A PETROGRAPHIC SURVEY OF REGOLITH BRECCIAS FROM THE APOLLO 15 AND 16 COLLECTION. D. S. McKay, SN4/NASA Johnson Space Ctr., Houston, TX 77058 and S. J. Wentworth, Lockheed, 1830 NASA Rd. 1, Houston, TX 77058

Introduction. As part of the new Regolith Initiative organized by the Lunar and Planetary Sample Team (1), we have begun a systematic study of thin sections of all of the regolith breccias in the Apollo collection. Initial work has concentrated on comparing textures of the breccias as seen in the optical petrographic microscope and on determining the relative abundance of regolith components such as spherules and agglutinates. SEM petrography using the techniques of Phinney (2) is also underway. We are using the classification scheme of Stöffler (3) who defines a regolith breccia as a clastic matrix breccia with detectable regolith constituents. We propose to subdivide this category using additional textural criteria.

Technique and Results. We have surveyed available thin sections for most regolith breccias in the Apollo 15 and 16 suites and redescribed them using a standardized form. A number of features for each section were noted including porosity, matrix texture, type and relative amount of regolith constituents and general degree of shock relative to other regolith breccias. Table 1 presents some of the descriptive results. Intergranular porosity in Table 1 refers to the relative amount of pore space between grains in the matrix and between matrix grains and clasts. Fracture porosity refers to the amount of pore space present in fractures and in vesicles in fracture-filling glass veins. Agglutinates include all glass fragments that are vesicular, clast-bearing and inhomogeneous. Spheres include both glassy and quench crystallized varieties. Shock features include aligned fracture patterns in matrix and clasts, fractured and crushed clasts, presence of vein glass, isotropic minerals, and undulatory extinction. The intensity scale used is qualitative and ranges from none through rare, minor, common and abundant. Quantitative parameters are also being determined by point counting. Point counting data from four of the continuous thin sections from Core 15010 is used to establish the calibration between this technique and population surveys from grain mounts from this core (2). This calibrated point counting is used to determine porosity, agglutinate content and the fraction larger than 0.5mm. Breccia 15086, for example, has an intergranular porosity of 34% and an agglutinate content of 21.5% in the 20-500 micrometer-size range. This porosity is 80% of that of the loose soil in core tube 15010 in the depth range used for calibration (27-47cm).

Discussion. As a primary subdivision of regolith breccias we use criteria based on porosity as first proposed by Chao (3,4), adding the restriction that the porosity used in this classification refers only to intergranular porosity. Fracture porosity is considered separately and is primarily characteristic of compact breccias. We also find it useful to add two additional subgroups to the original categories of porous and compact: namely, subporous and subcompact. These additional categories are added because a continuum apparently exists between the end member textures. Porous regolith breccias are most nearly like soils and allow the closest comparisons as we have done with 15086 and soil in Core 15010. Compact regolith breccias are least like soils from a textural standpoint and possibly from a compositional standpoint as discussed below.

Where are the Agglutinates? One of the most interesting results of our survey of the Apollo 15 and 16 regolith breccias is the relative lack of recognizable agglutinates in these rocks. In the compact regolith breccias agglutinates are nearly absent. In the porous breccias they are more common, but even here they are relatively sparse compared to soils. Breccia 15086 is

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among the most, if not the most, agglutinate rich of the Apollo 15 regolith breccias. Even so, its agglutinate abundance is only as high as the most agglutinate poor of the entire suite of Apollo 15 cores and soils for which we have equivalent data (except for the samples rich in volcanic glass beads). Compact regolith breccias are much more difficult to work with petrographically because original grain boundaries are indistinct or impossible to define. Vesicles characteristic of agglutinates and some other types of glasses may also be absent. The extremely low abundance of agglutinates in the compact breccias shown in Table 1, therefore, may be partly an artifact of identification. Spheres and glass fragments are well preserved in the compact breccias, so the clast-laden swirly texture of agglutinates should survive whatever process compacts these breccias. If this relative scarcity of agglutinates in the Apollo 15 and 16 regolith breccias is real, it sets constraints on where and when these breccias were made and it may also have implications for meteorite regolith breccias. Clearly, additional data including measurements of other maturity indices are important.

References: (1) Curatorial Newsletter, June 1982; (2) Phinney W., McKay D., Simonds C. and Warner J. (1976) Proc. Lunar Sci. Conf. 7th, p. 2469-2492; (3) Stöffler D., Knoll D. and Maerz U. (1979) Proc. Lunar Planet. Sci. Conf. 10th, p. 639-675; (4) Chao E., Boreman J. and Desborough G. (1971) Proc. Lunar Sci. Conf. 2nd, p. 797-816; (5) Chao E., Minkin J. and Best J. (1972) Proc. Lunar Sci. Conf. 3rd, p. 645-659.

Table 1

Sample Number	Intergranular Porosity	Fracture Porosity	Agglutinates	Spheres	Shock Features
15015	compact	high	very rare	rare	common
15059	compact	intermediate	rare	rare	common
15086	porous	low	common	common	minor
15205	compact	intermediate	rare	rare	common
15265	porous	low	minor	minor	minor
15295	compact	low	very rare	minor	common
15299	compact	low	very rare	minor	minor
15459	compact	high	rare	common	abundant
15498	compact	intermediate	rare	minor	abundant
15505	compact	high	very rare	rare	common
15558	porous	low	rare	minor	minor
15565	subporous	low	common	common	minor
15688	compact	high	rare	rare	abundant
60016	subporous	low	rare	minor	rare
60019	compact	intermediate	none	rare	common
60255	compact	intermediate	rare	rare	abundant
60275	compact	intermediate	none	minor	minor
61135	subcompact	low	rare	rare	minor
61195	compact	intermediate	rare	rare	common
61295	subporous	low	minor	minor	rare
65095	subcompact	low	rare	rare	minor
66035	subporous	low	rare	minor	minor
66075	subcompact	low	rare	rare	minor
67016	porous	low	none	very rare	minor
67455	subporous	low	very rare	none	rare

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