needs title

Final report prepared for NASA contract

NGR 08-001-029

by

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(NASA-CR-145777) LUNAR SOIL AND SURFACE PROCESSES STUDIES Final Report (Delaware Univ.) 97 p HC $5.00 CSCL 03E

N76-12921

Unclas

G3/91 01873

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PREFACE

The original objective of this research was to characterize glass particles in the lunar soil and to compare them to terrestrial analogues. These objectives have been met. In addition the study provided useful information concerning the nature of lunar surface processes (e.g. volcanism and impact), maturity of soils and chemistry and heterogeneity of lunar surface material. I feel, however, that the most important result of this study (which is supported by the work of A.M. Reid, E.C.T Chao, K. Keil and others) is that it demonstrates that the investigation of glass particles from the regolith of planetary bodies with little or no atmospheres can be a powerful method for learning about surface processes and chemistry of planetary surfaces. Thus I urge NASA to move ahead with any plans for the return of samples from other planetary bodies (especially the terrestrial planets and asteroids) using unmanned spacecraft.

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Introduction

In my original proposal, I pointed out that it was likely that the lunar soil would contain significant amounts of microscopic glassy particles of impact and/or volcanic origin. The objective was to study the glass particles, to establish their origin and to compare them with terrestrial igneous glasses and tektites. After investigation of Apollo 11 samples it became apparent that glass particles recovered from the lunar soil could tell us much about lunar surface processes (e.g. meteorite impact, volcanism and radiation history) and chemistry and heterogeneity of the lunar surface. Thus the study of the chemistry of the lunar surface (based on major element analysis of glass particles) was the major objective of all of my subsequent research. In order to accomplish these objectives twenty 0.25 to 4.88 gm samples of less than one millimeter lunar soils were studied (Table 1). Glass particles from Luna 16 and Luna 20 were also studied. A list of publications (and papers in press or preparation) resulting from NASA grant NGR-08-001-029-040 is given in Appendix A.

Method of Analysis

Each sample was sieved into three to six size fractions using nylon sieves. The modal composition of most size fractions was then determined using a binocular microscope with up to 50X magnification. In this way the relationship between glass content and other soil components was determined. Glass particles, particularly spherules, were removed using a wooden pick; described as to size, shape, color, transparency and surface features; and then placed into glass cavity slides.

For most of the samples, all of the glass particles (particularly the homogeneous-appearing fragments and spherules) from the coarser size fractions (>149 μm) were mounted for electron microprobe analysis. Random glass particles were picked from the finer (<149 μm) size fractions and also mounted for electron microprobe analysis. Each particle was individually described and mounted in a 1/4 inch metal cylinder with epoxy, ground down to expose a flat surface and polished using 6 micron diamond paste and then 0.05 micron alumina oxide powder. Prior to mounting them for electron microprobe analysis, the refractive indices of some (~400) particles were determined by the oil immersion method, usually to within ± 0.002.

Apollo 12-17 samples were analyzed using the electron microprobe facilities of the Planetology Branch at Goddard Space Flight Center. The Apollo 12, 14 and part of the Apollo 15 samples were analyzed with an ARL microprobe analyzer with three spectrometers, thus requiring three runs to analyze for nine elements. Part of the Apollo 15 and all of the Apollo 16 and 17 samples were analyzed using three spectrometers in combination with an energy dispersive system. This improved the analyses in some respects, since nine or more elements could be analyzed for simultaneously, but the accuracy for many of the elements was not as good as when the analyses were determined entirely by the wavelength dispersive system. Potassium and titanium values seemed to be the worst and often gave negative values. This was probably due to the problem of correcting for background when using the energy dispersive system. The Apollo 11 glasses (sample 10084,138) were analyzed using the microprobe facilities of the Division of Meteoritics at the Smithsonian Institution in Washington, D.C. Part of the analyses were done on a three spectrometer electron microprobe and part on a nine spectrometer electron microprobe. All of the samples were analyzed for Si, Ti, Al, Fe, Mg, Ca, Na, K and Mn. In addition, some were analyzed for P and some for Cr. Quartz (SiO_2), synthetic corundum (Al_2O_3) and glasses made up by Corning Glass Company and analyzed by the U.S.G.S. were used as standards for electron microprobe analyses.

After electron microprobe analysis the polished sections were studied using a petrographic microscipe and the presence or absence of vesicles, relict crystalline inclusions, devitrification and metallic particles was noted for each sample analyzed.

A particle track study was made of twelve Apollo 14 glasses from sample 14163 by G. A. Wagner and D. Storzer. The particle study was done in order to determine the uranium content and radiation history of glass particles whose major element composition had previously been determined by electron microprobe analysis as discussed above. For a discussion of method of analysis see Glass et al. (1972).

Major Results

GRAIN SIZE.

The most coarse-grained samples are two of the highland samples: 63501 and 68501 (Table 2). The third highland sample (64501) is also coarse-grained, but not as coarse as two Apollo 14 samples (14230,82 and 14149) and one Apollo 17 sample (74241). The most fine-grained sample investigated is the orange soil from Apollo 17 (74220). Apollo 15 soil sample, 15301, contains a large percentage of green glass spherules and is also fairly fine-grained. The Apollo 11 sample (10084) and Apollo 12 sample 12001 are intermediate in grain size.

MODAL COMPOSITION.

Sample 15301 has a high content (~20%) of homogeneous, transparent, emerald green glass spherules and fragments. The Apollo 17 orange soil (74220) contains ~90% deep red to black opaque glass spherules and fragments. Sample 74241 also has a high percentage (~20%) of deep red to black opaque glass spherules and fragments. These samples, therefore, have anomalously high glass contents (37-93%) as compared with the remainder of the samples which only contain from 7 to 26% discrete glass particles (Table 3).

The highland samples (63501, 64501 and 68501) can be distinguished from most of the mare samples by their higher crystalline (lithic plus mineral fragments) content and lower glass content (Table 3). The highland samples are also unique in that they contain high percentages of feldspar fragments (up to 20%) as compared with the mare samples which generally contain a greater percent of pyroxene fragments. Apollo 17 sample 78421 is in some respects more similar to highland samples than to mare samples. It has a high feldspar content and low glass content (Table 3).

Three Apollo 14 samples (14149; 14230,75; and 14230,82), like the Apollo 16 highland samples, have high crystalline contents and also low agglutinate contents (Table 3). All three of these samples are subsurface samples: 14149 is from the bottom of a trench; and 14230,75 and 14230,82 are core samples. Samples 10084, 15041 and 78421 have the highest agglutinate (glazed aggregate) contents of all the samples studied.

Most samples show a systematic variation in composition with grain size. In general, the lithic content decreases and the mineral grain and glass content increase with decreasing grain size (Table 3). In addition, the percent abundance of spherules generally shows an increase with decreasing grain size (Table 3). There does not, however, appear to be any systematic variation in agglutinate content with decreasing grain size.

As would be expected, the number of spherules per gram of sample also increases with decreasing grain size (Table 4). Regardless of the spherule content of a given sample the increase in number of spherules with decreasing grain size is approximately the same. On the average the 275-500 µm size fraction has nine times as many spherules as the 505-1000 µm size fraction. However, this trend is not obvious in any given sample because of the rarity of spherules in these size fractions. The 149-295 µm size fraction contains a little less than eight times as many spherules as the 295-505 µm size fraction and likewise the 74-149 µm size fraction contains approximately eight times as many as the 149-295 µm size fraction. The average increase in spherules with decreasing grain size, as shown in Table 4, is dominated by a few samples with high spherule content; 15101, 15301, 74220 and 74241. No spherules were recovered from the 505-1000 µm size fraction of these samples and the increase in spherules with decreasing size fraction is generally lower than for the remainder of the samples. The spherules in these samples (15101, 15301, 74220 and 74241) are probably of volcanic origin (see discussion section), whereas the spherules in the remainder of the samples are probably mostly of impact origin. (Evidence for an impact origin will be discussed in a later section.)

DESCRIPTION OF SPHERULES.

Shape. Over 3000 glass spherules have been described. Excluding fragments and irregular forms, spherical to oval-shaped forms represent approximately 97% of the spherules recovered (Table 5). Teardrop and dumbbell-shaped spherules make up less than 4%, with teardrops about 2.5 times as abundant as dumbbell forms.

Size. The size distribution of glass spherules (over 2000) is similar for all the samples (Table 6). The number of spherules increases with decreasing size. Less than one half of a percent occurred in the largest size fraction, while nearly 60% occurred in the smallest size fraction (88-124 μm) for which records were kept.

Color. The glass spherules (and fragments) studied range from opaque to transparent and occur in a wide range of colors from colorless, to green, yellow, brown, red and black and all shades in between. Glass spherules from the mare sites are predominantly yellow, brown or red in color. Colorless to pale green spherules are ubiquitous in mare samples, but rare (Table 7). Spherules from the highland samples, on the other hand, are mostly colorless to green or yellow.

Two samples are unusual in that they contain a high concentration of spherules with homogeneous appearance (and compositions). Sample 15301 contains mostly transparent emerald green spherules, whereas 74220 contains mostly deep red to opaque black spherules. Sample 15101 also contains a large percentage of emerald green spherules like those found in 15301. Likewise, sample 74241 contains a large number of spherules like the deep red to opaque black spherules found in sample 74220.

Surface features. The general appearance and surface texture of glass spherules from each sample were described with the aid of a binocular microscope with up to 50X magnification. A more detailed study, using a scanning electron microscope (SEM), was made of approximately eighty glass particles (mostly spherules) from Apollo 11, 12, 14 and 17 and one from Luna 16. The following features were found to be common on glass particles from every collection site: attached rock and mineral grains and rock flour, exposed vesicles, splashed silicate glass, metallic beads and mounds, impact pits and spallation zones.

Many of the opaque spherules have minute mineral grains or rock fragments embedded in or coating their surface (Fig. 1a).

The attached grains are often only on one side of the spherule, suggesting that they were embedded into the surface of the spherule as it landed on the regolith while still in a partially molten state.

Ropy to platy-shaped glassy fragments have been found that have a coating of very fine-grained light-colored dust (rock flour) (Fig. 1b). According to Meyer et al. (1971) the dust coating on the Apollo 12 ropy fragments is feldspar-rich. Most of these rock flour-coated, ropy to platy fragments have a KREEP composition (see section on chemistry). Similar fragments have been found in varying abundances at all of the collection sites but appear to be most abundant in the Apollo 12 and 14 soil samples.

Many of the opaque spherules have exposed vesicles which were apparently formed by outgassing (Fig. 1c). None have been observed on transparent glass spherules.

Blebs and/or coatings of silicate glass (Fig. 1d) have been observed on approximately a third of the glass particles studied. In some cases the splashed silicate glass has a composition indistinguishable from the glass spherule on which it occurs; in other cases the compositions appear to be slightly different.

Metallic beads or mound-like structures are visible on many of the glass particles. They range in diameter from less than 1 μm up to at least 25 μm. In general, the beads or mounds are randomly scattered over the surface of the spherules (Fig. 2a). In some cases they have coalesced to form irregular masses (Fig. 2b). However, on several of the spherules the metallic beads occur in a geometric pattern (Figs. 2c & d). The geometric pattern consists of large beads surrounded by a circle of smaller beads. The circle of smaller beads occurs out from the central bead a distance that is approximately equal to the diameter of the large central bead. In some cases the central bead has fallen out leaving a depression that is surrounded by a ring of small beads. (The geometric pattern is probably produced immediately after formation of a spherule when it is coated with a thin layer of Ni-Fe as it passes through a cloud of vaporized metal from the meteorite whose impact produced the glass. The metallic coating then draws up into beads due to surface tension and the larger beads sink into the still hot and partially molten surface of the glass spherule. On cooling the metal shrinks and in several cases falls out, leaving a shallow depression.) Electron microprobe analysis shows that the beads are predominantly Ni-Fe, but sulfur- and phosphorus-rich beads or mounds are also common (Canter and MacGregor, 1970).

Impact pits have been observed on a large number of glass particles (Fig. 3a). Several different types of morphologies have been observed: simple glass-lined pits with a raised rim, glass-lined pits with spallation zones surrounding them and glass-lined pits with radial fracture zones surrounding them.

A Luna 16 glass bead was studied that has a rather large (~200 μm dia.) microcrater on the surface with a centrally-located glass-lined pit slightly elevated above the surrounding area (Fig. 3). Surrounding the pit is a radial fracture zone, half of which has spalled off. The spall zone is more than half again as large as the radial fracture zone. It appears that if the impact had been less energetic, spallation would not have occurred and the central pit would have been entirely surrounded by a radial fracture zone. However, if the impact event had been more energetic, then the spallation would have probably completely removed the radial fracture zone producing an impact crater with a larger diameter (Glass, 1972).

Many glass spherules are broken or have large conchoidal fracture marks on their surfaces that are probably the result of low velocity impact (Fig. 3).

PETROGRAPHY.

Refractive index. The refractive indices of over 400 glass particles were determined. The glasses have a wide range in refractive index, from 1.485 to 1.71, and show a polymodal distribution (Fig. 4). The red glasses from the Apollo 17 orange soil have the highest refractive index (R.I.) measured and the high SiO_2 "granitic" glasses have the lowest.

Refractive index correlates well with glass color, and both R.I. and color are related to the composition (Figs. 5 & 6).

A plot of R.I. versus SiO_2 content shows two trends. One group consisting mostly of pale green to greenish yellow glasses has a wide range in SiO_2 content, but shows a rather small range in R.I. (mostly 1.595). These glasses have high Al_2O_3 and CaO contents and low FeO and TiO_2 contents. The second group of glasses have a much wider range in composition and R.I. These glasses show a strong inverse correlation between R.I. and SiO_2 content. In general, the dark brown to red glasses have high FeO and low SiO_2 contents and high refractive indices; whereas, the light-colored (colorless, yellow to yellow-brown) glasses have low FeO (and TiO_2) and high SiO_2 contents and low refractive indices.

Vesicles. Only about 16% of the glass particles that were mounted for electron microprobe analysis (excluding the opaque spherules found in the Apollo 17 orange soil) were opaque. Of these, nearly 60% were observed to contain vesicles. On the other hand, less than 20% of the non-opaque spherules contain vesicles.

Inclusions. Debye-Scherrer x-ray diffraction patterns obtained for approximately twenty Apollo 11 and 12 glass particles indicate that the most common crystalline phase present is pyroxene and feldspar with some olivine, ilmenite and metallic iron.

Petrographic studies were made of most of the polished sections prepared for electron microprobe analysis, and occasionally an inclusion was analyzed during electron microprobe analysis in order to help in identification. Plagioclase was the most often encountered phase. Pyroxene was also common and olivine and ilmenite were identified occasionally. Metallic particles were common. Based on form and composition, the crystalline inclusions can be separated into several different types: relict minerals, metallic spherules and crystals, and crystals produced by devitrification.

Relict crystal inclusions. Rounded mineral grains that appear to be inclusions of pre-existing minerals were observed in approximately 40% of the opaque glasses (excluding the opaque spherules from the Apollo 17 orange soil) (Fig. 7a), whereas only 10% or less of the non-opaque glasses contained relict inclusions. As mentioned above, the most common phases were pyroxene and plagioclase (anorthite) with some olivine and ilmenite.

Metallic spherules. Metallic spherules were observed in approximately 10% of the glasses. (Approximately 20%

of the opaque spherules contain them.) Nearly half of the Apollo 12 glasses were observed to contain metallic spherules, but less than 2% of the Apollo 11, 14, 15, 16 and 17 glasses were observed to contain them. Metallic spherules range in size from <1 μm to at least 30 μm in diameter (Fig. 7b). In some particles numerous submicron-sized metallic spherules delineate flow lines. In many of the glass spherules the metallic spherules are located near the surface.

Most of the metallic spherules are composed or iron with a few percent nickel. However, others are rich in Ni, S or P (for example see Table 8).

Black, opaque, octahedral crystals (2 to 5 μm dia.) (Fig. 7c) have been observed in several glass particles. Electron microprobe analysis indicates that they are composed of $\sim$94% Fe and 6% Ni with a trace of Co. The glass particles containing the Ni-Fe crystals are homogeneous and are free of Ni-Fe spherules or other crystalline materials. In a few cases the Ni-Fe crystals occur in a curved plane through the glass particle with other crystals scattered through the glass.

Devitrification. Excluding the glasses from the Apollo 17 orange soil, approximately 3% of the glasses studied were partially or completely devitrified. The devitrification product is most often plagioclase (Fig. 7d).

CHEMISTRY.

The major element compositions of over 1000 glass particles have been determined (94 Apollo 11, 161 Apollo 12, 315 Apollo 14, 207 Apollo 15, 190 Apollo 16, 213 Apollo 17, 1 Luna 16 and 20 Luna 20 glasses) (Table 9). These glasses show a wide range in composition, but most of the glasses from a given site have compositions similar to the rocks found at that site (Glass, 1971a; Glass, 1971b; Glass _et al._, 1972; Glass, 1973). The average composition of the glasses from a given soil sample is similar to the bulk composition of the soil (Table 10).

Histograms, variation diagrams, and cluster analysis show that the glass analyses tend to fall into clusters or groups (Glass, 1971a; Glass, 1971b; Glass _et al._, 1972; Glass, 1972; Glass, 1973; Reid _et al._, 1972b). A discussion of these groups is given in the discussion section.

UNIQUE GLASSES.

Apollo 15 Green Glasses. Transparent, emerald green glass spherules that are extremely homogeneous in composition are very abundant in some Apollo 15 samples. These glasses have low TiO_2 (~0.5%), Al_2O_3 (~7%) and high FeO (~20%) and MgO (~18%) contents. The TiO_2 content is especially low for glasses with an FeO content that high.

Although mostly spherical in shape, many dumbbell, teardrop and disc shapes were also observed. Many of the spherules are chipped or broken and fragments are common. These glasses do not contain vesicles. No relict crystalline inclusions have been observed, but several spherules have partly or completely devitrified to olivine Fo_{76-85}, giving them an opaque cream yellow color. On spherule contains a rather large (~50 μm dia.) Ni-Fe spherule.

The green glasses are most abundant in the soils from the Apennine Front, especially in soil from Spur Crater (Apollo 15 Preliminary Examination Team, 1972). The >149 μm size fractions of samples 15301,117; 15101,128 and 15041,85; contain approximately 18%, 2% and 0.3% transparent green glasses, respectively. Glasses with this composition have not been reported from the Apollo 12 site and none have been found during this investigation in any Apollo 17 sample. However, glasses similar in appearance and composition to the Apollo 15 green glasses have been found in Apollo 14 samples and rarely in Apollo 11 and 16 samples. Since the Apollo 14 site is located in the Fra Mauro Formation which is believed to be ejecta from the Imbrian Basin, the green glasses found in the Apollo 14 samples may have also originated in the Imbrian area.

<u>Apollo 17 Orange Soil Glasses</u>. One of the highlights of the Apollo 17 mission was the discovery of orange soil found on the rim of Shorty Crater. This soil is composed almost entirely of opaque black to transparent deep red glass spherules similar in size and shape to the Apollo 15 green

glasses. And, like the Apollo 15 green glasses, the transparent deep red spherules are homogeneous in composition, not only within a given particle, but also from particle to particle. These glasses are characterized by their high TiO_2 (~9%), FeO (~23%) and MgO (~15%) and low SiO_2 (~39%), Al_2O_3 (~6%) and CaO (~6.5%) contents (Glass, 1973). They have a refractive index somewhat greater than 1.71.

Again, a large proportion were chipped or broken and fragments were common. Micrometeorite impact craters were not observed, indicating short surface exposure time. They do not contain vesicles, relict crystal inclusions or metallic spherules. Many of the black opaque spherules have partly devitrified. The devitrification product is lath-shaped olivine crystallites (Fo_{70}) bordered by small crystals of ilmenite.

The opaque glasses have a wide range in composition, but their modal composition is the same as the average composition of the red spherules. Variation diagrams show that the analyses of these glasses establish linear trends that all have as one end member the composition of the olivine crystals in the opaque glasses and that pass through a point representing the average composition of the red glasses (Glass, 1973). This demonstrates that the variation in observed composition was produced by crystallization of the olivine crystals.

Glass particles similar in appearance and composition to the deep red glass spherules in the Apollo 17 orange soil have been found at other sites (e.g. Apollo 11).

Transparent Pale-Green High Al_2O_3 Glasses. Another group of glasses that deserves special mention is comprised of transparent pale-green glass fragments with high Al_2O_3 contents (Ave. ~25%) that are rare, but ubiquitous. These glass fragments (often rounded) have a distinct pale-green color and often have a dark-colored rock flour coating one or more surfaces. They do not contain vesicles or relict mineral inclusions and only occasionally contain metallic spherules. Some have partly devitrified to plagioclase. Most have a refractive index of ~1.595, but a smaller group that is similar in appearance and composition has an average R.I. of ~1.588. They are homogeneous within a single fragment and from particle to particle and from one site to the next (Table 11). They are compositionally similar to a large group of glasses with an average Al_2O_3 content of ~25% commonly found in highland soils. However, the pale-green glass fragments are more common in mare soils than in the highland samples investigated.

Discussion

GLASS CONTENT AS A MEASURE OF SOIL MATURITY.

During the passage of time the lunar soil becomes finer as a result of repeated bombardments by meteorites. Meteorite bombardment also produces glass and welds together soil fragments to produce breccia. Thus the maturity or age of a lunar soil should be reflected in its grain size and composition. That is to say, the average grain size decreases and the glass and breccia content increase with increasing maturity or age (for a more complete discussion see Lindsay, 1972). Using the glass content as a measure of age or maturity, however, should be done with caution as glass can be produced by volcanic as well as impact events. For example, the Apollo 15 green glass and Apollo 17 orange soil glass may have been formed by volcanic processes (this is discussed further in a later section). McKay et al. (1972) suggest that the content of glazed aggregates (or glassy agglutinates) may be a better measure of soil age or maturity than the total glass content, since such particles are probably produced only by meteorite bombardment. Variation diagrams of percent glassy agglutinates versus the percent of the soil in the finer size fractions shows that in general the glassy agglutinate content of the soil increases with decreasing average grain size of a soil (Fig. 8).

ORIGIN OF LUNAR GLASSES.

There is a great deal of evidence indicating that much of the glass found in the lunar soil was produced by meteorite impact. First of all, many of the lunar rocks and fragments recovered from the soil show evidence of shock metamorphism (Sclar, 1970; Short, 1970). In addition, many of the glass particles themselves show evidence of having an impact origin. Such evidence includes: 1) chemical heterogeneity, 2) inclusion of Ni-Fe spherules, and 3) inclusions of highly shocked relict crystals. As discussed in an earlier section, all of the above features are particularly characteristic of opaque glass particles, but are extremely rare in transparent glasses. In addition to the above evidence, glasses of monomineralic compositions are often found (e.g. maskylinite). (For a more complete discussion of the evidence for an impact origin of lunar glasses see Chao et al., 1970.)

There is also evidence that at least some of the lunar glasses were produced by volcanism. The opaque black to deep red glass particles that make up the Apollo 17 orange soil were apparently produced by volcanism. In addition to the negative evidence for impact (i.e. homogeneity, absence of Ni-Fe spherules and shocked relict crystalline inclusions) some of the glasses were found to contain euhedral olivine crystals that appear to be phenocrysts (McKay & Heiken, 1973). Many authors have suggested, therefore, that the Apollo 17 orange soil glasses have a volcanic origin (Reid et al., 1973; McKay & Heiken, 1973; Glass, 1973). It has further been suggested that these glasses were produced by lava fountaining and that by analogy the Apollo 15 green glasses were produced in a similar manner (Reid <u>et al</u>., 1973; McKay & Heiken, 1973).

