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

PPS21-P35 会場:コンベンションホール 時間:5 月 22 日 17:15-18:30

レーザー衝撃圧縮された鉱物の変成と衝撃波減衰
Shock-wave decay and shock metamorphism of laser-shocked minerals

永木 恵太 [1], 境家 達弘 [1*], 近藤 忠 [1], 門野 敏彦 [2], 弘中　陽一郎 [2], 重森 啓介 [2]
NAGAKI, Keita[1], SAKAIYA, Tatsuhiro[1*], KONDO, Tadashi[1], KADONO, Toshihiko[2], Youichirou Hironaka[2], SHIGEMORI, Keisuke[2]

[1] 大阪大学大学院理学研究科宇宙地球科学専攻, [2] 大阪大学レーザーエネルギー学研究センター
[1]Graduate School of Science, Osaka Univ., [2]ILE, Osaka Univ.

It is important to recover the shock-compressed samples for understanding the synthetic mechanism of high-pressure phase, shock metamorphism and shock-melt vein in meteorites. In the past, many impact experiments have conducted by using explosive or gas guns. In fact, although high-pressure phase in meteorites is recovered by the impact experiments (impact velocity is 1.5km/s and shock pressure is 26GPa) [1], the impact velocity in these methods is limited below 10km/s less than second escape velocity on the Earth. Recently, impact experiments at the velocity over 10km/s were conducted by using projectiles which were accelerated by high-power laser [2].

We developed the recovery technique of the laser-shocked materials at higher pressures (130-460GPa) in high-power laser system and estimated the pressure range of the production conditions from analyzing the structure of the shock metamorphism. We used the single crystal olivine (from San Carlos, USA) which is a major mineral of meteorites and of the Earth. We used the aluminum recovery cell. On this cell, titanium plate was located in the front of olivine to prevent the sample from being blow off. We used GXII/HIPER laser system at Institute of Laser Engineering (ILE), Osaka University [3]. The deformation, fracture and phase identification of the recovered olivine were observed comprehensively by optical microscopy, field emission-scanning electron microscopy (FE-SEM), electron backscatter diffraction (EBSD) and micro-Raman spectroscopy.

We recovered about 100 wt.% of the sample. There were some distinctive structures in the recovered sample. We estimated the shock wave attenuation rate from the distribution of these structures. The attenuation rates were 2.2-2.9 in our experiments. These attenuation rates were larger than that in previous experiment [4] and simulations [5, 6].

Part of this work was performed under the Joint Research of Institute of Laser Engineering, Osaka University.

References

[1] Tschauner, O. et al., Proceedings of the National Academy of Sciences, 106, 13691-13695, 2009.
[2] Kadono, T. et al., Journal of Geophysical Research, 115, E04003, 2010.
[3] Yamanaka, C. et al., Nucl. Fusion, 27, 19-30, 1987.
[4] Nakazawa, S., et al., Icarus, 156, 539-550, 2002.
[5] Ahrens, T. J., and J. D. O'Keefe, Int. J. Impact Eng., 5, 13-32, 1987.
[6] Pierazzo, E., et al., Icarus, 127, 408-423, 1997.

キーワード: 衝撃波, 変成, オリビン, レーザー, 回収, 実験
Keywords: Shock wave, Metamorphism, Olivine, Laser, Recovery, Experiment