[EJ] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS06]Formation and evolution of planetary materials in the Solar System

convener:Akira Yamaguchi(National Institute of Polar Research), Wataru Fujiya(Ibaraki University, College of Science), Yoko Kebukawa(横浜国立大学 大学院工学研究院, 共同), Masahiro KAYAMA(Department of Earth and Planetary Material Sciences, Faculty of Science, Tohoku University)

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This session will focus on the evolution in the Solar System with interaction and co-evolution in minerals, water, organic matter, and noble gas in meteorites and interplanetary dust particles. New innovative analytical and theoretical techniques in various fields will be discussed. The developing methods are welcome to submit for the future mainstream of meteorite study. In order to explore the planetary materials and their evolution, both meteorite studies and experimental approaches are necessary. In this session, we will discuss these topics from extraterrestrial sample analyses and experimental works. Research works on undifferentiated and differentiated meteorites and parent body processes such as aqueous alteration, thermal metamorphism, shock metamorphism, volcanic activity, and core-mantle-crust differentiation are especially included in this session.

[PPS06-P14]Structural change of quartz with shock-induced amorphization by synchrotron powder X-ray diffraction method.

*Yu Chang[1], Masahiro KAYAMA[2], Akira Miyake[3], Yohei Igami[4], Eiichi Tajika[1], Yasuhito Sekine[1], Toshimori Sekine[5], Takamichi Kobayashi[6] (1.Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, 2.Department of Earth and Planetary Material Sciences, Faculty of Science, Tohoku University, 3.Department of Geology and Mineralogy, Graduate School of Science, Kyoto University, 4.Graduate School of Science, Kyoto University, 5.Graduate School of Engineering, Osaka University, 6.National Institute for Material Science (NIMS))

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High-density silica glass is often observed in meteorites and terrestrial rocks that have experienced a heavy shock impact event in parent bodies and on terrestrial impact craters. The shock-induced silica glasses exist as lamellar microstructures in the crystalline quartz grains[AM1] (i.e., PDFs: planar deformation feature) in meteorites and impactites. Thus, the mineralogical properties of PDFs are used as an indicator for the shock pressure estimation [e.g., 1]. However, shock induced amorphization process that forms PDFs still remains question. In this study, we investigated the structural change of quartz into high-density silica glass with an increase of experimentally shock-induced pressure by synchrotron powder X-ray diffraction (XRD) measurement.

Reverberation shock experiments were performed for single crystals of terrestrial (Minas Gerais, Brazil) and synthetic quartz using a one stage propellant gun at National Institute for Material Science (NIMS). Powder XRD patterns of silicon as a standard, starting materials of quartz, and the shock-recovered samples were conducted at KEK Photon Factory (PF; beam line: PF BL-4B2). Powder XRD measurement is analyzed in the range of 8 to 150 degree with steps of 0.005 to 0.2 degree, where the X-ray irradiation time set at 2 to 5 seconds per steps.

X-ray diffraction patterns of the starting materials and the shock-recovered samples of quartz crystals demonstrates that the diffraction peaks become broader as the shock pressures increase. The FHWM of main diffraction peaks (e.g., lattice plane [010], [110], etc..) increases with shock pressure. Above 35 GPa, no diffraction pattern of quartz was identified from the shock-recovered samples, suggesting the complete transition of quartz to amorphous glass. Also, several crystal planes exhibit peak shifts with the pressure increase. Lattice parameter of quartz changes at pressure range of 5 ~ 35 GPa. For both a-axis and c-axis, the lattice parameter becomes higher as the increase of pressure. These results imply that the lattice expansion of quartz occurs depending on a formation of high-density silica glass at this pressure range. Additionally, the micro-strain increases and the crystallite size decreases with pressure increase, suggesting that the shock-induced amorphization was initiated by the lattice distortion and the structural defects induced by shock compression. Also, the response of XRD signals with shock pressure would be potentially available for a shock barometer for meteorites and impactites.

[1] Langenhorst (1994) EPSL