Rb-Sr AGE OF THE LARGE MARE BASALT CLAST IN BRECCIA 15459. L. Nyquist[1], H. Wiesmann[2], B. Bansal[2], C.-Y. Shih[2] ([1]SN4, NASA Johnson Space Center, Houston, TX, 77058; [2]Lockheed, 2400 NASA Rd. 1, Houston, TX, 77058).

An internal Rb-Sr isochron has been determined for sample 15459,350 from the large mare basalt clast in breccia 15459 as part of a consortium study led by M. Lindstrom (1). Ridley (2) described this and similar clasts as mare gabbros and concluded that they could be chemically and texturally interpreted as the slowly-cooled equivalents of the olivine-normative mare basalts. Ridley (2) also observed that a group of low-Ti mare glasses in the matrix of 15459 are equivalent to the most magnesian olivine-normative Apollo 15 basalts, but found no matrix glasses equivalent to the quartz-normative mare basalts. REE abundances of subsample 15459,31 were measured by mass spectrometry and found to be nearly identical to those of olivine-normative 15545,13 except for significantly lower Eu abundances (3). REE patterns for four other subsamples of the clast overlap those of other Apollo 15 basalts, whereas major element abundances are similar to those of ultramafic basalt 15385 (2,3). Interestingly, basalt 15385 has a unique REE abundance pattern (3) which makes its association with the 15459 clasts tenuous. Thus, although the 15459 clast has an olivine-normative basaltic composition and is apparently from a provenance composed predominately of such basalts, its relation to other olivine-normative Apollo 15 basalts is unclear.

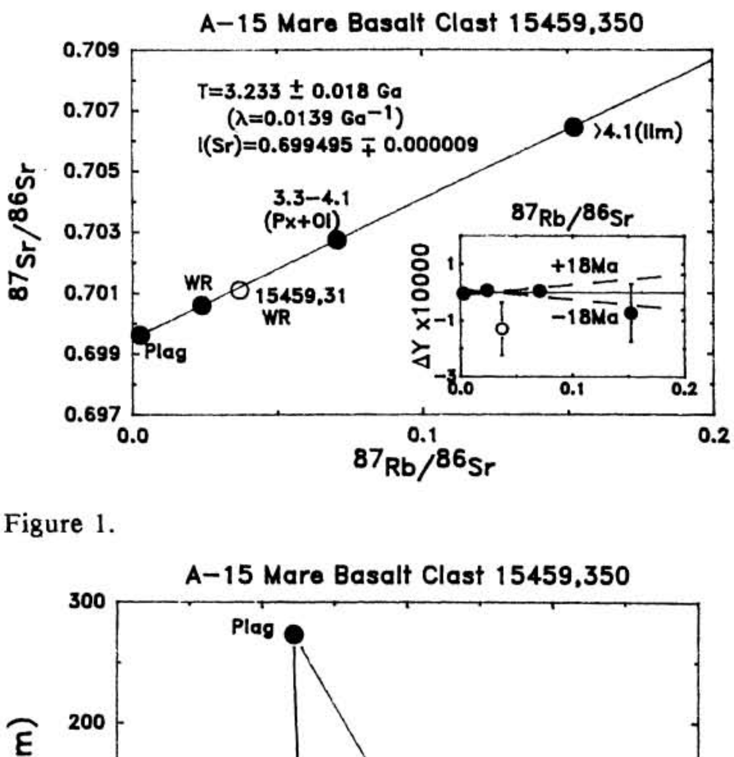

Figure 1.

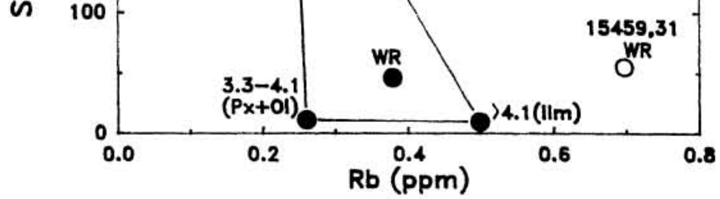

Figure 2.

Rb-Sr data for subsample 15459,350 are shown in Figure 1. Plagioclase was obtained by magnetic separation, the other minerals by heavy liquids. Analytical uncertainties in $^{87}Sr/^{86}Sr$ were 15-20 ppm except for the ilmenite. An earlier analysis of the clast, 15459,31 (5), is shown for comparison with the new data. The isochron age is determined by the data for the three lowest, most precise, points which, when regressed separately by the York (1966) method, (6) give T= 3.240$\pm$0.011 Ga ($\lambda(^{87}Rb)$ = 0.0139 Ga^{-1}) and I = 0.699493$\pm$5. The addition of the ilmenite data changes the regression only slightly to T = 3.233$\pm$0.018 Ga, I=0.699495$\pm$9. The Williamson (7) regression gives identical results except that the error limits are increased to $\pm$0.000015 for the initial ratio and $\pm$0.028 and $\pm$0.030 Ga for the three lowest data points and for all four data points, respectively. Deviations from the isochron determined by all the data are shown in the inset. Error limits for the three data points with the lowest Rb/Sr ratios are contained within the symbols. The quoted error limits include statistical uncertainties only and do not contain an additional ca. 0.5% uncertainty in the Rb/Sr ratio of the mixed spike and a comparable uncertainty due to

