POTASSIUM-ARGON ANALYSIS OF APOLLO 11 REGOLITH, Jeffrey R. Basford, Department of Physics, University of Minnesota, Minneapolis, MN 55455

Regolithic history of Mare Tranquillitatis has been studied using rare gas mass spectrometric and mineralogical techniques. Grain size-ordinate intercept analysis was applied to both ilmenite and plagioclase separates and to bulk soil from the <1 mm fines sample 10084,48. Although all the rare gases were examined only argon and associated K data will be discussed here.

From the data (Table 1) and the following discussion it appears that this Apollo 11 soil consists primarily of two components. The first, locally derived, forms 65-75% of the present day regolith and shows that a major outgassing event occurred approximately 2.8 AE ago (1 AE = 10^9 yr). The second component derived from lunar terra regions and contributes the remaining 25-35% of the soil. It exhibits a K-Ar age of 4.0± 0.2 AE which predates the total soil age (Table 1) as well as the Apollo 11 basalts.

It is known that the Apollo 11 rocks and soils are rich in titanium and hence ilmenite. The terra regions on the other hand are rich in anorthosite and poor in ilmenite. Assuming representative values of Apollo 11 rocks and Apollo 16 rocks and soils as end point contributions, chemical balances of the major metal oxides (e.g. Al_2O_3, FeO, TiO_2) consistently yield the 70-30 split noted above.

Fig. 2 shows the K-Ar isochron for six ilmenite size fractions between 4 and 147 microns. (In this method of plotting the slope yields directly the ratio of ($^{40}Ar_{radiogenic}$)/K and therefore the age.) The data closely follow the 2.8 AE best fit isochron with the single exception of a (not shown) coarser fraction which falls below the isochron and indicates a younger K-Ar age. Although not very noticeable in the figure there may be a slight tendency for the finer fractions to rise above the isochron. In Fig. 1 the plagioclase data from eight size fractions between 4 and 250 microns are plotted. Here, except for a coarser fraction which also appears young, the data scatters randomly around a best fit isochron near 4.0 AE. As is seen from the table the bulk soil has an age intermediate to these two components.

These results are interpreted to mean that there was a major regolith-forming event(s) in the Mare about 2.8 AE ago which produced the bulk of the soil now seen at the Apollo 11 site. The possible tendency noted for the finer size fractions of ilmenite to increase in age towards the total soil age may be due to the presence of older ilmenite grains which escaped heavy outgassing in this event and have been concentrated in the finer fractions by progressive comminution. The plagioclase fraction is viewed as (a) recording events which occurred in the lunar terra about 4.0 AE ago and (b) having been transported to its present position in the Mare with minimal loss of radiogenic argon. Perhaps, with the high retentivity of plagioclase for radiogenic argon (1-3) and the fact that there exist highland regions less than 50 km from the Apollo 11 site, transportation with low gas loss is not a difficult problem.

The surface correlated trapped argon isotopic ratios are also of interest

APOLLO 11 K-AR ANALYSIS

Basford, J. R.

(Table 1). Within the limits of experimental error the trapped 38/36 ratio is constant at 0.1890 for all components. The trapped 40/36 ratios, however, vary. The ilmenite and the soil values of 0.677 and 0.89 agree with earlier work on 10084 (4). The plagioclase trapped 40/36 value shows a large(~5%) scatter around 0.90. As would be expected the proposed locally derived ilmenite has a well defined ratio while the postulated older and more heterogeneous plagioclase has a less precise (and also higher) value. Whether these differences are due to mineralogical, geographical or secular variations remains an interesting problem.

REFERENCES

1. Eberhardt P.,Geiss J., Grögler N., Krähenbühl U. and Mörgeli M.(1971) Earth Planet. Sci. Lett. 11, pp. 245-247.
2. Murthy V.R.,Evensen N.M., Jahn B., Coscio M.R., Dragon J.C. and Pepin R.O.(1972) Science 175, pp 419-421.
3. Turner G., Huneke J.C., Podosek F.A. and Wasserburg G.J.(1972) Proc. Third Lunar Sci. Conf., Geochim. et Cosmochim. Acta Suppl. 3, Vol. 2, pp. 1589-1612. MIT Press.
4. Eberhardt P., Geiss J., Graf H., Grögler N., Krählenbühl U., Schwaller H., Schwarzmüller J. and Stettler A.(1970) Proc. Apollo 11 Lunar Sci. Conf., Geochim. et Cosmochim. Acta, Suppl. 1, Vol. 2, pp. 1037-1070. Pergamon.

Table 1

Component	K-Ar Age (AE)	$(40/36)_{TR}$	$(38/36)_{TR}$
Ilmenite	2.80 ±.12	0.6773±0.0062	0.18858 ±0.00043
Total Soil	3.40 ±.12	0.893 ±0.011	0.18951 ±0.00043
Plagioclase	4.00 ±.15	0.90~ ±0.05	0.18837 ±0.00067

APOLLO 11 K-AR ANALYSIS

Basford, J. R.

FIG. 1

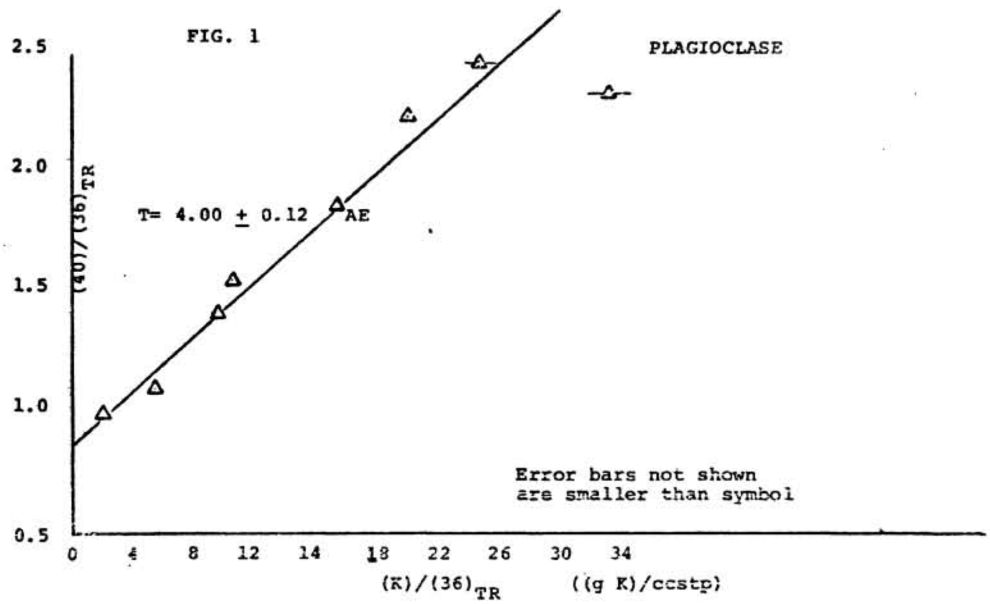

FIG. 2