PETROLOGY AND MINERALOGY OF THE BEARDSLEY H5 CHONDRITE: IMPLICATIONS FOR IMPACT MELTING. T. Niihara[1], Y. Tuduki[1], K. Misawa[2,3], T. Yokoyama[4], S. Yoneda[5], [1]Department of Applied Science, Faculty of Science, Okayama University of Science, 1-1 Ridai-cho, Kita-ku, Okayama, Okayama 700-0005, Japan (niihara@ous.ac.jp), [2]National Institute of Polar Research. 10-3 Midori-cho, Tachikawa, Tokyo 190-8518, Japan, [3]SOKENDAI, [4]Tono Geoscience Center, Japan Atomic Energy Agency, 959-31 Izumicho Jorinji, Toki, Gifu 509-5102, Japan, [5]National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba, 305-0005, Japan.

Introduction: Some brecciated chondrites contain alkaline-rich igneous clasts [1]. Their formational process is explained as early nebular condensates followed by shock melting [1]. The Beardsley chondrite (H5) possesses large amounts of Rb compared to other H chondrites [2]. Brecciated H-chondrites of Zag and Monahans (1998) have unique signature that contain halite crystals. This may indicate signature of aqueous alterations occurred in their parental bodies [3,4]. Hidaka et al. [5] reported Cs/Ba ratios for H chondrites of Beardsley and Zag as well as CAIs and suggested that primitive (aqueous) alteration in the Beardsley and Zag parent bodies occurred at 8.2–11.9 Ma and 13.9–17.6 Ma after CAI formation, respectively. However, detailed petrological and mineralogical signatures of Beardsley are still lacking and there is no petrological and mineralogical evidence for alteration such as presence of halite/sylvite or other alkaline-rich phases. Therefore, here we conduct petrological and mineralogical study for the meteorite, especially to clarify secondary effect(s) and distribution of alkaline elements on the chondrites and discuss the petrogenesis of Beardsley.

Sample and method: A polished thin section of the Beardsley chondrite was provided by National Museum of Nature and Science (Fig. 1). The PTS was observed under an optical microscope and a scanning electron microscope (SEM: JEOL JSM-6490 with accelerating

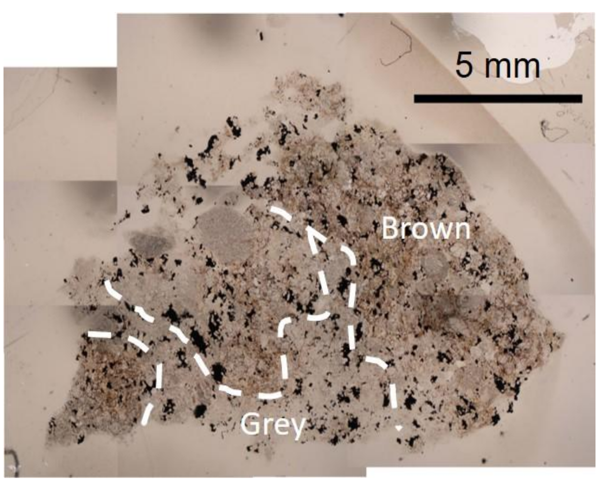

Figure 1. Thin section of Beardsley chondrite (open nicol). Two different lithologies (Brown and Grey) were identified.

voltage of 15 kV). Elemental distribution mapping was conducted using an EDS accompanying with SEM. Mineral compositions were determined with an electron probe micro analyzer (EPMA: JEOL JXA-8230) using accelerating voltage of 15 kV and beam current of 20 nA (focused beam). Bulk chemical compositions were estimated by averaging of the defocused beam analyses (DBA) [6]. All analyses were conducted at Okayama University of Science.

Results: The Beardsley chondrite consists of two different lithologies (here we call the brown and grey lithologies). The boundary between these lithologies is unclear.

The brown lithology contains coarse-grained pyroxene, olivine, metal and crystalline matrix. Several chondrules were identified in this lithology. Pyroxene grains in chondrules show undulatory extinction under optical microscope. Chemical compositions of constituent minerals in this lithology are generally homogeneous; pyroxene grains show Mg-rich and Ca-poor compositions ($En_{73-82}Fs_{16-18}Wo_{1-9}$) and olivine grains show Mg-rich compositions (Fo_{81-82}). Matrices has feldspathic compositions of $Ab_{79-84}An_{11-12}Or_{5-8}$. K_2O contents of matrix in the brown lithology (<2.3 wt.%) are lower than those in the grey lithology. K_2O content of the bulk brown lithology, estimated by DBA, is 0.12 wt.%. Abundant coarse metal (~500 µm) grains are observed. This lithology appears brownish since most of metal grains have rusty rims. Compositions of metals are within the range of martensite (Ni 6–8 wt.%).