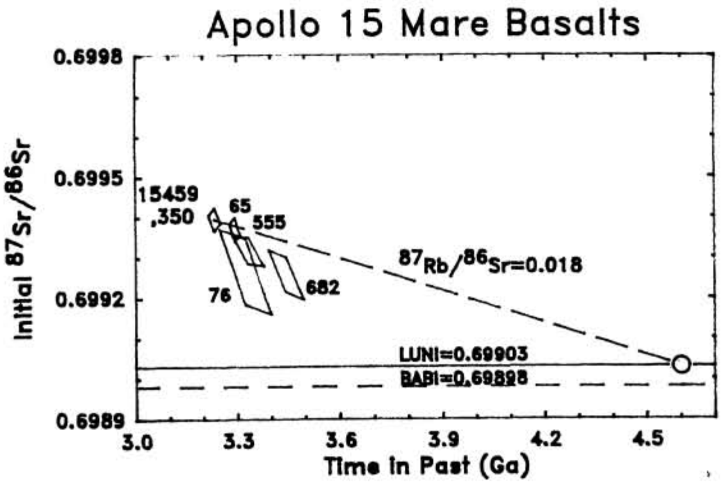

Figure 3.

isotopic fractionation of $^{87}Rb/^{85}Rb$.

Figure 2. shows Rb and Sr concentrations and demonstrates that the isochron is not simply a mixing line because no three points are collinear. The Rb concentration measured in the earlier analysis (5) was nearly twice as high as measured in this investigation, showing sample heterogeneity which is also evident in the trace element data of Lindstrom (1). However, the low Sr concentration of 55 ppm is reproduced.

Figure 3 shows the (T,I) parameters of 15459,31 in comparison with those of four Apollo 15 basalts analyzed by the Caltech group (8). I(Sr) for 15459, 350 has been adjusted downward by 0.00010 to account for differences in the measurement of the NBS 987 Sr standard.

The ^{39}Ar-^{40}Ar Age of clast sample 15459,32 was given as 3.33±0.06 Ga by Stettler et al. (9), apparently older than the Rb-Sr age. As shown in Figure 3, the (T,I) parameters of 15459,350 suggest an age which is marginally older than that of 15076. Stettler et al. (9) report an age of 3.35±0.04 Ga for 15076, nearly identical to that of the 15459 clast. However, the 15459,32 age spectrum lies lower than that for 15076 at all temperatures and shows a pronounced fall-off at high temperatures. The total Ar age of 15459,32 is 3.20 Ga in comparison to 3.34 Ga for 15076. The Rb-Sr and K-Ar data are in qualitative agreement in that both suggest that the 15459 basalt clast is slightly younger than 15076 and most other Apollo 15 basalts as well. Rb-Sr data show that there has been no significant disturbance of the Rb-Sr system. Correcting the ^{39}Ar-^{40}Ar ages for the new decay constants (10) gives ages of 3.29±0.06 Ga and 3.31±0.04 Ga for 15459,32 and 15076, respectively. Considering maximum error limits and various choices of the ^{87}Rb decay constant gives 3.23±0.04 Ga, 3.17±0.04 Ga, and 3.21±0.04 Ga for 15459,350 for $\lambda(^{87}Rb) = 0.0139\ Ga^{-1}$, $\lambda(^{87}Rb) = 0.0142\ Ga^{-1}$, and $\lambda(^{87}Rb) = 0.01402\ Ga^{-1}$, respectively. The last value gives a 4.56±0.05 Ga Rb-Sr age for the pristine eucrite Y75011,84 (12). The Rb-Sr and ^{39}Ar-^{40}Ar ages agree within error limits except for $\lambda(^{87}Rb) = 0.0142\ Ga^{-1}$. For 15076 the Rb-Sr data (8) give ages of 3.33, 3.26, and 3.30±0.08 Ga, respectively, for the above decay constants. Thus, we do not consider the apparent difference between the Rb-Sr and the ^{39}Ar-^{40}Ar ages of the 15459 basalt clast to be significant.

The 15459 basalt clast has perhaps the youngest age and highest I of the A15 basalts. As yet, there are no distinct groupings among the (T,I) parameters of the Apollo 15 basalts. The (T,I) parameters of the 15459 clast and those of quartz-normative 15065 are very similar and suggest the possibility that they came from the same source region, but if so, they do not appear to be comagmatic because the differences in bulk chemical composition of the olivine-normative and quartz-normative mare basalts cannot be explained by near surface crystal fractionation (4). The time averaged $^{87}Rb/^{86}Sr \sim 0.02$ in the source region(s) of the 15459 basalt clast and 15065 appears to be higher than for the source region(s) of 15076 and 15682. If, as we have argued (11), the bulk moon $^{87}Rb/^{86}Sr \sim 0.05$, the source region of the 15459 basalt clast was depleted in Rb/Sr during formation.

REFERENCES: (1) Lindstrom M. (1986) LPS XVII, 486-487. (2) Ridley W. I. (1977) Phil. Trans. R. Soc. Lond. A 285, 105-114. (3) Wiesmann H. and Hubbard N. J. (1975) A compilation of the lunar sample data generated by the Gast, Nyquist and Hubbard PI-ships, unpublished. (4) Rhodes J. M. and Hubbard N. J. (1973) PLSC 4, 1127-1148. (5) Nyquist L. E. et al. (1973) PLSC 4, 1823-1846. (6) York D. (1966) Can. J. Phys. 44, 1079-1086. (7) Williamson J. H. (1968) Can. J. Phys, 46, 1846-1847. (8) Papanastassiou D. A. and Wasserburg G. J. (1973) EPSL 17, 324-337. (9) Stettler A. et al. (1973) PLSC 4, 1865-1888. (10) Steiger R. and Jaeger E. (1977) EPSL 36, 359-362. (11) Nyquist L. E. et al. (1977) PLSC 8, 1383-1415. (12) Nyquist L. E. et al. (1986) JGR, 91, 8137-8150.