GENETIC RELATIONSHIP BETWEEN MARTIAN CHASSIGNITES AND NAKHLITES REVEALED FROM NOBLE GASES. K. Nagao[1], J. Park[2,3,4], J. Choi[1], J. M. Baek[1], M. K. Haba[5], T. Mikouchi[6], M. E. Zolensky[7], G. F. Herzog[3], C. K. Park[1], J. I. Lee[1], and M. J. Lee[1], [1]Korea Polar Res. Inst. (KOPRI), Yeonsu-gu, Incheon 21990, Rep. of Korea (nagao@kopri.re.kr), [2]Kingsborough Comm. Coll., Brooklyn, NY 11235, USA, [3]Dept. Chem. & Chem. Biol., Rutgers Univ. of Piscataway, NJ 08854, USA, [4]Amer. Muse. of Natural History (AMNH), NY 10024, USA, [5]Dept. of Earth & Planet. Sci., Tokyo Inst. of Technology, Meguro-ku, Tokyo 152-8551, Japan, [6]Univ. Museum, Univ. of Tokyo, Tokyo 113-0033, Japan, [7]ARES, NASA Johnson Space Center, Houston, TX 77058, USA.

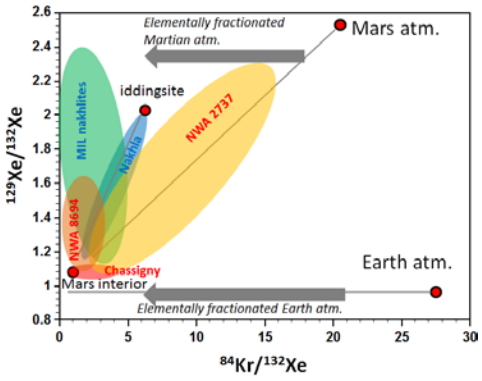
Introduction: A group called as Martian meteorites is composed of shergottites, nakhlites, chassignites, and orthopyroxenite, and they are thought to be derived from Mars. Among the Martian meteorites nakhlites and chassignites show similar cosmic-ray exposure (CRE) ages of 11-12 Ma, although petrologic characteristics are very different between them. Both nakhlites and chassignites indicate similar cooling rates, and would have cooled in identical scale of igneous bodies [e.g., 1, 2]. However, relationship between nakhlites and chassignites are still unclear, although they might have ejected at the same time, i.e., by accidentally coincidental impact events occurred at different places on Mars or by a single impact which excavated both nakhlites and chassignites resided in relatively small area. Here we propose that the chassignites show genetically close relationship with nakhlites, i.e., both groups could be located within a relatively narrow area from where a single impact could have launched those meteorites, based on noble gas data obtained in our laboratory. If chassignites were really ejected with nakhlites by a single impact, both types of meteorites will provide us with geological/petrological profile in the area where both pyroxene-rich lava (nakhlites) and dunite-rich rocks (chassignites) are located close to Martian surface.

Samples: Meteorites measured for noble gases, measured masses, and gas extraction methods (SH–stepwise heating, TM–total melting at 1800°C) are summarized.

Chassignites			Nakhlites				
Chassiny	NWA 2737	NWA 8694	Nakhla#	MIL 03346*	MIL 090030#	MIL 090032#	MIL 090136#
49.1 mg 8SH	109.3 mg 6SH	31.47 mg 9SH	126.4 mg 8SH	87.5 mg 15SH	43.7 mg 9SH	44.3 mg 9SH	49.0 mg 9SH
	221.9 mg 13SH	5.44 mg TM	13.6 mg TM	35.2 mg TM	4.75 mg 16SH	5.18 mg 17SH	5.16 mg 17SH
	210.7 mg 16SH						
	27.9 mg TM		* Reported in Nagao and Park (2008) [10]				
	26.3 mg TM		# Partly reported in Nagao et al. (2016) [11]				

Results and discussion: 1) Average CRE ages based on cosmogenic ^{3}He, ^{21}Ne and ^{38}Ar for nakhlites and chassignites calculated following the methods by [3, 4] are 11.5 ± 0.7 and 12.3 ± 3.6 Ma, respectively. The older age range with larger uncertainties for chassignites is mainly due to higher and lower ages yielded from ^{3}He and ^{38}Ar, respectively. It was already reported that ^{3}He yields consistently higher ages for Chassigny [5]. Both ages, however, overlap within experimental uncertainties, and also with most of ages reported [e.g., 5, 6, 7, 8].

2) In plot of ^{129}Xe/^{132}Xe versus ^{84}Kr/^{132}Xe (see figure) Martian meteorites are shown to contain several noble gas components of different origins, i.e., Martian interior (Chassigny), Martian atmosphere (Impact glasses in shergottites), elementally fractionated Martian atmosphere (aqueous altered minerals such as iddingsite), and elementally fractionated Earth atmospheric contamination. Our data for NWA 2737 plot along a mixing line between Martian interior and atmosphere, suggesting a presence of shock-implanted Martian atmosphere, consistent with the heavily shocked feature of this meteorite. The third chassignite NWA 8694 shows important trend suggesting a presence of both Chassigny-like and MIL-nakhlite-like noble gases. The characteristic trend for MIL is different from those for other nakhlites [9, 10, 11]. The similar trends observed for NWA 8694 and MIL nakhlites suggest that both rocks were affected by aqueous alteration under condition of extremely fractionated Martian atmospheric noble gases.



The identical CRE ages and characteristic noble gas compositions observed for both MIL nakhlites and NWA 8694 chassignite strongly support that both nakhlites and chassignites are launch-paired Martian meteorites.

References: [1] Mikouchi T. et al. (2017) *Ann. Meeting Meteorit. Soc.* Abst. #6109. [2] Mikouchi et al. (2006) *LPS XXXVII* Abst. #1865. [3] Eugster O. and Michel Th. (1995) *GCA* 59:177–199. [4] Welten K. et al. (1997) *Meteorit. Planet. Sci.* 32:891–902. [5] Ott U. (1988) *GCA* 52:1937–1948. [6] Okazaki R. et al. (2003) *Antarct. Meteorite Res. NIPR* 16:58–79. [7] Marty B. et al. (2006) *Meteorit. Planet. Sci.* 41:739–748. [8] Eugster O. (1997) *GCA* 61:2749–2757. [9] Murty S. V. S. et al. (2005) *LPS XXXVI* Abstract #1280. [10] Nagao K. and Park J. (2008) *LPS XXXIX* Abstract #1614. [11] Nagao K. et al. (2016) *Ann. Meeting Meteorit. Soc.* Abst. #6109.