Thus there is evidence that many of the glasses, particularly the opaque heterogeneous ones, are produced by impact; while others, for example the Apollo 17 orange soil glasses and possibly the Apollo 15 green glasses, are produced by volcanism. It is not possible to tell the origin of many of the transparent glass particles due to the absence of the criteria discussed above that would indicate either an impact or volcanic origin. At least some of these transparent glasses may have been formed by impact since one was found to contain a lechatelierite particle (Glass, 1971). Others, however, could have been formed by volcanism. Thus the relative abundance of impact-generated versus volcanically-produced glasses in the lunar soil is not known.

VAPOR FRACTIONATION.

Based on major element analyses, 125 Apollo 12 glass particles from sample 12057 were divided into six groups (Glass, 1971). Most of the glasses were similar in composition to the Apollo 12 crystalline rocks; especially one group referred to as normal basaltic glasses. The glasses in a second group, referred to as low-alkali basaltic glasses, are similar to the normal basaltic glasses, but have slightly higher average TiO_2, Al_2O_3, MgO and CaO and lower Na_2O, K_2O, P_2O_5 and SiO_2 contents. This difference in composition is what would be expected as a result of vapor fractionation.

Also in support of vapor fractionation is the fact that nearly all the low-alkali basaltic glasses are small (<150 μm dia.) spherules without bubble cavities or crystalline inclusions. The normal basaltic glasses, on the other hand, generally contain crystalline inclusions. This suggests that the low-alkali basaltic glasses were heated more intensely than were the normal basaltic glasses.

Since the lunar glasses show distinct clustering according to composition and since the bulk of the glasses from each collection site are similar in composition to the rocks and fines from the same site, it is unlikely that the major element contents of most of the glasses have been changed appreciably by vapor fractionation. Chao et al. (1970) also conclude that the major element contents of the lunar glasses they studied have not been appreciably affected by volatilization, and that the present compositions of these glasses probably closely reflect the compositions of the parent materials.

LUNAR SURFACE CHEMISTRY AS DEDUCED FROM PREFERRED GLASS COMPOSITIONS.

Many of the glass particles found in the lunar fines represent homogenized portions of lunar surface material whether formed by impact or volcanism. A gram sample of < 1 mm fines will contain hundreds or thousands of such particles > 50 μm in diameter. According to Shoemaker et al. (1970) ~ 50% of the regolith at the Apollo 11 site (and presumably other sites) is expected to have come from a distance less than 3.1 km, about 5% from distances greater than 1.0 km and as much as 0.5% or more from distances greater than 1000 km. Thus the investigation of lunar glass particles from a single sample of < 1 mm fines can indicate a great deal about the composition and heterogeneity of the lunar surface within a radius of several hundred kilometers of the collection site.

Histograms of Al_2O_3 content of the glasses from each site show a polymodal distribution (Fig. 9). The glasses from each site can be divided into two main groups: 1) high aluminum glasses with Al_2O_3 contents >~22%, and 2) low aluminum glasses with Al_2O_3 contents <~22%. The high aluminum glasses themselves can be divided into several groups bases on Al_2O_3 contents. The majority of the high aluminum glasses have an Al_2O_3 content between ~ 22% and 29% with a mode of ~ 25%. These glasses have compositions equivalent to anorthositic gabbro. Glasses with this composition are referred to as highland basalts by Reid et al. (1972).

A second group of high Al_2O_3 glasses has a mode at ~ 30% Al_2O_3 and is anorthositic or gabbro anorthositic in composition. A third group has a mode of ~ 36% Al_2O_3. The glasses in this last group have essentially anorthite compositions and many are probably maskylinite (diaplectic plagioclase glass).

The high aluminum glasses have compositions similar to the soil, breccias, and crystalline rocks found at the two highland sites, Apollo 16 and Luna 20. In addition, orbital x-ray fluorescence data obtained during Apollo 15 and 16 show that the hgihlands have maximum Al/Si ratios that lie between anorthositic gabbro and gabbroic anorthosite (Adler et al., 1973). Thus the high aluminum glasses were probably derived from the lunar highlands. This is consistent with the abundance of these glasses in the lunar samples. High aluminum glasses have been found in varying degrees in soil samples from all of the lunar sites (Reid et al., 1972a; Reid et al., 1972b; Glass, 1973), but are most abundant in samples from the highland sites where they make up $\sim$73% of the glasses analyzed (Table 12).

The most useful subdivision of the low aluminum glasses appears to be based on FeO content. Those with FeO contents $>$ 14% have compositions similar to mare basalts while those with FeO contents $<$ 14% have KREEP-like compositions. The glasses with FeO contents $>$ 14% have a wide range in composition but all are generally similar in composition to mare basalts. Such glasses are abundant in mare soil samples but make up $<$10% of the highland Apollo 16 glasses.

The composition and abundance distribution is thus consistent with a mare origin for these glasses.

The low FeO (<14%) glasses have lower FeO contents than mare basalts. They can be divided into two groups based on their K_2O contents. Those with $K_2O > 0.5\%$ resemble KREEP material as defined by Meyer et al. (1971). Glasses with KREEP-like compositions, but lower K_2O contents (<0.5%) are also present at most sites. Material with KREEP composition has been found at all Apollo and Luna sites and has been variously called norite, gray mottled fragments, non-mare basalts and Fra Mauro basalt or high alumina basalt (Reid et al., 1972a; Reid, 1974). Reid et al. (1973a) point out that low K, KREEP-like glasses are common in highland soils. Thus, these glasses are probably also derived from the highlands. KREEP material, on the other hand, has been shown by orbital gamma-ray experiments to be concentrated in the region of Mare Imbrium and Oceanus Procellarum (Trombka et al., 1973). This is puzzling because the similarity in composition between the low-K and high-K (KREEP) non-mare basaltic glasses suggests that they are closely related.

A fourth major group of glasses can be distinguished based on SiO_2 content. Glasses with SiO_2 contents >60% are rare, but ubiquitous. They have been found in small quantities at nearly all of the sampling sites. Most of these high silica glasses have SiO_2 contents of close to 76% and are very similar compositionally to the glassy mesostasis found in many of the mare basalts (Table 13).

COMPARISON BETWEEN SOIL COMPOSITION AND AVERAGE GLASS COMPOSITION.

The average composition of the glasses from each station is similar to the bulk composition of the soil at that station (Table 10). However, some systematic variations between average glass composition and bulk soil composition do occur. The glasses from mare soils generally have higher Al_2O_3 and CaO and lower TiO_2 and FeO contents than the soils from which they were separated. Likewise, the glasses from highland samples generally have lower Al_2O_3 and CaO and higher TiO_2 and FeO contents than the associated soils. The difference in composition suggests that the glass component in the mare soils is enriched in highland material in comparison to the bulk soil and that the glass component in the highland soils is enriched in mare material in comparison to the bulk soil.

COMPARISON BETWEEN LUNAR GLASS SPHERULES AND MICROTEKTITES.

Microtektites are microscopic (<1 mm dia.) glass spherules (found in deep-sea sediments) that have been related by geographical occurrence, age, petrography and chemistry to three of the four known tektite strewnfields (Glass, 1969; Glass, 1972c; Glass _et al._, 1973). Although the origin of tektites (and therefore microtektites) is not agreed upon by all investigators, most believe that they are the result of meteorite impact on the earth.

The largest microtektite found to date has a diameter of $\sim$1 mm. Similarly lunar glass spherules larger than 1 mm in diameter are rare. The size distribution of lunar glass spherules between 125-1000 μm is similar to that of the microtektites; however, the lunar glass spherules appear to increase in number with decreasing size at a greater rate than do the microtektites (Table 14).

The shape distribution of the lunar glass spherules is similar to that of the microtektites (Table 15). Both consist of 80-95% spheroidal forms with a minor amount of lens, oval, cylinder, dumbbell and teardrop forms. However, surface features on the lunar glass spherules are quite distinct from those observed on microtektites. This difference is probably due to the difference in environment of occurrence of the two glasses.

Although only a few lunar glass spherules have been directly dated most were probably formed over 3 b.y. ago. The known microtektites, on the other hand, were all formed less than 36 m.y. ago.

Lunar glass spherules with silica contents greater than 60% are extremely rare. Microtektites (and tektites), on the other hand, have SiO_2 contents >60%. An exception to this is the bottle-green microtektites found in association with the normal microtektites in all three strewnfields. The bottle-green microtektites have SiO_2 contents ranging down to ~46% and MgO contents as high as 27%. The lunar spherules that have SiO_2 contents within the range of the bottle-green microtektites have much lower MgO contents and/or too high FeO and too low Al_2O_3 contents to be similar to the bottle-green microtektites.

Of the 450 lunar glass spherules analyzed, only one had a SiO_2 content >60%. It was a transparent yellow-brown glass spherule with a diameter of ~100 μm. It contained no vesicles or inclusions and would be difficult, except for the surface sculpturing, to distinguish from a microtektite. The major element composition is, likewise, similar to microtektites except for a somewhat lower MgO content (Table 16).

Although few, if any, studies have been directed toward determining the FeO/Fe_2O_3 ratio and water content of the glass spherules themselves, much has been done on lunar material in general and it is reasonable to expect that the lunar glasses probably have high FeO/Fe_2O_3 ratios and low water contents. This is true also for tektites (and microtektites) and serves to distinguish tektites from terrestrial igneous glasses. Otherwise, however, most of the lunar glasses (particularly the spherules) are chemically distinct from known tektites and microtektites.

The similarity in appearance between the lunar glass spherules and microtektites is probably a result of both having been produced by the same process (i.e. impact).

Conclusions

Most of the conclusions reached in this study are supported by data presented by other investigators and many of the conclusions are similar to ones proposed by other investigators. The major conclusions are as follows:

1) The average grain size of a soil decreases and the glass (particularly agglutinate) content increases with age or maturity of the soil.

2) Glass particles found in the lunar fines have multiple origins. Many (particularly the black opaque ones) were formed by meteorite impact; others, like the Apollo 17 orange glasses (and the Apollo 15 green glasses), are probably of volcanic origin. However, the origin of many of the transparent glass spherules without crystalline inclusions is not possible to determine, and therefore the relative abundance of impact-generated versus volcanically-produced glasses is not known.

3) Most of the surface features (pits, metallic beads, splashed silicate glass, etc.) on the glass spherules are the result of meteorite impact.

4) Impact pits with radial fracture zones are the result of relatively low-energy impacts, whereas those with spallation zones are the result of relatively high-energy impacts.

5) The majority of the glass particles in a given soil sample have compositions similar to the rocks and soils collected at that site (exceptions are samples 15301 and 74220 that contain a high percentage of volcanically-produced glasses).

6) The average composition of the glasses from a given soil sample is similar to the bulk composition of the soil, but differs in such a manner as to indicate that most of the highland-derived material in a mare soil are glass and vice versa for a highland soil.

7) There is some evidence for a minor amount of vapor fractionation.

8) Lunar glass compositions tend to fall into clusters or groups that represent various "rock types" found on the lunar surface. The following are the major compositional groups and their equivalent "rock types":

a) $Al_2O_3 > 28\%$ (Anorthosite and gabbroic anorthosite)
b) 22% $Al_2O_3 < 28\%$ (Anorthositic gabbro)
c) $Al_2O_3 < 22\%$, $FeO < 14\%$, $K_2O > 0.5\%$ (KREEP)
d) $Al_2O_3 < 22\%$, $FeO < 14\%$, $K_2O < 0.5\%$ (low-K, KREEP-like basalt)

e) $11\% < Al_2O_3 < 22\%$, $FeO > 14\%$ (Mare basalt)

f) $Al_2O_3 < 11\%$, $FeO > 18\%$ (e.g. Apollo 15 green glasses and Apollo 17 orange soil glasses) (Ultrabasic)

g) $SiO_2 > 60\%$ ("Granitic").

The high (>22%) Al_2O_3 glasses are more abundant in highland samples and probably represent highland material. The high (>14%) FeO glasses with Al_2O_3 contents between 11 and 22% generally have compositions similar to mare basalts and are derived from a mare source area. Most of the high silica glasses (particularly those with SiO_2 contents close to 76%) are similar petrographically and compositionally to the glassy mesostasis in mare basalts and may therefore also have a mare origin. The source of the low Al_2O_3 (<22%) and low FeO (<14%) KREEP ($K_2O > 0.5\%$) and KREEP-like ($K_2O < 0.5\%$) glasses is more difficult to determine. Abundance of KREEP glasses in soil samples and orbital gamma-ray experiments indicate that KREEP material is concentrated around Mare Imbrium and Oceanus Procellarum. However, low-K, KREEP-like material appears to be more common in highland areas.

Acknowledgements.

Electron microprobe analyses were performed at Goddard Space Flight Center and the Meteoritical Division of the Smithsonian Institute with the help of F. Wood, A. Doan, E. Jarosewich , C. Obermeyer and J. Nelen. C. Inman and W. Kouns helped in preparation of Apollo 11 and 12 samples. R.J. Anstead and T. Nagase helped with SEM studies. The assistance of L.S. Walter is gratefully acknowledged. I thank I. Adler and J.A. Philpotts for making it possible to make initial study of Apollo 11 samples. Discussions with C.C. Schnetzler and B. French were most helpful. K.D. Glass, D. Colvin, P. Swetland and L. Rosen helped with data reduction. I am especially grateful to J.A. O'Keefe for encouragement and helpful discussions. J.A. Glass helped in preparing the manuscript. The initial studies of Apollo 11 and 12 samples were accomplished while the author was a National Research Council Postdoctoral Resident Associate at Goddard Space Flight Center.

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TABLE 1
Samples Investigated

Sample No.	Description	Weight (gm)	Location
10084,138	1 mm fines	0.492	Next to lunar module
12001,59	"	0.539	Northwest of lunar module
12057,54	"	0.513	Mixture of fines from several locations of Apollo 12 site
12070,129	"	0.424	10 m southwest of lunar module
14148,44	"	0.508	Station G, surface of trench
14149,55	"	0.277	Station G, bottom of trench
14156,41	"	0.495	Station G, middle of trench
14163,49	"	0.487	Bulk sample from EVA-1, near LM
14230,75	"	0.105	Sta G, second single core tube
14230,82	"	0.111	Sta G, second single core tube
14259,20	"	4.875	Comprehensive sample
15041,85	"	0.251	Sta 8, top of Soil Mechanics Trench
15101,128	"	0.248	Station 2, Apennine Front
15301,117	"	0.246	Station 7, Spur Crater
63501,23	"	0.252	Sta 13, 0.5 km southeast of rim crest of North Ray Crater
64501,3	"	0.254	Sta 4, highest on Stone Mountain
68501,29	"	0.248	Sta 8, ray of South Ray Crater
74220,89	"	0.261	Sta 4, South rim of Shorty Crater
74241,47	"	0.260	Sta 4, South rim of Shorty Crater
78421,25	"	0.229	Sta 8, base of Sculptured Hills
Luna 16-A40	glass bead	0.002	Mare Fecunditatis
Luna 20 SA0 518, 520,522,529&530	polished sections		Highlands just north of Mare Fecunditatis

TABLE 2

Size Analyses (Weight Percent)

Size Fraction (μm)	12057	12070
580	2.2	6.5
147-580	23.0	19.2
74-147	22.6	25.2
44-74	25.6	8.8
<44	26.6	40.3

Size Fraction (μm)	10084	12001
505-1000	4.12	4.0
295-505	5.32	4.7
149-295	10.62	11.3
74-149	15.13	14.5
44-74	64.80	20.7
<44		44.8

Size Fraction (μm)	14148	14149	14156	14163	14230, 75	14230 82
505-1000	2.8	6.8	5.3	5.3	10.5	16.8
295-505	4.2	6.7	5.2	4.6		
149-295	11.1*	11.9	10.7	9.4	8.8	10.5
74-149	13.6	11.7	13.9	11.6	33.0	30.4
44-74	29.8	19.8	20.2	24.1		
<44	38.5	43.1	44.7	45.0	47.7	42.3

Size Fraction (μm)	15041	15101	15301	63501	64501	68501
505-1000	2.5	2.9	2.6	7.9	6.7	8.1
295-505	3.2	3.3	4.2	7.6	5.7	8.2
149-295	10.0	10.1	11.2	13.9	12.0	13.1
74-149	13.4	14.4	14.7	14.5	13.2	14.7
44-74	22.8	24.2	23.0	19.6	62.4	19.5
< 44	48.0	45.0	44.4	36.5		37.1

Size Fraction (μm)	74220	74241	78421
505-1000	2.6	6.8	2.8
295-505	1.2	6.0	3.6
149-295	7.9	11.8	10.0
74-149	13.1	14.1	14.6
44-74	75.3	61.3	69.1
< 44			

* Part of this size fraction lost during sieving.

TABLE 3

Modal Analyses

	10084,133				12001,59			
Size Fraction	505-1000 (56)	295-505 (317)	149-295 (1471)	74-149 (1202)	505-1000 (56)	295-505 (266)	149-295 (1000)	74-149 (1005)
Lithic Grains								
White ±	1.8	0.6	1.0	0.4	0.0	1.5	1.9	2.3
Coarse	26.8	28.7	27.0	38.9	14.3	16.2	14.2	16.7
Fine					8.9	4.1	8.5	
Microbreccia	8.9	28.7	13.7	5.7	16.1	12.4	6.9	4.3
Mineral Grains								
Feldspar	0.0	0.3	0.8	8.1	0.0	2.2	3.1	3.3
Pyroxene	0.0	0.3	1.3		1.8	3.0	15.0	20.2
Olivine	0.0	0.0	0.6	2.6	0.0	0.0	0.7	0.3
Other	0.0	0.0			0.0	0.0	0.8	
Glassy Agglutinates	35.7	26.8	46.4	32.2	28.5	27.1	26.7	30.2
Glass Particles								
Fragments								
Opaque	23.2	13.2	6.5	10.4	21.4	30.1	20.0	21.0
Transparent								
Bottle-green	1.8	0.3	1.3	0.7	3.6	0.4	0.8	0.2
Other					0.0	0.0	0.8	0.7
Ropy Forms ≠	1.8	0.6	0.4	-	3.6	1.9	0.2	0.0
Spherules								
Opaque	0.0	0.0	0.7	0.6	1.8	1.1	0.4	0.8
Transparent	0.0	0.3	0.2	0.3				
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 3

Modal Analysis (cont.)

	14148,44				14149,55			
Size Fraction	505-1000 (48)	295-505 (264)	149-295 (1004)	74-149 (1009)	505-1000 (53)	295-505 (194)	149-295 (1007)	74-149 (1004)
Lithic Grains								
White ±	0.0	2.6	2.6	2.8	0.0	1.5	4.7	4.0
Coarse	8.4	(29.2	(32.7	(31.7	49.1	33.5	26.8	(34.0
Fine	10.3	(	(	(	7.5	18.6	18.1	(
Microbreccia	8.4	6.1	0.6	0.0	24.5	9.3	2.7	3.6
Mineral Grains								
Feldspar	(	2.6	1.6	5.2	0.0	1.0	4.0	10.6
Pyroxene	(4.2	0.0	0.8	2.3	(1.9	(0.5	(4.6	(
Olivine	(	0.0	0.1	0.7	(	(	(	(5.1
Other	(	0.0	0.9	1.5	0.0	0.0	0.0	(
Glassy Agglutinates	50.0	37.5	34.4	31.0	11.3	21.1	22.2	20.6
Glass Particles								
Fragments								
Opaque	10.4	18.9	20.9	24.3	5.7	9.8	15.6	19.4
Transparent								
Bottle-green	2.1	0.4	0.2	0.2	0.0	0.0	0.0	0.0
Other	0.0	1.1	2.1	2.0	0.0	1.5	0.6	1.3
Ropy Forms ≠	4.2	0.8	1.2	0.1	0.0	2.1	0.3	0.0
Spherules								
Opaque	0.0	0.8	(1.7	(1.0	0.0	1.0	(0.5	(1.4
Transparent	0.0	0.0	(	(	0.0	0.0	(	(
Other	2.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0

TABLE 3

Modal Analysis (cont.)

Size Fraction	14156,41 505-1000 (65)	295-505 (293)	149-295 (1000)	74-149 (1000)	14163,49 505-1000 (54)	295-505 (242)	149-295 (1000)	74-149 (1097)
Lithic Grains								
White ±	3.1	2.0	2.6	2.2				3.4
Coarse	43.1	36.5	30.8	30.2	42.6	40.5	45.7	29.0
Fine								
Microbreccia	9.2	7.5	2.7	0.0	1.8	2.5		0.0
Mineral Grains								
Feldspar		0.7	2.7	3.9		1.6	3.4	9.8
Pyroxene	0.0	0.7	3.0	3.4	1.8	0.8	2.1	3.7
Olivine		1.0	0.9	0.7		0.0	0.4	1.6
Other		0.0	0.6	0.5		0.0	1.3	2.6
Glassy Agglutinates	29.2	37.2	38.9	34.6	13.0	32.2	25.8	12.9
Glass Particles								
Fragments								
Opaque	13.9	9.6	14.8	21.6	33.3	9.9	12.7	24.5
Transparent								
Bottle-green	0.0	0.7	0.0	0.1	3.7	0.8	0.3	0.0
Other	0.0	0.7	1.8	1.2	0.0	6.6	6.6	10.6
Ropy Forms ≁	0.0	1.7	0.4	0.2	0.0	4.1	0.7	0.2
Spherules								
Opaque	1.5	1.7	0.8	1.2	3.7	0.8	1.0	1.1
Transparent	0.0	0.0			0.0	0.0		
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4

TABLE 3

Modal Analyses (cont.)

	14230,75		14230,82		15041,85		
Size Fraction	295-1000 (84)	149-295 (1014)	295-1000 (82)	149-295 (1000)	505-1000 (21)	295-505 (96)	149-295 (843)
Lithic Grains							
White +	0.0	1.4	4.9	4.3	0.0	1.0	1.1
Coarse	29.8	31.6	45.1	33.9	9.5	5.2	8.9
Fine							
Microbreccia	32.1	15.1	15.9	13.1	57.1	27.1	12.8
Mineral Grains							
Feldspar	0.0	5.2	0.0	5.2	0.0	3.1	3.3
Pyroxene	0.0	2.2	0.0	3.3	0.0	3.1	10.1
Olivine	0.0		0.0		0.0		
Other	0.0	0.2	0.0	1.0	0.0		
Glassy Agglutinates	26.2	19.3	24.4	20.5	19.0	39.6	49.7
Glass Particles							
Fragments							
Opaque	8.3	17.6	8.5	14.3	9.5	19.8	10.8
Transparent							
Bottle-green	1.2	0.2	0.0	0.7	0.0	0.0	0.0
Other	0.0	2.9	0.0	3.2	0.0	1.0	1.9
Ropy Forms ≠	0.0	1.9	1.2	0.0	0.0	0.0	0.0
Spherules							
Opaque	1.2	1.4	0.0	0.5	4.8	0.0	0.6
Transparent	1.2		0.0		0.0	0.0	0.9
Other	0.0		0.0	0.0	0.0	0.0	0.0

TABLE 3

Modal Analysis (cont.)

	14148,44				14149,55			
Size Fraction	505-1000 (48)	295-505 (264)	149-295 (1004)	74-149 (1009)	505-1000 (53)	295-505 (194)	149-295 (1007)	74-149 (1004)
Lithic Grains								
White +	0.0	2.6	2.6	2.8	0.0	1.5	4.7	4.0
Coarse	8.4	(29.2	(32.7	(31.7	49.1	33.5	26.8	(34.0
Fine	10.3	(	(	(	7.5	18.6	18.1	(
Microbreccia	8.4	6.1	0.6	0.0	24.5	9.3	2.7	3.6
Mineral Grains								
Feldspar	(	2.6	1.6	5.2	0.0	1.0	4.0	10.6
Pyroxene	(4.2	0.0	0.8	2.3	(1.9	(0.5	(4.6	(
Olivine	(	0.0	0.1	0.7	(	(	(	(5.1
Other	(	0.0	0.9	1.5	0.0	0.0	0.0	(
Glassy Agglutinates	50.0	37.5	34.4	31.0	11.3	21.1	22.2	20.6
Glass Particles								
Fragments								
Opaque	10.4	18.9	20.9	24.3	5.7	9.8	15.6	19.4
Transparent								
Bottle-green	2.1	0.4	0.2	0.2	0.0	0.0	0.0	0.0
Other	0.0	1.1	2.1	2.0	0.0	1.5	0.6	1.3
Ropy Forms ≠	4.2	0.8	1.2	0.1	0.0	2.1	0.3	0.0
Spherules								
Opaque	0.0	0.8	(1.7	(1.0	0.0	1.0	(0.5	(1.4
Transparent	0.0	0.0	(	(	0.0	0.0	(	(
Other	2.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0

TABLE 3

Modal Analyses (cont.)

