REGOLITH HISTORY OF LUNAR METEORITES EET87521 AND YAMATO-793274; O. Eugster, Th. Michel, and S. Niedermann, Physikalisches Institut, University of Bern, Switzerland, and U. Krähenbühl, Anorganisch chemisches Institut, University of Bern, Switzerland.

We report first results of our noble gas and K analyses on samples from brecciated basaltic lunar meteorites EET87521 and Y-793274. Light matrix chip EET87521,38 (0.155g) and dark matrix chip EET87521,39 (0.322 g) were obtained from the NASA Planetary Materials Laboratory and split Y-793274,66 from the National Institute of Polar Research, Tokyo. We performed a large number of bulk and grain size analyses. The average values for bulk material are given in Tables 1 and 2.

Table 1 Cosmic-ray produced noble gases and cosmic ray exposure ages (preliminary data).

	^{21}Ne	^{38}Ar	^{126}Xe	$^{131}Xe/^{126}Xe$	T_{21}	T_{38}	T_{126}	T_{av}
	$10^{-8}cm^3STP/g$		$10^{-12}cm^3STP/g$		Ma (2π exposure)			
EET87521,38 light matrix	0.53 ±0.03	0.56 ±0.30	-	-	5.9 ±1.2	6.6 ±3.6	-	6.2
EET87521,39 dark matrix	0.32 ±0.02	0.58 ±0.20	*	*	3.6 ±0.7	6.8 ±2.4	*	5.2
Y-793274,66	38 ±4	72 ±20	36 ±6	4.8 ±1.2	320 ±70	550 ±160	470 ±140	450

Table 2 Trapped and radiogenic noble gases, K concentration and K-Ar age (preliminary data).

	Trapped solar wind noble gases								
	^{20}Ne	^{36}Ar	^{84}Kr	^{132}Xe	$^{20}Ne/^{22}Ne$	$^{40}Ar/^{36}Ar$	$^{40}Ar_r$	K ppm	K-Ar age Ma
EET87521,38	108 ±6	117 ±5	-	-	12.4 ±0.2	<2	1030	280 ±40	3300 ±250
EET87521,39	51 ±6	55 ±5	*	*	12.4 ±0.2		1460	330 ±70	3600 ±400
Y-793274,66	28500 ±4000	14000 ±3000	7.1 ±1.4	0.75 ±0.15	12.5 ±0.1	2.3 ±0.2	-	-	-

Noble gas concentration in units of 10^{-8} cm^3 STP/g. * In progress.

EET87521 experienced the lowest exposure to cosmic rays (6 Ma 2π exposure age) of any lunar meteorite analyzed till now. Among the lunar samples from the Apollo and Luna missions only South Ray crater rocks (Apollo 16) show lower cosmic ray exposure ages (2 Ma [1]). The ^{36}Cl activity in EET87521 is about 1 dpm/kg bulk [2]. Adopting a 4π saturation activity of 22 dpm/kg bulk and a terrestrial age of ≤600'000 years we calculate a moon-Earth transfer of ≤100'000 years and a duration of residence in the top meter of the lunar regolith immediately before ejection of ≤200'000 years. Therefore, most cosmic ray exposure must have occurred on the moon earlier in lunar history. From the K and radiogenic ^{40}Ar concentrations we calculate K-Ar ages of 3300 ± 250 Ma and 3600 ± 400 Ma for the two splits (Table 2). This is in the range of lunar mare basalts.

Y-793274 contains high concentrations of cosmogenic and solar wind noble gases. Adopting lunar surface production rates the duration of residence in the lunar regolith was about 450 Ma (Table 1). In terms of regolith exposure Y-793274 is a mature regolith breccia with $(^{20}Ne/^{22}Ne)_{tr}$ = 12.5 (Table 2), typical for lunar surface material. The $(^{40}Ar/^{36}Ar)_{tr}$ ratio of 2.3 indicates that solar wind particles were trapped early in lunar history.

