CATHODOLUMINESCENCE AND RAMAN SPECTROSCOPIC CHARACTERIZATION OF EXPERIMENTALLY SHOCKED PLAGIOCLASE. M. Kayama[1], A. Gucsik[3], H. Nishido[1], K. Ninagawa[2] and, A. Tsuchiyama[4] [1]Research Institute of Natural Sciences, Okayama University of Science, 1-1 Ridai-cho, Okayama, 700-005, Japan (kayama0127@gmail.com), [2]Department of Applied Physics, Okayama University of Science 1-1 Ridai-cho, Okayama, 700-0005, Japan, [3]Max Planck Institute for Chemistry, Department of Geochemistry, Joh.-J. Becherweg 27, D-55128 Mainz, Germany, [4]Department of Earth and Space Science, Osaka University, 1-1 Machi-kaneyama, Toyonaka, Osaka 560-0043, Japan.

Introduction: Cathodoluminescence (CL) spectroscopy and microscopy provide useful information on existence and distribution of defect and trace elements in minerals. CL intensity and peak position depend mainly on activator concentration, composition and crystal fields, which might be related to genetic conditions of the formation and subsequent metamorphism such as shock events. Futhermore, CL features are affected by shock pressure including a post-shock temperature effects. This fact indicates that CL might be a useful technique to evaluate the stage of shock metamorphism in the rock-forming minerals such as plagioclase. In this study, CL and Raman measurements of experimentally shocked plagioclase ($Ab_{60}An_{40}$) at 0, 20, 30 and 40 GPa were carried out for the evaluation of shock metamorphic effect on them.

Sample and methods: Polished thin sections of unshocked and experimentally shocked plagioclase ($Ab_{60}An_{40}$) at 20, 30 and 40 GPa were employed for CL and Raman measurements. CL spectra were carried on in the range from 300 to 800 nm using a secandary electron microscope-cathodoluminescence (SEM-CL) system, which is comprised of an SEM (JEOL: JSM-5410) combined with a grating monochromator (OXFORD: Mono CL2). The Raman spectroscopy was performed using a Raman micros-spectrometer (JASCO: NRS-2100) with an Ar laser of 514.5 nm wavelength.

Results and discussion: CL spectra of unshocked plagioclase have four broad peaks at around 350, 420, 570, and 750 nm, which can be assigned to Eu^{2+}, structural defect, Mn^{2+}, and Fe^{3+} center, respectively (Fig. 1)[1, 2]. Their CL intensities decrease with an increase in experimentally shock pressure, whereas CL spectral peaks assigned to Mn^{2+} only appear in shocked plagioclase at 30 GPa. The wavelength of this spectral peak shifts from 570 nm for unshocked plagioclase to 630 nm for shocked plagioclase at 20 and 30 GPa. CL spectral peak at 420 nm is observed in plagioclase shocked at 40 GPa, whereas it has not been recognized in the plagioclase at 0, 20 and 30 GPa. This peak might be assigned to self-trapped exciton (STE). Similar blue emission has been observed in maskelynite from Dhofar 019 and Shergotty, which consist of much maskelynite. It indicates that CL spectral peak at 420 nm is characterised by the existence of maskelynite. Raman spectrum of unshocked plagioclase shows a pronounced peaks at around 170, 280, 480 and 510 cm^{-1}, whereas the spectra of shocked plagioclase at 20 and 30 GPa exhibit two peaks at around 480 and 510 cm^{-1}. Their Raman intensities also decrease with an increase in shock pressure. Shocked plagioclase at 40 GPa shows a weak and broad spectral peak at around 450 cm^{-1}, which can be assigned to T-O-T symmetrical stretching vibration. These results suggest that peak shift of CL spectral peak at around 470 nm might be caused by the alteration of crystal field related to Mn^{2+} activator. Raman spectral analysis indicates that higher shocked plagioclase at 20 and 30 GPa have their lower crystallinity without any change of framework configuration. It is responsible for a decrease in CL intensity with an increase in shock pressure. These results imply that CL and Raman spectroscopy of plagioclase can be expected to evaluate shock pressure induced in terrestrial and meteoritic samples.

References

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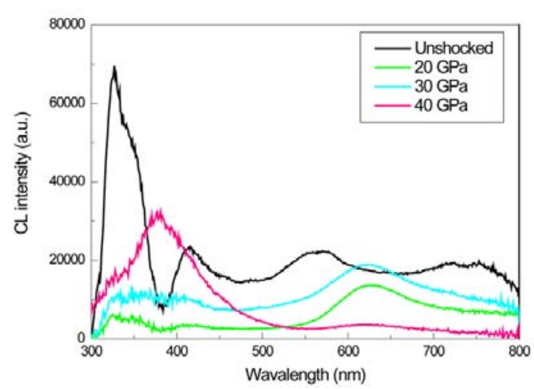

Fig. 1 CL spectra of unshocked and experimentally shocked plagioclase at 20, 30 and 40 GPa.