The grey lithology contains coarse-grained pyroxene accompanying fine-grained overgrown rims and matrix glasses (Fig. 2A). Coarse-grained metallic particles are rare in this lithology and abundant sub-µm sized metal and sulfide droplets (Fig. 2B) are observed. We cannot identify chondrule in this lithology. Coarse-grained minerals in the grey lithology are mostly pyroxene; some of them are accompanying fine-grained metals or sulfide droplets along cracks. Newly crystallized fine-grained minerals are found at the rim of coarse-grained pyroxene grains or are embedded in matrix. Compositions of constituent minerals are more heterogeneous than those in the brown lithology. Pyroxene grains show wide ranges of chemical zoning, Mg-rich core to Fe- and Ca-rich rim ($En_{49-83}Fs_{6-19}Wo_{1-45}$). Coarse-grained pyroxene grains have Mg-rich and

Ca-poor composition. Euhedral to subhedral fine-grained pyroxene and overgrown pyroxene have Fe- and Ca-rich composition. Matrices have slightly heterogeneous composition ($Ab_{78-85}An_{9-16}Or_{4-6}$) relative to those in the brown lithology and contains up to 8 wt.% of K_2O. Higher K_2O portions are patchily distributed (Fig. 2C, D). K_2O content of the bulk grey lithology, estimated by DBA, is 1.57 wt.% which is an order of magnitude higher than that estimated for the bulk brown lithology.

Discussion and summary: Coarse-grained metals with rusty rims in the brown lithology have higher Ni contents than kamacite and lower Ni contents than taenite in H chondrites [7], which is similar to those observed in the shock melted chondrite Yamato-791088 [7]. On the other hand, the metallic particles in the grey lithology are mostly sub-μm in size and are embedded in newly crystallized minerals, matrix glass or in the cracks of coarse-grained minerals. Euhedral to subhedral fine-grained pyroxene grains in the grey lithology generally have Fe- and Ca-rich composition. Some of them have Mg-rich composition in the core of the grain and are similar composition with pyroxene grains in the brown lithology, suggesting they could be relict materials. These features are similar to those observed in impact melted H-chondrites [7], implying that the grey lithology is a product of impact melting event(s). K_2O contents of matrix glass in the grey lithology are higher than those of other impact melted H-chondrites (~2 wt.%) [7]. The higher K_2O content in the grey lithology cannot be explained only by an impact melting process but is still unclear at this stage.

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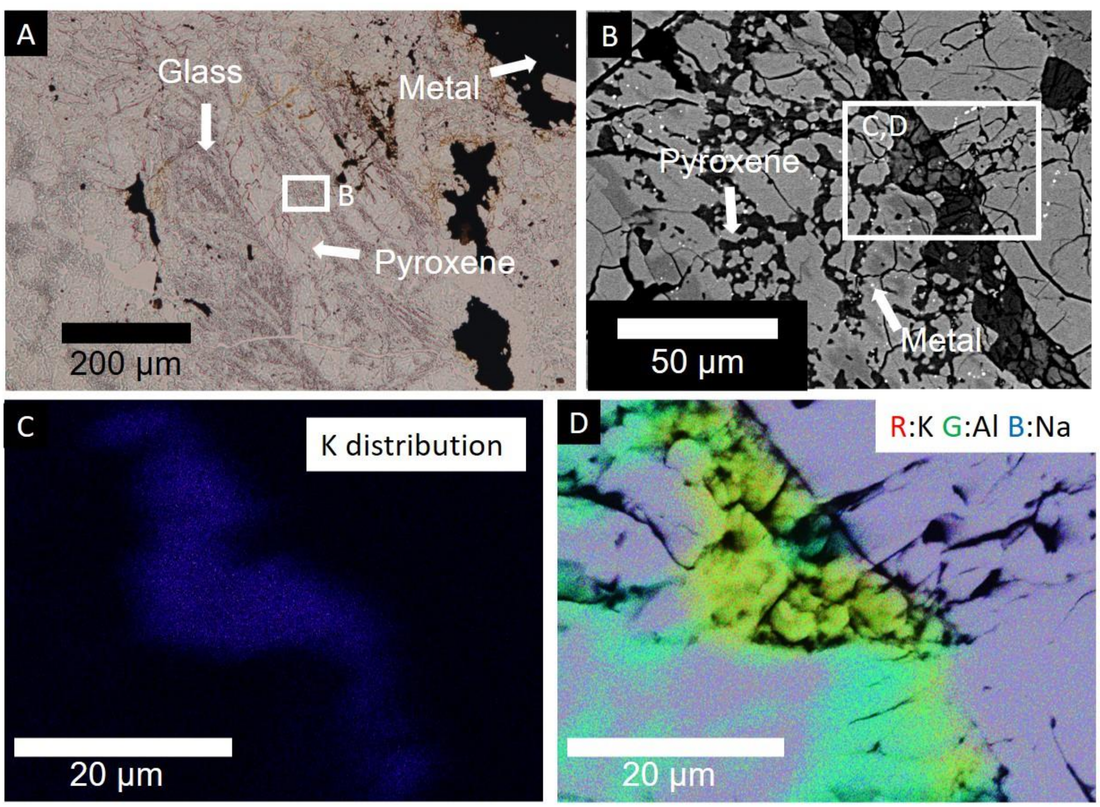

Figure 2. Grey lithology of Beardsley chondrite. (A) Optical microscope image (open nicol). (B) Close up of rectangular region in A (Back scattered electron image). (C, D) Elemental distribution of the rectangular region in B. (C) Blue region contains up to 8 wt.% of K_2O. (D) RGB composite image of K, Al and Na.