FORMATION OF CARBON-RICH GRAINS BY THE CHELYABINSK AND NIO METEORITIC SHOWERES.

Yasunori Miura[1] and Tanosaki Takao[2]. [1] Yamaguchi University, Yamaguchi, Yamaguchi 753-0074, Japan, [2] Kougakuin University, Tokyo, Japan. yasmiura50@gmail.com

Introduction: Carbon-rich sources of carbon-bearing materials are largely unknown in cosmic space from carbon-star interior formation to any celestial bodies, where main dynamic process is considered to be collision impact process with celestial bodies to planets (including Earth). We have been studied on carbon formation from reformed rocks of carbon-bearing compounds naturally and artificially, because any carbon-rich materials are usually difficult to be separated by normal condition of fluids and rocks. Recently we have reported preliminary that many examples of carbon-rich grains can be obtained at collision explosions in Earth's atmosphere by meteorite showers of the Nio and Chelyabinsk meteorites [1, 2]. The purpose of the present paper is to elucidate the formation of carbon-rich grains formed by meteoritic showers in air.

Carbon-rich grains of the Chelyabinsk meteorite: The Chelyabinsk meteorite (LL5) fallen recently (15th February, 2013) showed meteoritic shower which have been collected many “fragments” of ca. 400 pieces on the fields (ca. 3.5kg in total). The samples in this study are collected at Deputaskiy, Russia (Nos.CH-19 to 21) and unknown field (sample No.CH-50 similar to No.CH-20) [2] as follows.

1) All fragments are mainly changed by the collected grains on the ground caused by the meteorite shower processes of carbon-rich (No.20), mixed (No.19) and complete new fragments (No.21) as shown in Figs.1 to 3.

2) Sample No. CH-19 which is largely mixed with chondrite and carbon shows iron-rich sulfides, carbides and isolated carbon-bearing grains, where irregular void-rich textures shows larger evaporating process in local sites (Figs.1-3) This indicates that meteorite shower produces carbon-rich grains which was reported from the comet and/or previous sediments of impact sites [2].

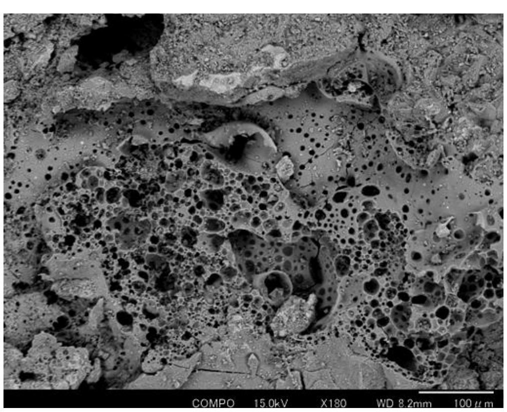

Fig. 1. Electron micrograph of the Chelyabinsk meteorite with void-rich texture to show local quenched process.

3) Sample No. CH-20 shows primordial chondritic composition with considerable carbon contents which is irregularly mixed with chondrite and carbon.

4) Sample No. CH-21 which is not primordial meteorite of chondritic materials shows SiC in composition. This indicates that meteorite shower produces single grains of moissanite SiC which was previously reported from the cosmic dusts and original sediments of impact sites [2].

5) All exploded fragments in air contain significant carbon contents with the analytical FE-SEM (JEOL) instrument. However, carbon-separation to show the most carbon-rich grains (>80%C) are only obtained at the completely mixed sample (No.CH-19) among partial melted sample (No.CH-20) and re-melting crystalline material SiC (No.CH-21) [2].

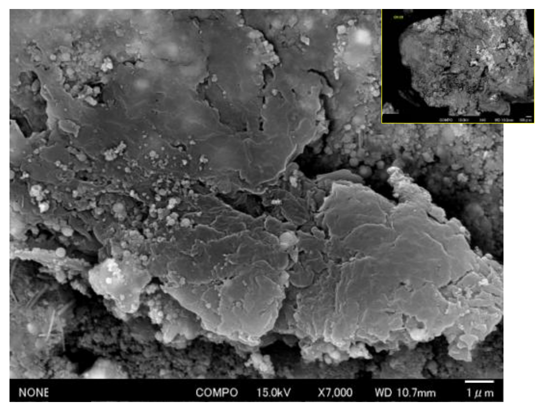

Fig. 2. Electron micrograph (compositional images) of the sample Chelyabinsk (CH-19 in this study) with analytical scanning electron-microscope (FE-SEM) shows carbon separated grains by complete evaporation process by meteorite explosion in air [2].

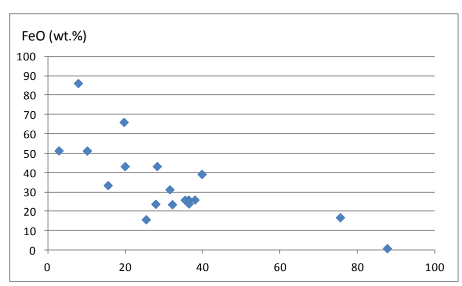

Fig. 3. Carbon content (x-axis) with FeO (wt.%) of the analytical FE-SEM observations of the three samples of the Chelyabinsk (CH-19, 20 and 21), which shows carbon-rich grains are obtained (CH-19 to 21) [2].