	63501,23			64501,3		68501,29		
Size Fraction	505-1000 (56)	295-505 (224)	149-295 (1132)	505-1000 (40)	295-505 (177)	505-1000 (58)	295-505 (228)	149-295 (818)
Lithic Grains								
White ±	7.1	7.6	7.8	5.0	11.3	5.2	5.3	3.9
Coarse	41.1	38.8	47.8	25.0	23.2	53.4	49.6	40.1
Fine	17.8							
Microbreccia	5.4	19.2	3.4	22.5	14.7	5.2	8.3	6.1
Mineral Grains								
Feldspar	7.1	6.7	14.3	20.0	24.8	3.4	4.4	8.9
Pyroxene	0.0			0.0		0.0	0.0	
Olivine	0.0	0.4	1.3	0.0	1.7	0.0	0.0	0.4
Other	0.0			0.0		0.0	0.0	
Glassy Agglutinates	12.5	18.8	13.3	12.5	13.0	24.1	21.5	33.1
Glass Particles								
Fragments								
Opaque	5.4	8.0	10.6	7.5	10.2	8.6	10.1	5.5
Transparent								
Bottle-green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	1.8	0.4	1.1	5.0	1.1	0.0	0.9	1.2
Ropy Forms ≠	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spherules								
Opaque	1.8	0.0	0.1	2.5	0.0	0.0	0.0	0.5
Transparent	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2
Other	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0

TABLE 3

Modal Analysis (cont.)

	14148,44				14149,55			
Size Fraction	505-1000 (48)	295-505 (264)	149-295 (1004)	74-149 (1009)	505-1000 (53)	295-505 (194)	149-295 (1007)	74-149 (1004)
Lithic Grains								
White +	0.0	2.6	2.6	2.8	0.0	1.5	4.7	4.0
Coarse	8.4	(29.2	(32.7	(31.7	49.1	33.5	26.8	(34.0
Fine	10.3	(	(	(	7.5	18.6	18.1	(
Microbreccia	8.4	6.1	0.6	0.0	24.5	9.3	2.7	3.6
Mineral Grains								
Feldspar	(	2.6	1.6	5.2	0.0	1.0	4.0	10.6
Pyroxene	(4.2	0.0	0.8	2.3	(1.9	(0.5	(4.6	(
Olivine	(	0.0	0.1	0.7	(	(	(	(5.1
Other	(	0.0	0.9	1.5	0.0	0.0	0.0	(
Glassy Agglutinates	50.0	37.5	34.4	31.0	11.3	21.1	22.2	20.6
Glass Particles								
Fragments								
Opaque	10.4	18.9	20.9	24.3	5.7	9.8	15.6	19.4
Transparent								
Bottle-green	2.1	0.4	0.2	0.2	0.0	0.0	0.0	0.0
Other	0.0	1.1	2.1	2.0	0.0	1.5	0.6	1.3
Ropy Forms ≠	4.2	0.8	1.2	0.1	0.0	2.1	0.3	0.0
Spherules								
Opaque	0.0	0.8	(1.7	(1.0	0.0	1.0	(0.5	(1.4
Transparent	0.0	0.0	(	(	0.0	0.0	(	(
Other	2.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0

TABLE 3

Modal Analyses (cont.)

Size Fraction	78421,25 505-1000 (21)	295-505 (106)	149-295 (960)
Lithic Grains			
White +	14.3	9.4	4.5
Coarse	(4.8	3.8	3.7
Fine	(	10.4	8.4
Microbreccia	23.8	16.0	12.2
Mineral Grains			
Feldspar	4.8	5.7	7.2
Pyroxene	0.0	0.9	1.6
Olivine	0.0	0.0	0.5
Other	0.0	1.9	0.8
Glassy Agglutinates	47.6	42.5	51.6
Glass Particles			
Fragments			
Opaque	4.8	8.5	8.8
Transparent			
Bottle-green	0.0	0.0	0.0
Other	0.0	0.9	0.5
Ropy Forms ≁	0.0	0.0	0.0
Spherules			
Opaque	0.0	0.0	0.9
Transparent	0.0	0.0	0.3
Other	0.0	0.0	0.0

+ Opaque white highly fractured grains.

≁ Ropy to platy or rounded glass particles coated with rock flour.

( ) Number of grains

TABLE 4

Glass Spherule Abundance in Various Size Fractions

Sample No.	Spherules per gm of sample 505-1000*	295-505*	149-295*	74-149*
10084,138	0	38	325	3265
12001,59	46	119	196	1710
14148,44	0	94	496	4544
14149,55	0	108	365	3262
14156,41	38	192	379	4513
14163,49	77	89	417	4296
14230,75	182		645	—
14230,82	0	0	427	—
15041,85	156	0	476	3631
15101,128	0	488	1355	3762
15301,117	0	2020	7420	58,127
63501,23	50	0	199	2356
64501,3	59	0	262	—
68501,29	0	0	525	2636
74220,89	0	567	16,100	91,000
74241,47	0	256	1876	16,920
78421,25	0	0	393	6250
ave.	27	248	1874	14,734

*Size fraction (microns)

TABLE 5

Shape Distribution of Glass Spherules (Percent Abundance)

Sample No.	Sphere	Oval	Teardrop	Dumbbell	Fragments	Other	Total
10084,138	62	9	2		13	4	90
12001,59	54	8	2	1	9	7	81
12057,54	227	20	6	5	37	11	306
12070,129	306	25	6	1	38	9	385
14148,44	87	19	1	2	21	6	136
14149,55	89	10		1	16	7	123
14156,41	85	21	7	1	25	6	145
14163,49	172	27	14	3	48	14	278
14230,75	6			1	4		11
14230,82	5	2			3		10
14259,20							
15041,85	112	11	2	1	8	3	137
15101,128	100	2			10	7	119
15301,117	324	16	4	2	21	47	414
63501,23	71	3	3		16	1	94
64501,3	9				2		11
68501,29	82	8	3	1	19	1	114
74220,89	329	74	8	1	93	25	530
74241,47	57	5		2	9	11	84
78421,25	6	3					9
Total	2182	263	58	22	392	159	3076
%	70.9	8.6	1.9	0.7	12.7	5.2	100.0

TABLE 6

Size Distribution of Spherical-Shaped Glass Spherules (Percent Abundance)

Sample No.	12057	12070	14163	14148	14156	14149	12001	15301
Class limits (µm)	(175)	(238)	(199)	(117)	(97)	(101)	(62)	(368)
500-1000	0	0.4	1.5	0.4	1.2	0	0.9	0.1
354-499	0.6	3.0	1.0	0.0	1.2	2.0	1.8	0.6
250-333	2.9	3.7	4.0	1.5	2.0	4.0	2.7	3.1
177-249	7.4	13.4	8.0	11.7	7.4	6.9	20.7	8.5
125-176	26.2	21.0	29.1	21.6	19.8	28.7	26.1	33.4
88-124	62.9	58.5	56.3	64.8	68.3	58.4	47.7	54.2

	15101 (107)	15041 (124)	63501 (75)	68501 (88)	74220 (418)	74241 (69)	10084 (66)	(Ave.)
500-1000	0	0.8	0	0	0.0	0	0	0.4
354-499	3.2	0.0	0	0	0.3	0.8	0.4	1.0
250-353	6.4	0.8	0	1.1	3.0	2.8	1.9	2.7
177-249	14.1	12.1	0	10.2	16.9	6.3	12.1	10.4
125-176	21.4	27.4	24	30.7	38.7	26.1	30.0	26.9
88-124	43.6	58.9	76	58.0	41.0	64.0	55.6	57.9

() Total number

TABLE 7

Percent Abundance of Glass Spherules according to Color

Sample No.	Colorless	Green	Yellow	Brown	Red
10084,138		7.9	10.5	34.2	47.4
12001,59			12.2	82.9	4.9
12057,54	4.0	11.3	11.3	70.2	3.2
12070,129	3.9	9.7	9.7	73.5	3.2
14148,44	3.1	22.7	24.7	49.5	
14149,55	1.2	12.3	27.2	55.6	3.7
14156,41	1.9	16.8	30.8	44.9	5.6
14163,49	2.8	14.7	28.8	49.7	3.9
14230,75		37.5		62.5	
14230,82		25.0	25.0	50.0	
15041,85	0.9	19.1	30.0	44.5	5.5
15101,128	3.7	58.3±	11.1	23.1	3.7
15301,117		90.6±	2.5	3.9	2.9
63501,23	8.7	14.5	46.4	28.9	1.4
64501,3		22.2	44.4	33.3	
68501,29	7.5	26.9	40.9	21.5	3.2
74220,89	0	0	0.3	0	99.7
74241,47	3.7	11.1	1.9	3.7	79.6
78421,25	0	0	20.0	60.0	20.0
Ave.	2.1	29.9	14.8	30.7	22.4

±Mostly deep emerald green

TABLE 8

Composition of Metallic and Sulfide Spherules in Glass Fragments from Apollo 12

Sample No. 12057

WEIGHT PER CENT

Sample No.	Size of Inclusion (μm)	(Electron Microprobe Analysis) Fe	Ni	P	S	Total*	Ni/Fe
201	8 x 10	87	1.5	1.6	0.2	90.3	0.017
212 S	9	81	3	2.4	0.2	86.6	0.035
212 I	10 x 24	90	2.5	0.3	0.1	92.9	0.028
207	12	51	11.5	0.1	25	87.6	0.25
217	32	89	6.5	1.6	0.0	97.1	0.073
200	10 x 32	55	3	0.0	30	88.0	0.055
165	8 x 10	79	6.5	2.1	0.4	88.0	0.082
160	6 x 10	12	32.0	0.15	2.4	46.6	2.67
164	8 x 9	80	8	2.6	0.0	90.6	0.10

*The low totals are due to the fact that the electron beam overlapped onto the surrounding silicate glass.

TABLE 9

Major Element Composition, Refractive Index and Description of Glass Particles

SAMPLF NO.	SIO2	TIO2	AL2O3	FEO	MNO	MGO	CAO	NA2O	K2O	CR2O3	TOTAL	R.I.	COLOR	TYPE
						APOLLO 11								
22	37.0	8.4	5.3	23.7	0.24	14.5	8.1	0.53	0.17		97.94		O	S
123	39.2	6.8	13.9	15.3	0.17	8.4	13.7	0.11	0.06		97.64		DRD	S
124	40.6	7.5	11.4	16.1	0.16	7.1	13.2	0.27	0.16		96.49		DRD	S
125	40.3	4.4	13.4	17.1	0.17	8.9	13.1	0.12	0.06		97.55		YBR	S
128	43.0	0.48	8.4	20.9	0.21	14.8	9.8	0.26	0.06		97.91		YGR	S
129	47.7	0.5	24.7	5.5	0.06	5.1	15.9	0.75	0.10		100.31		GRGY	S
472	43.7	6.95	13.34	15.75	.19	8.99	11.08	.502	.206		100.661		O	F
473	44.5	5.42	9.12	20.69	.25	7.30	9.92	.275	.310		97.753		O	F
474	42.2	6.50	12.81	14.14	.15	9.71	12.3	.45	.26		98.57		O	F
475	42.3	6.11	11.55	15.03	.20	8.96	11.09	.502	.161		95.866		O	F
476	42.1	6.74	13.85	14.58	.18	8.04	11.61	.284	.120		97.495		O	F
477	41.8	6.97	11.97	15.18	.21	7.94	11.27	.484	.188		95.978		O	F
478	42.3	10.23	10.30	19.02	.24	7.19	10.74	.462	.515		101.023		DGY	F
479	44.3	4.47	18.03	14.71	.14	9.45	11.74	.432	.126		103.358		DGY	F
480	50.2	.07	34.48	.23	.04	.14	16.68	2.036	.087		103.975		GRGY	F
481	51.8	2.19	15.64	11.37	.14	7.72	10.25	.347	.317		99.752		YBR	F
482	42.0	6.82	15.36	13.71	.18	7.76	12.4	.126	.063		98.369		O	S
483	40.9	7.78	12.64	16.76	.18	8.80	11.71	.096	.120		98.935		O	S
484	39.0	9.72	5.61	23.40	.22	13.83	7.46	.310	.105		99.626		O	S
485	41.9	5.96	10.66	20.31	.21	9.51	10.58	.003	.079		99.201		O	S
486	46.0	3.57	14.34	11.70	.17	13.49	9.97	.331	.082		99.640		ORBR	S
487	37.8	7.54	16.82	13.83	.18	8.82	13.93	.000	.068		99.002		RD	S
488	42.7	5.30	14.34	13.72	.14	9.03	12.03	.306	.162		97.38		O	S
489	42.2	8.14	10.85	17.29	.21	8.03	11.02	.440	.255		98.484		RDBR	S
490	43.7	4.52	18.36	11.74	.14	8.34	13.18	.258	.086		100.369		BR	S
1	48.1	.36	25.56	5.87	.08	7.42	14.31	.150	.024		101.884		PGR	S
492	44.8	3.53	14.41	14.55	.19	9.94	10.95	.299	.120		98.798		BL	S
493	44.4	3.58	14.69	12.70	.17	13.31	10.69	.292	.054		99.867		YBR	S
494	42.6	4.04	20.45	10.35	.11	7.47	14.14	.105	.059		99.332		RDBR	S
495	42.1	4.83	14.75	16.11	.16	8.52	12.25	.037	.068		98.818		DRD	S
496	35.9	8.41	16.36	15.10	.22	9.61	14.17	.019	.068		99.798		O	S
497	41.2	5.73	13.05	14.58	.17	8.71	12.15	.400	.188		96.176		O	S
498	39.9	7.98	13.24	16.29	.20	8.88	12.33	.096	.074		98.962		O	S
499	46.7	.34	19.90	9.13	.14	14.07	11.27	.329	.078		101.965		YGR	S
500	35.9	8.71	15.91	16.25	.21	9.18	13.91	.178	.109		100.337		DRD	S
501	46.1	.30	31.45	3.06	.04	4.03	16.74	.108	.094		101.900		PBR	F
502	50.0	1.83	16.85	10.15	.11	7.57	10.79	.843	.759		98.891		YBR	F
503	45.2	.02	36.23	.18	.01	.16	19.67	.462	.055		101.925		C	F
504	42.3	7.95	12.27	15.77	.19	7.68	11.96	.452	.334		98.903		RDBR	F
505	42.3	6.75	13.32	14.05	.17	8.87	10.83	.504	.141		96.971		RDBR	F
506	46.1	1.27	17.12	11.73	.12	9.42	11.91	.126	.036		97.834		GR	F
507	46.5	.05	35.22	.11	.01	.10	18.86	.583	.092		101.472		PBR	F
508	46.3	.55	25.07	6.41	.09	7.00	14.95	.381	.085		100.794		GRGY	F
509	42.0	7.91	10.23	17.29	.22	8.14	10.86	.371	.163		97.171		O	F
510	42.7	7.73	10.31	18.62	.25	9.65	10.55	.501	.148		100.419		O	F
514	46.7	.38	27.60	4.19	.04	4.44	15.72	.663	.075		99.808		PGRY	F
515	46.8	.15	30.40	2.63	.04	4.09	16.56	.573	.050		101.293		C	F
516	48.9	.01	34.42	.12	.00	.07	16.92	1.949	.050		102.439		C	F
517	47.0	.03	34.35	.76	.03	.50	18.89	.518	.029		102.107		C	F
518	46.1	.44	25.38	5.82	.07	8.02	14.81	.188	.039		100.867		PGR	F
0	45.5	.37	25.03	5.77	.08	7.37	14.40	.212	.065		98.797		GRY	F
521	46.6	.52	27.17	5.34	.07	5.16	15.24	.500	.103		100.703	1.595	PGR	F
522	46.7	.45	25.29	5.92	.06	8.01	14.35	.210	.057		101.047	1.596	PGR	F
523	47.2	.40	24.23	5.52	.08	8.60	14.16	.250	.031		100.471	1.595	PGR	F

524	46,7	,53	23,43	6,46	,07	8,99	13,64	,129	,055		100,004	1,597	PGR	F
525	46,5	,35	24,50	6,05	,07	8,02	14,64	,123	,040		100,293	1,595	PGR	F
526	46,1	,36	25,47	5,76	,07	7,50	14,70	,164	,043		100,167	1,597	PGR	F
527	43,9	,33	24,94	5,30	,05	7,21	14,29	,150	,092		96,222	1,594	PGR	F
528	46,9	,40	25,32	5,75	,06	7,30	14,56	,220	,062		100,572	1,595	PGR	F
529	46,5	,35	25,23	5,85	,07	8,04	14,72	,140	,056		100,956	1,595	PGR	F
530	44,9	,37	25,55	5,72	,07	7,68	14,81	,133	,025		99,258	1,594	PGR	F
532	46,9	,26	29,30	3,97	,04	4,23	16,37	,463	,041		101,574		GRGY	F
536	41,0	9,12	11,15	16,88	,19	8,13	11,02	,113	,070		97,673		DRD	S
539	39,4	7,57	14,65	15,39	,16	8,50	12,95	,057	,023		98,700		O	S
540	37,6	10,08	5,81	22,67	,25	13,61	7,72	,386	,081		98,207		DRD	S
541	37,3	8,98	5,41	22,46	,26	13,41	7,33	,280	,153		95,610		O	S
542	45,5	3,66	18,01	9,70	,12	8,22	12,52	,784	,124		98,642		O	S
543	44,2	4,84	10,52	20,83	,26	6,65	10,54	,167	,065		98,072		DRD	S
544	42,4	6,27	16,09	12,99	,14	8,40	12,89	,071	,050		99,301		RD	S
545	36,4	3,83	18,64	14,00	,11	9,95	12,16	,000	,058		95,156		BR	S
566	40,8	1,16	25,63	5,66	,06	7,86	14,84	,067	,039		96,070		C	S
547	45,5	3,51	14,14	11,86	,17	12,95	10,23	,875	,135		99,370		BR	S
548	47,1	,63	24,95	5,41	,05	8,05	14,04	,139	,066		100,435		GRY	S
549	38,6	9,83	5,46	23,41	,24	13,52	7,78	,171	,121		99,132		O	S
550	42,8	5,69	15,09	13,55	,17	7,78	12,57	,507	,152		98,309		O	S
551	42,0	7,39	13,22	15,13	,23	8,74	11,61	,052	,174		98,513		RD	S
552	41,0	5,44	18,70	12,16	,14	8,30	13,58	,050	,007		99,377		DRD	S
555	37,6	9,85	5,65	23,40	,30	13,57	7,89	,178	,207		98,629		DRD	S
556	37,2	9,61	5,26	22,65	,27	14,02	7,51	,246	,200		96,984		O	S
557	37,8	8,10	16,35	14,60	,15	9,12	13,98	,000	,078		100,187		DRD	S
558	49,8	,34	21,79	5,80	,08	7,22	12,69	2,317	,148		100,130		Y	S
559	38,2	9,54	5,55	23,11	,23	14,18	7,58	,366	,166		98,947		O	S
560	42,1	5,75	15,94	13,63	,16	8,83	12,47	,053	,123		99,052		RDBR	S
1	38,2	9,86	5,67	23,52	,25	14,31	7,86	,236	,185		100,090		DRD	S
562	38,0	9,85	5,43	23,44	,24	14,06	7,62	,168	,164		98,932		DRD	S
563	38,0	6,91	18,23	13,35	,17	9,00	14,72	,000	,130		100,485		DRD	S
564	37,3	8,02	16,52	14,49	,18	9,45	14,22	,061	,139		100,358		O	S
565	43,4	4,68	12,67	14,04	,15	10,07	11,01	,415	,173		96,562		BR	6
566	40,6	5,92	13,86	14,92	,22	8,15	12,51	,352	,265		96,773		O	S
567	46,8	3,05	15,18	11,23	,17	13,17	11,49	,408	,297		101,765		O	S
569	39,2	9,78	5,80	23,59	,30	14,08	7,70	,235	,220		100,820		O	S
570	45,6	,82	14,25	14,49	,19	11,58	10,68	,388	,245		98,287		DBR	S
571	37,3	9,63	5,57	23,61	,24	14,18	7,54	,367	,188		98,581		DRD	S
572	39,5	10,54	7,77	14,71	,22	11,69	12,26	2,387	,308		99,409		O	S

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2	47,4	0,96	27,0	4,44	0,06	6,55	16,6	0,80	0,10		103,91	1,588	GRY	F
154	44,9	0,22	23,1	4,90	0,06	11,1	14,9	0,15	0,04	0,3	99,67	1,595	BGR	F
155	44,9	0,32	24,3	5,85	0,09	8,69	16,4	0,15	0,03	0,2	100,93	1,595	BGR	F
156	44,2	0,31	24,4	5,70	0,07	7,50	17,0	0,23	0,04	0,25	99,70	1,595	BGR	F
157	44,6	0,29	24,6	5,83	0,07	8,24	16,3	0,18	0,03	0,25	100,39	1,595	BGR	F
158	44,5	0,36	25,7	4,73	0,24	8,08	17,1	0,31	0,05	0,2	101,27	1,595	BGR	F
159	44,1	0,21	28,9	3,49	0,05	3,67	18,5	0,22	0,05	0,1	99,29	1,595	Y	F
160	47,6	1,95	14,4	13,3	0,14	9,50	11,2	0,47	0,32	0,5	99,38	1,616	BR	F
161	45,5	2,40	14,0	14,9	0,15	9,02	12,3	0,50	0,24	0,6	99,61	1,629	GRGY	F
163	48,8	1,98	14,6	13,0	0,14	9,76	11,1	0,52	0,39	0,5	100,79	1,613	Y	F
164	51,3	1,41	15,9	10,2	0,11	5,86	11,8	0,94	0,84	0,3	98,66	1,588	GR	F
165	52,0	1,42	16,1	10,5	0,12	5,68	11,7	0,99	0,84	0,3	99,65	1,589	GR	F
166	47,8	2,32	15,5	13,2	0,14	8,47	11,6	0,84	0,49	0,6	100,96		RDBR	F
167	48,1	2,13	14,7	12,2	0,14	9,41	11,3	0,67	0,42	0,45	99,52	1,608	Y	F
168	48,3	2,51	15,0	12,0	0,14	8,04	10,9	1,04	0,67	0,4	99,00	1,611	BR	F
169	45,3	4,58	11,0	20,0	0,20	6,69	11,9	0,62	0,20	0,4	100,89	1,662	RDBR	F
170	46,2	2,45	13,9	14,2	0,16	9,08	11,4	0,65	0,35	0,65	99,04	1,625	GRGY	F

