

## CLASSIFICATION OF THE HACHI-OJI METEORITE AND COMPARISON WITH THE SONE METEORITE.

S. Yoneda<sup>1</sup>, A. Yamaguchi<sup>2,5</sup>, R. Okazaki<sup>3</sup>, N. Imae<sup>2,5</sup>, M. Kimura<sup>2</sup>, R. Kataoka<sup>2,5</sup>, K. Iwahashi<sup>4</sup>, T. Mori<sup>6</sup>, and M. Komatsu<sup>5</sup>. <sup>1</sup>National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba 305-0005, Japan (s-yoneda@kahaku.go.jp), <sup>2</sup>National Institute of Polar Research, Midoricho 10-3, Tachikawa, Tokyo 190-8518, Japan, <sup>3</sup>Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan, <sup>4</sup>National Institute of Japanese Literature, Midoricho 10-3, Tachikawa, Tokyo 190-8518, Japan, <sup>5</sup>SOKENDAI (the Graduate University for Advanced Studies), Hayama, Kanagawa 240-0193, Japan, <sup>6</sup>Konica Minolta Science Dome (Hachioji Children's Museum of Science), 9-13 Oyokocho, Hachioji, Tokyo 192-0062, Japan.

**Introduction:** The Hachi-oji meteorite fell in the center of the Hachioji city, Tokyo, Japan on 29 December 1817 [1-3]. It fell as a large shower including several ~1m-size stones and its strewn field is about 10 km wide. There is a series of governmental documents left, which records that part of the recovered meteorites were sent to the Tokugawa Shogunate Government and were examined but judged as a kind of volcanic rocks. All the stones had been lost since then. Around 1950, a small chip (~0.3 gram) of the meteorite was found in classical documents (envelope) of the Tuchimikado family in Kyoto, who were in charge of making Japanese calendars in the Edo (Tokugawa Shogun) era [3]. The chip was enclosed with a document on the Hachi-oji recovery. In the same envelope, however, a paper describing about the Sone meteorite, fell in Kyoto in 1866, was also included. Thus, a question arises whether the small chip is part of Hachi-oji or Sone. Since it was difficult to examine the small chip using analytical techniques in the 1950s, no detailed descriptions of this chip had been available. In 2013, this chip (now ~0.1 gram) was donated to the National Museum of Nature and Science, Tokyo, along with the documents.

**Samples and Methods:** We performed a petrological and noble gas study of the "Hachi-oji" chip. Polished thick and thin sections (PTSs) are made from 20 mg chip and examined optically and with a scanning electron microscope and electron microprobe analyzer (EPMA). Coarse powders, 0.7 and 5.4 mg were used for X-ray diffraction (XRD) analysis and noble gas study respectively. The powder sample for noble gas analysis was embedded in resin and polished to investigate with EMPA. The sample was washed and recovered from the resin and used for noble gas analysis. We also performed the same analyses for the Sone meteorite for comparison.

**Results and Discussion:** The X-ray measurement by Gandolfi attachment for each small fragment (~0.3 mm in size) commonly showed: (1) orthopyroxene 511 appears suggesting equilibrated chondrite, and (2) olivine 130 is consistent with H chondrite. PTSs of Hachi-oji and Sone show moderately recrystallized textures with a few chondrules. Large FeNi metal nodules are observed. The shock stages of both the meteorites are S1. Olivine Fa in Hachi-oji range from 17.96-20.06, and those of Sone, 17.91-19.62. Pyroxene Fs for Hachi-oji range from 15.46-17.29 and those for Sone from 15.80-17.82. The results indicate that the Hachi-oji chip is a H5 chondrite, the same group as Sone [4-6]. Their cosmic ray exposure and K-Ar ages are close to each other, and average  $19.3 \pm 2.9$  Ma and  $4.49 \pm 0.41$  Ga, respectively. The exposure age is in good agreement with the previous measurement of the bulk Sone meteorite, 16 Ma [7] and this age is outside of the 6-8 Ma major peak in the distribution of exposure ages for H chondrites [8]. There is little difference in petrologic and noble gas data of these two meteorites. This may indicate that the 0.1 gram chip found in the classical envelope was in fact part of Sone.

**Conclusions:** The "Hachi-oji" meteorite chip is classified as a H5 chondrite by petrological and noble gas studies. However, we cannot exclude the possibility that this chip is a fragment of the Sone meteorite, which is also a H5 chondrite, since H5s are one of the most common meteorite group.

**References:** [1] Shibukawa T. (1895) *Chigaku Zasshi (Journal of Geography)*, 2, 246-247. [2] Jimbo K. (1906) *Beiträge zur Migeralogie von Japan*, 2, 30-52. [3] Murayama S. (1967) *Shizenkagaku to Hakubutukan (Natural science and museums)*, 34, 163-170. [4] Miyashiro A. et al. (1963) *Bulletin of the National Science Museum*, 6, 352-355. [5] Mason B. (1967) *Geochim. Cosmochim. Acta* 31, 1100-1103. [6] Shima M. et al. (1986) *Meteoritics*, 21, 59-78. [7] Takaoka N. et al. (1989) *Z. Naturforsch.* 44a, 935-944. [8] Eugster O. et al. (2006) In "Meteorites and the Early Solar System II", 829-851.