A New Extraction System for Extremely Low Level ^{14}C in Meteorites.

H. Kusuno[1], T. Fukuoka[1], H. Matsuzaki[2] and Y. Miyairi[3], [1]Graduate school of Geo-environmental Science, Rissho University, [2]School of Engineering, The University of Tokyo, [3]Atomspher and Ocean Research Institute, The University of Tokyo.

Introduction:

Terrestrial ages of Antarctic meteorites are useful tool to investigate frequency of meteorite falls, pairing of meteorites and accumulation mechanism of meteorites on Antarctic ice sheet. In the Yamato mountain region, more than 13,000 various classes of meteorites have been collected. Terrestrial ages of Yamato meteorites have been known to be concentrated less than 70 kyr compared with those of other site meteorites such as Allan Hills (ALH) meteorites [1, 2, 3]. We determined terrestrial ^{26}Al ages of 47 Yamato HED (howardite, eucrite and diogenite) meteorites. Terrestrial ages of those meteorites distributed from recent to 380 kyr (Kusuno, unpublished data) and 70% of them were less than 70 kyr. We tried determination of ^{14}C (half-life 5730 yr) contents of those Yamato HED meteorites to study distribution of terrestrial ages which showed younger terrestrial ages.

HED meteorites include extremely low level carbon, which is only cosmogenic ^{14}C (saturated ^{14}C amount: 10^8 atoms/g [4]) because volatile elements including carbon are absent in these meteorites. Therefore the low ^{14}C blank system, which is less than 10^4 atoms ^{14}C, is required to extract cosmogenic ^{14}C from HED meteorites. Modern atmosphere has 10^8 atoms of ^{14}C per one litter (modern carbon of $^{12}C/^{14}C$ ratio = $1.2 * 10^{-12}$). Therefore the ^{14}C need to be extracted in low pressure system, which is less than 10^{-1} Pa. Furthermore the extraction system needs furnace which can heat 0.1 – 1 g meteorite samples equally up to 1300 degrees C (melting temperature of Eucrites) with step wised heating, because to recover 100% ^{14}C in HED meteorites, we need to find the release temperature of cosmogenic ^{14}C from HED meteorite samples.

We designed and produced a new simple and compact system for extraction of extremely low level ^{14}C in HED meteorites at Rissho University. This system is able to heat 0.1-1 g meteorite samples equally with step wised heating up to 1500 degrees in less than 10^{-3} Pa.

Design of the Extraction System:

Previous studies extracted cosmogenic gasses from extraterrestrial samples or terrestrial rock (quartz) samples with Radio Frequency (RF) furnace [2, 5], resistance furnace [6, 7] or electrode furnace [8]. RF furnace and electrode furnace are able to be minimized the volume. For RF furnace, however, it is difficult to control temperature and is difficult to heat samples equally. The sample boat of Electrode furnace is often made of Mo or Ta which are high electric resistance. Those metals release carbon [9] and react with carbon. Resistance furnace successfully used for terrestrial quartz samples [7]. We applied resistance furnace to extraction system for extraction ^{14}C in HED meteorites. However, resistance furnace requires large volume for cooling furnace tube. We minimized volume of furnace tubing by application of crucible furnace.

Fig. 1 shows the extraction system of Rissho University. The volume of furnace chamber with high pure alumina tubing is about 250 ml. Pressure of this system reaches less than $1*10^{-3}$ Pa at room temperature by vacuum for one hour and reaches the least to $8*10^{-5}$ Pa by vacuum for 24 hours.

In our presentation, we will present blank level of the extraction system at the Rissho University and preliminary data for ^{14}C terrestrial ages of HED meteorites.

References:

[1] Nishiizumi, K. et al. (1989) *Earth Planet. Sci. Lett.* 93, 299-313. [2] Jull, A. J. T. et al. (1993) *Proc. NIPR Symp. Antarct. Meteor*. 6, 374-380. [3] Jull, A. J. T. et al. (1999) *Antarct. Meteor. XXIV*, 62-63 (abstract). [4] Masarik, J and Reedy, R. (1994) *Geochim. Cosmochim. Acta* 58, 5307-5317. [5] Minami, M. et al. (2006) *MAPS* 41, 529-540. [6] Lifton, N. A. et al. (2001) *Geochim. Cosmochim. Acta* 65, 1953-1969. [7] Pigati, J. S. et al. (2010) *Radiocarbon* 52, 1236–1243. [8] Bajo, K. et al. (2011) *Earth Planets Space* 63, 1097-1111. [9] Jull, A. J. T. et al. (1994) *NIM B* 92, 308-310.

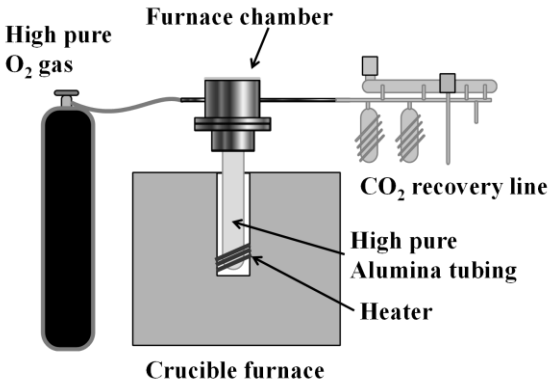

Figure 1. The extremely low level ^{14}C extraction system for HED meteorites at Rissho University