

APOLLO 11 REVISITED: NEW DETERMINATIONS OF RADIONUCLIDE CONTENTS OF APOLLO 11 SAMPLES, J. E. Keith and L. J. Bennett, NASA Johnson Space Center, Houston, TX 77058.

The primordial radionuclide contents of 10 Apollo 11 samples have been determined by non-destructive gamma ray spectrometry at the Radiation Counting Laboratory. The gamma ray spectrometer and the data reduction techniques used at the Radiation Counting Laboratory have been discussed previously (1). Of these 10 measurements, all involving counting times between 10,000 and 20,000 minutes, 4 were redeterminations of 3 rocks previously measured -- 10003, 10019 and 10057. Although the redeterminations involved much longer counting times than were possible during the original examination of Apollo 11 samples, no major discrepancies were found with those measurements. Six samples whose gamma ray spectra had not previously been measured -- 4 breccias, 10046, 10048, 10060 and 10061, and one high-K basalt, 10024, and one low-K basalt, 10045, were measured.

Figure 1 shows the K contents of all Apollo 11 samples that have been determined by gamma ray spectrometry as a function of their U contents. Similar results have been obtained by small (<0.1 g) sample methods (see 2 and references therein). All the results shown in Figure 1 relate to samples weighing at least tens of grams, so that sampling errors should not be significant, even in the case of the breccias. One can see that the K concentration shows a linear dependence on the U concentration. Compared to other missions, the groupings seem extraordinarily simple and tight; the low-K and high-K basalts form two small groups at the ends of the trend line and the breccias form a somewhat more elongated region between them, with the fines at the low-K end. As observed by Tera et al. (2) the same sort of dependence is displayed by Rb, Cs, Ba and U vs K (see also, Goles et al., 3). In each case the breccias lie between the high- and low-K basalts and slightly to the K-poor side of the mixing line. Hence it is not possible to make the breccias from mixtures of the present-day fines and the high-K basalts alone, even though these are the major constituents (3,4). Even though the K, Rb, Cs, Ba, U and Th are all found principally in the interstitial phases (2,5,6), only the K displays this behavior in the breccias. The plot of the Th content vs U content shows a linear dependence of Th on U. In this plot the low-K basalts, the high-K basalts and the breccias have the same positions relative to each other that they have in Figure 1, except that the breccias do not display a systematic deviation from the regression line. The slope of this line is about 3.9 and it has an insignificant Th intercept (7). The addition of the new data changed this dependence very little.

In Figure 2 we show the K contents of all lunar samples as a function of the U content for each mission. The line segments represent the least-squares fit of the data (7) and the end points of the lines lie near the extremes of the data. The low-K Apollo 11 basalts lie in the same region as low-K samples from other missions. As can be readily seen, the high-K basalts are anomalously enriched compared to all other lunar samples.

#### REFERENCES:

1. Clark R.S. and Keith J.E. (1973) Proc. Lunar Sci. Conf. 4th, p. 2105-2113.

## APOLLO 11 REVISITED

Keith J. E. and Bennett L. J.

2. Tera F. et al. (1970) Proc. Apollo 11 Lunar Sci. Conf., p. 1637-1657.
3. McKay D.S. and Morrison D.A. (1971) J. Geophys. Res. 76, p. 5658-5669.
4. Gales G.G. et al. (1970) Proc. Apollo 11 Lunar Sci. Conf., p. 1177-1194.
5. Albee A.L. and Chodos A.A. (1970) Proc. Apollo 11 Lunar Sci. Conf., p. 135-157.
6. Philpotts J.A. and Schnetzler C.C. (1970) Science 167, p. 493-495.
7. Keith J.E. et al. (1974) Proc. Lunar Sci. Conf. 5th, p. 2121-2138.
8. O'Kelley G.D. et al. (1970) Proc. Apollo 11 Lunar Sci. Conf., p. 1407-1423.
9. Perkins R.W. et al. (1970) Proc. Apollo 11 Lunar Sci. Conf., p. 1455-1471.
10. York D. (1966) Can. J. Phys. 44, p. 1079-1086.

