

15445 AND 15455: ORIGIN AND PRELIMINARY AGE DATA.

M.L. Bernstein, Dept. of Earth and Space Sciences, State Univ. of N.Y., Stony Brook, NY 11794

Introduction 15445 and 15455 may be crystalline melt breccias produced during the Imbrium event (1). The purpose of this study is to examine this premise and to try to date the impact using the laser-argon and stepwise-release techniques. A previous attempt by (2) was unsatisfactory, as it did not produce an adequate plateau.

Impact melt origin The evidence for an impact melt origin of 15445 and 15455 is as follows: 1) The clasts incorporated in the matrix are extensively shocked while the matrix is not. 2) The matrix shows siderophile element contamination (3,4), but the clasts are pristine (5,6). 3) The clasts are much older than the matrix (4.4-4.5 vs. 3.9 b.y.) (2,7,8,9). 4) The olivine-plagioclase microcrystalline texture of the matrix has been replicated by dynamic crystallization runs for a LKFM composition, with cooling rates on the order of $25^{\circ}\text{C hr}^{-1}$ (10). This is consistent with the two-stage cooling model for fragment-laden impact melts (11).

Crater or basin? 15445 and 15455 must have been derived from a multi-ring basin because only that could have excavated to the depths indicated by the following: 1) No basalt, KREEP, regolith or other clasts of surface origin have been found. Norite, troctolite and spinel troctolite are most abundant. 2) Determination of the forsterite + cordierite = enstatite + spinel solid-solid reaction boundary in the $\text{MgO-Al}_2\text{O}_3\text{-SiO}_2$ system by (12) requires a minimum depth of 26 km for the stability of the 15445 spinel troctolite assemblage. This eliminates local craters such as Aristillus, Autolycus and Archimedes as possible sources since they did not excavate deeper than 10 km (13).

Siderophiles The data of (14) seem to imply a link between 15445 and 15455 and Imbrium. However, the objections of (15) require that the question of distinctive Imbrium and Serenitatis signatures be examined without the benefit of Au, Ni or Ge data. An inspection of Ir, Re, Os and Pd data for Apollo 14 and 15 (most likely to be associated with Imbrium) and Apollo 17 (most likely Serenitatis) shows no such relationship (Figs. 1 and 2). This is especially apparent in the Ir-Re-Os plot (fig. 1) where normalized abundances for bulk breccias and breccia matrices from the various sites all cluster together near the center of the graph.

Ages Preliminary laser probe $^{40}\text{Ar}\text{-}^{39}\text{Ar}$ data indicate a matrix age for 15455 of about $3.90 \pm .25$ b.y. Unfortunately low signal to blank ratios prevented greater accuracy. There is also a suggestion of incomplete degassing of plagioclase clasts. Early returns for the 15445 stepwise release data show a disturbed pattern exhibiting no real plateau, with a drop-off at 1100°C , similar to that obtained for 15455 by (2). A weighted average gives an age of $3.76 \pm .09$ b.y. Calculated ^{38}Ar exposure ages for 15445 and

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15455 are 220 and 190 m.y. respectively.

Conclusions 1) 15445 and 15455 are crystalline melt breccias produced by either the Imbrium or Serenitatis events. 2) The siderophile data and our knowledge of the lithologies present in the Apennine Front are inadequate for us to distinguish between the two. 3) Available age information is also inadequate to distinguish between Imbrium and Serenitatis origins. A resolution of better than ± 0.02 b.y. is probably required to do this. 4) Attempts to work out the crustal structure in the Apollo 15 area may be hazardous if one does not take into account the lithologies known to occur in these rocks of deep-seated origin.

References

- (1) Ryder G. and Bower J.F. (1977) Proc. Lunar Sci. Conf. 8th, p. 1895-1923. (2) Alexander E.C.Jr. and Kahl S.B. (1974) Proc. Lunar Sci. Conf. 5th, p. 1353-1373. (3) Granapathy R. Morgan J.W. Krahenbuhl U. and Anders E. (1973) Proc. Lunar Sci. Conf. 4th, p. 1239-1261. (4) Gros J. Takahashi H. Hertogen J. Morgan J.W. and Anders E. (1976) Proc. Lunar Sci. Conf. 7th, p. 2403-2425. (5) Warren P.H. and Wasson J.T. (1979) Proc. Lunar Planet. Sci. Conf. 10th, p. 583-610. (6) Warren P.H. and Wasson J.T. (1978) Proc. Lunar Planet. Sci. Conf. 9th, p. 185-217. (7) Nyquist L.E. Hubbard N.J. Gast P.W. Bansal B.M. Wiesmann H. and Jahn B. (1973) Proc. Lunar Sci. Conf. 4th, p. 1823-1846. (8) Nyquist L.E. Reimold W.U. Bogard D.D. Wooden J.L. Bansal B.M. Wiesmann H. and Shih C-Y. (1981) Proc. Lunar Planet. Sci. Conf. 12B, p. 67-97. (9) Nyquist L.E. Wiesmann H. Wooden J. Bansal B.M. and Shih C-Y. (1980) Papers presented Conf. Lunar Highlands Crust, p.122-124. (10) Thornber C.R. and Huebner J.S. (1980) Proc. Conf. Lunar Highlands Crust, p. 233-252. (11) Simonds C.H. Warner J.L. and Phinney W.C. (1976) Amer. Mineral. 61, p. 569-577. (12) Baker M.B. and Herzberg C.T. (1980) Proc. Lunar Planet. Sci. 11th, p. 535-553. (13) Croft S.K. (1981) Workshop on Apollo 16, p. 40-43. (14) Anders E. (1978) Proc. Lunar Planet. Sci. Conf. 9th, p. 161-184. (15) Delano J.W. and Ringwood A.E. (1978) Proc. Lunar Planet. Sci. Conf. 9th, p. 111-159.