171	47,9	3,00	12,0	16,1	0,18	8,83	10,6	0,60	0,34	0,6	100,15	1,620	BR	F
172	49,6	1,51	17,5	10,9	0,11	6,19	12,5	1,17	0,65	0,4	100,53	1,605	GRY	F
173	47,1	2,44	13,0	15,6	0,15	8,06	11,4	0,75	0,41	0,6	99,51	1,628	GRGY	F
174	48,5	2,27	15,5	11,6	0,13	7,59	11,6	0,60	1,13	0,35	99,27		O	F
175	45,9	4,16	10,9	20,0	0,20	8,24	10,9	0,67	0,97	0,6	102,54		O	F
176	48,9	1,92	17,0	11,3	0,12	7,62	11,9	1,02	0,69	0,35	100,82		O	F
177	46,1	2,23	12,0	15,1	0,16	10,1	10,9	0,54	0,24	0,8	98,17		O	F
178	45,1	0,29	23,6	5,78	0,08	10,3	16,0	0,28	0,03	0,25	101,71		O	F
179	45,2	2,45	10,7	17,4	0,19	10,7	12,1	0,42	0,20	0,7	100,06		O	F
180	45,1	2,10	12,6	16,1	0,18	10,1	12,2	0,45	0,17	0,7	99,70		O	F
182	42,0	0,44	29,1	0,81	0,03	6,73	20,0	0,10	0,03	0,1	99,34	1,587	Y	S
183	46,7	1,97	16,0	12,4	0,15	9,87	12,1	0,31	0,14	0,4	100,04	1,621	GR	S
184	43,7	2,46	15,0	13,6	0,16	9,47	12,2	0,16	0,08	0,4	97,23	1,636	BR	S
185	42,8	2,53	14,5	15,8	0,17	9,92	12,0	0,16	0,08	0,5	98,46		RDBR	S
186	46,5	2,87	12,7	17,8	0,18	8,03	12,3	0,41	0,14	0,75	101,68		Y	S
187	40,1	4,25	11,3	23,2	0,20	9,34	11,4	0,24	0,07	0,7	100,80		RDBR	S
188	46,2	2,98	13,6	15,5	0,19	10,4	11,1	0,46	0,20	0,6	101,23		GY	S
189	45,3	2,38	12,0	17,2	0,18	10,2	11,0	0,58	0,29	0,65	99,78		GY	S
191	45,9	2,84	13,4	15,9	0,19	10,3	11,3	0,56	0,27	0,7	101,36		O	F
192	47,6	2,84	10,1	20,2	0,22	9,76	11,4	0,43	0,24	0,9	103,69		O	F
194	45,0	0,32	25,4	6,12	0,06	8,99	16,5	0,10	0,03		102,52	1,594	BGR	F
195	45,4	0,35	25,5	6,91	0,08	9,39	16,7	0,09	0,02		104,44	1,596	BGR	F
196	48,5	1,50	16,9	9,10	0,11	11,0	11,2	0,90	0,77		99,98	1,595	YGR	F
197	42,6	2,45	9,67	20,4	0,17	13,4	8,54	0,34	0,21		97,78		BR	F
198	48,4	2,04	16,2	10,8	0,12	8,39	11,7	0,95	0,72		99,32	1,604	BR	F
199	46,6	2,24	9,38	21,3	0,19	12,0	10,0	0,33	0,14		102,18	1,654	BR	F
200	48,8	2,36	14,6	11,2	0,14	8,12	11,1	1,04	0,85		98,21	1,605	Y	F
201	46,4	2,75	13,0	15,4	0,15	8,62	11,4	0,51	0,26		98,49	1,631	Y	F
202	48,7	2,14	14,7	12,0	0,13	8,35	11,3	0,90	0,75		98,97	1,612	BR	F
203	49,1	1,74	16,7	10,1	0,11	8,10	11,6	0,94	0,82		99,21	1,604	GRY	F
204	48,9	1,68	16,4	10,8	0,11	7,73	11,7	0,97	0,81		99,10	1,599	GRY	F
205	48,0	2,41	15,1	12,2	0,14	9,84	11,0	0,85	0,53		100,07	1,612	YGR	F
206	48,4	2,05	15,2	12,6	0,13	7,66	11,5	1,07	0,80		99,41	1,604	GRY	F
207	48,4	2,51	14,7	12,3	0,14	8,76	10,8	1,00	0,80		99,41	1,612	GRY	F
208	47,3	2,32	15,0	12,3	0,14	9,49	11,4	0,73	0,59		99,27	1,613	GRY	F
209	48,7	2,24	16,0	11,1	0,11	8,11	11,6	1,16	0,75		99,77	1,608	YGR	F
210	45,6	2,60	13,4	15,2	0,18	9,57	11,7	0,52	0,24		99,01	1,618	YGR	F
211	48,5	1,98	17,1	10,3	0,12	7,69	11,6	1,05	0,73		99,07	1,603	BR	F
212	46,1	2,48	12,8	13,6	0,15	8,21	11,6	0,76	0,28		95,98	1,633	BR	F
213	49,0	2,24	17,0	10,6	0,13	7,80	11,7	1,09	0,77		100,33	1,603	YBR	F
214	45,7	3,05	10,5	18,3	0,21	9,54	11,4	0,47	0,17		99,34	1,646	YGR	F
215	48,3	2,17	13,4	11,8	0,12	8,10	10,6	0,96	0,83		96,28	1,605		F
216	49,0	1,95	15,7	11,5	0,14	8,06	11,1	0,99	0,81		99,25	1,609	BR	F
217	46,9	3,27	11,4	17,2	0,17	11,4	10,7	0,40	0,24		101,68	1,643	GR	F
218	47,0	2,83	13,8	13,9	0,14	9,43	11,6	0,56	0,29		99,55	1,627	BR	F
219	46,7	4,15	11,0	18,0	0,19	6,55	11,7	0,87	0,45		99,61		RDBR	F
223	41,9	8,60	10,7	17,1	0,20	10,1	11,8	0,24	0,05		100,69		RD	F
224	43,5	0,30	32,0	1,69	0,03	6,10	20,5	0,22	0,03		104,37	1,588	GRY	S
225	51,9	0,21	21,2	6,16	0,08	10,7	13,1	0,30	0,04		103,69	1,588	Y	S
226	57,1	0,39	15,8	7,36	0,09	5,42	10,3	1,84	1,27		99,57	1,555	Y	S
227	49,2	1,15	20,5	6,84	0,08	9,06	13,1	0,77	0,35		101,05	1,588	GR	S
229	38,8	0,35	34,6	1,65	0,02	6,05	22,0	0,10	0,03		103,60	1,595	Y	S
230	45,8	1,18	18,8	8,15	0,06	12,3	12,0	1,22	0,32		99,83		YGR	S
231	47,1	1,50	18,1	10,7	0,12	11,5	12,5	0,37	0,12		102,01	1,613	GRY	S
232	46,0	1,75	18,6	9,47	0,09	10,3	13,0	0,13	0,11		99,45	1,608	YGR	S
233	47,1	1,10	21,5	8,28	0,09	8,54	14,1	0,55	0,17		101,43	1,597	YGR	S
234	51,8	1,53	17,6	8,59	0,09	8,46	11,2	1,53	0,90		101,70	1,592	YGR	S
235	49,2	2,04	15,8	11,2	0,13	8,07	11,7	1,03	0,76		99,93	1,616	BR	S

236	45,7	2,32	12,0	16,1	0,17	12,7	10,4	0,06	0,06	99,51	1,641	YBR	S
237	42,3	2,98	16,3	13,5	0,15	10,5	13,2	0,09	0,07	99,09	1,642	BR	S
238	41,7	3,00	15,7	16,1	0,18	11,1	13,9	0,09	0,06	101,83		BR	S
239	41,1	2,55	15,6	16,0	0,16	11,7	13,9	0,05	0,04	101,10	1,652	BR	S
40	48,0	1,89	17,2	11,7	0,12	11,1	12,2	0,16	0,11	102,48	1,624	GR	S
241	46,1	2,61	13,2	15,9	0,19	10,3	11,6	0,28	0,12	100,30	1,627	YBR	S
242	47,5	1,82	13,2	14,1	0,15	10,8	11,1	0,68	0,52	99,87	1,626	YGR	S
243	46,6	2,35	13,9	14,6	0,16	9,22	11,3	0,33	0,18	98,64	1,623	YBR	S
244	46,9	0,80	20,3	8,41	0,08	4,92	14,3	0,65	0,31	96,67		YGR	S
245	44,7	3,28	11,6	18,6	0,20	8,82	12,3	0,11	0,07	99,68	1,653	YBR	S
246	43,9	3,77	11,8	18,3	0,18	9,60	11,2	0,13	0,09	98,97	1,659	BR	S
247	41,4	3,65	14,0	16,4	0,17	11,1	12,8	0,09	0,06	99,67	1,657	BR	S
248	40,7	3,79	14,8	16,7	0,19	10,3	13,9	0,06	0,04	100,48	1,660	YBR	S
250	44,6	2,85	15,7	14,7	0,14	10,1	12,6	0,18	0,07	100,94	1,650	BR	S
251	43,6	3,00	13,9	16,3	0,16	10,1	12,3	0,37	0,17	99,90		O	S
252	41,4	3,05	15,1	15,5	0,10	10,5	13,4	0,10	-	99,15	1,650	YBR	S
254	49,7	2,21	15,6	11,7	0,12	9,29	11,4	0,67	0,46	101,15		YGR	S
255	42,8	2,89	15,8	15,3	0,16	10,9	12,5	0,08	0,08	100,51	1,643	YGR	S
257	38,1	3,45	16,2	16,9	0,19	12,4	15,1	0,06	0,05	102,45	1,663	YBR	S
258	39,6	5,20	10,1	21,5	0,23	12,0	11,0	0,05	0,05	99,73	1,690	RDBR	S
259	42,7	3,49	12,2	18,6	0,19	12,8	11,1	0,10	0,08	101,26	1,654	YBR	S
260	40,0	2,96	15,1	16,8	0,18	10,9	13,7	0,07	0,04	99,75	1,655	YBR	S
261	43,0	2,81	11,8	18,1	0,18	11,8	11,7	0,05	0,05	99,49	1,660	BR	S
262	40,0	2,94	15,1	15,6	0,17	10,3	14,0	0,05	0,05	98,21	1,649	YBR	S
263	39,1	3,82	13,7	18,0	0,18	12,1	12,8	0,08	0,06	99,84	1,664	YBR	S
265	42,5	2,83	12,9	17,0	0,18	12,1	11,8	0,08	0,04	99,43	1,648	BR	S
266	45,1	3,43	13,2	16,6	0,17	9,74	11,3	0,38	0,16	100,08		O	S
267	45,5	3,16	14,1	15,7	0,14	8,89	11,4	0,54	0,24	99,67		O	S
271	45,2	2,92	11,8	16,9	0,19	8,71	12,2	0,37	0,19	98,48		O	S
75	45,7	0,19	22,5	7,86	0,07	10,7	14,2	0,65	0,15	102,02		Y	S
276	47,6	3,15	16,9	11,5	0,15	9,50	12,4	0,65	1,08	102,93		O	S
278	42,3	2,68	14,6	16,4	0,17	11,0	12,9	0,06	0,04	100,15		BR	S
280	45,7	3,83	12,6	16,7	0,17	10,1	11,3	0,22	0,11	100,73		BR	S
283	47,5	2,81	14,7	14,6	0,15	9,32	11,6	0,25	0,16	101,09		BRY	S
286	43,4	2,23	17,3	13,9	0,16	12,7	12,7	0,07	0,05	102,51		YGR	S
287	41,4	5,62	13,4	17,6	0,19	9,76	12,5	0,05	0,04	100,56		BR	S
289	46,7	2,80	16,7	13,8	0,14	8,38	12,8	0,64	0,33	102,29		BR	S
290	46,3	0,15	34,3	0,35	0,02	1,19	20,4	0,83	0,06	103,60		YGR	S
291	44,1	3,57	11,5	17,2	0,17	10,6	10,5	0,44	0,20	98,28		O	S
296	41,5	3,02	9,14	20,7	0,23	14,9	9,62	0,23	0,15	99,49		BR	S
298	46,1	0,95	26,1	5,69	0,11	3,40	18,6	0,60	0,18	101,73		YBR	S
299	46,6	0,18	29,6	3,93	0,03	1,00	18,2	0,78	0,27	100,59		Y	S
300	46,5	1,95	10,6	20,2	0,23	8,67	12,3	0,28	0,16	100,89		BR	S
328	45,0	0,41	25,3	5,75	0,08	9,20	14,9	0,11	0,07	100,82		BGR	F
329	44,2	0,41	25,0	5,84	0,07	8,99	14,8	0,14	0,12	99,57		BGR	F
330	45,2	0,43	25,0	6,00	0,08	9,21	14,8	0,12	0,08	100,92		BGR	F
331	44,3	0,35	25,1	5,56	0,06	8,93	14,9	0,13	0,12	99,45		BGR	F
332	50,0	2,88	14,8	12,1	0,14	7,80	10,0	0,72	0,60	99,04		YBR	F
333	47,4	2,83	11,7	15,4	0,19	9,76	9,66	0,60	0,54	98,12		YBR	F
334	46,6	3,86	9,61	19,2	0,22	8,39	10,3	0,34	0,26	98,78		RDBR	F
335	43,7	5,29	9,14	20,4	0,22	8,49	10,2	0,44	0,24	98,12		RD	F
336	48,6	2,27	15,6	11,7	0,14	8,47	10,4	0,96	0,81	98,95		GY	F
337	44,1	3,59	9,93	18,9	0,20	8,70	9,76	0,56	0,31	96,05		RDBR	F
338	47,1	3,46	12,0	17,5	0,18	8,66	10,3	0,27	0,22	99,69		RDBR	S
39	46,2	0,42	25,3	3,91	0,06	8,57	14,6	1,02	0,11	100,19		GRGY	S
40	44,9	0,36	27,5	3,30	0,05	8,12	15,9	0,57	0,14	100,84		C	S
341	52,0	2,21	13,9	11,3	0,14	7,33	9,33	0,73	0,68	97,62		Y	S
342	41,8	5,18	10,3	19,8	0,20	8,37	9,84	0,61	0,31	96,41		RD	S

343	42,8	4,22	7,64	23,0	0,21	13,4	7,28	0,29	0,22	99,06		RD	S
344	42,3	0,44	30,9	1,91	0,04	4,94	17,9	0,15	0,09	98,67		GY	S
345	40,7	0,32	31,4	1,75	0,03	3,75	18,6	0,15	0,08	96,78		C	S
346	44,0	0,34	29,3	0,67	0,02	8,26	17,9	0,04	0,05	100,58		C	S
347	41,7	0,35	29,8	2,55	0,04	7,14	17,7	0,17	0,07	99,52		C	S
348	41,4	0,42	31,9	2,91	0,04	6,31	18,1	0,15	0,09	101,32		GY	S
350	43,2	0,44	29,4	3,24	0,06	7,49	17,0	0,25	0,10	101,18		GY	S
351	45,1	0,31	27,2	4,21	0,09	9,41	15,3	0,70	0,11	102,43		GY	S
352	37,1	0,43	36,0	1,15	0,01	5,70	20,6	0,24	0,11	101,34		C	S
354	47,3	2,14	15,2	13,6	0,15	9,03	11,2	0,28	0,27	99,17		Y	S
355	45,1	1,61	12,6	15,3	0,18	12,7	10,5	0,20	0,17	98,36		YGR	S
356	48,8	0,35	27,5	3,21	0,05	5,70	15,3	0,59	0,12	101,62		YGR	S
358	44,8	3,38	10,4	17,9	0,19	9,74	9,49	0,32	0,25	96,47		YGR	S
359	45,0	3,71	12,1	17,5	0,19	10,2	10,7	0,24	0,23	99,87		YBR	S
360	45,1	2,97	13,1	16,5	0,18	10,0	11,0	0,13	0,24	99,22		Y	S
361	47,1	2,39	16,3	13,1	0,15	8,44	11,7	0,19	0,21	99,58		Y	S
362	47,5	3,03	14,0	13,9	0,14	8,47	10,4	0,24	0,26	97,94		YBR	S
363	45,1	2,92	14,7	15,0	0,16	9,91	11,3	0,17	0,24	99,50		BR	S
365	42,9	2,92	14,3	15,4	0,18	10,7	11,3	0,12	0,20	98,02		BR	S
366	43,2	3,03	15,0	16,0	0,17	11,0	11,6	0,14	0,20	100,34		BR	S
367	42,4	2,65	14,0	15,8	0,16	11,2	10,9	0,12	0,20	97,43		BR	S
368	38,8	3,49	4,12	29,8	0,23	12,8	6,36	0,22	0,24	96,06		RDBR	S
369	38,2	3,18	15,3	15,4	0,18	11,8	12,3	0,07	0,18	96,61		RDBR	S
370	41,7	4,09	12,2	18,1	0,19	11,1	10,6	0,13	0,18	98,29		RDBR	S
371	44,3	3,39	12,3	17,0	0,19	10,0	10,6	0,19	0,21	98,18		BR	S
372	47,1	1,87	17,0	15,7	0,14	8,79	11,9	0,51	0,33	103,34		O	S
373	45,8	3,40	9,27	20,1	0,21	13,1	8,45	0,36	0,35	101,04		O	S
375	45,0	2,80	18,1	13,8	0,15	8,04	12,3	0,55	0,26	101,00		O	S
APOLLO 14													
378	50,8	2,02	16,4	10,2	0,12	9,46	9,97	1,32	1,08	101,37	1,598	BRY	F
379	49,0	2,28	17,2	9,61	0,12	8,02	10,5	1,35	0,96	99,04	1,601	YBR	F
380	45,2	0,40	24,8	5,98	0,08	8,86	15,0	0,21	0,09	100,62	1,588	LBGR	F
381	50,7	3,03	15,1	11,0	0,13	6,96	10,5	1,16	0,70	99,28	1,603	DRD	F
382	45,3	0,39	25,1	5,90	0,07	9,65	14,8	0,20	0,09	101,50	1,596	PGR	F
383	46,9	1,00	24,2	6,97	0,08	7,23	14,3	0,31	0,22	101,21	1,595	YGR	F
384	53,6	1,85	15,6	9,42	0,10	6,66	9,98	1,33	1,66	100,20	1,580	YGR	F
385	49,9	2,01	16,9	9,44	0,10	7,71	10,3	1,55	1,18	99,09	1,590	LY	F
386	45,8	0,36	26,9	4,93	0,06	8,62	15,4	0,23	0,07	102,37		GY	S
389	45,2	0,39	26,1	5,95	0,07	8,62	15,3	0,16	0,09	101,88		LBGR	F
390	45,5	0,39	24,6	6,24	0,08	8,54	14,7	0,29	0,11	100,45		LBGR	F
391	47,7	2,03	15,9	10,8	0,11	10,7	10,3	0,94	0,76	99,24		DYGR	F
392	51,2	2,14	13,6	11,8	0,12	9,41	8,17	0,98	0,95	98,37		DYGR	F
393	48,1	4,60	14,9	12,4	0,13	7,94	10,0	1,09	0,96	100,12		DBR	F
395	44,7	0,38	24,2	6,37	0,08	8,73	14,9	0,33	0,10	99,79		GY	F
396	45,0	0,53	24,8	6,58	0,07	9,00	14,7	0,36	0,15	101,19		GY	F
397	45,1	3,05	15,7	12,0	0,12	10,5	9,93	0,94	0,61	97,95		DGY	F
402	48,9	1,93	17,4	9,97	0,11	7,98	10,9	1,21	0,84	99,24		YBR	F
408	47,7	1,96	19,8	10,7	,11	9,52	11,5	,79	,51	102,59		DY	F
410	45,1	0,93	27,9	4,90	0,07	4,94	16,3	0,13	0,11	100,38		YGR	F
411	51,2	1,54	17,2	10,1	0,11	5,61	10,9	1,34	1,06	99,06		YGR	F
412	46,5	0,07	29,9	0,62	0,02	0,19	18,2	2,14	0,13	97,77		DGY	F
417	49,5	3,13	15,0	11,4	0,11	8,84	9,64	1,20	1,18	100,00		RDBR	F
419	49,2	2,80	14,4	11,0	0,13	8,42	9,27	1,42	1,43	98,07		RD	F
420	45,5	0,33	25,4	6,09	0,08	8,34	14,8	0,22	0,08	100,84		Y	F
422	47,5	1,28	21,5	7,91	0,08	4,78	12,7	1,33	0,51	97,59		DGY	F
423	49,2	1,93	17,9	9,58	0,11	6,98	10,9	1,54	1,01	99,15		Y	F
424	51,8	1,91	15,7	10,2	0,11	6,58	9,63	1,00	1,06	97,99		DGYO	F
425	48,0	1,87	20,0	7,13	0,09	6,35	12,1	1,73	0,65	97,92		DGY	F

427	44,7	0,24	30,4	3,63	0,06	3,36	17,6	0,29	0,12	100,40	1,580	LBGR	F
428	54,2	2,20	15,6	10,9	0,13	5,64	10,9	0,39	0,43	100,39	1,587	DY	F
429	47,8	2,83	13,5	14,7	0,17	9,08	10,5	0,66	0,37	99,61	1,624	YBR	F
30	45,5	3,86	9,93	20,7	0,21	9,58	9,25	0,38	0,43	99,84	1,657	YBR	F
33	46,2	0,47	26,2	5,35	0,07	6,54	15,5	0,46	0,22	101,01	1,589	GY	F
434	49,7	0,99	20,0	8,24	0,09	7,60	12,3	0,52	0,43	99,87	1,590	GRY	F
435	52,5	1,49	17,5	9,85	0,12	5,08	11,2	0,97	0,70	99,41	1,583	DY	F
436	48,2	1,76	15,8	10,5	0,12	11,3	9,96	1,19	0,80	99,63	1,604	DY	F
437	50,2	2,25	17,9	10,1	0,12	4,36	11,2	1,74	1,11	98,98	1,589	YBR	F
438	46,9	0,84	10,2	18,1	0,22	14,0	9,82	0,41	0,30	100,79	1,633	YGR	F
441	50,8	1,24	19,5	1,31	0,07	14,4	11,8	1,69	0,29	101,10		BL	S
442	45,1	1,57	12,4	16,7	0,18	14,0	10,3	0,12	0,23	100,60		Y	S
445	46,5	0,77	10,1	18,2	0,21	17,5	9,68	0,36	0,23	103,55		Y	S
446	46,7	2,70	12,2	18,6	0,21	7,54	10,6	0,81	0,41	99,77		DRD	F
447	46,4	2,98	10,4	20,0	0,21	9,62	9,94	0,51	0,38	100,44		RDBR	F
448	55,8	0,94	15,7	9,27	0,10	4,45	8,85	1,23	2,65	98,99		DY	F
449	49,1	1,44	17,2	9,96	0,10	10,3	10,2	0,66	0,54	99,50		DY	F
450	44,5	0,36	25,5	5,40	0,06	9,11	15,1	0,11	0,11	100,25		LBGR	F
451	44,8	0,42	24,7	6,20	0,08	8,50	15,1	0,35	0,10	100,25		LOR	F
452	47,2	1,42	19,3	8,27	0,13	10,7	12,1	0,37	0,50	99,99		DGY	F
453	46,8	1,85	18,5	9,53	0,12	8,22	11,8	1,12	0,74	98,68		LY	F
454	47,7	2,06	18,4	10,5	0,11	6,19	11,3	1,47	0,89	98,62		Y	F
456	46,5	1,99	17,2	11,1	0,13	10,4	11,2	0,70	0,51	99,73		GRGY	F
457	49,7	1,70	13,9	12,7	0,16	9,50	9,03	1,44	1,08	99,21		GRGY	F
459	49,5	2,18	19,0	6,49	0,12	9,56	10,4	1,33	0,48	99,06		DGY	F
470	49,0	2,02	17,7	9,79	0,11	7,87	10,8	1,30	0,86	99,45		DY	F
471	55,0	2,87	12,7	13,6	0,16	3,76	9,81	1,02	0,83	99,75	1,596	YBR	S
472	41,3	0,27	31,5	0,74	0,03	8,51	18,5	0,10	0,07	101,02		C	S
473	46,7	0,73	10,2	18,1	0,21	14,2	9,38	0,50	0,28	100,50	1,635	DYGR	S
4	50,5	2,91	14,1	12,3	0,13	6,98	9,41	1,56	1,32	99,21	1,597	YBR	S
476	39,5	6,25	9,29	25,5	0,24	9,81	9,37	1,00	0,35	101,31	1,712	DRD	S
477	47,7	2,20	17,4	11,5	0,13	8,27	11,1	0,80	0,57	99,67		O	S
479	49,2	1,25	20,0	4,55	0,07	11,9	11,7	2,12	0,46	101,25		O	S
481	43,5	3,53	7,80	22,0	0,24	14,4	7,94	0,76	0,27	100,44		BL	S
482	45,4	1,44	19,0	10,2	0,12	12,3	11,8	0,20	0,15	100,61		BL	S
487	47,5	1,81	17,8	10,3	0,11	9,48	10,8	0,97	0,53	99,30		BRGR	F
488	48,7	1,73	19,0	10,0	0,11	9,57	11,3	1,42	0,95	102,78		DGY	F
489	45,9	0,40	25,4	6,02	0,08	9,08	14,9	0,23	0,08	102,09		BGR	F
490	46,8	2,17	14,5	12,7	0,15	8,94	11,0	0,92	0,69	97,87		YBR	F
491	44,8	0,34	24,1	6,29	0,08	8,51	15,0	0,28	0,16	99,56		LGY	F
493	45,7	0,31	25,2	5,87	0,07	8,97	14,5	0,21	0,13	100,96		Y	S
494	44,9	0,38	25,4	6,01	0,07	8,52	14,3	0,20	0,18	99,96		BGRO	F
495	48,0	1,98	15,5	12,0	0,12	11,2	9,27	1,21	0,73	100,01		YGR	F
496	55,0	1,80	13,8	11,0	0,12	3,78	8,71	1,69	1,96	97,86		BR	F
499	48,5	2,25	15,7	11,8	0,13	7,63	10,5	1,25	0,92	98,68		DBR	F
500	49,0	1,96	17,1	10,3	0,10	7,45	10,5	1,38	1,00	98,79		YBR	F
501	51,9	1,71	17,2	9,62	0,12	5,61	10,6	0,70	0,45	97,91		DY	S
502	46,3	0,67	9,36	18,4	0,20	16,2	9,15	0,42	0,19	100,89		YGR	S
503	46,4	0,65	9,90	18,0	0,19	14,9	9,60	0,38	0,24	100,26		YGR	S
504	42,6	0,15	26,8	1,17	0,02	14,3	15,2	0,01	0,09	100,34		C	S
505	42,5	0,19	26,5	0,80	0,03	13,0	15,8	0,02	0,07	98,91		C	S
506	42,3	4,35	9,01	23,3	0,24	11,4	9,55	0,51	0,26	100,92		DRD	S
507	45,3	1,90	19,4	10,7	0,12	10,0	12,5	0,12	0,21	100,25		RD	S
508	45,1	1,74	16,4	13,3	0,13	12,4	10,5	0,17	0,23	99,97		BR	S
9	44,4	1,99	18,5	10,8	0,13	10,4	12,1	0,13	0,20	98,65		BR	S
510	51,0	0,29	24,1	4,42	0,08	7,37	14,3	0,50	0,12	102,18		WH	S
512	44,8	0,38	24,7	6,33	0,07	8,21	14,9	0,27	0,14	99,80		LGY	F
513	40,1	2,32	26,8	0,83	0,02	13,8	16,2	0,02	0,10	100,19		C	F