Carbon-rich grains of the Nio meteorite: The Nio meteorite (H3-4) fallen on Niho to Miyano, Yamaguchi, Japan (night on 8th August, 1897) shows meteoritic shower exploded on 40km above ground, where we have collected many fragments of 1,212 spherules and ca.40 pieces on the old rice-fields at the Niho- to Miyano-towns separately [2] as follows (with my previous laboratory students).

1) Japanese rice-paddy with many soil-layers can be stored fallen meteoritic fragments which we can still collected in the grounds of 4 to 5 concentration sites, though the reported meteorites are 2 to 3 pieces so far.

2) Carbon-rich grains can be obtained as FeC in compositions at xenoliths-like materials in the spherules as shown in Figs. 4 and 5.

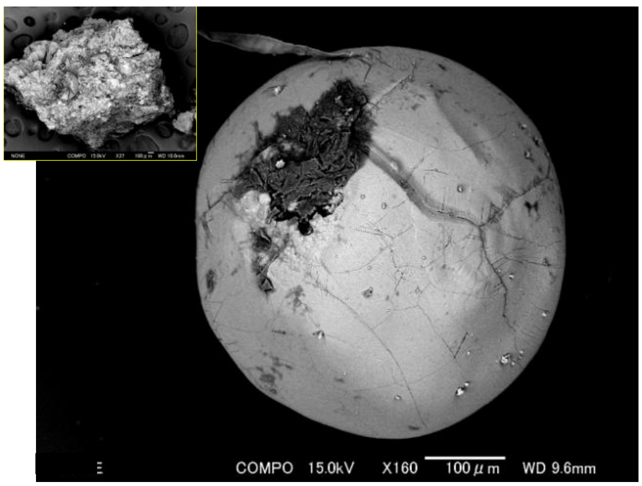

Fig. 4. Electron micrograph (compositional image) of the Nio (H3-4) meteorite shower spherules collected in the rice paddy at Niho, Yamaguchi, Japan.

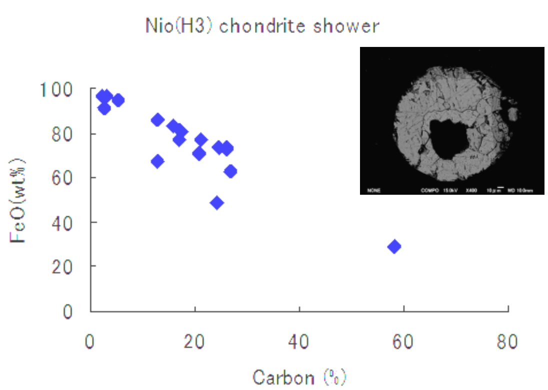

Fig.5. Carbon content (x-axis) with FeO (wt.%) of the analytical FE-SEM observations of the Nio meteorite spherules, which shows carbon-rich grains are formed separately.

Carbon concentration sites: Terrestrial carbon sources are considered to be complicated from the deep interior to shallow surface in active planet Earth, though there are no consideration on sources of meteoritic asteroids concentrated on meteoritic shower explosions in air (not from terrestrial rocks) as shown in Fig.6. The present results are considered to be new carbon-concentrated source within Earth's air by meteoritic shower process, which might be clues for carbon materials on the air planet of the Solar System [2, 3].

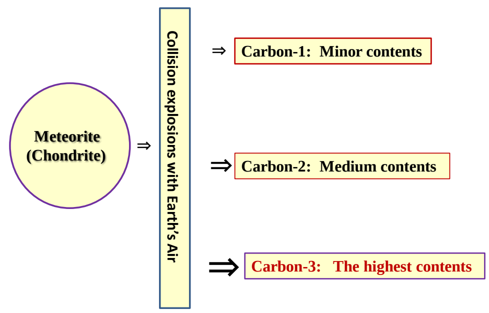

Fig.6. Outline of carbon concentration processes from types-1 to 3 on meteoritic shower explosion in air [1-3].

Summary: The present study is summarized as follows:

1) Carbon separation and concentration process can be found at explosions of meteorite shower in air of the Chelyabinsk (Russia) and Nio (Japan) meteorites.

2) The present results suggest that two meteorite shower produce carbon-rich FeS and moissanite SiC grains which were considered to be originated from the comet and/or previous sediments of impact sites [2].

3) Carbon concentration process by explosions of meteoritic is considered to be new site and sources between extraterrestrial and terrestrial locations.

4) The present result can be explained new carbon source of impact-related sites (without any remained craters or meteorites).

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References: [1] Miura Y. (2013): LPS XXXIV, #1654, .#3098. [2] Miura Y. (2014): Inter. Mineral. Assoc. 2014 (Johannesburg, SA) #689. [3] Miura Y. (2015). Submitted (in the same volume).