PPS05-P01 Room:Convention Hall Time:May 25 15:30-16:45

Impact water release mechanism of antigorite

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Serpentine is present in primitive carbonaceous chondrites as well as in subducted oceanic crust and its dynamic behaviors play important role to understand the origin of planetary water. It is believed there were many collisional processes during the early planetary formation. Powdered samples of a natural serpentine (antigorite), encapsuled in steel containers, were subjected shock recovery experiments as a function of shock pressure and porosity. The degree of dehydration was estimated by thermal gravimetric (TG-DTA) analyses, powder x-ray diffraction (XRD) method, and transmission electron microscopy (TEM). The results indicate that the dehydration is sensitive to the shock pressure, porosity, and sample amount in the present study. Taking into account the shape of the recovered containers, the reaction is found to have occurred more violently in larger amounts of samples with higher porosity even at relatively low peak pressures. When degassing portion of water in the present experiments on powdered samples is compare with that for solid antigorite that was subjected in open space (Lange and Ahrens, 1980), the relationship between peak pressure and releasing water is almost identical each other in the pressure rage of 20-35 GPa. This implies that peak pressure plays a key parameter for impact degassing of serpentine. These results are applicable for understanding the origin of water on the planets including the Earth.

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PPS05-P02 Room:Convention Hall Time:May 25 15:30-16:45

Cathodoluminescence of maskelynite in meteorite and impactite

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Maskelynite is an important material in planetary sciences to interpret shock metamorphic effects on impactite and meteorite. Recent scientific interests, therefore, focus on the formation processes of maskelynite by shock metamorphism, but it has been uncertain whether maskelynite is produced by shock-induced amorphization of plagioclase in solid-state reaction or by quenching from shock-induced dense melts of plagioclase at high-pressures. Cathodoluminescence (CL) spectroscopy can reveal crystal-chemical properties for the existence and distribution of defects and trace elements in materials with high-spatial resolution, which should be more informative to shock-induced minerals. This technique is expected to clarify a formation process of maskelynite from feldspar. In this study, CL analysis of maskelynite and K-rich feldspar glass in impactite and meteorite, as well as diaplectic glass derived from shock experiment for feldspars has been conducted to interpret shock-induced effects on a glassification of the feldspar.

Maskelynite and K-rich feldspar glasses originated from K-feldspars (K-feldspar glass) in amphibolite from Ries crater and in Martian meteorites of Dhofar 019, Shergotty, Zagami and NWA 2975 and lunar meteorite of NWA 4734 were employed for CL measurements. Single crystals of sanidine from Eifel, Germany, albite from Minas Gerais, Brazil and andesine from Bekily, Madagascar were selected as starting materials for shock recovered experiments at pressure of 40.1 GPa. Synthetic hollandite-$KAlSi_3O_8$ and meteoritic Na-lingunite from Y-790729 were analyzed as reference materials to compare their CL data with those of the feldspar glasses.

CL spectra of maskelynite and K-feldspar glasses in impactite and meteorites consist of emission bands at 330 and 380 nm. Similar UV and blue CL emissions are also recognized in CL spectra of diaplectic glasses derived from the shock recovered sanidine, albite and andesine. The deconvolution of CL spectra in the UV-blue spectral region for maskelynite, K-feldspar glass and diaplectic glasses originated from shock experiment indicates Gaussian components at 3.88 and 3.26 eV, which have been undetectable in the unshocked feldspars. The emission components are, therefore, characteristic CL signals of maskelynite, K-feldspar glasses and diaplectic glass derived from the shock recovered feldspars. CL spectra of the hollandite-$KAlSi_3O_8$ and Na-lingunite also show emission bands at 330 and 380 nm, which can be deconvoluted into the components at 3.88 and 3.26 eV. These emission intensities are appreciably higher than those of maskelynite, K-feldspar glass and diaplectic glass obtained from shock experiment. This might be responsible for octahedral coordination of all Si and Al atoms in the former and some of them in the latter. The facts imply that the emission components might be assigned to shock-induced defect centers in the Al and Si octahedra produced at high pressure. Furthermore, diaplectic glasses from disordered feldspar tend to exhibit higher intensities of the components at 3.88 and 3.26 eV than those from ordered feldspar at same shock pressure, possibly arising from a difference in the transition shock pressure into diaplectic glass among the feldspars. Accordingly, the CL signals can be applied as an estimation method for the degree of Si-Al order in the original feldspar affected before shock impact.

CL images of the lunar meteorites revealed that the maskelynite contacted with or located near melt pockets has a dull CL emission compared to those far from ones. This might be explained by either an elimination of the shock-induced defect centers in diaplectic glass by annealing or a difference in the formation process between dull and bright CL areas, that is, diaplectic glass and glass quenched from a shock-induced dense melt at high pressure.

Keywords: Cathodoluminescence, Maskelynite, Meteorite, Impactite, Shock experiment, Lingunite

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PPS05-P03 Room:Convention Hall Time:May 25 15:30-16:45

High-pressure phase analyses in shock-melt veins: New L6 chondrite in Queensland, NE Australia

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We investigate the high-pressure mineral phases in the shock-induced melt veins in new L6 chondrite obtained from Queensland in NE Australia. The preliminary research shows that the shock veins contain a number of high-pressure phases including ringwoodite, majorite, akimotoite, hollandite-structured plagioclace, which are fragments of the solid-state transformation of chondrite matrix. We conducted petrographic observations and laser-Raman micro-analyses for high-pressure mineral phases in/adjacent the melt veins of new chondrite to estimate the pressure- and temperature- conditions during shock event. The melt-veins show three distinct textures corresponding to distance from host chondrite; 1) vein edges 30-um-wide show mineral assemblage of majorite + ringwoodite + akimotoite with minor rounded metal-sulfide, 2) the middle of the vein 730-um-wide contains majorite + magnesiowustite with irregular-shaped metal-sulfide, 3) the outer rim of the melt vein consists of glass which can represent silicate melt under high-pressure and temperature conditions. These distinct differences of texture and constituent indicate heterogeneity of quench rate in the melt vein. Although the mineral assemblages in the vein edge and centre are distinctly different, the pressure range of both assemblages are consistence with crystallization from similar pressure conditions. The matrix in the vein edge crystallized at about 23-25 GPa and in the vein center crystallized at about 21-25 GPa. The estimation of crystallization pressure suggests that silicate melt with high-pressure phases in the vein quenched and consolidated during pressure pulse remained.

Keywords: Shock-melt vein, L6 chondrite, laser-Raman spectroscopy