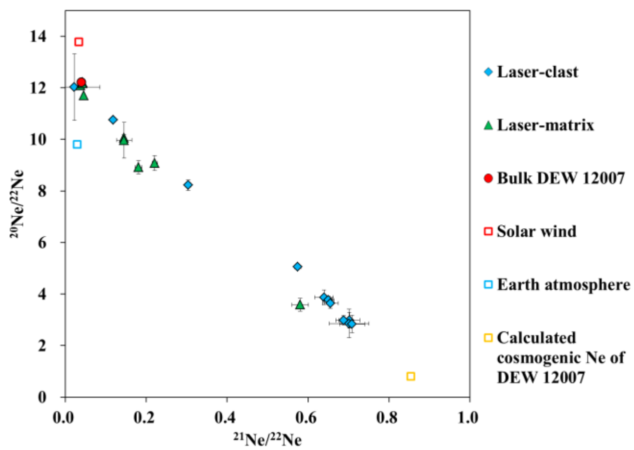
IN-SITU NOBLE GAS ANALYSIS OF MOUNT DEWITT 12007 LUNAR METEORITE.

J. Choi[1,2], K. Nagao[1], J. Park[3,4,5], J. M. Baek[1], J. I. Lee[1,2], D. S. Ebel[5,6], and M. K. Weisberg[3,5,6]. [1]Korea Polar Research Institute (KOPRI), Incheon 21990, Korea (jisu@kopri.re.kr), [2]University of Science and Technology (UST), Daejeon 34113, Korea, [3]Kingsborough Community College, Brooklyn, NY 11235, USA, [4]Deptment Chemistry and Chemical Biology, Rutgers University, Piscataway, NJ 08854, USA, [5]American Museum of Natural History (AMNH), New York, NY 10024, USA, [6]Deptment of Earth and Environmental Science, Graduate Center, City University New York, New York 10016, USA.

Introduction: Lunar meteorites were launched from the surface of the Moon, and provide information about formation of lunar crust. Mount DeWitt 12007 (DEW 12007) is a mingled regolithic breccia classified as a lunar meteorite [1,2]. DEW 12007 is composed of lunar crustal rocks of various origins, and it is suggested as a launch-paired meteorite with other mingled ones such as Yamato 793274 (Y 793274) and Queen Alexandra Range 94281 (QUE 94281) based on geochemical data [1]. It has complex cosmic-ray exposure history with a shielding depth of 340–360 g/cm^2 before its ejection from the Moon and the short transition time from the Moon to Earth [3]. As a result of short transition time, noble gases of DEW 12007 are largely related with its residence on surface of the Moon such as implantation of solar gases and cosmic-ray exposure. In this study, we report the results of noble gas analyses of various clasts and matrices observed on a thick section prepared from DEW 12007 by the laser heating method. The bulk sample was also measured by the furnace heating method.

Methods: Two kinds of samples were prepared for noble gas analyses; a bulk sample (0.213 mg in weight) without any distinguishable clasts, and a thick section. The thick section, 1mm thick, was prepared for in-situ noble gas analysis using a 1064 nm wavelength fiber laser. Both samples were preheated at 150 °C for 24 h to remove terrestrial gases in the noble gas extraction and purification line. Bulk sample was totally melted at 1800 °C for 30 min for noble gas extraction. On the other hand, 20 spots on either clasts or matrices of the thick section were melted by laser heating for gas extraction. In this laser analyses, the thick section of the sample was not penetrated by laser heating, due to the thickness of the sample. Weight of melted materials at the spots were calculated as ~6 μg based on observed dimensions of the laser-ablated area with assumed 200 μm depth of each laser pit and 3 g/cm^3 of density [1]. He, Ne, Ar, Kr, and Xe were measured with the modified-VG5400 noble gas mass spectrometer at KOPRI.

Results & Discussion: Bulk DEW 12007 contains high concentrations of solar gases, i.e., ^{3}He/^{4}He = (3.99 ± 0.07) × 10^{-4} with 1.6 × 10^{-4} ccSTP/g of ^{4}He, ^{20}Ne/^{22}Ne = 12.229 ± 0.016 with 1.8 × 10^{-4} ccSTP/g of ^{20}Ne, and ^{21}Ne/^{22}Ne = 0.0398 ± 0.0001. Results of Ne isotope ratios by laser analyses are distributed on mixing line between fractionated solar wind [4] and cosmogenic Ne as shown in the figure. High concentration of solar gases comparable with that of bulk sample was released only from the matrix part by the laser analyses. (^{40}Ar/^{36}Ar$_{trap}$) is calculated from bulk data and some laser data containing solar gases, and obtained value of 2.3 agrees well with 2.4 and 2.2 proposed for launch-paired meteorites, Y 793274 and QUE 94281, respectively [5,6]. Cosmogenic ^{21}Ne and ^{38}Ar concentrations are calculated by using bulk DEW 12007 data as end member of fractionated solar wind for trapped Ne and mixing lines from results of laser analyses with considering (^{20}Ne/^{22}Ne)$_c$ = 0.80, (^{36}Ar/^{38}Ar)$_c$ = 0.65, and (^{36}Ar/^{38}Ar)$_t$ = 5.32. (^{21}Ne/^{22}Ne)$_c$ = 0.85 was calculated from the mixing line. (^{21}Ne/^{38}Ar)$_c$ of plagioclase-rich clasts are lower than 1, while pyroxene-rich clasts have higher than 1, up to 24. In case of solar gas-poor and solar gas-rich matrices, the ratios are divided into two ranges of 0.1–0.4 and 1.2–3.5, respectively, while the bulk shows lower value of 0.6. The difference corresponds to different chemical composition of analysed phases, because main target elements to produce ^{21}Ne$_c$ and ^{38}Ar$_c$ are Mg and Ca, respectively. As the results obtained at present have large experimental uncertainties in determining melted mass by laser heating, we will present more quantitative studies of the complex exposure history of this meteorite on the lunar surface, at the meeting, by improving experimental settings.



References: [1] Collareta A. et al. (2016) *Meteoritics & Planetary Science* 51:351–371. [2] Ruzicka A. et al. (2017) *Meteoritics & Planetary Science* 52:1014. [3] Nishiizumi K. et al. (2016) *Annual Meteoritical Society Meeting* 79, Abstract #6514. [4] Grimberg A. et al. (2006) *Science* 314:1133–1135. [5] Eugster O. et al. (1992) *Proceedings of the NIPR Symposium on Antarctic Meteorites* 5:23–35. [6] Polnau E. and Eugster O. (1998) *Meteoritics & Planetary Science* 33:313–319.