514	45,8	0,63	9,51	18,1	0,19	15,4	9,27	0,38	0,24	99,52		YGY	F
515	49,2	1,77	18,2	8,80	0,10	5,81	11,2	1,70	1,28	98,06		DGYO	F
516	45,8	4,97	11,2	18,6	0,19	7,74	9,97	0,46	0,44	99,37		DRD	F
517	48,4	2,64	13,5	15,0	0,15	9,02	10,1	0,76	0,51	99,93		OR	F
8	44,9	0,31	25,1	5,94	0,07	8,60	15,0	0,13	0,13	100,18		BGR	F
519	49,0	1,98	15,5	10,6	0,11	9,23	10,3	1,15	0,94	98,81		DY	F
520	51,5	1,49	17,3	8,63	0,10	7,15	10,6	1,13	1,10	99,00		GRY	F
523	40,2	3,10	13,7	18,3	0,19	12,4	10,9	0,11	0,20	99,10		DRD	S
524	44,1	3,33	13,9	17,1	0,19	8,18	11,3	0,14	0,23	98,41		DBR	S
525	48,4	1,66	15,9	11,1	0,13	11,0	10,2	0,47	0,40	99,26		DY	S
526	46,8	0,70	9,73	18,3	0,20	14,9	9,62	0,34	0,25	100,84		YGR	S
527	40,6	0,25	32,6	1,56	0,03	6,20	18,8	0,16	0,13	100,33		C	S
528	44,7	1,03	7,11	23,5	0,24	16,4	8,21	0,42	0,26	101,87		YGR	S
529	43,3	1,21	6,57	22,9	0,22	15,7	8,00	0,28	0,24	98,42		YGR	S
530	49,2	1,97	17,0	9,95	0,12	6,73	10,8	1,44	0,96	98,17		BR	S
532	46,5	0,77	9,56	19,4	0,19	15,0	8,71	0,40	0,29	100,82		LGY	S
537	48,0	2,73	16,3	11,3	0,12	9,22	10,2	1,04	0,79	99,70		DBR	S
538	46,2	0,06	34,8	0,10	0,02	0,09	18,6	1,14	0,14	101,15		C	F
539	45,5	0,32	24,0	5,59	0,07	[illegible],49	14,2	0,20	0,15	98,52		LGR	F
541	45,7	0,31	25,0	6,12	0,08	8,18	14,7	0,42	0,08	100,59		GY	F
542	48,9	1,79	18,6	8,64	0,10	8,42	10,9	1,30	0,75	99,40		YBR	F
544	47,9	1,79	16,5	11,1	0,12	10,5	10,5	0,85	0,63	99,89		GR	F
546	41,5	1,99	20,6	10,3	0,11	11,6	13,1	0,16	0,18	99,54		YBR	S
547	46,8	0,70	9,87	17,7	0,20	15,1	9,49	0,39	0,27	100,52		YGR	S
548	49,7	2,03	17,4	9,71	0,11	6,93	10,8	1,59	1,13	99,40		BRY	S
549	47,3	2,28	16,1	12,5	0,13	9,53	10,8	1,06	0,54	100,24		BRY	S
550	47,8	2,36	18,1	10,3	0,12	8,93	11,8	0,89	0,47	100,77		DO	S
551	47,9	0,48	17,5	10,5	0,13	13,6	10,4	0,31	0,19	101,01		LYGR	S
552	49,9	3,30	14,9	10,8	0,11	8,24	9,35	1,02	0,94	98,56		O	S
3	47,6	2,79	13,8	15,3	0,16	8,58	10,9	1,16	0,36	100,65		OR	S
554	45,2	0,32	24,9	5,99	0,08	8,3	15,1	0,26	0,13	100,28		PGR	F
555	48,4	2,77	16,3	11,3	0,12	8,23	10,4	1,34	0,81	99,67		YBR	F
556	41,7	7,35	8,39	22,7	0,22	8,56	9,24	0,94	0,42	99,52		DRD	F
557	48,5	1,77	17,1	10,1	0,11	9,66	10,9	0,73	0,53	99,40		DY	F
558	45,8	0,32	25,3	6,06	0,08	8,47	14,9	0,37	0,12	101,42		PGR	F
559	47,6	2,00	17,5	10,2	0,12	9,97	10,9	0,90	0,57	99,76		GY	F
560	45,4	0,29	25,6	5,63	0,07	8,53	15,2	0,27	0,11	101,10		PGR	F
561	46,5	1,30	23,2	4,96	0,06	10,3	13,7	0,30	0,15	100,47		C	S
562	45,4	0,29	28,4	1,55	0,03	7,32	16,4	0,88	0,04	100,31		C	F
563	42,1	4,51	6,90	24,9	0,25	13,6	7,90	0,89	0,37	101,42		DRD	S
564	42,7	1,93	21,3	9,43	0,11	10,2	13,1	0,08	0,17	99,02		BR	S
565	46,7	2,53	16,3	12,4	0,13	9,06	10,3	0,96	0,68	99,06		BL	S
566	46,8	0,72	9,65	17,6	0,19	15,5	9,12	0,40	0,28	100,26		YGR	F
567	47,2	0,10	33,0	0,64	0,02	0,09	17,3	1,64	0,38	100,37		C	S
568	48,0	1,83	17,5	10,5	0,12	10,3	11,1	0,26	0,17	99,78		Y	S
570	46,8	2,98	12,7	16,6	0,18	9,74	9,87	0,90	0,48	100,25		YBR	F
571	50,3	2,11	16,7	10,7	0,11	7,06	10,8	1,55	1,01	100,34		BR	F
572	48,1	1,63	17,3	9,74	0,10	10,7	10,6	0,87	0,59	99,63		Y	F
576	47,7	1,73	20,1	8,62	0,10	6,39	12,3	1,14	0,76	98,84		DBR	F
579	45,3	2,18	13,7	16,2	0,18	9,42	11,2	0,68	0,28	99,14	1,629	GR	F
580	58,8	2,32	11,7	9,99	0,14	3,73	7,54	1,74	2,36	98,32		YBR	F
582	48,0	2,17	15,3	12,0	0,14	9,43	10,1	1,06	0,73	98,93		YBR	F
586	41,7	4,30	8,53	21,4	0,23	12,9	8,75	0,10	0,22	98,13		RDBR	S
588	43,6	1,03	6,65	23,0	0,28	16,2	8,07	0,14	0,26	99,23		YGR	S
590	44,1	0,64	7,11	19,1	0,21	19,1	7,83	0,19	0,13	98,41		YGR	S
1	47,7	1,62	18,3	9,60	,10	9,63	10,7	,45	,37	98,47		DY	S
592	47,6	1,11	20,9	9,21	0,10	9,17	10,8	0,65	0,61	100,15		BLO	S
593	45,8	1,72	18,3	9,08	0,12	9,29	11,0	0,67	0,51	96,49		BLO	S

595	45,1	0,66	8,86	18,9	0,22	16,2	8,28	0,26	0,19	98,67	YGR	S
596	43,9	1,92	18,2	11,9	0,14	10,7	11,5	0,24	0,21	98,71	DO	S
597	47,4	2,18	16,1	11,2	0,14	9,23	10,4	0,32	0,25	97,22	DY	S
598	44,0	1,94	18,7	10,6	0,13	9,80	11,2	0,47	0,36	97,20	BR	S
599	47,6	2,22	16,1	11,5	0,15	9,26	11,0	0,47	0,37	98,67	DY	S
600	47,2	2,24	16,4	11,6	0,13	9,03	10,5	0,51	0,25	97,86	YBR	S
602	48,2	1,29	18,5	6,56	0,09	9,39	11,3	1,45	0,93	97,71	YGR	S
603	45,2	0,74	9,65	17,5	0,21	14,3	9,54	0,27	0,21	97,62	YGR	F
604	47,0	1,90	16,0	10,1	0,14	9,51	10,3	1,01	0,68	96,64	GYGR	F
605	47,0	1,75	16,5	9,89	0,12	10,0	10,2	0,77	0,75	96,98	YGY	F
606	45,0	0,67	9,33	17,5	0,21	15,1	9,22	0,28	0,25	97,56	DBGR	F
607	43,5	5,77	10,5	21,5	0,24	6,20	10,6	0,71	0,59	99,61	BLO	F
608	50,3	2,97	13,0	12,3	0,14	6,24	10,3	0,79	0,82	96,86	ORBR	F
609	45,5	0,80	23,7	5,91	0,08	7,03	13,9	0,35	0,18	97,45	LYGR	F
610	45,2	0,33	23,3	5,34	0,08	11,4	13,4	0,29	0,14	99,48	PGR	F
611	45,8	1,68	15,4	12,4	0,12	10,5	10,2	0,64	0,44	97,18	GRBR	F
612	45,3	0,40	23,9	6,06	0,07	8,54	14,4	0,19	0,04	98,90	GR	F
613	47,5	1,19	22,3	6,92	0,12	6,70	13,2	0,78	0,51	99,22	GYGR	F
615	47,8	1,79	17,7	8,03	0,11	7,55	11,8	0,91	0,65	96,34	DGY	S
616	47,8	1,94	19,6	5,69	0,09	5,15	12,7	1,25	0,56	94,78	DGY	F
617	47,9	1,86	15,6	10,2	0,12	8,95	10,3	0,85	0,66	96,44	DGY	F
620	45,7	0,64	9,58	17,3	0,22	14,7	9,27	0,28	0,27	97,96	YGR	S
623	41,0	2,09	19,2	10,8	0,12	10,5	12,4	0,06	0,11	96,28	BR	S
624	45,8	1,93	15,4	12,2	0,17	9,84	10,3	0,63	0,45	96,72	DO	S
625	44,9	0,65	9,41	17,7	0,18	15,0	8,84	0,25	0,20	97,13	YGR	S
626	42,7	3,89	11,8	19,9	0,21	7,76	10,3	0,29	0,25	97,10	RDBR	S
628	41,5	2,21	19,0	10,9	0,15	11,4	12,3	0,03	0,14	97,63	BR	S
629	45,9	1,83	17,4	11,3	0,16	10,2	10,8	0,12	0,16	97,87	YBR	S
630	45,7	3,87	9,07	18,1	0,21	6,48	10,3	0,72	0,36	94,81	RDOR	F
631	48,7	2,91	15,6	10,4	0,14	8,94	9,80	0,86	0,82	98,17	Y	F
632	45,3	0,67	9,81	17,4	0,22	14,4	9,15	0,25	0,21	97,41	YGR	F
633	44,8	0,08	33,0	0,04	0,02	0,05	17,5	1,28	0,10	96,87	C	F
634	42,3	4,58	8,49	20,5	0,23	11,5	8,98	0,50	0,29	97,37	RD	F
635	45,6	3,38	16,8	9,46	0,14	9,33	11,6	0,31	0,19	96,81	-	F
636	44,6	1,79	18,4	10,4	0,10	10,2	11,6	0,11	0,15	97,35	BR	F
637	45,7	0,65	9,73	18,2	0,22	14,7	9,11	0,40	0,18	98,89	-	S
638	45,3	0,70	9,71	17,3	0,21	14,7	9,25	0,36	0,25	97,78	YGR	F
639	46,2	1,99	20,1	11,8	0,13	8,69	12,2	0,65	0,34	102,10	BLO	S
640	48,2	1,56	17,7	10,9	0,12	11,4	10,9	0,43	0,46	101,67	GRGY	S
641	47,3	1,92	16,4	10,4	0,13	10,6	10,7	0,34	0,15	97,94	YBR	S
642	43,9	0,04	35,4	0,40	0,01	0,12	19,2	0,57	0,06	99,70	DGR	S
643	46,9	2,34	16,8	10,1	0,13	10,2	9,97	0,92	0,49	97,85	GRBL	S
644	45,9	0,12	35,9	0,06	0,01	0,05	18,3	1,34	0,13	101,81	C	F
645	37,7	0,37	35,8	1,16	0,03	5,76	20,0	0,17	0,08	101,07	C	F
646	45,2	0,27	27,4	3,62	0,06	8,60	15,1	0,12	0,07	100,44	PGR	F
647	45,4	0,42	25,5	6,14	0,08	8,40	14,6	0,19	0,16	100,89	PYGR	S
648	45,8	0,31	24,7	5,97	0,09	9,23	14,3	0,16	0,09	100,65	PYGR	F
649	46,0	0,81	23,9	6,34	0,09	7,54	14,0	0,35	0,21	99,24	LYGR	F
650	44,1	0,40	27,2	4,51	0,06	5,08	15,6	0,31	0,09	97,35	PGR	F
651	45,0	0,41	26,0	6,02	0,09	8,49	14,7	0,15	0,10	100,96	PGR	F
652	44,4	0,31	24,4	5,54	0,08	8,82	14,2	0,14	0,02	97,91	PGR	F
653	46,5	0,78	10,6	17,7	0,23	13,5	9,80	0,42	0,32	99,85	YGR	F
654	45,6	0,76	10,3	17,3	0,18	13,3	9,69	0,38	0,25	97,76	YGR	F
655	47,7	1,37	20,2	8,45	0,10	10,6	11,6	0,55	0,33	100,90	DY	F
656	52,8	1,50	18,3	9,45	0,12	5,27	10,8	1,20	0,76	100,20	DY	F
657	48,8	2,09	15,5	12,6	0,17	7,91	10,8	0,52	0,38	98,77	YBR	F
658	48,1	2,66	15,2	12,1	0,15	10,0	10,1	0,86	0,69	99,86	YBR	F
659	47,5	2,32	14,6	11,0	0,14	9,08	10,1	0,82	0,43	95,99	YBR	F

660	46,7	1,94	13,2	13,9	0,18	10,5	9,92	0,80	0,58	97,72		YBR	F
662	46,4	2,68	13,1	13,3	0,15	9,61	10,3	0,20	0,13	95,87		BR	F
663	46,1	4,23	10,4	20,7	0,22	8,16	9,40	0,36	0,37	99,94		RDBR	F
664	49,4	2,13	13,3	13,0	0,17	4,34	9,75	1,17	1,13	94,39		RDBR	F
665	45,1	0,32	25,8	5,55	0,06	8,87	14,6	0,17	0,09	100,56		C	F
666	44,6	0,38	25,1	6,08	0,09	8,35	14,4	0,24	0,12	99,36		C	F
667	48,5	2,33	15,0	11,7	0,15	9,54	9,81	1,05	0,77	98,85		YBR	F
669	49,8	2,36	16,5	11,6	0,15	7,25	10,2	1,20	0,85	99,91		BR	F
670	42,4	0,37	23,0	6,47	0,07	8,18	13,5	0,22	0,04	94,25		WH	F
672	46,7	1,76	19,4	8,34	0,10	6,52	12,0	0,86	0,48	96,16		DBR	F
673	47,2	1,80	16,7	11,1	0,12	10,2	10,6	0,82	0,56	99,10		BRO	F
674	46,4	3,14	12,7	17,0	0,21	9,55	9,95	0,59	0,37	99,91		BRO	F
675	46,3	2,49	14,9	12,5	0,13	8,64	9,70	0,89	0,92	96,47		DBRO	F
679	45,8	0,70	10,3	17,3	0,21	13,9	9,35	0,38	0,21	98,15	1,629	YGR	F
680	46,6	0,63	10,3	17,9	0,20	14,0	9,74	0,38	0,27	100,02	1,635	YGR	F
681	45,1	0,66	9,62	16,7	0,20	14,6	9,32	0,34	0,21	96,75	1,636	YGR	F
682	45,3	0,36	25,6	6,29	0,07	8,13	14,9	0,28	0,12	101,05		YGR	F
683	47,8	2,32	14,8	10,9	0,13	7,65	9,84	1,22	0,93	95,59		YBR	F
684	47,1	1,59	17,7	9,48	0,11	9,39	10,8	0,86	0,56	97,59		GYO	F
685	46,4	1,97	16,8	10,6	0,19	9,70	10,5	0,73	0,46	97,35		DGYO	F
686	46,3	1,81	17,1	10,3	0,12	9,72	10,8	0,68	0,48	97,31		DGYO	F
						APOLLO 15							
1	46,2	1,88	11,0	18,6	0,23	12,4	9,02	0,64	0,09	100,06	1,648	DBR	F
2	49,7	1,38	17,7	9,12	0,12	9,31	10,1	1,26	0,50	99,19	1,595	YBR	F
3	48,5	1,17	17,8	8,74	0,14	10,6	9,95	1,20	0,42	98,52	1,596	BRY	F
4	45,9	0,17	25,2	6,35	0,09	8,20	13,9	0,13	0,13	100,37	1,595	YGR	F
5	48,8	0,66	18,5	8,10	0,13	12,9	10,5	0,84	0,20	100,63	1,603	YGR	F
6	49,5	1,79	17,1	10,2	0,13	6,06	9,84	1,82	1,01	97,45	1,592	DBRY	F
7	46,3	1,83	15,2	14,6	0,19	11,9	10,6	0,36	0,12	101,10	1,629	YBR	F
8	51,3	1,61	16,4	9,98	0,14	9,04	9,99	1,30	0,57	100,33	1,595	YBR	F
9	57,0	1,90	15,8	10,6	0,13	5,37	9,45	1,69	1,36	103,30	1,590	YBR	F
10	55,2	1,74	13,9	13,7	0,15	6,40	9,40	1,10	0,78	102,37		YBR	F
11	47,9	0,74	22,6	7,29	0,08	8,75	13,6	0,69	0,13	101,78	1,595	YGR	F
12	46,4	0,15	25,1	5,73	0,10	10,1	14,0	0,10	0,18	101,86	1,595	LYGR	F
13	49,0	0,00	33,1	0,56	0,04	0,22	16,3	2,76	0,39	102,37	1,564	C	F
688	44,8	0,53	7,45	20,5	0,23	17,5	8,17	0,16	0,23	99,57		PGR	F
689	48,8	1,39	17,1	10,3	0,12	9,25	10,4	0,62	0,60	98,58		GY	F
691	51,2	1,43	17,0	10,2	0,12	9,37	10,2	0,95	0,65	101,12		YBR	F
692	42,9	0,98	18,7	10,6	0,10	14,6	11,0	0,96	0,27	100,11		GY	S
693	46,4	0,20	25,7	7,96	0,03	2,49	14,8	0,69	0,35	98,62		GY	S
694	46,0	0,57	7,76	19,3	0,22	17,6	8,32	0,20	0,20	100,17		YGR	S
695	43,3	3,32	8,51	21,8	0,23	13,1	8,27	0,50	0,30	99,33		RDBR	S
696	42,1	3,96	8,74	22,7	0,25	11,9	8,71	0,52	0,31	99,19		RDBR	S
697	42,3	3,52	8,76	22,1	0,24	12,4	8,31	0,51	0,29	98,43		RDBR	S
698	44,8	0,55	7,22	20,8	0,23	17,5	8,08	0,17	0,19	99,54		PGR	S
699	45,5	0,57	7,26	20,6	0,22	18,0	8,22	0,20	0,22	100,79		PGR	S
700	45,1	0,57	7,62	20,4	0,22	17,3	8,09	0,17	0,22	99,69		PGR	S
701	46,5	0,52	8,22	19,2	0,20	16,9	9,28	0,18	0,23	101,23		YGR	F
702	46,0	1,00	22,7	7,17	0,07	8,13	13,5	0,53	0,14	99,24		GRY	F
703	48,3	1,36	18,0	9,20	0,11	9,02	11,1	0,77	0,57	98,43		BRY	F
704	51,0	1,47	16,2	10,0	0,12	8,79	10,2	0,81	0,72	99,31		Y	F
707	43,0	0,49	6,63	22,0	0,24	20,5	7,14	0,13	0,24	100,37		YGR	F
708	47,3	0,92	18,9	8,34	0,10	13,1	11,4	0,60	0,42	101,08		BRGY	F
709	47,2	1,01	18,7	8,36	0,10	11,9	11,2	0,71	0,43	99,61		BRGY	F
710	50,4	1,50	17,1	10,0	0,13	8,94	10,8	0,86	0,57	100,30		YGR	F
711	50,1	2,66	14,4	14,8	0,14	5,65	10,3	0,77	0,82	99,64		PLGY	F
712	44,4	0,55	7,29	20,5	0,22	18,1	8,27	0,15	0,23	99,71		Y	F
713	49,6	1,43	17,2	9,63	0,12	9,16	10,3	0,87	0,66	98,97		Y	F

