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RARE GAS ANALYSES ON NEUTRON IRRADIATED LUNAR SAMPLES;
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1. ^{40}Ar-^{39}Ar Dating: Gas retention ages have been measured using the ^{40}Ar-^{39}Ar method for a suite of Apollo 12 samples and from an Apollo 15 sample. The ages (in units of 10^9 yr) are:

Sample	This Work	Other Laboratories	
12002	3.29 ± .04 (± .06)	3.24 ± .05 [1]	
12020	3.20 ± .03 (± .06)		
12022	3.18 ± .04 (± .06)		
12051	3.32 ± .04 (± .06)	3.27 ± .05 [1]	
12065	3.23 ± .03 (± .06)	3.24 ± .05 [1]	
15555	3.33 ± .05	3.30 ± .05 [2]	3.22 ± .03 [3]

Our ages are relative to an assumed monitor age of 4.56 ± .05 b.y. for the St. Severin meteorite and were calculated using a ^{40}K mean life of 1.825 x 10^9 yr [4]. The first error listed is the relative error for comparing one sample to another. The second error is the absolute error and is for inter-laboratory comparison. Although the ages agree well with the ^{40}Ar-^{39}Ar ages obtained by other workers, they are not directly comparable because each laboratory is using different ^{40}K decay constants. For instance, for comparison to the ages obtained by Turner [1] our results should be systematically reduced by 0.03 b.y.

The Apollo 12 results support the observation [5] that small but real age differences exist within the Apollo 12 samples. The age of 15555, a basalt from the rim of Hadley Rille, corresponds to the older ages obtained for the Apollo 12 basalts. If 15555 is representative of the basalts filling Imbrium and if the Fra Mauro ages from Apollo 14 [6] date the formation of the Imbrium basin, then the basalts filling the basin postdate its formation by at least 500 m.y. Therefore, the basalts filling Imbrium cannot be simple impact melts but must represent some lunar igneous activity which occurred long after the basin was formed.

2. Trace Element Determinations: In conjunction with our ^{40}Ar-^{39}Ar dating program we analyze the krypton and xenon in the neutron irradiated lunar samples. Elemental abundances can be determined for those elements (Se, Br, I, Te-Ba, U) which produce isotopes of krypton and xenon in the reactor. We have previously shown that the retention of gaseous neutron capture products by the

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samples varies widely for different elements. For instance, ^{128}Xe from ^{127}I is very loosely bound while ^{131}Xe from ^{130}Ba is tightly bound. The Apollo 12 and 14 samples were irradiated in evacuated quartz "break seal" capsules. We were able to measure all of the neutron produced isotopes including the low temperature fractions which had been lost in previous experiments. In addition to trace element determinations, we also were able to check for any ^{40}Ar or ^{39}Ar which might have been lost from the samples during the irradiation.

The following preliminary data have been obtained for Apollo 12 samples:

Sample	Temp. °C	[Br] ppb	[Ba] ppm	[I] ppb	[U] ppb
12002	80	96 ± 23	0.08 ± .02	52.0 ± 7.8	0.8 ± 0.3
	350	20.2 ± 3.6	< .03	1.9 ± 0.3	< 1.0
	1730	11.7 ± 1.9	47.6 ± 5.7	0.6 ± 0.1	174 ± 21
	Total	127 ± 23	47.8 ± 5.7	54.5 ± 7.8	176 ± 21
12020	80	111 ± 20	0.18 ± .02	30.1 ± 4.3	< 1.6
	350	5.1 ± 1.1	< .04	0.8 ± 0.2	< 0.6
	1730	5.7 ± 0.9	45.4 ± 5.4	0.4 ± 0.2	168 ± 21
	Total	121 ± 20	45.7 ± 5.4	31.3 ± 4.3	170 ± 21
12022	80	35 ± 17	0.17 ± .02	69.0 ± 9.4	< 0.9
	350	6.1 ± 1.8	< 0.2	3.2 ± 0.4	< 4.0
	1730	7.6 ± 1.2	57.6 ± 6.9	0.4 ± .2	204. ± 25
	Total	48 ± 17	58.0 ± 6.9	72.6 ± 9.4	209. ± 26
12051	80	104 ± 24	.08 ± .02	14.6 ± 5.1	0.3 ± 0.1
	350	27.6 ± 4.7	.03 ± .02	1.0 ± 0.3	< 1.5
	1730	14.0 ± 2.2	69.5 ± 8.3	0.7 ± 0.1	245 ± 30
	Total	146 ± 25	69.6 ± 8.3	16.3 ± 5.1	247 ± 30
12065	80	*	*	*	*
	350	∿8.7 ± 1.8	< .03	∿0.4 ± 0.2	< 1.2
	1730	8.3 ± 1.3	51.1 ± 6.1	0.5 ± 0.1	201 ± 24
	Total	*	51.2 ± 6.1	*	203 ± 24

*The 80^{o} fraction of 12065 was lost because the "break seal" apparently was not gas tight. Some of the 350^{o} fraction may have been lost also.

The Ba and U concentrations agree well with the values published by several other groups. The I and Br values compare well with those of Reed and Jovanovic [7] for the one rock where comparison is possible. Our bromine values are systematically high than those obtained by Anders et al. [8].

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The trace elements correlate with the ^{40}Ar-^{39}Ar ages. The oldest rock 12051, has the highest Br, Ba and U contents and the lowest I content. The youngest rock, 12022, has the lowest Br content and the highest I content. The older basalts at the Apollo 12 site were enriched in the refractory elements Ba and U and depleted in the volatile element I relative to the younger basalts. Br correlates with Ba and U rather than I.

Loss of ^{40}Ar was not significant for the Apollo 12 samples. No useful information was obtained on Se or Te concentrations.

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