The systematic investigations of high-pressure polymorphs in shocked L type ordinary chondrites. M. Miyahara[1], A. Yamaguchi[2], E. Ohtani[3], M. Saitoh[1], [1]Hiroshima Univ., Japan, [2]NIPR, Japan, [3]Tohoku Univ., Japan.

Introduction:

Recent many investigations have revealed that high-pressure polymorphs ubiquitously occur in shocked ordinary chondrites (e.g., 1-8). We can constrain a shock pressure condition and impact velocity using a high-pressure polymorph assemblage in the shocked ordinary chondrite. Most previous investigations have focused on type 6, especially L6 ordinary chondrite, because it is the most abundant among meteorites and we can easily find a high-pressure polymorph. Few systematic investigations about a high-pressure polymorph in other type ordinary chondrites such as H, LL and L3-L5 have not been conducted up to now. A parent-body of an ordinary chondrite is expected to have an onion shell-like structure. We have to clarify the inventories of high-pressure polymorphs included in all type ordinary chondrites from type 3 to type 6 (or 7) to elucidate the destruction process of an ordinary chondrite parent-body.

Accordingly, we initiated the systematic investigations of high-pressure polymorphs included in ordinary chondrites. In the first period of this project, we have worked on L type ordinary chondrite. L3, L4 and L5 ordinary chondrites have been hardly investigated from the view of high-pressure mineralogy. We focused on these L type ordinary chondrites.

Experimental methods:

Antarctica L-type ordinary chondrite (mainly Yamato and Asuka meteorites) thin sections were allocated from the NIPR collections. First, we observed the thin sections under an optical microscope to pick up a specimen with a shock-induced melting texture. Second, the whole area of thin section was scanned automatically under the BSE image mode of a FEG-SEM (JEOL JSM-7100F). Individual BSE image was combined each other, and became one image depicting the whole area of the specimen. We meticulously searched for a melting texture in the specimen using the combined BSE image. Individual melting texture was observed under higher magnification BSE image to find phase transformation textures. Finally, we identified high-pressure polymorphs by a laser micro-Raman spectroscopy (Renishaw inVia).

Results and discussion:

Type 3: Four L3 type ordinary chondrites were selected for this study through preliminary optical microscopic observations. Chondrules are slightly flattened. The boundaries between the flattened chondrules and surrounding matrices are unambiguous. Several melting textures are observed at the boundaries. The melting textures are not vein-like but isolated, which appear to be a melt-pocket occurred in a shocked Martian meteorite (hereafter, a melt-pocket). High-pressure polymorphs were not identified in and around the melt-pockets although several maskelynite occur.

Type 4: Ten L4 type ordinary chondrites were selected for this study. The boundaries between chondrules and matrices are not clear compared with L3 ordinary chondrite. The grain-sizes of constituents in the matrices are coarser than L3 ordinary chondrite. Melt-pockets occur at the boundaries. Some melt pockets occur in the matrices. A melt-vein occurs only in one specimen. Jadeite occurs in feldspar grains entrained in and around the melt-pockets or melt-vein. Maskelynite was also identified.

Type 5: Five L5 type ordinary chondrites were selected for this study. The boundaries between chondrules and matrices are ambiguous. All melting textures occur as a melt-vein. Jadeite occurs in feldspar grains entrained in or around the melt-veins. Maskelynite was also identified. Wadsleyite was identified only in one sample. The olivine grain entrained in the melt-vein partly transforms into wadsleyite.

Many previous studies report the existence of shock-induced melt-veins and high-pressure polymorphs in L6 ordinary chondrites. Shock-induced melting was confirmed in L3, L4 and L5 ordinary chondrites besides L6 ordinary chondrite. Most shock melting occur as a melt-vein in L6 and L5, whereas as a melt-pocket in L3 and L4. Ringwoodite, wadsleyite, akimotoite, majorite, bridgmanite, jadeite, lingunite and tuite are identified in and around the melt-veins of L6 (e.g., 1-8). Only jadeite was ubiquitously identified in and around the melt-veins and melt-pockets of L4 and L5. The shock pressure condition can be estimated based on a high-pressure polymorph phase equilibrium diagram deduced from a static high-pressure synthetic experiment. The shock pressure of L6 is about from 13 to 24 GPa (e.g., 1-8). The existence of jadeite in most L4 and L5 is suggestive of pressure condition 2.5 GPa or more (9). The high-pressure polymorphs of olivine and low-Ca pyroxene are hardly included in L4 and L5, indicating that the pressure condition is less than about 12 GPa. Accordingly, the pressure condition of L4 and L5 would be about from 2.5 to 12 GPa, which is a little lower than that of L6. The shock pressure condition of L3 would be less than about 2.5 GPa. With increasing a petrological type, the melting texture and shock pressure condition change systematically, which will become a clue for clarifying ordinary chondrite parent-body destruction mechanism.

Acknowledgement:

This research was supported by the NIPR through General Collaboration Project no. 26-31. This study was supported by a grant-in-aid for Scientific Research, No. 22000002 and No. 26800277 by MEXT to E.O. and M.M., respectively.

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