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月隕石 NWA 4734 に記録された衝突履歴の研究
Dynamic event recorded in a lunar meteorite NWA 4734

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It is assumed that Late Heavy Bombardment (LHB) occurred in the inner solar system from 4.1 to 3.8 billion years ago. Many planetesimal and/or meteorites collided on the Earth during LHB. The Moon also would experience LHB because many impact craters and thick regolith exist on the Moon. Lunar meteorites would have information about such dynamic events occurred on the Moon. Shock pressure condition could be estimated based on high-pressure mineral assemblages contained in the lunar meteorites.

In this study, we investigated a lunar meteorite, Northwest Africa (NWA) 4734 by scanning electron microscope (SEM), Raman spectroscopy, electron probe micro analyzer (EPMA), X-ray diffraction (XRD) and Cathodoluminescence (CL) spectroscopy. Previous work [1] reports that the high-pressure polymorph of SiO_2 may exist in NWA 4734. Accordingly, we focused our investigation on the high-pressure polymorphs of SiO_2.

NWA 4734 is unbrecciated basalt. Major constituent minerals of NWA 4734 studied here are clinopyroxene, plagioclase (maskelynite), olivine, ilmenite, and SiO_2. Many shock-melt veins and melt pockets exist in the NWA 4734. Raman spectroscopy and SEM observations show that dendritic coesite exists in the SiO_2 gain entrained in the shock-melt vein. Raman spectroscopy indicates that pyroxene-glass was identified in the matrix of the shock-melt vein, which might originate from silicate-perovskite. SiO_2 grains with lamellar textures were observed in a host-rock of NWA 4734. XRD patterns indicate that the SiO_2 grain contains alpha-PbO_2-type SiO_2 seifertite (a = 4.079(2) A, b = 5.030(2) A, c = 4.485(1) A). A small amount of stishovite was identified by XRD, CL and Raman in some SiO_2 grains with lamellar textures. The phase equilibrium diagram of SiO_2 show that cristobalite transforms to seifertite at ~40 GPa at room temperature [2, 3]. It is likely that the SiO_2 grain was originally cristobalite based on several previous studies [e.g., 1, 4]. Accordingly, shock pressure condition recorded in NWA 4734 is at least ~40 GPa.

Reference
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