Cathodoluminescence microcharacterization of ballen silica in impactites. T. Okumura[1], A. Gucsik[2], H. Nishido[1] and K. Ninagawa[3], [1]Research Institute of Natural Sciences, Okayama University of Science, 1-1 Ridai-cho, Okayama 700-0005, Japan, E-mail: okumura@rins.ous.ac.jp; [2]Max Planck Institute for Chemistry, P. O. Box 3060, D-55020 Mainz, Germany; [3]Department of Applied Physics, Okayama University of Science, 1-1 Ridai-cho, Okayama 700-0005, Japan.

Introduction: The physical state of silica is a very useful index for shock-metamorphism [1]. In this study, we used cathodoluminescence (CL) microscopy and spectroscopy to characterize ballen silica structure. "Ballen silica", characterized by bubble-wall texture under a petrological microscope, has been observed in impactites [2-4]. Bischoff and Stöffler [3] found that ballen silica represents recrystallized diaplectic glass that had undergone the transition to cristobalite and then to α-quartz.

Samples: The ballen silica samples were obtained from six terrestrial impact craters; Dellen, Mien (both Sweden), Lappajärvi (Finland), Rochechouart (France), Terny (Ukraine), and Ries (Germany).

Analytical Procedures: CL measurements were done on carbon-coated, polished thin sections. Color CL imaging was performed on a CL microscope. The system was operated at 15 kV accelerating voltage and a beam current of 0.5 mA. CL colour images were captured using a digital photomicrographic camera system. High-resolution CL images and spectra were acquired using a scanning electron microscope (SEM) equipped with a grating-type monochromator, SEM-CL system. This system was operated at 15 kV accelerating voltage and a probe current of 1.5 nA. CL spectra were recorded in the wavelength range of 350-750 nm with 1 nm spectral resolution and a dwell time of 1 second per step by photon counting.

CL Characteristics of Ballen Silica: The Ballen silica shows fairly weak (faint) CL with homogeneous feature in its grain (Fig. 1). Ballen silica samples exhibit almost same spectral pattern with two broad band peaks at around 390 and 660 nm (Fig. 2), which might be assigned to self-trapped excitons (STE) or an intrinsic and nonbridging oxygen hole centers (NBOHC), respectively, recognized in amorphous and crystalline silica [5]. In addition, ballen silica from Lappajärvi crater shows bright and heterogeneous CL with a broad band centered at around 410 nm (Fig.2), presumably attributed to a self-trapped exciton (STE) or an intrinsic [6]. Micro-XRD and micro-Raman analyses show that fairly homogeneous CL part is α-quartz and heterogeneous CL part is composed of α-cristobalite and α-quartz. These indicate that ballen silica could be formed in the quenching process from relatively high temperature.

Consequently, CL microscopy and spectroscopy are an easy and powerful technique for identifying silica polymorphs in ballen, and CL investigation provides a new knowledge due to clarify the formation mechanism of ballen silica.

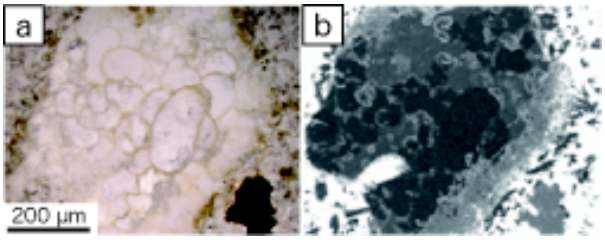

Figure 1. Microphotograph (a) and CL image (b) of ballen silica from Lappajärvi crater, Finland.

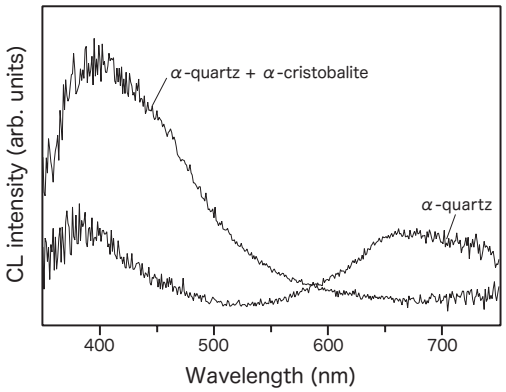

Figure 2. CL spectra of ballen silica from Lappajärvi crater, Finland.

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