PRELIMINARY INVESTIGATION OF BOULDERS 2 and 3, APOLLO 17, STATION 2: PETROLOGY AND Rb-Sr MODEL AGES, A. L. Albee, A. A. Chodos, R. F. Dymek A. J. Gancarz, and D. S. Goldman, Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91109. Contribution No. 2439.

Preliminary petrologic studies on samples from Station 2 indicate that the upper layered units of the South Massif are composed of metaclastic rocks. It can also be inferred from the clast assemblage that the formation of these units predates the extrusion of mare and feldspathic basalts. The clasts are predominantly members of the ANT-suite which, based on a Rb-Sr study of a dunite clast, apparently existed 4.6 b.y. ago [1].

The boulders at Station 2 are derived from the upper third of the South Massif and apparently include the two major lithologic units which comprise the South Massif. Samples of both matrix material and clasts were collected from a 2m tan-grey breccia boulder (#2) and a 0.5m blue-grey breccia boulder (#3). The matrix samples from both boulders are moderately-recrystallized metaclastic rocks not dissimilar to many metaclastic rock samples collected and described from the Apollo 16 site. Preliminary results on documented chips and thin-sections from these boulders are reported by members of the consortium elsewhere in this volume and include: field observations [2]; chemical data [3]; track and microcrater data and surface exposure ages [4]; petrologic and isotopic studies [1].

BOULDER #2 samples 72315 and 72335 were collected from an irregular 0.5m area which appeared to be a breccia clast and samples 72355, 72375, and 72395 were collected to represent the matrix of this boulder. Binocular microscope examination of these samples shows them to be similar-looking, sugary-textured, coherent, homogeneous metaclastic rocks. They contain only a few percent of clasts larger than 2-3mm. These are predominantly shocked plagioclase, but include anorthositic rock and single crystals of olivine and pyroxene. The largest such clast is 10mm across, but somewhat larger, highly-vesicular patches may be vestigial breccia inclusions. These patches are rich in irregularly-shaped vesicles and contain relatively coarse-grained plagioclase and pyroxene which are in the matrix and which also project into the vesicles. Sample 72395 contains a shallow, 10x14mm vesicle lined with pyroxene and plagioclase crystals. Irregular zones of slit vesicles and tiny spherical vesicles (<1mm) also occur in these samples.

The samples of both the clast and matrix from this boulder appear nearly identical in thin-section and contain about 20% megaclasts (0.1 to 2.5mm) set in a finer-grained, partially-recrystallized matrix. The clasts are mostly single crystals of plagioclase, but include some shocked grains and anhedral aggregates. Clasts of olivine, pyroxene, and pink spinel are much less abundant. Secondary overgrowths and reaction rims occur on numerous clasts.

The matrix consists of anhedral grains of plagioclase, pyroxene, and olivine. Portions of the matrix contain up to 10% K_2O. Plagioclase is not lath-shaped and pyroxene and olivine do not form oikocrysts as in many Apollo 16 metaclastic rocks. The compositions of these minerals are similar in the matrix and clasts in all five samples (fig. 1). Opaque minerals, which constitute several percent of the rock, include ilmenite, armalcolite, rutile, ulvöspinel, spinel, troilite, and Fe-metal.

The nature of the irregular patch, tentatively identified by Schmitt on the moon as a large clast, is not yet clear. Petrographically, both sets of samples are similar, but chemical data indicate that one sample from the clast (72315) differs from the other four [3]. Clast sample 72315 has had a much shorter exposure on the lunar surface than the matrix sample (72395) [4], suggesting that the irregular patch seen by Schmitt could be a spalled surface. Since no spalled fragments are present at the foot of the boulder, the time of spalling may predate the emplacement of the boulder in its present position.

Rb-Sr model ages (T_{BABI}) for chips from samples 72315, 72335, 72355, 72375, and 72395 are 4.54, 4.49, 4.38, 4.37 and 4.46 b.y., respectively [5]. Similar model ages have been obtained previously from other such metaclastic rocks, which yielded recrystallization ages of about 3.95 b.y. by $^{40}Ar/^{39}Ar$ stepwise heating or Rb-Sr internal isochrons.

BOULDER #3 samples 72415 to 72418 were collected from a single 10x20cm clast of crushed dunite and sample 72435 was collected to represent the matrix. Photographs indicate that, although the boulder contains a variety of 2-6cm clasts, the clast of dunite is the largest. Sample 72435 differs from the samples of boulder #2 in color (dark blue-grey), by a lesser abundance (by∼5%) and size (up to 15mm) of clasts, and by the presence of large (up to 8mm) smooth-walled vesicles. It contains zones of aligned, slit vesicles and minute spherical vesicles as in boulder #2, but not the crystalline-appearing, highly-vesicular patches. The large clasts include anorthosite, troctolite, dunite and individual crystals of olivine, pyroxene and shocked and unshocked plagioclase. No volcanic-textured clasts are present.

The thin section shows about 15% megaclasts set in a metaclastic groundmass which is finer-grained than the matrix of boulder #2. Most of the clasts are plagioclase, including shocked crystals which exhibit a felty, recrystallization texture. In addition, many plagioclase clasts have secondary overgrowths of plagioclase. Pyroxene and olivine, have a limited range of Mg/Fe which is similar to boulder #2, but some plagioclase is more sodic than in boulder #2 (fig. 1). One unique mineral is a 20μm grain of cordierite included in a spinel, which itself is part of a plagioclase-rich, lithic clast.

The clast of dunite, which exhibits a complex shock history and consists almost entirely of olivine (Fo_{86-89}), is discussed in a separate abstract [1]. Despite the complex shock history, isotopic data indicate an extremely old age (4.60±0.09 b.y.) for this rock [1].

DISCUSSION These preliminary data indicate that boulders #2 and #3 are metaclastic rocks, characterized by a great abundance of ANT-type material and by the general absence of both mare and feldspathic basalts. If these boulders are indeed from the upper portion of the South Massif, then the two units comprising the South Massif must be composed of metaclastic rock. From the abundance of ANT-type material and the absence of both mare and feldspathic basalts, it may be inferred that the formation of these units predates the extrusion of these basalts. Alternatively, the restricted clast population may just represent derivation from a limited source region. The

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occurrence of the 4.6 b.y. old dunite in a metaclastic unit, which contains clasts restricted to the ANT-suite, as well as the petrologic similarity of dunite to the ANT-suite of rocks, strongly suggest that the ANT-suite also formed at 4.60 b.y. even though most returned ANT samples have been extensively modified by later events. This corroborates the various hypotheses [6], which suggest that the lunar crust formed very early in the evolution of the moon by extensive melting with associated differential, gravitational separation of opaque oxides, olivine, pyroxene, plagioclase, and residual liquid.

REFERENCES

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FIGURE 1