715	47,7	1,72	13,8	15,5	0,17	9,26	10,6	0,59	0,42	99,76		YBR	F
716	47,6	1,60	13,7	14,5	0,16	10,3	10,2	0,70	0,46	99,22		GY	F
718	50,6	1,16	13,6	12,1	0,17	11,1	10,9	0,54	0,60	100,77		PLGY	F
719	47,2	1,00	18,1	8,26	0,09	12,2	11,4	0,63	0,42	99,30		GY	F
723	46,7	1,35	17,0	12,3	0,13	11,4	10,8	0,52	0,35	100,55		GRGY	F
724	48,6	1,13	18,0	9,31	0,12	11,4	11,2	0,77	0,52	101,05		GRGY	F
725	45,8	1,80	13,2	17,8	0,17	10,2	10,5	0,42	0,31	100,20		GY	F
726	50,3	1,45	16,8	10,1	0,12	8,90	10,2	0,89	0,71	99,47		GRGY	F
728	45,0	0,53	6,93	20,5	0,21	17,8	7,94	0,23	0,20	99,34	1,649	PGR	F
729	44,1	4,81	10,6	19,8	0,20	9,75	9,71	0,84	0,41	100,22	1,650	BR	F
730	47,6	0,55	25,6	5,58	0,07	7,38	13,9	0,70	0,34	101,92	1,652	YGR	F
731	42,4	3,45	8,38	22,1	0,24	14,3	8,11	0,58	0,31	99,87	1,658	BR	F
732	46,9	1,29	17,5	8,05	0,10	13,4	10,6	0,64	0,33	98,81	1,655	YGR	F
734	42,8	3,47	8,57	22,2	0,23	14,3	8,04	0,57	0,26	100,44	1,659	BR	F
735	44,3	0,57	6,99	20,6	0,22	17,7	8,10	0,22	0,20	98,90	1,651	PGR	F
736	44,7	0,52	7,39	20,4	0,22	17,5	8,22	0,19	0,20	99,34		PGR	S
737	44,9	0,53	7,28	20,5	0,22	18,0	8,07	0,23	0,22	99,95		PGR	S
738	45,2	0,55	7,24	20,2	0,21	17,8	8,20	0,22	0,21	99,83		PGR	S
739	44,9	0,56	7,66	20,6	0,21	17,8	8,20	0,21	0,17	100,31		PGR	S
740	45,8	0,53	7,40	20,5	0,23	17,5	8,13	0,21	0,19	100,49		PGR	S
741	36,7	13,1	8,97	20,4	0,21	10,5	8,40	0,78	0,38	99,44		BL	S
742	42,3	3,60	8,42	21,9	0,24	13,1	8,43	0,66	0,29	98,94		DRD	S
743	41,6	4,64	9,47	21,7	0,21	10,9	9,01	0,64	0,34	98,51		DRD	S
744	43,2	1,94	14,6	15,9	0,18	12,2	11,5	0,11	0,22	99,85		DBR	S
747	42,5	1,57	20,1	10,2	0,12	12,2	12,6	0,03	0,15	99,47		BRGR	S
748	47,3	0,80	17,3	8,36	0,11	12,9	11,0	1,03	0,23	99,03		YGR	S
749	42,9	3,67	8,59	22,8	0,23	12,3	8,90	0,56	0,31	100,26		RDBR	S
750	43,2	3,58	8,06	22,6	0,22	13,3	8,15	0,60	0,29	100,02		BL	S
751	49,6	1,51	16,3	10,0	0,12	8,40	10,5	0,97	0,69	98,09		GRBR	F
[illegible]4	48,1	1,21	20,7	8,37	0,10	10,3	12,0	0,80	0,46	102,04		GR	F
755	46,3	1,85	18,1	10,9	0,13	10,3	11,2	0,55	0,34	99,67		GRGY	F
756	47,2	1,59	14,9	13,3	0,17	10,9	11,6	0,84	0,24	100,74		GY	F
758	49,9	1,53	16,8	11,0	0,12	9,31	10,4	1,11	0,65	100,82		GRBR	F
759	46,7	1,21	16,4	12,8	0,14	11,9	11,0	0,65	0,31	101,11		GRGY	F
761	44,8	0,53	7,75	20,7	0,21	17,4	8,31	0,19	0,23	100,12		PGR	F
765	42,1	3,35	9,41	22,9	0,22	12,6	8,91	0,51	0,27	100,27		RDOR	S
766	45,3	0,57	7,70	19,9	0,20	18,9	8,39	0,09	0,17	101,22		DGY	S
769	45,1	0,57	7,95	20,1	0,22	18,4	8,25	0,21	0,22	101,02		OR	S
772	45,6	1,15	16,9	11,4	0,16	10,1	10,9	1,16	0,34	97,71		ODGY	F
773	45,8	0,56	7,97	20,2	0,21	19,3	7,95	0,29	0,22	102,50		PGR	S
774	44,4	0,49	6,98	20,2	0,21	17,9	8,10	0,23	0,21	98,72		PGR	S
776	46,4	1,39	19,1	10,7	0,13	10,4	11,5	0,54	0,29	100,45		BR	S
777	49,8	1,27	17,1	9,47	0,11	8,88	11,0	0,94	0,56	99,13		GRGY	F
782	51,1	2,07	17,9	11,0	0,13	9,85	10,4	1,32	0,53	104,30		DGY	F
784	45,5	0,54	7,70	20,4	0,22	18,4	8,13	0,28	0,21	101,38		PGR	S
785	44,9	0,57	7,46	19,4	0,21	18,6	8,14	0,27	0,22	99,77		PGR	S
786	46,7	2,23	10,1	18,2	0,22	9,24	9,97	1,52	0,38	98,56		DRD	S
787	44,2	1,59	16,1	13,0	0,15	11,3	11,4	0,17	0,20	98,11		BL	S
788	42,7	3,37	8,71	22,2	0,23	13,4	8,17	0,46	0,30	99,54		RDBR	S
789	42,6	1,84	14,8	15,7	0,17	11,5	11,8	0,11	0,19	98,71		DYBR	S
790	43,2	3,85	9,41	22,0	0,21	11,9	9,08	0,58	0,31	100,54		DRD	S
791	51,3	1,03	3,87	18,8	0,23	18,8	6,51	0,19	0,21	100,94		O	S
792	47,1	0,50	8,18	19,0	0,22	17,9	8,84	0,09	0,19	102,02		DRD	F
793	48,4	0,26	23,2	4,52	0,06	10,5	12,7	0,28	0,11	100,03		C	S
[illegible]4	40,8	1,25	19,8	13,6	0,10	10,9	12,1	0,13	0,18	98,86		GRY	S
795	37,6	0,53	26,4	8,47	0,11	10,6	15,5	0,05	0,12	99,38		YGR	S
798	44,8	0,09	35,7	0,27	0,06	0,10	19,1	0,65	0,29	101,06		C	F
799	43,9	0,34	21,3	6,71	0,08	14,2	12,2	0,30	0,13	99,16		C	S

800	48,0	0,98	19,3	7,94	0,10	10,6	11,3	1,10	0,45	99,77		LGR	F
801	44,3	3,24	14,2	16,8	0,19	11,2	10,9	0,14	0,25	101,22		DBR	S
802	34,2	2,28	19,5	14,7	0,18	15,4	13,9	0,06	0,18	100,40		DBR	S
805	40,4	1,43	21,7	10,1	0,13	11,4	13,9	0,07	0,12	99,25		DY	S
806	45,5	1,10	15,9	12,5	0,14	11,5	11,6	0,56	0,20	99,00		GY	S
807	44,8	0,55	7,52	20,5	0,22	18,8	7,97	0,29	0,22	100,87		YGR	S
808	42,3	2,27	8,30	23,6	0,25	14,4	8,57	0,60	0,28	100,57		BR	S
809	41,4	1,98	13,4	17,2	0,20	12,9	11,6	[illegible]	0,17	98,89		BR	S
810	44,9	0,52	7,20	20,0	0,22	18,0	8,2	0,28	0,20	99,54		PGR	S
811	44,3	0,50	7,22	20,1	0,22	17,7	8,13	0,25	0,22	98,64		PGR	S
812	41,9	3,48	8,86	21,2	0,22	13,2	8,24	0,74	0,10	97,94	1,660	RDBR	F
813	45,1	3,94	9,92	21,1	0,21	9,75	9,05	0,21	0,36	99,64	1,660	RDBR	S
814	49,2	1,48	11,9	22,0	0,30	7,36	9,09	0,73	0,01	102,07		C	F
815	45,9	0,51	7,46	19,7	0,20	18,8	8,17	0,16	0,22	101,12	1,641	PGR	F
816	46,5	0,90	14,9	12,3	0,17	11,8	9,86	0,99	0,24	97,66	1,608	DBR	F
817	46,7	1,33	15,6	13,0	0,16	12,1	10,8	0,48	0,36	100,53	1,604	GRGY	F
818	45,7	0,60	7,72	19,4	0,21	18,8	7,74	0,25	0,01	100,43	1,640	GR	F
820	48,7	1,88	16,6	10,5	0,12	9,09	10,6	0,63	0,60	98,72	1,604	DY	F
821	46,6	0,99	18,1	10,9	0,16	10,9	11,2	0,69	0,24	99,78	1,609	GRGY	F
822	44,9	0,57	7,19	20,4	0,22	18,4	8,35	0,15	0,24	100,42	1,641	PGR	F
823	45,5	3,58	9,78	20,8	0,24	8,78	9,60	0,56	0,49	99,33	1,658	DRD	F
824	42,8	3,41	8,81	21,7	0,24	13,3	8,58	0,46	0,30	99,60	1,664	RDBR	S
825	45,7	0,52	7,56	19,5	0,20	18,3	8,24	0,17	0,21	100,40	1,638	YGR	S
826	45,2	0,51	7,56	20,0	0,19	18,4	8,34	0,16	0,25	100,61	1,642	PGR	S
827	44,8	0,53	7,39	20,3	0,21	18,1	8,40	0,16	0,23	100,12	1,641	LGR	S
828	47,8	0,10	32,6	0,74	0,05	0,08	15,6	3,12	0,27	100,36	1,603	GRY	F
829	43,2	3,44	8,90	21,3	0,23	13,9	9,22	0,54	0,35	101,08		RDBR	F
830	46,3	0,95	17,8	8,60	0,12	10,7	11,9	0,52	0,31	97,20		DY	F
831	45,4	0,62	7,22	19,6	0,22	18,7	7,94	0,18	0,20	100,08		GY	F
832	45,5	0,54	7,53	21,0	0,21	18,5	8,46	0,10	0,21	102,05		ORBR	S
833	45,7	1,67	14,8	15,1	0,15	10,9	10,5	0,12	0,21	99,15		Y	S
834	45,0	5,69	2,13	30,4	0,25	7,83	9,36	0,14	0,40	101,20		DBR	S
835	45,7	1,63	14,6	14,8	0,15	10,9	10,9	0,16	0,30	99,14		LBR	S
836	45,8	0,70	8,67	19,3	0,19	16,3	8,50	0,29	0,18	99,93		C	S
837	42,6	2,22	11,5	18,0	0,19	14,1	9,80	0,06	0,23	98,70		YBR	S
838	43,0	1,44	19,5	11,2	0,12	11,9	12,7	0,03	0,18	100,07		YBR	S
839	45,6	0,54	7,34	19,6	0,21	18,2	7,80	0,17	0,19	99,65		YGR	S
840	45,1	1,89	14,1	15,7	0,17	10,5	11,1	0,40	0,34	99,30		DGY	F
841	47,0	0,16	33,4	0,46	0,01	0,33	16,7	1,64	0,14	99,84		C	F
842	47,1	1,62	12,1	16,3	0,18	12,1	9,90	0,34	0,31	99,95		GY	F
843	49,7	1,31	17,4	10,1	0,10	9,74	11,0	0,60	0,66	100,61		YGY	F
845	50,2	1,51	16,7	9,81	0,12	9,01	10,8	0,77	0,69	99,61		GY	F
847	49,0	0,98	20,0	9,21	0,11	7,87	11,7	0,60	0,52	99,99		Y	F
848	45,3	0,49	25,7	6,13	0,07	8,9	14,3	0,08	0,14	101,11		PGR	F
849	44,7	0,59	7,41	20,2	0,21	18,1	7,98	0,15	0,21	99,55		PGR	S
850	48,1	1,38	16,7	9,16	0,14	9,61	9,83	1,17	0,46	96,55		BR	F
851	54,2	1,45	19,6	7,54	0,12	3,34	10,7	1,17	0,37	98,49		YBR	F
852	45,2	3,82	9,31	20,6	0,22	9,86	9,10	0,37	0,49	98,97		RD	F
854	50,0	1,52	16,6	9,96	0,11	9,33	10,8	0,74	0,69	99,75		LBR	F
855	42,5	0,60	3,00	30,6	0,31	21,3	2,82	0,27	0,00	101,40		YBR	F
856	51,0	1,33	18,0	10,3	0,11	9,52	10,9	0,69	0,66	102,51		YGR	F
857	46,4	1,18	13,6	14,8	0,18	12,4	8,96	0,71	0,28	98,51		OBL	F
858	46,1	1,50	12,5	17,0	0,21	11,2	9,88	0,59	0,12	99,10		ODBR	F
859	49,3	1,33	16,3	10,8	0,16	10,7	11,0	1,25	0,85	101,69		Y	F
860	46,3	1,58	15,6	14,9	0,15	12,0	11,3	0,38	0,33	102,54		BR	F
861	45,0	0,60	7,50	20,0	0,21	18,4	7,71	0,25	0,05	99,72		LYGR	F
882	41,0	1,56	15,6	15,2	0,18	12,4	11,0	0,09	0,04	97,07		ODBR	S
883	49,2	2,16	13,9	14,2	0,19	9,50	9,80	0,35	0,07	99,37		BR	S

884	47,5	1,15	17,0	11,6	0,16	11,6	10,6	0,55	0,22	100,38	YGR	S
885	46,1	1,06	19,4	8,57	0,14	12,2	10,7	0,75	0,22	99,14	DY	S
886	48,4	0,20	21,3	2,72	0,10	16,3	11,3	0,09	0,08	100,49	LGRY	S
887	44,0	1,44	15,9	13,9	0,20	11,2	10,5	0,16	0,05	100,38	BR	S
888	45,5	0,60	8,00	18,9	0,22	17,5	7,90	0,05	0,03	98,70	BRO	F
889	44,3	0,80	23,7	7,93	0,13	8,72	12,6	0,86	0,22	99,26	OGY	S
890	43,7	0,60	7,91	18,8	0,22	18,4	7,49	0,25	0,00	97,37	LYGR	F
891	45,8	0,29	7,37	20,4	0,28	18,5	7,41	0,21	0,01	100,27	OR	F
892	47,0	0,22	8,12	18,6	0,28	16,7	8,01	0,07	0,02	99,02	O	F
893	37,6	12,4	8,73	21,6	0,23	10,7	8,08	0,99	0,03	100,36	OBL	S
894	46,8	0,87	20,0	10,2	0,10	10,1	9,70	2,08	0,24	100,09	GY	F
895	41,1	1,76	15,3	15,4	0,19	12,4	11,1	0,06	0,11	97,42	DBL	S
896	40,8	7,42	10,5	18,2	0,21	9,50	9,97	0,26	0,00	96,86	DRD	F
897	45,8	1,45	16,0	14,2	0,16	11,0	9,96	0,26	0,10	98,93	DY	S
898	44,8	0,50	7,67	18,9	0,23	19,0	7,60	0,27	0,01	98,98	GY	S
899	44,1	0,27	34,9	0,50	0,11	0,22	17,8	0,64	0,14	98,68	C	S
900	40,6	1,44	16,6	14,2	0,22	14,5	10,2	0,04	0,00	97,80	DBR	S
901	46,9	1,46	13,6	15,7	0,22	10,6	9,65	0,35	0,04	98,52	BR	S
902	45,0	0,50	7,52	20,1	0,24	18,6	7,75	0,25	0,01	99,97	LYGR	F
903	44,0	1,44	14,7	16,3	0,19	12,6	10,8	0,05	0,05	100,13	ODBR	S
904	43,1	1,63	15,4	16,1	0,18	11,8	11,4	0,06	0,06	99,73	RDBR	S
905	48,5	0,80	21,8	6,80	0,14	10,4	12,0	0,98	0,24	101,66	LY	S
906	45,4	0,90	15,7	12,6	0,16	16,0	9,23	0,17	0,07	100,23	YGR	S
907	44,3	0,60	7,58	19,4	0,22	19,0	7,56	0,26	0,07	98,99	LYGR	S
908	46,7	1,38	16,5	13,4	0,17	11,6	11,1	0,19	0,13	101,17	YBR	S
909	44,7	1,08	17,6	12,0	0,19	12,2	10,5	0,10	0,00	98,37	GRBR	S
910	45,8	0,46	7,52	20,1	0,2	17,7	8,6	0,27	0,0	100,65	YGR	S
911	45,2	1,48	15,1	15,3	0,18	11,9	11,2	0,12	0,0	100,48	DBR	S
912	49,2	0,62	17,6	8,58	0,09	12,0	11,0	2,42	0,02	101,53	LGR	S
913	46,1	1,41	12,9	16,6	0,18	10,8	11,0	0,27	0,01	99,27	LYBR	S
914	45,8	1,52	12,2	18,2	0,18	11,9	10,1	0,18	0,01	100,09	DBR	S
915	45,7	0,45	7,48	19,6	0,19	17,2	8,5	0,34	0,0	99,46	YGR	S
917	42,8	1,80	16,2	15,4	0,18	11,7	11,8	0,24	0,0	100,12	YBR	S
918	46,4	0,48	7,38	19,8	0,19	18,2	8,4	0,24	0,01	101,10	YGR	F
921	36,1	1,49	15,5	17,5	0,18	16,2	12,8	0,01	0,01	99,79	DBR	S
922	52,8	3,55	8,61	15,0	0,18	12,6	7,0	0,99	0,29	101,02	DY	F
923	51,2	0,88	17,8	9,93	0,15	9,17	10,9	1,27	0,38	101,68	Y	F
924	45,2	0,50	7,17	19,5	0,20	17,3	8,3	0,22	0,0	98,39	GRY	F
926	55,0	0,56	17,8	7,25	0,12	8,98	9,2	1,26	1,27	101,44	LYGR	F
927	40,9	13,0	10,5	17,7	0,19	9,32	11,2	0,24	0,02	103,07	DRD	F
928	47,9	0,81	16,3	11,6	0,13	10,9	10,8	0,30	0,0	98,74	DY	F
930	41,9	11,0	10,2	18,4	0,19	9,65	10,8	0,53	0,02	102,69	DRD	F
931	53,6	0,92	16,6	9,95	0,13	6,91	11,3	0,75	0,02	100,18	Y	F
932	48,2	1,05	17,7	11,0	0,15	11,3	10,8	0,56	0,0	100,76	DY	F
933	45,8	0,28	28,0	4,63	0,09	6,37	16,0	0,10	0,0	101,27	LYGR	F
934	45,5	4,16	9,96	19,5	0,20	9,99	10,0	0,68	0,15	100,14	BR	F
935	52,0	1,82	15,7	10,5	0,16	8,68	9,9	1,12	0,56	100,44	GY	F
936	46,0	2,14	9,75	20,2	0,19	10,1	10,4	0,62	0,01	99,41	BR	F
937	52,0	1,56	17,0	10,5	0,13	5,30	10,4	2,15	1,16	100,20	LYBR	F
938	45,4	4,14	12,8	15,6	0,16	10,3	10,9	0,46		99,96	RDBR	F
939	47,2	1,40	14,0	14,8	0,18	11,0	10,8	0,45	0,02	99,85	DY	F
940	45,7	0,34	25,7	6,13	0,12	9,37	14,9	0,03	0,0	102,29	LYGR	F
943	44,9	1,25	12,4	16,8	0,18	13,4	10,8	0,10	0,01	99,84	YBR	S
944	40,7	1,28	15,9	15,9	0,17	13,6	12,1	0,04	0,01	99,70	YBR	S
945	47,5	0,78	20,9	9,00	0,15	7,39	15,0	0,59	0,01	101,32	BR	S

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14	46,3	0,48	24,0	5,21	0,10	9,60	13,2	0,88	0,28	100,05	DGY	F
15	44,7	6,39	10,2	16,0	0,21	8,32	13,8	0,44	0,00	100,06	BLO	F

16	45,6	0,1	34,8	2,36	0,04	0,91	17,7	0,84	0,06	102,41	Y	F
17	46,5	0,54	22,6	7,51	0,09	8,41	13,5	0,87	0,36	100,38	DGY	F
18	44,6	0,30	25,6	6,03	0,10	7,88	14,6	0,35	0,03	99,49	YGR	F
19	45,2	0,33	28,0	4,63	0,10	6,44	15,[illegible]	0,71	0,22	101,13	YGR	F
[illegible]0	43,6	0,50	26,6	5,45	0,12	7,03	14,0	0,84	0,28	98,42	DGY	F
21	45,2	0,30	28,4	4,59	0,10	6,05	15,9	0,74	0,20	101,48	DBL	F
22	45,1	0,44	20,2	10,5	0,15	9,46	12,6	0,61	0,09	99,15	GRY	F
23	43,2	0,15	29,8	4,32	0,09	4,29	16,6	0,53	0,19	99,17	C	F
24	43,3	0,50	24,4	10,2	0,14	8,79	14,2	0,45	0,22	102,20	GY	F
25	43,2	0,30	27,5	6,39	0,13	8,94	14,2	0,34	0,15	101,15	Y	F
26	44,3	0,42	26,1	5,61	0,10	6,54	15,0	0,66	0,23	98,96	DGY	F
27	43,8	0,02	32,8	2,77	0,08	1,03	18,3	0,75	0,22	99,77	LGY	F
28	45,3	0,80	20,8	7,16	0,12	10,2	12,5	0,40	0,16	97,44	YBR	S
29	42,3	0,42	27,2	7,16	0,12	8,03	15,1	0,08	0,13	100,54	YGR	F
30	43,5	0,45	7,92	22,0	0,23	17,0	8,41	0,32	0,02	99,85	DGR	S
31	49,7	2,01	15,2	11,9	0,15	6,74	8,76	2,31	1,52	98,29	ORBR	F
32	43,1	0,40	30,0	4,37	0,10	5,15	15,8	0,46	0,21	99,59	LY	F
33	45,3	0,50	24,2	5,10	0,10	8,67	13,2	0,68	0,22	97,97	YGR	F
34	47,0	0,14	25,8	4,79	0,10	6,44	14,6	0,62	0,17	99,66	LYGR	F
35	42,5	0,25	27,0	5,65	0,11	7,04	14,7	0,46	0,21	97,92	LYGR	S
36	43,6	0,36	27,4	4,93	0,11	5,34	16,0	0,68	0,23	98,65	YDBR	S
38	41,6	0,14	31,4	3,15	0,09	4,46	18,2	0,22	0,17	99,43	YBR	S
39	42,1	0,20	31,1	3,77	0,09	4,89	17,7	0,17	0,20	100,22	Y	F
40	50,8	2,80	17,0	11,4	0,15	4,26	9,99	1,59	0,65	98,64	OBL	F
41	45,7	0,30	28,4	3,09	0,10	5,76	15,5	0,29	0,18	99,32	BR	S
42	46,4	0,20	29,5	2,24	0,09	4,77	16,2	0,86	0,17	100,43	DBR	S
43	39,6	0,10	35,5	5,94	0,10	4,75	15,0	0,22	0,00	101,21	LYBR	S
44	44,1	0,25	27,1	5,90	0,10	7,08	15,4	0,38	0,17	100,48	YGR	F
45	45,0	0,25	29,3	4,11	0,10	5,53	15,6	0,71	0,21	100,81	Y	F
[illegible]6	42,7	0,50	26,8	5,58	0,13	8,07	14,3	0,16	0,21	98,45	YGR	S
47	42,7	0,50	25,1	6,98	0,14	8,67	13,9	1,33	0,33	99,65	YBR	F
48	45,2	0,17	26,9	4,35	0,11	6,74	14,6	1,84	0,25	100,16	YGY	F
49	40,7	0,48	22,0	8,23	0,14	13,0	12,5	0,15	0,12	97,32	YGR	F
50	43,9	0,14	25,8	5,34	0,10	8,45	13,9	0,10	0,13	97,86	YGRY	F
51	43,5	0,22	28,2	4,41	0,10	5,27	15,7	0,75	0,17	98,32	YGR	F
52	44,6	0,50	26,9	5,58	0,11	6,92	14,6	0,36	0,17	99,74	GRGY	F
53	45,7	0,34	26,4	5,20	0,10	5,95	14,7	0,99	0,20	99,58	GRY	F
54	43,9	0,30	30,3	3,36	0,[illegible]	3,42	16,5	1,39	0,21	99,47	Y	B
55	43,6	0,48	24,1	7,81	0,12	8,30	12,9	0,96	0,18	98,45	ODGY	F
56	44,1	0,28	28,1	3,68	0,09	6,38	15,3	0,73	0,17	98,83	ODGY	F
57	43,6	0,69	28,2	4,60	0,10	2,44	15,8	1,16	0,18	96,77	BR	F
58	44,6	0,30	28,2	4,58	0,08	5,64	15,3	0,74	0,20	99,64	OGY	F
59	43,6	0,28	27,7	4,79	0,09	6,61	15,1	0,77	0,21	99,15	OBL	F
61	42,4	7,67	10,9	16,0	0,20	10,8	10,6	0,44	0,01	99,02	DRD	F
62	39,1	0,36	28,2	6,82	0,10	8,39	15,7	0,06	0,13	98,86	DY	F
63	42,4	7,89	12,5	14,2	0,17	9,69	11,2	1,32	0,15	99,52	RD	F
64	44,7	0,20	26,3	2,79	0,09	10,4	14,1	0,05	0,13	98,76	LYGR	F
65	48,2	0,53	29,1	5,62	0,10	7,31	16,2	0,06	0,14	107,26	CGR	S
66	43,8	0,10	29,7	3,86	0,09	5,10	17,2	0,14	0,14	100,13	C	S
67	38,1	0,48	29,6	5,36	0,11	7,13	16,9	0,06	0,15	97,89	C	S
68	38,0	0,38	30,1	5,41	0,10	7,53	17,1	0,04	0,19	98,85	LBR	S
70	40,1	0,23	28,4	5,21	0,08	7,06	16,0	0,04	0,16	97,28	YGR	S
72	41,9	8,16	9,92	18,9	0,22	10,3	9,85	0,81	0,00	100,06	DRD	F
73	46,3	3,70	10,1	20,3	0,24	8,97	8,98	0,26	0,08	98,93	DBR	F
[illegible]4	51,6	3,96	13,4	13,6	0,17	4,87	9,17	1,89	0,62	99,28	OR	F
[illegible]5	52,3	2,24	14,5	11,1	0,16	6,36	8,46	1,84	1,50	98,46	YBR	F
76	50,3	2,45	15,0	11,8	0,17	7,38	9,37	0,81	0,22	97,50	DY	F
78	44,9	0,39	15,0	12,5	0,18	12,9	10,6	1,39	0,14	98,00	DYGR	F

