K AND U SYSTEMATICS AND AVERAGE CONCENTRATIONS ON THE MOON. Ernest Schonfeld, NASA Johnson Space Center, Houston, TX 77058.

Concentrations of K, U, and Th from many missions (1,2,3) were summarized. The K-U systematics are shown in figures 1, 2, and 3. There are several observations one can make: A) The Th/U ratio for the majority of the lunar samples is 3.8 $\pm$ 0.2. The exceptions are granite 12013 that has a Th/U ratio of 3.3 (1) and the Apollo 17 mare basalts have a Th/U ratio of 3.2 (3). B) The majority of the soils and breccias (exceptions are those of Apollo 11 and Luna 16 samples) follow a K:U trend-line (figure 1) between the mare basalts and KREEP suggesting simple mixtures between those 2 components. There are problems with this simple approach since new rock types have been found such as low K Fra Mauro basalt (4), VHA basalt (5), KREEPy 16 (average of 65015, 60315, and 62235), and KREEPy 17 (noritic breccia from Apollo 17 (3)) that have rather similar K/U ratios to KREEP and fall on the trend line in figure 1. Therefore based only on the K-U systematics it is difficult to determine the component abundance in the soils and a multicomponent and multielement mixing model analysis is required (6,7). C) The Apollo 11 soil and breccias follow a different trend line between the high and low K mare basalts from Apollo 11. Mixing models calculations using many components and elements, show that there are other components present such as an "anorthositic" and KREEP components (6). This mixing line has a negative intercept in the K axis that does not have any geochemical significance since it is a mixing line.

Comparison with other element systematics. The K-U systematics of lunar samples are important in understanding the processes by which the moon was formed and evolved (8). The K/U ratio in lunar samples is rather constant when compared with ratios found in the earth and meteorites (figure 3). Recently, other similar pairs of volatile-refractory systematics have been developed showing also relative constancy of the ratio of large-ion lithophile trace-elements such as K-La (9), K-Ba, K-Zr (10). These and the K-Sm systematics for lunar samples are compared in figure 2 for a variety of rock types. This figure shows that in all cases the ratios for these pairs is much smaller than the value found in chondrites suggesting enrichment of refractory elements and depletion of volatile elements on the moon (8). These ratios are rather constant but there is a "fine" structure or small degree of variability in ratios.

K and U concentrations of the average upper mantle of the moon. Of the 2 trend lines in figure 3 one is the meteoritic trend line and the other is the approximately constant K/U line for the Moon (average about 2500). Assuming that the bulk composition of that part of the moon where most of the lunar samples were derived had K and U concentrations that follow the meteoritic trend line, then the intersection of those 2 trend lines would give the K and U concentrations of the upper mantle of the moon or that part of the moon where most lunar samples were derived. That intersection for a K/U ratio of 2500 is 220 ppm K and 85 ppb U. The U concentration agrees with the value calculated by Wänke (9) using a different approach. For K/U ratios of 1500 and 3500 the calculated U values are 110 and 70 ppb respectively. There could therefore be a small degree of original heterogeneity in the moon, consistent with the "fine" structure shown before in other systematics (K-Ba, K-Zr, K-Sm and K-La). The above value of the concentration of U can be compared with the

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U concentration estimated for the moon from the heat flow experiment in the Apollo 15 and 17 sites (11), that corresponds to about 75 ppb of U (assuming uniform distribution of U, K/U=2500 and Th/U=3.8), suggesting that not only the upper mantle but probably a large part of the moon, on the average, is enriched about 7 times in U with respect to chondrites.

