P141-005 **Room: 301A** **Time: May 20 9:52-10:05**

U-Pb isotopic systematics on experimentally shocked baddeleyite up to 57 GPa

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The age significance of isotope chronometers in shocked, but not totally molten, extraterrestrial materials is not agreed yet [1-2]. Numerous isotopic data from different isotopic systems have been obtained for meteorites, but most meteorites with apparent shock ages do not show petrographic evidence of strong shock metamorphic overprint. Baddeleyite (ZrO_2) is an important mineral for U-Pb dating of lunar and Martian meteorites. By compression, monoclinic baddeleyite shows sequential transition to two orthorhombic phases up to 70 GPa [3].

We performed shock recovery experiments on baddeleyite at the shock pressures of 24, 34, 47 and 57 GPa using a propellant gun at NIMS [4], to understand the shock effects on U-Pb isotopic systematics of baddeleyite. We used coarse-grained baddeleyite from Phalaborwa, South Africa, (2059.8 Ma) for a starting material. The baddeleyite is mixed with a coarse-grained terrestrial basalt sample from North Kona, Hawaii [5] with a weight ratio of 1:2. The mixture was encapsulated in a stainless steel cylindrical container and pressed at 29 MPa. Porosity of the samples before the shock experiments was 26-30 %.

Textures of the starting material and the run products were examined by a scanning electron microscope with a cathode luminescence detector (SEM-CL; JEOL JSM-5900LV). We analyzed Raman spectra with a Micro Raman spectrometer (JASCO NRS-1000). In situ U-Th-Pb isotopic analysis was carried out using a polished section with the SHRIMP II ion microprobe at NIPR [6].

SEM-CL observation and Raman spectroscopy

Textures of the matrices of each run product did not change from those of the unshocked basalt. Olivine phenocrysts and baddeleyite grains in shocked samples were irregularly fractured. The matrices were partly melted at the shock pressures of 34 and 47 GPa and were totally melted at 57 GPa. Numerous vesicles (~10-40 micrometer in diameter) were observed in the 47 and 57 GPa samples. We could not observe CL in the unshocked baddeleyite. Luminescence appeared at the rim of baddeleyite grains and along the fractures in the 24 GPa sample. In addition to the features, weak luminescence at the inner part of baddeleyite grains was produced in the 34 GPa sample. In the 47 and 57 GPa sample, the whole baddeleyite grains emit luminescence. These observations show a correlation between the brightness of CL and the shock pressures. There is no measurable Raman peak shift from the unshocked baddeleyite in the 24 GPa baddeleyite sample. Raman peak shifts of 2 cm^{-1} and 4 cm^{-1} from the unshocked baddeleyite were observed in the 34 and 47 GPa samples, respectively. The Raman spectra of the 57 GPa sample were similar to those of the 47 GPa sample. These results suggest that the Raman peaks were shifted under the effect of pressure. The CL and Raman spectra are potentially useful tools for characterizing the shock stage of baddeleyite in non molten samples.

U-Pb isotopic systematics

There is no correlation between shock pressures and degrees of discordancy. Lead loss from baddeleyite was observed for none of the experimentally shocked samples. In addition, the ^{206}Pb-^{207}Pb ages of the shocked baddeleyites are indistinguishable from those of the unshocked baddeleyite within error. The data on U-Pb isotope and corresponding ages for the experimentally shocked baddeleyite are indistinguishable from those of the unshocked baddeleyite. The shock pressures of ~57 GPa do not measurably affect U-Pb systematics in our experimentally shocked baddeleyites.

[1] Misawa K. and Yamaguchi A. (2007) *MAPS, 42,* A108. [2] Bouvier A. et al. (2008) *EPSL, 266,* 105-124. [3] Ohtaka O. et al. (2001) *Phys. Rev, B, 63,* 174108-1-174108-8. [4] Sekine T. et al. (1987) *J. Material. Sci., 22,* 3615-3619. [5] Yokose H. et al. (2005) *Marine Geol., 219,* 173-193. [6] Misawa K. et al. (2005) *GCA., 69,* 5847-5861.