NEW $^{40}\text{Ar} - ^{39}\text{Ar}$ AGES OF APOLLO 16 BRECCIAS AND 4.42 AE OLD ANORTHO-
SITES. E.K. Jessberger, B. Dominik, T. Kirsten, Th. Staudacher, Max-Planck-In-
stitut für Kernphysik, Heidelberg, Germany.

The Apollo 16 landing site is that with the largest diversity of radiometric rock ages, ranging from -3.85 AE up to 4.47 AE (1,2,3), whereby ages between 3.9 and 4.0 AE are most frequent. This age diversity, the lack of a "near-
by" large impact basin and the great variety of rock textures (4) make the
Apollo 16 site most suitable to investigate the role of local cratering in lu-
nar highland chronology ("crater dominated" vs. "basin dominated" chronology
(3,5,6)). We performed $^{40}\text{Ar} - ^{39}\text{Ar}$ dating of 11 subsamples of five A16 breccias, all belonging to the petrogenic sequence of Warner et al.(4) for partially or
totally recrystallized breccias having equilibrated matrices. The intention was
to add further data to the times of recrystallization of impact generated A16
breccias and to continue the search for very old clasts which survived reset-
ting during these impacts.

SAMPLES: 67435 is a polymict breccia which contains ANT-type clasts, in
particular a cumulate spinel troctolite, extensively described in (7). 33E is
a light gray matrix sample containing 13% monomineralic clasts imbedded in a
fine-grained recrystallized groundmass. Clasts are subrounded plagioclases,spo-
radically olivine, size 15-160 μm, reaction rims. 33B and 33C are dark gray
angular coherent breccia clasts. Lithologically distinct from E, 30% clasts,
15-300 μm, mainly twinned plagioclase laths with well defined sharp edges, no
reaction rims with the well equilibrated groundmass. 33A is a single coarse
angular clast of 9.3 mg of strongly calcic plagioclase (Ang5.6-Ang6.9; micro-
probe analysis). Very low concentrations of FeO (.13%) and other minor elements
point toward a primary plutonic origin from an anorthositic crust, 33D similar as A, but several individual crystals were combined to yield 15 mg. 65055,12A
crystalline porphyritic basalt (melt rock), fine-grained, feldspathic,subophi-
lic; plagioclase euhedral (15-200 μm); interstitial pyroxene (50-250 μm); an-
gular and subrounded areas of mesostasis ( <30 μm). Minor olivine, ulvöspinel,
Fe, troilite, chromite. 65055,12B is a physically separable dark part of almost
identical lithology. 64535,7 anorthositic breccia clast. Angular plagioclase
and pyroxene clasts (50-1000 μm) imbedded without reaction rims in a very fine
grained feldspathic matrix. 64536,3 anorthositic breccia clast similar to the previous.
64536,12 polymict breccia clast, mainly dark "cherty" groundmass in which the
needle-like plagioclase laths (1-10 μm) are probably resulting from devitrifi-
cation and/or recrystallization of glass. Lithic and mineral pyroxene clasts.
62255,14 shocked pyroxene-rich clast from light matrix-dark clast breccia.

DATING: All procedures, corrections, monitors, and data evaluations were
similar to those described in (8). Two irradiations were performed with
$^{40}\text{Ar} - ^{39}\text{Ar}$ monitor=45.70 ( M1/75: all 67435 and 62255) and 75.04 ( M2/75: all
others), respectively. 8 out of 11 samples yield well defined plateau ages. The
results are summarized in the Table, age spectra are shown in the Figures.

INTERPRETATION: The preponderance of ages around 3.95 AE at the A16 site
is again documented from the data. At the same time, however, age differences
between 3.95 and 4.04 AE are significant and exclude that one major event has
totally reset all A16 breccias. In addition, since breccia clasts with ages of
3.95(B) and 4.04AE(C) coexist within one polymict breccia (67435), it is clear
that any melting which may have been associated with the particular impact that
NEW $^{40}$Ar-$^{39}$Ar AGES OF APOLLO 16......

Jessberger E.K. et al.

compacted this rock has not isotopically equilibrated all of its inherited pre-existing breccia clasts. Whether at least the younger clast B dates the compaction or also an earlier impact could only be decided if the groundmass, approximately represented by sample E, would yield a good plateau age, which it does not. Opposed to the impact which compacted 67435, 65055 presents an example of complete resetting in an impact which produced a total melt. Accordingly, both subsamples have identical age spectra. The devitrification observed in the anorthositic clasts 64535,7 and 64536,3 suggests also in these cases that the ages date extensive impact melting with subsequent recrystallization in the ejecta blanket. In general, preexisting clasts and breccias may be affected completely, moderately, or not at all, depending on their retentivity and on the degree of impact melting (see also 9).

