{99}) have been demonstrated under moderately high temperature using an externally heated diamond anvil cell with pressure duration of tens of minutes. The temperature and time dependence of the amorphization pressure of albitic plagioclase and its mechanism of amorphization were investigated on the basis of the Raman spectroscopy and transmission electron microscopy (TEM) of recovered specimens. Combining the data of the in situ X-ray diffraction study of Ab_{98} plagioclase [5] and those of the present study [6], we find a clear trend where the amorphization pressure decreases with increasing temperature. In addition, the results of the present study suggest that shorter pressure duration results in a lower degree of amorphization in plagioclase. The formation of maskelynite in shocked meteorites does not necessarily require the very high shock pressure (30-90 GPa) that was previously estimated on the basis of shock recovery experiments [1]. The shock pressure calibration, especially for high shock stages, needs further reevaluation.

References:
[1] Stoffler, D., K. Keil, and E. R. D. Scott (1991) *Geochim. Cosmochim. Acta* 55, 3845?3867.
[2] Beck, P., P. Gillet, A. El Goresy, and S. Mostefaoui (2005) *Nature* , 435, 1071-1074.
[3] Ohtani, E., Y. Kimura, M. Kimura, T. Takata, T. Kondo, and T. Kubo T. (2004) *Earth Planet. Sci. Lett.*, 227, 505-515.
[4] Xie, Z., and T. Sharp (2007) *Earth Planet. Sci. Lett.*, 254, 433-445.
[5] Kubo, T., M. Kimura, T. Kato, M. Nishi, A. Tominaga, T. Kikegawa, and K. Funakoshi (2010) *Nature Geosci.* , 3, 41-45.
[6] Tomioka, N., H. Kondo, A. Kunikata, T. Nagai (2010) *Geophy. Res. Lett.*, 37, doi:10.1029/2010GL044221

Keywords: shock metamorphism, maskelynite, plagioclase, diamond anvil cell