CATHODOLUMINESCENCE CHARACTERIZATION OF "BALLEN QUARTZ" IN IMPACTITES.

T. Okumura[1], A. Gucsik[2], H. Nishido[3], K. Ninagawa[4], M. Schmieder[5], E. Buchner[5] [1]Open Research Center, 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]Research Institute of Natural Sciences, Okayama University of Science, 1-1 Ridai-cho, Okayama 700-0005, Japan. [4]Department of Applied Physics, Okayama University of Science, 1-1 Ridai-cho, Okayama 700-0005, Japan. [5]Institute of Planetology, University of Stuttgart, Herdweg 51, D-70174, Stuttgart, Germany.

Introduction: "Ballen quartz" observed in impactites is characterized by bubble-wall texture under a petrological microscope. It has been known to be formed as a reversion product from lechatelierite or diaplectic quartz glass at a shock pressure from ~30 to ~55 GPa [1, 2]. However, its formation mechanism has not been understood well. In this study, we characterize ballen quartz by means of cathodoluminescence (CL) microscopy and spectroscopy.

Samples and methods: The samples were selected from ballen quartz found in terrestrial impact craters; Dellen, Mien (both Sweden), Lappajärvi (Finland), Terny (Ukraine), and Ries (Germany). Their polished thin sections coated with 20 nm thickness carbon were employed for CL imaging and spectral analysis using a SEM-CL system comprising a secondary electron microscope combined with a grating-type monochromator. The measurements were carried on at an acceleration voltage of 15 kV with a beam current of 1.5 nA.

Results and discussion: The Ballen quartz shows fairly weak CL with homogeneous feature in its grain. Most of all samples exhibit a broad band peak at around 650 nm, which might be assigned to a nonbridging oxygen hole center (NBOHC) recognized in amorphous and crystalline SiO_2 [3]. The CL spectral profiles are almost same among the samples, suggesting the resemblance of the crystal field around luminescence centers inferred from similar formation mechanism of ballen quartz. The sample from Lappajärvi crater has another band peak at around 450 nm, presumably attributed to a radiative recombination of the self-trapped exciton (STE) or an oxygen deficient center (ODC) [4]. Micro-XRD analysis shows that this part is composed of cristobalite and α-quartz. This indicates that ballen quartz might be formed in the quenching process from relatively high temperature. Furthermore, micro-Raman spectral analysis will be performed on the samples to identify minor crystal phase and to estimate quartz crystallinity.

Consequently, the facts obtained from CL result imply that the post-shock superheating effect could play a key role in the formation of ballen quartz texture.

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