The anorthositic plagioclase clasts 67435,33A and D have retained their extremely high age of 4.42 AE. They escaped metamorphism in the breccia forming event as is also indicated by the lack of reaction rims with the matrix. Their well defined plateau ages together with the petrological nature of the samples point strongly towards a direct relation to the age of the primary anorthositic crust.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Weight (mg)</th>
<th>Ca (%)</th>
<th>K (ppm)</th>
<th>$^{39}$Ar-Ca Exposure Age (m.y.)</th>
<th>Total K-Ar Age (AE)</th>
<th>Plateau Range ($^{39}$Ar Plateau Age (AE)</th>
<th>Fig. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>67435,33E(matrix)</td>
<td>42.1</td>
<td>6.3</td>
<td>1190</td>
<td>52</td>
<td>1410</td>
<td>3.82±0.09</td>
<td>70-99</td>
</tr>
<tr>
<td>67435,33B(dark clast)</td>
<td>42.8</td>
<td>8.8</td>
<td>1520</td>
<td>51</td>
<td>3.08±0.01</td>
<td>63-99</td>
<td>900</td>
</tr>
<tr>
<td>67435,33C(dark clast)</td>
<td>57.8</td>
<td>6.6</td>
<td>445</td>
<td>46</td>
<td>3.59±0.01</td>
<td>49-93</td>
<td>900</td>
</tr>
<tr>
<td>67435,33A(plagioclase)</td>
<td>9.3</td>
<td>8.5</td>
<td>270</td>
<td>45</td>
<td>4.11±0.03</td>
<td>34-99</td>
<td>900</td>
</tr>
<tr>
<td>67435,33B(plagioclase)</td>
<td>15.0</td>
<td>9.6</td>
<td>300</td>
<td>48</td>
<td>4.08±0.02</td>
<td>46-99</td>
<td>900</td>
</tr>
<tr>
<td>67435,33C(plagioclase)</td>
<td>69.8</td>
<td>9.6</td>
<td>575</td>
<td>2.4</td>
<td>3.94±0.01</td>
<td>14-99</td>
<td>900</td>
</tr>
<tr>
<td>67435,33D(basalt)</td>
<td>48.1</td>
<td>9.5</td>
<td>615</td>
<td>2.2</td>
<td>3.94±0.01</td>
<td>8-99</td>
<td>900</td>
</tr>
<tr>
<td>65055,12A(basalt)</td>
<td>69.8</td>
<td>9.6</td>
<td>575</td>
<td>2.4</td>
<td>3.94±0.01</td>
<td>14-99</td>
<td>900</td>
</tr>
<tr>
<td>65055,12B(basalt)</td>
<td>48.1</td>
<td>9.5</td>
<td>615</td>
<td>2.2</td>
<td>3.94±0.01</td>
<td>8-99</td>
<td>900</td>
</tr>
<tr>
<td>64535,7(anorth.clast)</td>
<td>67.8</td>
<td>11.6</td>
<td>123</td>
<td>1.9</td>
<td>3.82±0.04</td>
<td>31-92</td>
<td>900</td>
</tr>
<tr>
<td>64536,3(anorth.clast)</td>
<td>65.2</td>
<td>11.9</td>
<td>265</td>
<td>1.7</td>
<td>3.88±0.02</td>
<td>21-97</td>
<td>900</td>
</tr>
<tr>
<td>64536,12(matrix)</td>
<td>53.4</td>
<td>6.7</td>
<td>1410</td>
<td>2.4</td>
<td>4.00±0.02</td>
<td>3-47</td>
<td>900</td>
</tr>
<tr>
<td>62255,14(clast)</td>
<td>52.0</td>
<td>9.5</td>
<td>55</td>
<td>3</td>
<td>3.66±0.08</td>
<td>no plateau defined</td>
<td>900</td>
</tr>
</tbody>
</table>

APPENDIX: 1. Low temperature $^{40}$Ar losses in our samples, which occurred subsequent to the compaction, are absent in totally recrystallized melts (64535), moderate in monomict clasts (64535,7; 64536,3), and strong in polymict breccias (67435,33 B,C). 2. The exposure ages given in the Table confirm the well established ages of South Ray Crater (-22 m.y., Stations 2,4,5) and North Ray Crater (-50 m.y., Station 11 (67435)) (10).
NEW $^{40}$Ar-$^{39}$Ar AGES OF APOLLO 16

Jessberger E.K. et al.

REFERENCES: (1) Kirsten et al., Proc. 4th, 1751 (1973); (2) Schaeffer & Usmani, Proc. 4th, 1751; (3) Kirsten & Horn, Proc. 6th, 1751; (4) Meunier et al., Proc. 5th, 1751; (5) Meunier et al., Proc. 6th, 1751; (6) Meunier et al., Proc. 7th, 1751; (7) Meunier et al., Proc. 8th, 1751; (8) Jessberger et al., Proc. 4th, 1751; (9) Arvidson et al., Proc. 5th, 1751; (10) Arvidson et al., Proc. 6th, 1751.