References (1) O'Kelley et al. Proc. Lunar Science Conf. Apollo 11, 12, 14,15, 16 (1970-73). (2) Lunar sample catalog Apollo 16, MSC-03210 (1972) (3) Lunar sample catalog. Apollo 17, MSC-03211 (1973). (4) A.M. Reid et al., Meteoritics 7, 395 (1972). (5) N.J. Hubbard et al. Science 181, 339 (1973). (6) E. Schonfeld and C. Meyer, Jr. GCA, Suppl 3, Vol. 2, 1397 (1972).(7) E. Schonfeld(this volume). (8) P.W. Gast, The Moon 5, 121 (1972). (9) H. Wänke et al. GCA, Suppl 4, Vol. 2, 1461 (1972).(10) A.R. Duncan et al. GCA, Suppl. 4, Vol. 2, 1097 (1972). (11) M.G. Langseth et al., Lunar Science IV, 455 (1973).

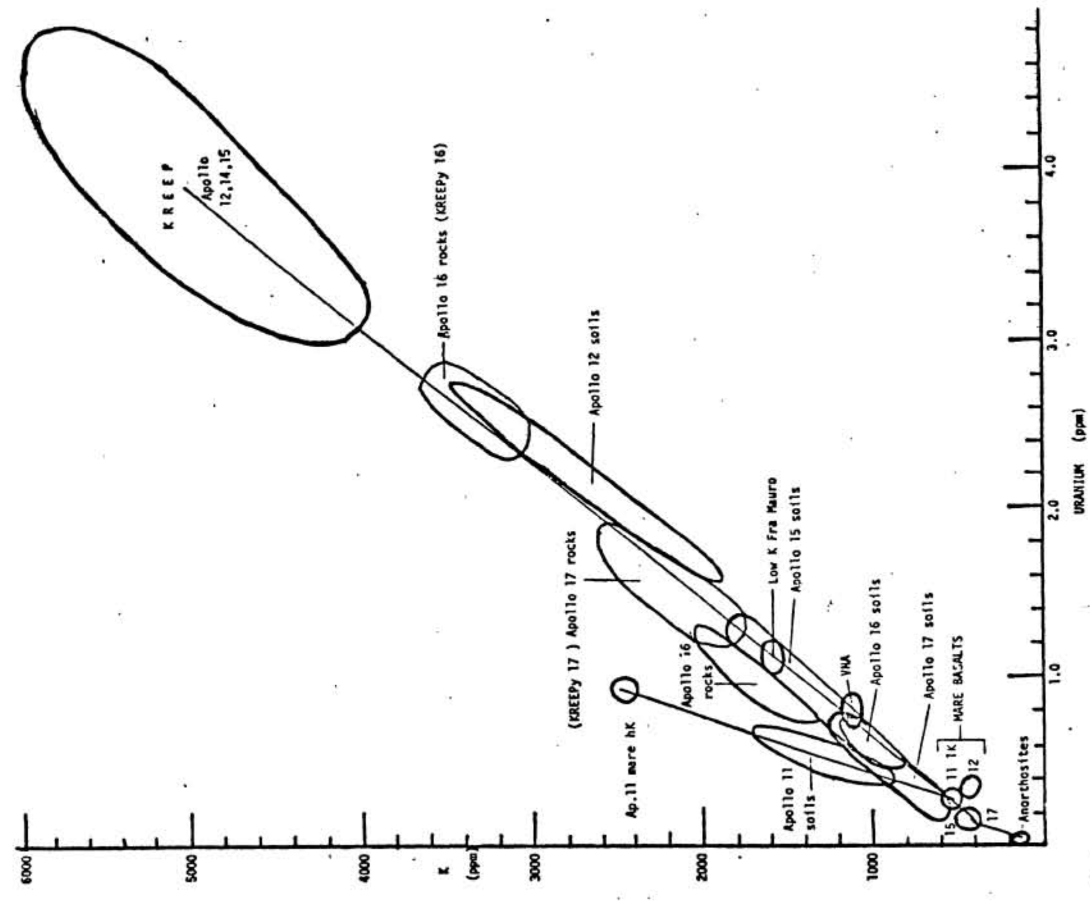

FIGURE 1. K-U SYSTEMATICS OF LUNAR SAMPLES

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K AND U SYSTEMATICS

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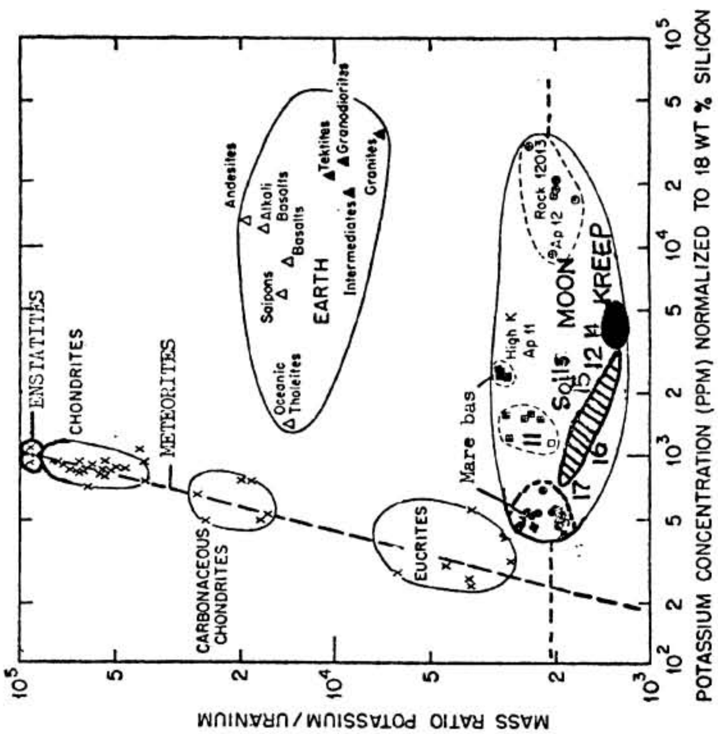

Figure 3

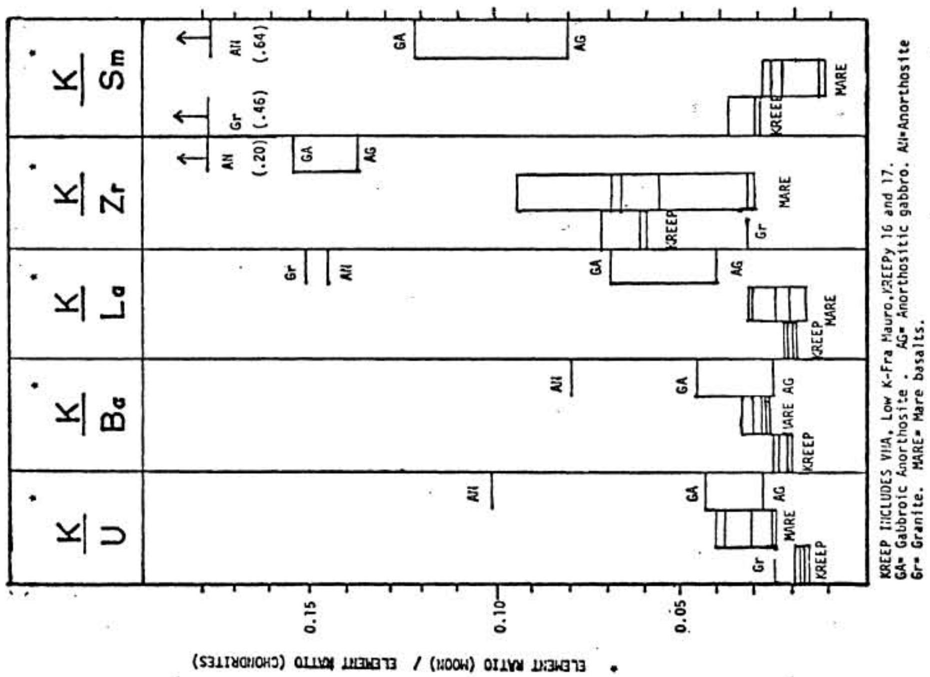

Figure 2

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