67015: A KREEPY BRECCIA FROM NORTH RAY CRATER, Ursula B. Marvin, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138.

Breccia 67015 is being investigated by a miniconsortium consisting of Ursula Marvin (mineralogy/petrology), Marilyn Lindstrom (major and trace elements), and Charles Hohenberg (\(^{40}\)Ar/\(^{39}\)Ar dating). This is a progress report on continuing research. More details on the chemical data may be found in the abstract by M. Lindstrom in this volume.

Sample 67015, from Station 11 on the rim of North Ray Crater, bears a strong macroscopic resemblance to several other light-colored samples from the same locality. It also appears petrographically similar to others. It is a feldspathic fragmental breccia with a friable matrix and four main types of lithic clasts: cataclastic anorthosites, granulitic anorthositic gabbros, poikilitic gabbroic anorthosites, and gray aphanitic melt rocks. No KREEP-rich accessory minerals or glassy mesostases were observed in the thin sections, yet the INAA analyses show that 67015 is exceptionally KREEPy in comparison with other North Ray Crater breccias.

The main source of the KREEP component is one of the melt rocks, a dark-gray, finely vesicular aphanite laden with angular clasts. This melt is the most abundant and conspicuous type of clast in the breccia. It occurs in small fragments of less than 1 mm and in lobate masses over 6 cm long. In bulk composition it is the most mafic component we have analyzed (wt % FeO = 7.6). The groundmass is, however, markedly inhomogeneous. Electron microprobe analyses of 10 points in the matrix, which has a very fine micropoikilitic texture, show the following ranges in four major elements (wt %): MgO = 4.0-25.3; FeO = 3.2-19.0; Al\(_2\)O\(_3\) = 4.2-27.6; CaO = 4.3-14.0. The KREEP component of the matrix also varies, as indicated by microprobe analyses that range from wt % K\(_2\)O = 0.0-0.29. A bulk sample of this melt rock yielded the highest values of rare earth elements of any material in the breccia. Lindstrom reports La = 23.2 ppm (70x chondrites).

Approximately 75% of the clasts in the dark-gray melt rock are plagioclase fragments and 20% are angular fragments of pyroxene or olivine. There are a few small lithic clasts, and sparse metal grains that have compositions in the meteoritic range: Fe 94%, Ni 5.5%. Lindstrom's bulk analyses show relatively high values of Ni (525 ppm) and Co (41.8 ppm). Scattered clasts of this melt rock must account for the unexpectedly high KREEP content (e.g. La = 11-28x chondrites) measured by Lindstrom in the matrix and bulk samples of 67015. Where this KREEP-rich component comes from, and why it was incorporated into 67015 but not into the other essentially KREEP-free feldspathic fragmental breccias from North Ray Crater, are questions awaiting resolution by the consortium after additional studies are completed and the results are placed in the context of the regional geology.

A second common type of melt rock occurs as blocky to rounded clasts of medium-gray aphanitic material up to 3 cm wide. These melts are more feldspathic in composition than the dark-gray ones described above. In thin sections some of them appear to have subtle flow banding, with plagioclase crystallites roughly aligned in a groundmass that is sufficiently feldspathic to show a blue fluorescence in the electron microprobe beam. Other melts that
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look much the same macroscopically have a darker groundmass with an almost
dendritic texture punctuated by minute platelets of ilmenite. Approximately
20 to 25% of the clasts in these melts are mafic fragments. Bulk analyses
range from about 4.9 to 5.7 wt % FeO and show rare earth values of approxi-
mately 1.5 to 3x chondrites. These medium-gray melt rocks could be mixtures
of common highlands anorthosites and the dark Fe- and KREEP-rich melt.

Anorthosite clasts, most of which are less than 4 mm in section, are
abundant in 67015. Some of them are coarse-grained, twinned plagioclase that
remains unaltered except for varying degrees of crushing. Others are plagi-
oclase that has been transformed in situ to leafy maskelynite with segregated
lenses and droplets of dark-colored ferroan anorthosite glass. Both types are
common in other North Ray Crater breccias. The clasts of granulitic anortho-
sitic gabbros are also standard varieties.

Breccia 67015 includes several rounded, coarse-grained, basaltic-looking
clasts, the largest of which was about 1.2 cm in diameter. On thin sectioning
all of these clasts proved to be poikilitic intergrowths of plagioclase,
olivine, and pyroxene. All of them are undoubtedly crystallized products of
impact melts, because they are too rich in plagioclase to have been magmatic
eruptives. The poikilitic clasts vary widely in mineralogy and composition.
The modes and composition of two of them, determined by electron microprobe
analyses, are as follows:

<table>
<thead>
<tr>
<th>Poikilitic Clast B-10</th>
<th>Poikilitic Clast B-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>77% Plagioclase</td>
<td>72% Plagioclase</td>
</tr>
<tr>
<td>11% Olivine</td>
<td>9% Olivine</td>
</tr>
<tr>
<td>12% Pigeonite</td>
<td>19% Augite</td>
</tr>
<tr>
<td>An96Or0.0</td>
<td>An95Or0.3-0.4</td>
</tr>
<tr>
<td>Fo65</td>
<td>Fo74</td>
</tr>
<tr>
<td>En64Fs29Wo7</td>
<td>En47Fs10Wo43</td>
</tr>
</tbody>
</table>

The K2O content of the plagioclase in clast B-10 is 0.0%, and this
reflects an extraordinarily low content of rare earth elements (measured by
Lindstrom) in the bulk clast. Poikilitic components generally tend to be
fairly KREEPy, but Clast B-10 contains only 0.617 ppm La, in contrast with
4.80 ppm in Clast B-7. In terms of the virtual absence of REE, Clast B-10 is
unlike any other crystalline material reported from North Ray Crater.

Its two exceptional components, the KREEP-rich melt and the KREEPless
poikilitic crystalline, do not average out to make 67015 an ordinary member of
the North Ray Crater suite. They double both the problems and the interest in
unraveling the history and provenance of this rock.