79	45,8	0,00	35,8	0,38	0,02	0,06	18,7	1,12	0,21	102,09		C	F
80	44,8	0,14	28,4	4,96	0,08	5,21	15,6	0,79	0,18	100,16		GY	F
81	49,7	0,85	19,1	5,63	0,11	11,3	12,0	0,58	0,00	99,27	1,592	YGR	F
82	45,7	0,55	28,2	4,72	0,07	4,96	15,8	1,09	0,16	101,26		LGRY	F
83	44,0	0,32	28,3	4,64	0,10	5,80	15,8	0,47	0,04	99,47	1,589	YGR	F
84	42,7	0,44	26,4	5,95	0,11	7,30	14,7	0,32	0,04	97,96	1,597	YGR	F
85	44,4	0,25	26,8	5,58	0,11	7,06	14,8	0,90	0,04	99,94	1,590	DYGR	F
86	51,5	4,14	13,3	13,4	0,17	5,24	8,96	1,44	0,43	98,58	1,594	YBR	F
87	45,9	1,10	10,1	17,7	0,20	15,3	9,86	0,08	0,00	100,24	1,640	DGYY	F
88	46,4	0,62	26,9	5,74	0,08	6,01	15,2	0,79	0,21	101,95	1,590	LGR	F
89	45,1	0,4	27,5	6,46	0,07	5,64	15,3	0,63	0,04	101,14	1,590	YGR	F
90	43,2	0,50	25,8	5,88	0,12	7,49	14,6	0,75	0,04	98,38	1,589	YGR	F
91	45,3	0,10	34,5	0,48	0,04	0,05	18,5	1,23	0,00	100,20	1,579	C	F
92	49,7	0,00	31,4	0,35	0,04	0,06	14,[illegible]	4,13	0,34	100,02	1,588	LBR	F
93	46,7	0,15	27,9	5,29	0,09	6,45	15,[illegible]	0,41	0,20	102,99	1,589	LYGR	F
94	44,7	0,24	27,6	4,27	0,08	6,21	15,0	0,87	0,17	99,14	1,588	CGY	F
95	44,9	0,10	28,3	4,50	0,08	5,46	15,9	0,80	0,14	100,18	1,586	YGR	F
96	43,8	3,82	14,6	15,0	0,17	10,5	10,3	0,83	0,05	99,07	1,641	DBR	F
97	46,3	0,06	26,4	5,04	0,08	6,76	15,4	0,19	0,11	100,34	1,588	LGR	F
98	45,1	0,09	25,8	5,82	0,10	8,61	14,5	0,12	0,12	100,26	1,595	LGR	F
99	45,8	0,31	24,2	6,45	0,10	8,89	13,6	0,40	0,21	99,96	1,594	LGR	F
100	51,3	2,39	16,0	11,7	0,13	6,84	10,0	1,43	0,96	100,75	1,600	RDBR	F
101	45,3	3,04	16,4	12,5	0,17	9,65	11,0	0,92	0,11	99,09	1,629	YBR	F
102	46,0	0,04	27,4	4,27	0,08	6,76	15,2	0,35	0,21	100,31	1,588	LGR	F
103	49,7	3,31	13,9	11,7	0,14	9,52	11,0	1,19	0,71	101,17	1,611	DBR	F
104	52,4	3,69	12,8	13,3	0,15	5,13	8,68	1,38	0,66	98,19	1,605	DBR	F
111	45,8	0,00	35,8	0,27	0,03	0,08	18,8	1,09	0,27	102,14	1,584	C	F
112	44,2	0,08	26,0	4,44	0,11	6,93	14,5	0,28	0,14	96,68	1,582	C	F
116	45,4	0,1	35,6	1,76	0,02	0,09	18,6	0,58	0,0	102,15	1,573	C	F
117	47,3	0,6	19,8	8,43	0,07	10,4	11,1	0,83	0,2	98,73	1,608	YGR	F
118	45,4	0,1	34,4	1,41	0,05	0,12	17,1	2,06	0,0	100,64	1,573	C	F
119	39,6	11,2	9,97	17,6	0,18	10,8	10,1	0,22	0,0	99,67	1,636	DRD	F
120	45,7	0,3	24,7	6,46	0,07	11,0	13,0	0,72	0,02	101,97	1,586	GR	F
121	46,3	0,1	36,4	1,57	0,02	0,14	18,7	0,60	0,03	103,86	1,588	C	F
122	44,4	0,3	26,2	6,43	0,09	8,05	14,2	0,47	0,02	100,16	1,588	GR	F
237	45,5	0,1	35,9	2,30	0,11	0,13	17,1	0,69	0,0	101,83		C	F
239	41,0	0,2	20,3	12,4	0,10	11,2	9,50	1,96	0,02	96,68		GR	F
240	46,5	0,2	28,0	6,33	0,12	8,76	13,8	0,12	0,08	103,91		PGR	F
241	46,6	1,17	17,6	9,98	0,09	11,1	9,38	0,97	0,1	96,99		YGR	F
242	50,2	3,93	16,5	9,40	0,14	11,0	8,53	1,65	0,54	98,89		Y	F
243	49,9	2,47	16,6	9,85	0,14	7,87	9,26	2,10	0,0	98,1		YBR	F
257	46,7	0,8	19,0	12,1	0,17	8,83	11,4	0,61	0,03	99,64		GRY	S
259	43,8	0,3	25,9	7,36	0,14	7,99	12,8	0,41	0,0	98,7		PGRY	S
260	46,2	0,3	23,4	6,77	0,09	8,29	11,5	0,41	0,11	97,01		GR	S
261	48,5	0,2	26,2	6,12	0,13	7,15	13,6	0,48	0,02	102,4		YGY	S
262	46,8	0,4	18,6	11,9	0,19	11,0	10,9	0,85	0,0	100,64		PBR	S
263	52,0	0,3	9,90	14,4	0,14	19,2	6,03	0,24	0,0	102921		PY	S
264	46,7	0,4	26,8	7,22	0,14	8,76	12,7	1,09	0,11	103,92		GRGY	S
265	41,6	0,3	26,8	8,09	0,14	8,59	13,4	0,09	0,0	99,01		BL	S
266	44,8	0,1	35,8	2,36	0,10	0,21	17,0	0,49	0,01	100,87		C	F
267	46,5	0,1	35,2	2,28	0,14	0,04	15,8	1,79	0,12	101,97		C	F
268	47,5	0,2	26,1	7,00	0,15	5,92	13,1	0,38	0,0	100,35		PGR	F
269	50,4	0,5	18,1	9,08	0,13	10,2	12,1	2,14	0,01	102,66		PGR	F
270	49,7	0,3	21,1	8,74	0,13	9,29	10,6	1,27	0,12	101,25		GR	F
271	45,3	0,2	25,8	6,79	0,14	9,32	13,0	0,10	0,0	100,65		GR	F
272	48,2	0,2	35,5	2,52	0,13	0,12	18,1	0,95	0,1	105,82		C	F
274	46,5	0,2	25,3	7,96	0,08	7,91	12,8	0,41	0,0	101,16		GR	F
275	46,3	0,4	27,8	6,06	0,10	5,90	13,7	1,18	0,01	101,45		GRGY	F

276	46.3	0.4	26.6	6.16	0.12	6.30	13.5	1.16	0.0	100.54	GY	F
277	45.7	0.3	29.1	4.99	0.12	5.54	14.2	1.07	0.05	101.07	GY	F
278	46.1	0.2	30.9	4.87	0.12	4.27	15.0	0.86	0.05	102.37	YBR	F
279	52.5	2.71	14.5	11.7	0.16	7.75	7.86	2.05	0.50	99.73	OR	F
280	45.6	0.2	30.8	4.59	0.15	3.75	15.4	0.87	0.05	101.41	GY	F
281	62.0	3.46	13.1	11.4	0.17	0.42	3.97	3.87	3.99	102.38	GY	F
282	52.5	4.16	13.0	12.8	0.17	5.49	7.85	1.95	0.5	98.42	DRD	F
284	41.1	[illegible].5	11.0	17.2	0.18	9.49	9.53	0.48	0.03	99.51	DRD	F
285	46.5	0.2	28.5	5.30	0.17	5.67	13.8	1.10	0.05	101.29	GY	F
286	51.8	1.84	15.3	10.7	0.16	8.26	8.25	2.42	0.72	99.45	GY	F
287	46.[illegible]	0.4	26.1	7.26	0.13	9.09	13.0	0.96	0.05	103.29	GY	F
288	48.[illegible]	.2	25.5	6.50	0.14	7.35	12.4	0.56	0.2	101.15	GY	F
289	45.8	.2	30.6	4.47	0.09	3.92	15.2	0.99	0.01	101.28	PY	F
290	46.0	[illegible].5	25.9	6.78	0.15	5.78	13.4	1.38	0.35	100.24	Y	F
291	50.7	3.74	13.5	12.0	0.17	5.75	8.16	1.76	0.48	96.26	BR	F
292	51.4	3.39	14.5	12.0	0.17	5.38	8.67	1.49	0.52	97.52	BR	F
293	48.1	0.3	26.9	6.27	0.14	4.67	14.1	1.17	0.03	101.68	W	F
294	42.9	0.05	35.8	1.69	0.02	0.14	18.1	0.59	0.0	99.29	GY	F
295	43.7	0.1	34.8	1.92	0.02	0.48	17.7	0.78	0.0	99.5	PBR	F
296	44.5	0.1	34.4	2.31	0.03	0.59	17.2	1.11	0.05	100.29	RDBR	F
298	34.0	0.4	32.1	6.00	0.08	8.42	16.9	0.02	0.0	97.92	Y	S
300	39.4	0.2	31.0	5.39	0.07	6.34	16.2	0.17	0.0	98.77	C	S
303	39.3	0.2	32.2	4.55	0.07	6.28	16.6	0.09	0.0	99.29	Y	S
304	43.5	0.4	9.58	20.8	0.20	14.3	9.2	0.44	0.0	98.42	YGR	S
307	41.4	0.3	28.5	5.75	0.06	6.47	14.4	0.28	0.0	98.16	Y	S
310	44.2	0.2	22.6	8.96	0.10	9.74	12.7	0.16	0.0	98.66	BGR	S
946	45.8	0.13	34.3	0.42	0.06	0.08	17.7	1.86	0.06	100.41	C	F
947	43.2	0.10	36.1	0.32	0.05	0.07	18.6	0.89	0.02	99.35	C	F
948	45.1	0.60	22.8	7.19	0.10	9.13	13.5	0.53	0.22	99.17	BL	F
949	43.4	0.49	23.4	10.1	0.14	8.27	13.4	0.66	0.02	99.88	BL	F
950	45.5	0.99	27.4	5.47	0.07	5.86	15.8	0.50	0.16	101.75	DGY	F
951	45.1	0.49	30.5	2.75	0.04	4.55	17.1	0.57	0.18	101.28	BR	F
952	46.0	0.50	24.6	6.29	0.10	8.41	14.0	0.86	0.13	100.89	GYO	F
953	43.4	0.41	32.5	2.75	0.04	3.76	17.7	0.29	0.11	100.96	C	S
955	45.2	0.46	27.5	4.99	0.09	5.93	15.4	0.38	0.00	99.95	LYGR	S
956	45.5	0.39	28.2	4.33	0.05	5.00	16.4	0.06	0.13	100.06	YGR	S
957	46.2	0.43	28.8	3.85	0.06	5.22	16.4	0.20	0.13	101.29	C	S
958	44.8	0.34	27.7	5.83	0.08	7.45	16.8	0.88	0.17	104.05	Y	S
960	47.8	0.67	23.4	6.02	0.08	8.15	14.1	0.11	0.14	100.47	C	S
961	41.6	0.59	30.8	4.19	0.05	5.90	17.7	0.04	0.15	101.02	YGR	S
962	38.8	0.71	31.3	4.65	0.05	6.55	18.3	0.02	0.12	100.50	YGR	S
963	42.1	0.54	25.4	8.46	0.08	8.70	14.5	0.09	0.14	100.01	YGR	S
964	40.1	1.18	28.3	5.87	0.06	7.56	17.3	0.06	0.13	100.56	Y	S
966	36.5	0.86	31.2	5.47	0.08	7.67	18.2	0.02	0.13	100.13	YBR	S
967	44.6	0.45	27.2	5.74	0.10	6.50	15.3	0.18	0.02	100.09	BR	S
968	56.9	2.07	14.0	8.48	0.08	4.97	7.37	2.0	2.82	98.69	YBR	S
969	48.6	0.30	25.2	4.38	0.07	5.85	14.7	1.24	0.20	100.54	YGR	S
970	44.3	0.54	7.67	21.2	0.20	17.6	8.24	0.22	0.21	100.18	PGR	S
971	44.2	0.58	8.34	21.8	0.21	17.0	8.24	0.23	0.23	100.83	DYGR	S
972	42.2	0.57	27.9	6.24	0.08	7.85	15.9	0.06	0.12	100.92	LYGR	S
973	37.1	0.70	26.1	9.53	0.10	11.1	15.4	0.04	0.16	100.23	YBR	S
974	44.3	0.36	27.8	5.27	0.07	6.53	15.9	0.22	0.13	100.60	PGR	S
975	42.4	0.81	27.3	5.58	0.06	7.53	16.3	0.03	0.14	100.15	YGR	S
976	42.9	0.60	27.2	6.31	0.13	6.00	15.4	0.17	0.00	98.71	GRY	F
977	42.2	0.70	27.9	5.63	0.06	7.48	16.2	0.04	0.13	100.34	YBR	S
978	41.2	4.65	17.6	12.1	0.15	11.4	12.2	0.17	0.00	99.47	RDBR	F
979	39.8	0.60	28.4	6.44	0.12	7.83	16.2	0.04	0.00	99.43	YGR	S
980	42.2	2.32	15.7	15.0	0.18	8.79	14.1	0.05	0.19	98.53	BR	S

981	46,8	0,38	23,6	5,34	0,07	9,26	14,2	0,19	0,16	100,00	YGR	F
983	43,4	6,46	9,95	17,2	0,21	10,9	10,0	0,22	0,22	98,56	RD	F
984	51,3	4,28	12,9	13,4	0,16	4,88	8,87	1,93	0,64	98,36	YBR	F
986	45,5	0,63	25,1	5,50	0,07	7,74	14,6	0,47	0,23	99,84	GRGY	F
987	52,4	3,60	12,5	13,0	0,15	4,65	9,10	1,22	1,02	97,64	YBR	F
988	43,9	0,33	30,0	2,89	0,05	5,63	17,1	0,02	0,08	100,00	LYGR	F
989	43,4	6,04	10,1	17,7	0,21	11,2	9,97	0,20	0,27	99,09	RDOR	F
990	45,5	0,41	25,4	5,21	0,09	7,64	14,7	1,30	0,28	100,53	PGR	F
991	49,0	0,32	25,2	5,03	0,07	6,06	15,0	0,54	0,16	101,38	PGR	S
994	44,3	0,52	30,8	2,92	0,05	5,46	17,1	0,22	0,13	101,50	LY	F
996	45,3	0,70	27,5	5,03	0,06	5,61	16,2	0,34	0,17	100,91	GRY	F
997	43,8	0,48	30,3	2,69	0,04	5,84	17,2	0,14	0,09	100,58	C	S
998	47,5	0,86	17,3	11,3	0,16	10,4	12,0	0,61	0,21	100,34	GRGY	S
999	45,4	0,37	26,5	5,34	0,08	7,26	14,6	0,52	0,18	100,25	GR	F
						APOLLO 17						
133	38,5	8,60	6,01	21,9	0,25	15,5	6,22	0,59	0,08	97,65	O	S
134	40,0	9,16	5,86	23,4	0,29	15,2	6,53	0,58	0,02	101,04	ODRD	S
135	39,2	6,36	5,69	22,8	0,26	15,9	6,37	0,57	0,00	99,15	O	S
136	38,9	9,15	5,87	22,7	0,27	14,8	6,45	0,67	0,07	98,88	ODRD	F
137	39,1	9,17	5,91	23,3	0,26	13,5	6,59	0,53	0,09	98,45	ODRD	F
138	41,4	13,5	7,31	23,0	0,29	7,49	9,42	0,60	0,04	103,05	ODRD	S
139	39,0	9,06	5,93	22,8	0,32	15,8	6,40	0,71	0,05	100,07	ODRD	F
140	37,6	8,76	5,88	23,0	0,33	15,4	6,47	0,65	0,05	98,14	ODRD	F
141	40,6	8,37	5,28	24,6	0,23	16,5	6,82	0,37	0,02	102,79	ODRD	S
142	39,2	9,33	6,88	21,8	0,26	11,5	7,41	0,71	0,02	97,11	ODRD	S
143	38,8	8,81	6,02	24,5	0,30	16,5	5,80	0,54	0,12	101,39	ODRD	S
144	37,6	2,80	2,08	24,6	0,23	29,0	1,49	0,24	0,09	98,13	ODRD	S
145	38,3	3,33	2,49	20,0	0,22	34,0	2,31	0,27	0,08	101,00	ODRD	F
146	40,4	9,25	6,97	23,6	0,29	13,2	5,99	0,91	0,00	100,61	ODRD	F
148	40,9	10,3	6,17	23,4	0,31	9,95	8,13	0,55	0,08	99,79	ODRD	F
149	43,5	13,7	9,05	20,4	0,05	5,29	9,95	1,03	0,07	103,04	ODRD	F
150	40,5	11,9	6,66	23,5	0,34	9,44	8,50	0,49	0,05	101,38	ODRD	F
151	39,9	10,9	7,54	22,0	0,27	9,33	7,72	0,80	0,04	98,50	ODRD	F
152	40,1	11,5	7,58	22,4	0,15	8,70	8,52	0,76	0,02	99,73	ODRD	F
153	42,4	12,9	8,82	20,3	0,28	5,08	10,6	0,80	0,03	101,21	ODRD	F
155	38,7	9,97	6,21	22,8	0,42	12,3	7,21	0,54	0,10	98,25	ODRD	S
156	38,9	9,45	6,12	22,5	0,48	13,9	6,72	0,41	0,09	98,57	ODRD	S
157	46,8	0,88	19,9	8,91	0,08	10,8	11,2	0,61	0,26	99,44		F
158	46,2	0,30	23,8	6,58	0,12	9,77	12,6	0,37	0,21	99,95	LGR	F
159	40,2	9,62	6,00	23,6	0,30	15,3	6,49	0,61	0,08	102,20	O	S
161	40,2	9,62	6,17	23,2	0,17	15,0	6,74	0,62	0,05	101,77	O	S
162	40,5	8,67	5,78	23,6	0,28	14,9	6,55	0,57	0,06	100,91	O	S
163	40,7	9,54	6,15	23,3	0,19	15,5	6,56	0,66	0,12	102,72	ODRD	S
164	40,6	9,94	5,90	23,6	0,23	15,4	6,76	0,52	0,07	103,02	ODRD	S
165	38,3	9,50	5,87	22,4	0,28	15,8	6,40	0,54	0,08	99,17	ODRD	S
166	39,7	9,95	6,06	23,3	0,30	15,5	6,80	0,55	0,06	102,22	ODRD	S
167	39,3	8,75	5,76	23,0	0,33	15,5	6,48	0,65	0,05	99,82	ODRD	S
168	38,9	8,33	5,88	22,4	0,28	15,4	6,27	0,63	0,05	98,14	ODRD	S
169	39,4	8,85	5,93	22,4	0,16	16,1	6,50	0,65	0,08	100,07	DRD	S
170	40,3	9,44	6,01	23,1	0,21	15,5	6,49	0,62	0,04	101,71	DRD	F
172	38,2	8,50	5,98	22,2	0,23	15,5	6,30	0,64	0,05	97,60	ODRD	S
173	39,3	9,06	5,92	22,7	0,24	14,9	6,46	0,68	0,00	99,26	ODRD	S
174	38,5	8,23	5,95	22,4	0,21	15,8	6,42	0,63	0,03	98,17	ODRD	F
176	39,4	8,83	5,90	22,2	0,24	14,6	6,44	0,52	0,04	98,17	YDRD	F
177	38,7	8,88	5,90	22,4	0,32	16,1	6,23	0,66	0,02	99,21	DRD	F
178	39,1	8,90	5,95	22,6	0,22	15,7	6,37	0,59	0,08	99,51	DRD	F
179	47,0	0,68	11,3	16,6	0,31	10,8	8,84	0,27	0,01	95,81	YGR	F
180	48,4	1,92	15,0	8,20	0,23	11,9	14,7	0,31	0,12	100,78	GRGY	F

