PPS24-P03 会場:コンベンションホール 時間:5 月 23 日 18:15-19:30

南極雪から回収された宇宙塵の希ガス同位体
Noble gas isotopes of micrometeorites collected from Antarctic snow

岡崎 隆司 [1*], 飛松 優 [1], 野口 高明 [2], 辻本 真一 [2], 大久保 彩 [3], 中村 智樹 [4], 海老原 充 [5], 伊藤 正一 [6], 薮田 ひかる [7], 橘 省吾 [6], 永原 裕子 [3], 寺田 健太郎 [7]
Ryuji Okazaki[1*], Yu Tobimatsu[1], Takaaki Noguchi[2], TSUJIMOTO, Shinichi[2], Aya Okubo[3], Tomoki Nakamura[4], Mitsuru Ebihara[5], Shoichi Itoh[6], Hikaru Yabuta[7], Shogo Tachibana[6], Hiroko Nagahara[3], Kentaro Terada[7]

[1] 九州大学大学院理学研究院, [2] 茨城大学理学部理学科, [3] 東京大学大学院理学系研究科地球惑星科学専攻, [4] 東北大学大学院理学研究科地学専攻, [5] 首都大学東京理工学研究科, [6] 北海道大学大学院理学研究院自然史科学部門, [7] 大阪大学理学研究科
[1]Department of Earth and Planetary Sciences, Kyushu University, [2]College of Science, Ibaraki University, [3]Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, [4]Department of Earth and Planetary Materials Sciences, Faculty of Science, Tohoku University, [5]Graduate School of Science and Engineering, Tokyo Metropolitan University, [6]Department of Natural History Sciences, Hokkaido University, [7]Department of Earth and Space Science, Osaka University

As a comprehensive study [e.g., 1], we have been investigating micrometeorites (MMs) collected from Antarctic snow in 2003 and 2010 by JARE. MMs used in this study were recovered by filtering melted snow water at 20 ^oC in a clear room at Ibaragi Univ. Each MM was investigated by several analytical methods: identification using SED-EDS, followed by characterization by SR-XRD, TEM, micro-Raman, SEM, and EPMA analyses, and additionally by INAA, and/or noble gas mass spectroscopy. We classified the MMs investigated into five types based on their mineralogical features: 1) refractory, 2) chondrule-like, 3) fine-grained polycrystalline, 4) coarse-grained crystalline, and 5) phyllosilicate-rich MMs. Here, we report results of noble gas analyses for the MMs and show the relation between their noble-gas and mineralogical features.

Each of the samples mounted on Mo sheets was removed using acetone, and packed into an Al cup. The Al cups were set in a sample holder of a small furnace (designed for submicrogram to milligram samples) equipped with a purification line of the noble gas mass spectrometer at Kyushu Univ. The samples were heated *in vacuo* at 150 ^oC for 1 day to reduce adsorbed atmospheric gas contamination. Each sample was heated stepwise at 400, 650, and 1800 ^oC to extract noble gases. Absolute abundances and ratios of noble gas isotopes were calibrated by measuring known amounts of atmospheric gas and a He standard gas with $^3He/^4He$ of 1.71E-4. Blank levels of He and Ne at every extraction temperatures are reasonably low but those of the other elements are comparable to those released from MMs: e.g., ^4He = 5E-12, ^{20}Ne = 5E-13, ^{36}Ar = 1E-12, ^{84}Kr = 1E-14, ^{132}Xe = 3E-15 cm^3 STP for the 1800 ^oC blank run.

Samples studied are two chondrule-like MMs, one fine-grained MM, and three coarse-grained MMs, and are 30-60 micrometers in diameter. Isotopic ratios of He and Ne are indicative of solar wind (SW) origin, while elemental ratios of $^4He/^{20}Ne$ are $<$90, lower than SW value (~650 [2]). Release profiles of SW noble gases are different among MMs: two out of seven begin to release noble gases at 400 ^oC, three at 650 ^oC, and two at 1800 ^oC. This indicates that they were heated to varying degrees during atmospheric entry. Plotting ^4He concentrations against $^4He/^{20}Ne$ ratios, a positive correlation is observed in the MMs, as is the case with Itokawa particles [3], IDPs [4], unmelted MMs [5, 6], and cosmic spherules [7]. The largest amounts of He and Ne among the MMs studied were obtained from a fine-grained MM (D03IB67), which consists mainly of sub-micron olivine and low-Ca pyroxene grains. This MM releases noble gases at 400-1800 ^oC, indicating that this MM was not heated above 400 ^oC during atmosphere entry. The TEM observation revealed that this MM contains abundant solar flare track with ~5E10 /cm^2 density, which corresponds to $>$1E4-years exposure [8] to solar wind and flare. The presence of the flare track is consistent with the noble gas release temperature, since the track can be erased by flash heating above ~600 ^oC [9].

A chondrule-like MM (D03IB057) and a single olivine MM (D10IB170) contain only small amounts of He and Ne with the lowest $^4He/^{20}Ne$ ratios (1.4 and 0.4, respectively). They release detectable amounts of noble gases only at 1800 ^oC. Both of the MMs show signs of higher degrees of heating: the uppermost surface layer of D03IB057 is partly melted, while that of D10IB170 is decomposed into magnetite and glass.

References: [1] Yabuta et al. (2012) LPSC XXXXIII (Abs. #2239). [2] Heber et al. (2009) GCA 73, 7414-7432. [3] Nagao et al. (2011) Science 333, 1128-1131. [4] Nier and Schlutter (1990) Meteoritics 25, 263-267. [5] Osawa and Nagao (2002) Antarct. Meteorite Res., 15, 165-177. 6] Osawa et al. (2003a) Meteorit. Planet. Sci. 38, 1627-1640. [7] Osawa et al. (2003) Antarct. Meteorite Res. 16, 196-219. [8] Bradley (2006) In: Meteorites, Comets, and Planets. [9] Fraundorf et al. (1982) GCA 45, 915-943.

キーワード: 微隕石, 希ガス, 太陽風
Keywords: micrometeorites, noble gas, solar wind