Fig. 1 shows that $^{21}Ne_c$ and $^{36}Ar_{tr}$ of lunar meteorites are related. For ALHA81005, Y-791197, and Y-793274 the $^{21}Ne_c/^{36}Ar_{tr}$ ratios are about 0.002 (Fig. 2), quite similar to that of Luna 16 soil. EET87521 shows a slightly higher ratio of 0.005. These four lunar meteorites have low $(^{131}Xe/^{126}Xe)_c$ ratios, that is they experienced shallow shielding ($\leq$50g/cm^2) during cosmic ray exposure. For MAC88105 a ratio $(^{131}Xe/^{126}Xe)_c$ of 6.36 was measured, corresponding to 85 g/cm^2 shielding [3]. Consequently cosmic-ray produced noble gases are enriched relative to solar wind particles which are trapped only at the top of the lunar regolith, resulting in $^{21}Ne_c/^{36}Ar_{tr}$ = 0.092. For the paired meteorites Y-82192/3 and Y-86032 it had been shown that the material was exposed to cosmic rays mainly after the rock was ejected from the moon [4,5]. Its $^{21}Ne_c/^{36}Ar_{tr}$ ratio is 0.147. Solar wind particles are extremely rare in these samples.

Conclusions. From the same characteristics of the cosmogenic ^{21}Ne and solar wind ^{36}Ar inventory in ALHA81005, Y-791197, Y-793274, and EET87521 as found in lunar soil we conclude that these four lunar meteorites acquired not only the solar wind particles but also most of the stable cosmic-ray produced noble gases when the material was still in the form of surface soil on the moon, that is, before breccia formation. For EET87521 this pre-compaction exposure lasted about 6 Ma, for Y-793274 about 450 Ma. The moon-Earth transfer time for EET87521 was less than 100'000 years. Its K-Ar age is 3300 - 3600 Ma.

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References. [1] Arvidson R. et al., The Moon 13, 259-276 (1975). [2] Herzog G.F., pers. comm. (1990). [3] Eugster O. et al., Geochim. Cosmochim. Acta, in press (1990). [4] Nishiizumi K. et al., Abstr. 11th Symp. Antarctic Meteorites, Tokyo, Natl. Inst. Polar Res., 58-59 (1986). [5] Eugster O. et al., Proc. NIPR Symposium on Antarctic Meteorites, No. 2, 25-35 (1989).

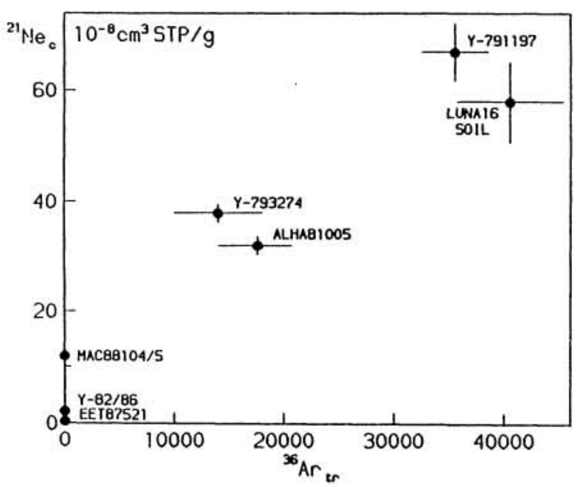

Fig. 1 Cosmic-ray produced ^{21}Ne vs. trapped solar wind ^{36}Ar in lunar meteorites and Luna 16 soil.

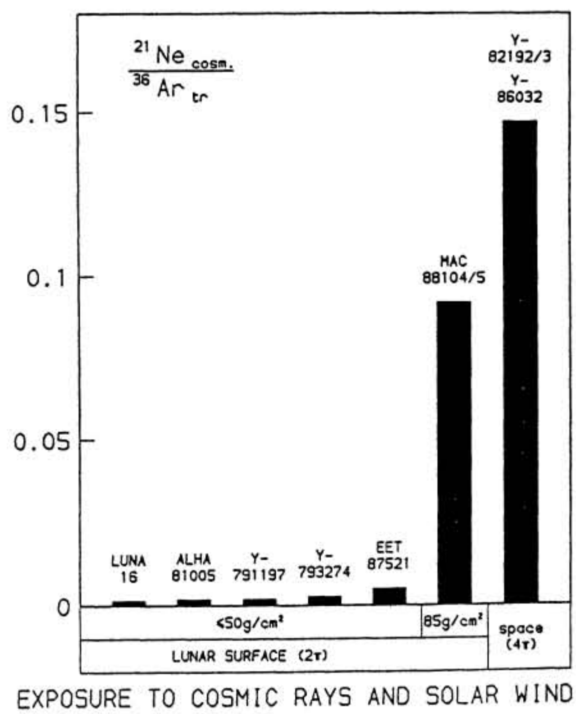

Fig. 2 Ratio of cosmic-ray produced ^{21}Ne to solar wind trapped ^{36}Ar in lunar meteorites and Luna 16 soil.