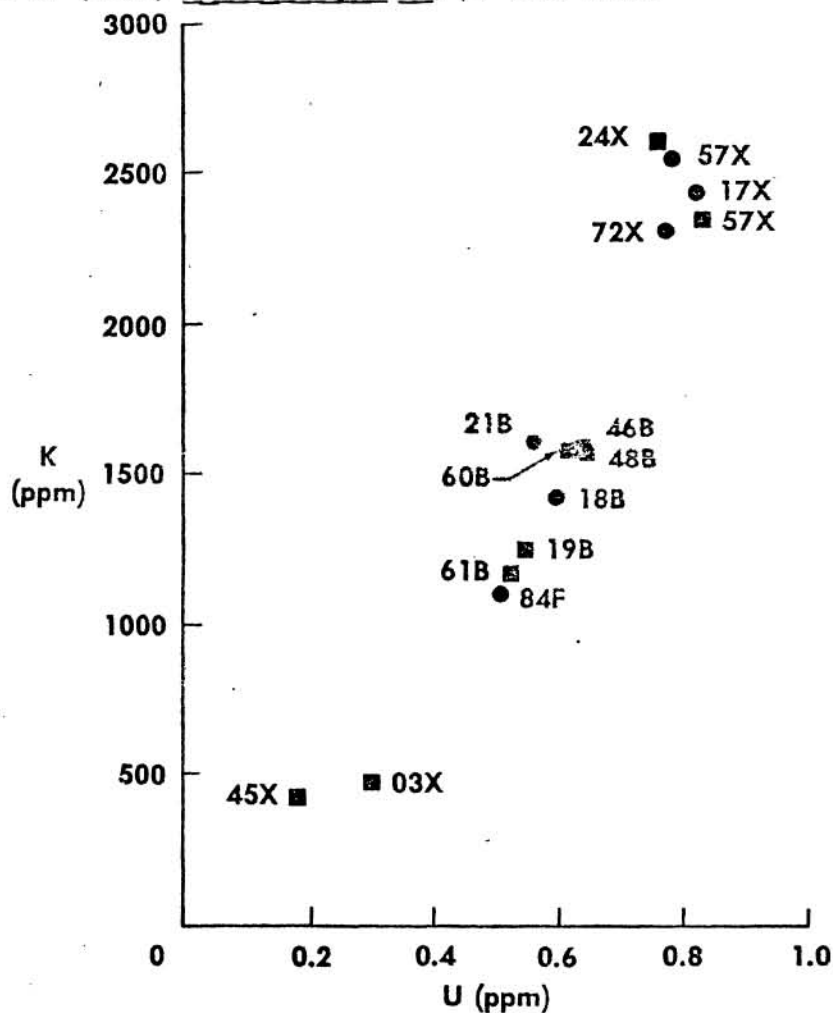


Figure 1. Apollo 11, K vs. U. All nondestructive gamma ray results (8, 9 and this work) known to us are shown. Where more than one measurement was made on a sample, the results were averaged. All results from this work are shown as squares, all others as circles. The numbers next to the symbols denote the sample numbers; 17 = 10017, X = crystalline, B = breccia, F = fines.

## APOLLO 11 REVISITED

Keith J.E. and Bennett L.J.

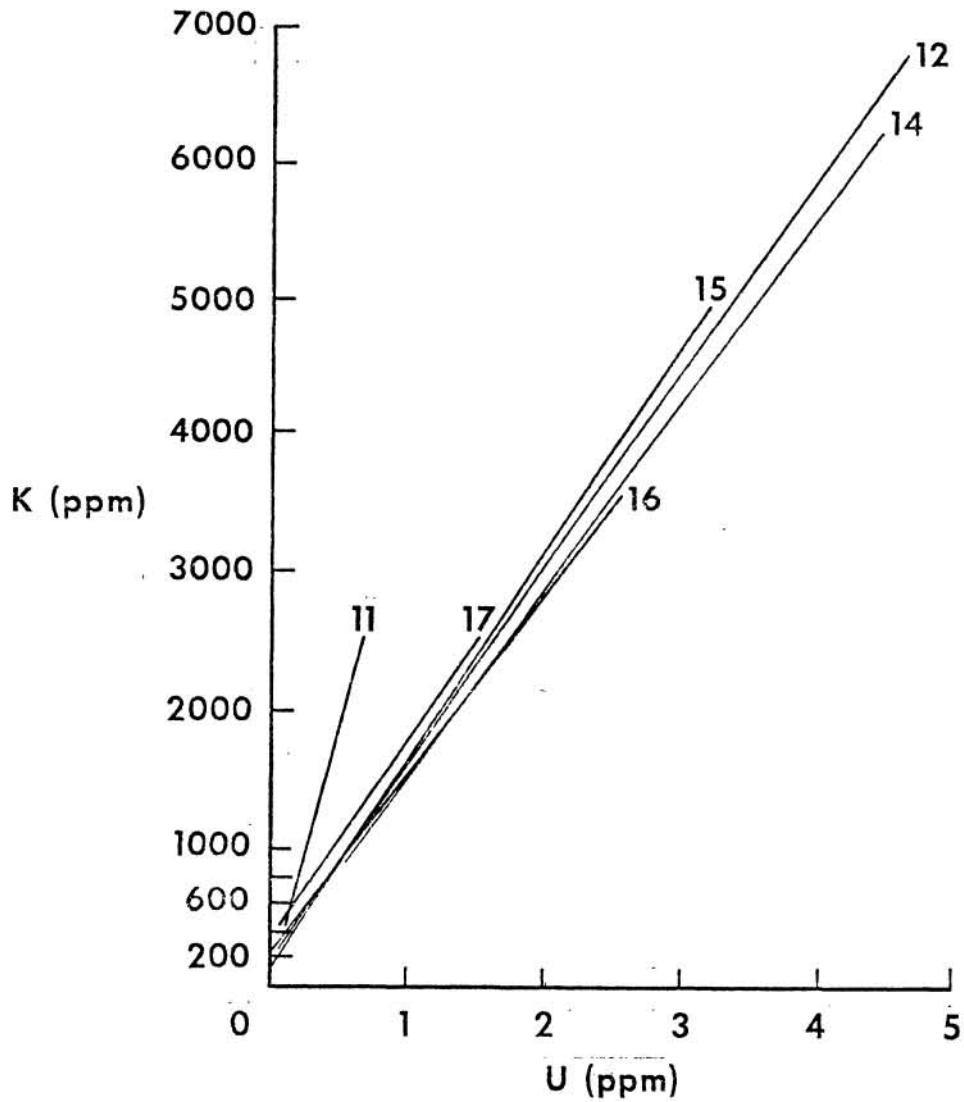


Figure 2. All missions, K vs. U. Each line segment represents the regression of K on U by the method of York (10). The ends of the line segments lie near the extremes of the data used to derive them.