181	38,5	9,41	6,23	22,4	0,29	15,1	6,60	0,76	0,07	99,36		DRD	S
182	39,3	9,16	6,05	23,2	0,36	15,1	6,43	0,72	0,10	100,42		ODRD	S
183	38,2	8,99	5,89	22,0	0,31	16,2	6,10	0,78	0,06	98,53		OOR	S
184	39,7	9,20	6,00	22,8	0,25	15,9	6,27	0,73	0,04	100,89		ODRD	S
185	39,7	9,42	6,71	24,9	0,34	14,1	6,07	0,86	0,03	102,13		O	S
187	39,4	9,53	5,95	23,0	0,29	15,5	6,41	0,81	0,00	100,89		DRD	S
188	40,0	9,45	6,25	23,3	0,35	14,9	6,46	0,70	0,08	101,49		DRD	S
189	39,0	9,74	6,01	22,5	0,29	15,1	6,62	0,70	0,01	99,97		DRD	F
190	39,5	9,61	6,21	22,5	0,23	15,2	6,43	0,67	0,00	100,35		DRD	S
191	39,0	9,30	6,16	22,9	0,43	16,0	6,42	0,70	0,05	100,96		DRD	S
192	38,9	9,22	6,18	22,8	0,42	15,5	6,20	0,73	0,08	100,03		DRD	S
193	39,3	9,48	6,06	22,6	0,31	15,4	6,29	0,67	0,03	100,14		DRD	F
194	39,8	9,25	6,05	22,5	0,36	14,8	6,29	0,66	0,01	99,72		DRD	F
196	38,3	8,19	5,56	23,9	0,26	17,8	4,80	0,78	0,11	99,70		O	F
199	40,1	9,68	6,10	22,9	0,30	15,3	6,42	0,62	0,07	101,49		DRD	S
200	39,3	2,32	1,49	21,8	0,19	35,3	1,33	0,19	0,00	101,92		O	S
201	44,0	0,10	21,6	6,30	0,17	14,7	11,2	0,56	0,11	98,74	1,599	LGR	F
202	48,2	0,63	13,2	16,1	0,42	9,13	9,51	0,38	0,11	97,68	1,615	YGR	F
203	39,3	9,44	6,03	22,9	0,23	15,2	6,56	0,66	0,06	100,38	1,713	DRD	F
204	38,8	8,37	5,70	22,8	0,30	15,7	6,37	0,73	0,15	98,92	1,713	RD	F
205	38,8	9,36	5,78	22,6	0,25	16,2	6,34	0,65	0,03	100,01	1,713	DRD	F
206	40,8	9,48	6,08	23,4	0,35	15,1	6,68	0,69	0,05	102,63	1,713	DRD	F
207	39,3	9,22	5,88	23,0	0,43	15,3	6,26	0,83	0,00	100,22	1,713	DRD	F
208	46,8	0,60	23,2	7,32	0,11	8,29	12,9	1,02	0,16	100,40		LGR	F
209	46,6	0,53	17,1	9,86	0,18	13,6	9,47	0,35	0,06	97,75		LGR	F
210	46,2	0,11	25,5	4,56	0,16	9,81	13,0	2,25	0,32	101,91		LGR	F
211	45,0	0,27	23,8	5,74	0,21	9,91	11,7	0,41	0,20	97,24		LGR	F
212	45,6	0,10	26,1	5,05	0,16	8,45	13,3	0,35	0,21	99,32		LGR	F
213	44,2	0,06	28,9	3,01	0,11	5,80	15,9	0,14	0,08	98,20		LGR	F
214	44,9	0,07	25,9	5,09	0,13	8,50	13,1	0,67	0,18	98,54		LGR	F
215	44,7	0,12	26,3	5,19	0,16	8,77	12,9	0,73	0,19	99,06		LGR	F
216	46,0	0,07	26,0	5,08	0,16	8,72	13,6	0,57	0,16	100,36		LGR	F
217	45,1	0,24	24,5	6,05	0,20	9,60	12,5	0,47	0,11	98,77		C	F
218	47,3	0,84	21,0	8,12	0,18	9,25	10,9	0,82	0,31	98,72		YGR	F
219	49,9	2,16	17,0	9,81	0,23	8,83	9,12	1,26	0,35	98,66		DY	F
220	46,6	0,13	24,8	6,20	0,08	9,34	12,8	0,39	0,18	100,52		GR	F
244	40,7	13,4	9,13	19,1	0,15	10,5	9,9	1,41	0,15	104,44	1,705	BL	F
245	44,9	0,25	24,5	5,92	0,08	10,0	12,9	0,71	0,0	99,26	1,586	LGR	F
246	45,9	0,28	25,5	6,06	0,11	9,17	14,4	0,67	0,01	102,10	1,588	LGR	F
247	45,2	0,09	34,9	1,87	0,03	0,13	17,5	1,70	0,01	101,43	1,589	LGR	F
250	45,2	0,33	24,6	6,58	0,08	10,6	14,0	0,71	0,08	102,18	1,588	LGR	F
251	49,3	0,65	12,7	17,4	0,19	8,24	11,7	0,38	0,01	100,57	1,593	YGR	F
252	46,2	0,30	26,0	6,38	0,09	9,05	14,3	0,61	0,02	102,95	1,586	LGR	F
253	48,0	0,62	12,3	17,0	0,19	8,07	11,8	0,51	0,01	98,50	1,592	YGR	F
254	45,9	0,20	26,9	5,55	0,12	9,02	14,6	0,56	0,0	102,85	1,586	LGR	F
312	40,1	2,7	19,7	11,4	0,17	7,57	12,2	0,78	0,09	94,71		BL	F
313	46,1	0,7	26,3	7,84	0,09	6,24	14,2	0,75	0,15	102,37		PRGY	F
314	44,6	0,17	24,6	5,72	0,05	7,60	13,8	0,53	0,0	97,07		Y	F
315	44,7	0,4	12,4	19,3	0,24	8,38	11,0	0,22	0,01	96,65		GRGY	F
316	40,2	5,7	9,96	14,9	0,12	14,4	8,2	0,68	0,03	94,19		DGY	F
317	46,4	2,0	13,1	17,2	0,19	10,7	10,4	0,25	0,07	100,31		DGY	F
318	45,4	0,3	22,9	7,57	0,10	9,12	12,9	0,48	0,0	98,77		GY	F
319	46,1	0,95	23,3	7,90	0,27	8,34	13,4	0,56	0,02	100,84		GY	F
320	44,4	0,2	24,5	6,74	0,07	8,83	12,8	0,40	0,0	97,94		PIGY	F
321	46,2	0,28	25,0	6,56	0,08	7,81	14,2	0,60	0,1	100,83		PIGY	F
322	44,2	4,7	6,87	10,2	0,15	12,0	18,0	0,17	0,05	96,34		DBR	F
323	46,5	0,6	26,0	3,16	0,1	8,31	15,0	0,08	0,0	99,75		PGR	S
324	46,0	0,33	21,2	9,88	0,11	8,64	13,4	0,18	0,0	99,74		YGR	S

325	39.0	11.7	8.35	22.3	0.31	8.38	9.6	0.78	0.2	100.62	RDBL	S
326	45.4	0.10	25.0	5.90	0.05	8.53	14.2	0.51	0.01	99.7	PGR	F
327	45.2	0.15	25.3	5.90	0.07	8.01	14.0	0.48	0.0	99.11	PGR	F
328	45.5	0.12	25.2	5.96	0.09	8.06	14.5	0.55	0.02	100.00	PGR	F
[illegible]9	45.8	0.16	26.1	5.74	0.07	9.25	14.8	0.40	0.01	102.33	PYGR	F
330	46.8	5.1	12.5	15.7	0.20	3.28	14.6	0.80	0.16	99.14	BL	F
331	44.5	4.4	9.88	14.1	0.24	8.03	19.0	0.31	0.18	100.64	BL	F
332	50.4	3.8	13.8	13.4	0.15	4.27	13.6	0.93	0.17	100.52	BL	F
333	36.5	0.08	38.0	1.78	0.03	2.66	21.4	0.03	0.02	100.5	RDBL	F
334	49.9	4.8	15.2	12.2	0.15	3.70	15.4	0.87	0.3	102.52	BLGR	F
335	40.7	8.8	13.3	17.5	0.20	11.5	9.4	0.72	0.25	102.37	BL	F
336	49.1	1.1	3.62	14.9	0.22	13.4	16.5	0.13	0.1	99.07	DGY	F
337	46.4	0.6	16.5	18.5	0.06	7.42	12.0	0.31	0.05	101.84	Y	F
339	38.7	13.2	8.15	21.5	0.25	5.99	10.8	0.60	0.27	99.46	PBR	F
340	44.7	0.13	28.3	5.05	0.09	8.34	15.2	0.77	0.02	102.60	Y	F
341	45.5	0.15	28.0	4.77	0.08	6.38	16.0	0.46	0.08	101.42	GY	F
342	45.2	0.3	24.1	7.57	0.12	10.6	13.3	0.33	0.01	101.53	W	F
343	46.9	0.3	28.2	5.16	0.09	5.53	16.0	0.88	0.03	103.09	Y	F
344	45.8	0.4	23.8	6.89	0.09	8.14	14.0	0.73	0.07	99.92	Y	F
345	37.0	12.8	8.32	18.8	0.23	9.20	10.6	0.69	0.09	97.73	Y	F
346	45.3	0.6	22.0	7.99	0.09	10.4	13.0	0.53	0.01	99.92	GRGY	F
347	45.7	0.3	24.7	6.68	0.07	9.56	13.8	0.54	0.01	101.36	DGY	F
348	45.6	0.5	22.7	7.06	0.08	9.47	13.2	0.51	0.01	99.22	DGY	F
349	38.2	8.9	5.68	22.5	0.27	15.6	7.2	0.70	0.09	99.14	DGY	F
350	45.7	0.3	23.5	7.00	0.10	9.50	13.6	0.47	0.05	100.22	DGY	F
351	44.9	0.4	23.1	7.58	0.09	10.9	12.9	0.49	0.0	100.36	GRGY	F
352	40.0	0.05	31.7	1.81	0.03	10.4	17.4	0.03	0.0	101.42	C	S
353	46.9	0.2	24.5	5.85	0.1	8.84	14.6	0.54	0.02	101.55	PGR	S
354	41.3	0.05	32.3	1.79	0.03	10.1	17.3	0.04	0.0	102.91	C	S
[illegible]5	45.1	0.2	26.3	5.90	0.09	6.98	15.8	0.18	0.01	100.56	YGR	S
356	44.7	0.3	24.2	6.96	0.07	9.66	13.8	0.37	0.0	100.06	GRY	S
357	48.5	0.6	13.3	16.7	0.21	8.35	12.7	0.18	0.02	100.56	YGR	S
358	47.2	0.7	18.6	8.71	0.15	13.2	11.3	0.45	0.0	100.31	Y	S
359	39.3	0.2	28.6	3.52	0.06	15.1	14.4	0.05	0.0	101.23	W	S
360	45.9	0.3	23.6	6.96	0.07	9.58	13.9	0.54	0.0	100.85	DRD	S
361	38.7	8.9	5.96	22.5	0.26	16.2	6.9	0.65	0.1	100.17	DRD	S
362	38.0	8.9	5.78	22.3	0.27	15.6	7.2	0.66	0.1	98.81	DRD	S
363	38.4	9.0	6.25	22.0	0.27	14.7	7.6	0.70	0.05	98.97	DRD	S
364	38.6	10.1	6.44	21.5	0.27	11.5	8.4	0.78	0.1	97.69	BL	S
365	48.1	0.8	11.9	18.5	0.23	7.90	11.8	0.34	0.03	99.60	BL	S
366	46.1	0.2	25.6	5.83	0.07	9.25	14.5	0.60	0.01	102.16	PGR	F
367	45.3	0.2	25.4	6.04	0.07	9.16	14.6	0.62	0.05	101.44	PYGR	F
368	45.8	0.0	34.5	1.53	0.06	0.0	18.2	1.51	0.05	101.65	C	F
369	46.7	0.2	25.6	5.96	0.09	9.48	14.6	0.60	0.1	103.24	W	S
370	45.5	0.4	24.3	6.53	0.07	9.14	14.2	0.32	0.01	100.47	GRY	F
371	47.1	0.5	21.8	8.06	0.10	10.1	13.0	0.48	0.01	101.15	YGR	F
372	45.7	0.5	21.8	8.82	0.11	9.49	13.2	0.71	0.06	100.39	YGR	F
373	45.3	0.2	25.3	5.84	0.09	9.27	14.7	0.50	0.03	101.23	PY	F
374	46.2	0.3	24.2	7.22	0.09	9.87	13.6	0.44	0.01	101.93	GR	F
375	49.6	1.3	3.45	12.6	0.19	15.6	16.8	0.18	0.09	99.81	DRD	F
376	46.7	0.5	24.1	7.10	0.10	7.09	14.0	1.11	0.11	100.81	GY	F
377	40.9	10.7	15.5	15.7	0.2	7.59	11.2	1.43	0.3	103.52	BL	F
378	38.2	9.1	5.81	22.6	0.27	15.6	7.1	0.70	0.12	99.5	BL	F
379	39.7	11.6	9.46	17.2	0.22	9.20	12.2	0.65	0.24	100.47	DRD	F
[illegible]0	40.8	11.2	7.22	21.9	0.26	7.09	10.7	0.80	0.18	100.15	DRD	F
[illegible]	46.9	0.4	23.6	7.12	0.10	9.54	13.6	0.33	0.0	101.59	GY	F
382	46.3	0.4	22.3	7.97	0.12	10.4	13.3	0.46	0.04	101.29	GY	F
383	45.8	0.3	24.1	7.31	0.11	9.29	13.8	1.23	0.05	101.99	GY	F

384	45,8	0,26	24,4	6,96	0,11	9,83	14,0	0,30	0,04		101,70		GR	F
385	46,3	0,26	23,7	7,36	0,11	9,78	13,8	0,28	0,03		101,62		GR	F
386	46,4	0,3	22,9	7,47	0,10	9,69	13,3	0,34	0,01		100951		GRY	F
387	44,7	0,17	23,3	5,80	0,06	10,9	13,1	0,41	0,0		98,44		W	F
89	39,1	8,9	7,43	20,8	0,25	14,0	8,2	0,64	0,13		99,45		GY	F
390	46,4	0,4	23,8	8,34	0,12	8,03	13,9	0,47	0,1		101,56		C	S
391	44,0	0,4	9,42	18,0	0,20	15,2	9,0	0,38	0,0		96,6		YGR	S
392	37,7	8,8	5,96	21,7	0,25	15,8	7,2	0,54	0,02		97,97		DRD	S
394	39,8	11,0	8,46	19,8	0,26	7,20	9,9	0,79	0,13		97,34		DRD	S
396	37,7	8,9	5,74	22,0	0,26	15,5	7,2	0,50	0,1		97,9		DRD	S
397	35,8	14,4	7,63	22,9	0,26	11,8	7,9	0,91	0,17		101,77		BL	S
398	46,1	0,35	21,6	7,79	0,12	12,6	12,7	0,37	0,0		101,63		BL	S
409	42,4	5,64	15,5	13,5	0,23	10,6	11,7	0,39	0,1		100,06		BR	F
410	44,1	0,0	33,6	0,57	0,17	0,10	18,2	0,93	0,01		97,68		BL	F
411	42,9	4,8	17,5	11,4	0,12	11,5	12,3	0,38	0,06		100,96		DGY	F
412	41,9	4,2	17,1	11,8	0,36	11,6	12,2	0,27	0,04		99,47		DGY	F
413	44,6	0,0	33,7	1,32	0,13	1,41	18,8	0,37	0,03		100,36		C	F
414	42,2	2,3	20,6	9,81	0,29	10,5	13,2	0,05	0,0		98,95		YBR	S
415	39,1	3,25	19,9	9,90	0,19	12,8	13,0	0,03	0,0		98,17		DBR	S
416	48,7	0,95	19,9	6,90	0,12	10,1	12,5	1,08	0,09		100,34		DY	S
417	38,1	8,75	5,74	22,1	0,28	16,4	7,4	0,40	0,08		99,25		DRD	S
418	40,9	8,9	12,1	16,4	0,26	8,71	11,2	0,15	0,07		98,69		BR	S
419	40,0	7,7	5,81	24,1	0,28	15,9	8,6	0,24	0,05		102,68		BL	S
420	48,0	0,0	32,6	0,76	0,06	0,37	17,0	2,23	0,04		101,06		DBR	S
421	43,4	4,3	16,6	12,2	0,24	11,4	11,8	0,28	0,07		100,29		DBR	F
422	45,8	0,35	31,8	2,31	0,08	2,73	17,3	1,13	0,07		101,57		YGR	F
423	45,0	0,25	25,4	5,31	0,15	8,84	14,8	0,08	0,01		99,84		GRY	F
424	46,6	0,3	25,2	5,51	0,06	9,67	14,2	0,15	0,01		101,70		GRY	F
425	45,1	0,6	23,2	6,65	0,16	11,1	14,2	0,13	0,02		101,16		YGR	F
26	40,5	7,3	11,6	15,6	0,29	13,1	12,8	0,19	0,07		101,45		GRGY	F
427	38,7	1,4	24,1	7,71	0,07	11,5	14,7	0,03	0,01		98,22		DGY	F
428	43,9	5,1	15,6	12,2	0,28	9,95	11,6	0,28	0,06		98,97		DBR	F
429	44,0	5,0	12,9	16,1	0,17	9,78	11,7	0,38	0,1		100,13		DBR	F
430	39,1	9,2	5,92	23,4	0,26	15,7	7,7	0,44	0,08		101,80		DRD	F
431	33,8	3,9	21,4	11,7	0,20	13,8	14,8	0,02	0,05		99,67		DBR	S
432	39,9	2,05	20,9	9,44	0,16	12,5	13,4	0,02	0,0		98,37		YBR	S
433	41,0	8,75	7,50	21,8	0,30	12,0	9,5	0,77	0,14		101,76		PY	S
434	41,0	3,0	19,5	10,6	0,28	11,6	12,6	0,05	0,0		98,63		DBR	S
436	40,0	1,0	20,3	12,7	0,34	10,1	14,7	0,02	0,06		99,22		GR	S
437	38,3	8,9	5,75	22,4	0,30	16,3	7,7	0,38	0,09		100,12		DRD	S
438	39,1	9,0	5,65	22,0	0,36	15,0	7,5	0,50	0,09		99,20		BL	S
439	38,8	0,75	24,5	6,84	0,27	11,5	14,7	0,01	0,0		97,37		GR	S
440	44,6	0,0	34,2	0,48	0,06	0,24	18,0	1,26	0,05		98,89		PY	F
441	42,7	1,26	20,7	7,63	0,17	16,3	12,1	0,04	0,0		100,90		DY	S
442	39,3	8,9	5,79	22,4	0,33	15,0	7,5	0,33	0,06		99,61		DRD	S
443	39,8	9,2	6,70	23,9	0,41	13,4	7,7	0,94	0,64		102,69		BL	S
444	46,1	1,4	16,2	11,9	0,27	8,88	11,4	0,10	0,0		96,25		DY	S
445	43,5	4,85	11,3	20,1	0,29	9,02	11,3	0,40	0,08		100,84		DRD	S
446	46,5	0,2	26,0	6,12	0,18	7,09	15,0	0,27	0,03		101,39		PGR	F
447	48,5	0,95	11,7	18,0	0,25	10,4	11,1	0,19	0,07		101,16		YGR	S
448	41,5	3,6	18,9	11,5	0,34	11,3	13,1	0,04	0,04		100,32		BR	S
449	39,4	3,8	13,3	16,1	0,14	14,2	11,1	0,04	0,03		98,11		BR	S
							LUNA 16							
585	41,8	2,9	15,7	16,1	0,19	9,5	12,4	0,21	0,22	0,27	99,29	1,640	YBR	S
							LUNA 20							
06	42,8	0,67	24,0	8,37	0,11	10,4	14,8	0,06	0,14		101,35	1,606	LYBR	S
107	47,2	0,37	24,0	5,92	0,08	8,22	14,1	0,42	0,12		100,43	1,582	LGR	S
109	45,4	0,44	24,7	6,66	0,08	8,53	14,8	0,21	0,12		100,94	1,594	GR	F

110	43.7	0.32	26.2	6.68	0.10	7.78	14.9	0.08	0.00	99.76	1.572	PGR	S
	44.5	0.55	23.2	5.45	0.11	7.98	14.3	0.30	0.18	96.57		BR	F
	45.6	0.42	24.2	6.04	0.08	8.87	14.3	0.26	0.13	99.90		C	F
	45.7	0.66	23.3	7.48		8.74	15.0	0.35	0.18	103.41		C	F
	46.2	0.09	35.0	0.06		0.09	19.9	0.85	0.13	102.32		C	F
	47.6	1.99	11.8	18.1		10.3	11.3	0.58	0.30	101.97		YBR	F
	46.9	0.50	24.3	7.03		8.36	14.8	0.59	0.20	102.68		YBR	F
	46.6	0.63	23.4	7.80		8.47	14.7	0.55	0.21	102.36		DBR	F
	44.6	0.19	27.0	3.41		10.6	15.2	0.08	0.08	101.16		C	F
	46.4	0.28	28.8	3.94		3.25	17.5	0.54	0.12	100.83		C	F
	46.4	0.60	21.8	8.53		9.52	13.7	0.56	0.21	101.32		DBR	F
	45.6	0.48	19.7	10.2		11.5	12.0	0.74	0.23	100.45		GY	F
	45.8	0.72	22.0	9.62	0.12	7.20	14.0	0.21	0.15	99.82		C	F
	45.5	0.57	23.2	6.87	0.09	8.67	14.1	0.42	0.14	99.56		C	F
	45.2	0.44	24.7	6.14	0.07	8.90	14.3	0.41	0.16	100.32		C	F
	45.6	1.15	12.6	19.0	0.22	11.3	11.4	0.07	0.19	101.53		LBR	F
	46.3	1.89	10.1	24.4	0.32	4.90	11.7	0.29	0.26	100.16		GRGY	F

R.I. = Refractive index.

COLOR CODE: O = opaque, RD = red, Y = yellow, BR = brown, GR = green, GY = grey, BL = black, BGR = bottle green, WH = white, C = colorless, P = pale, L = light, D = dark (for Apollo 15 PGR = pistachio or emerald green).

TYPE: F = fragment, S = spherule, B = bleb.

TABLE 10

Average Glass Compositions Compared to Bulk Soil Composition

Sample No.	10084 Soil [1]	10084 Ave. Glass (94)	12057 Ave. Glass (118)	12070 Soil [2]	12070 Ave. Glass (40)
SiO_2	41.78	43.0	45.8	45.91	44.5
TiO_2	7.41	4.69	2.29	2.81	2.20
Al_2O_3	13.47	16.9	16.2	12.50	18.2
FeO	15.65	12.8	13.0	16.40	12.1
MnO	0.22	0.15	0.14	0.22	0.13
MgO	8.07	8.80	9.19	10.00	9.03
CaO	12.13	12.4	12.7	10.43	12.5
Na_2O	0.37	0.38	0.50	0.41	0.33
K_2O	0.15	0.13	0.31	0.25	0.23

Sample No.	14148 Ave. Glass (38)	14149 Ave. Glass (44)	14156 Ave. Glass (33)	14163 Soil [2]	14163 Ave. Glass (64)
SiO_2	46.3	46.0	46.7	47.17	47.8
TiO_2	1.54	1.90	1.77	1.79	1.73
Al_2O_3	17.6	15.6	18.5	17.22	18.4
FeO	11.3	12.4	10.6	10.35	10.2
MnO	0.12	0.15	0.12	0.22	0.12
MgO	10.1	9.91	9.33	9.37	8.59
CaO	11.7	10.8	11.9	10.95	11.7
Na_2O	0.58	0.57	0.77	0.66	0.87
K_2O	0.45	0.43	0.42	0.58	0.59

TABLE 10 (cont'd)

Sample No.	14230,82	15041	15101	
	Ave. Glass (45)	Ave. Glass (89)	Soil [2]	Ave. Glass (57)
SiO_2	46.2	46.6	45.95	45.0
TiO_2	1.38	1.67	1.27	1.47
Al_2O_3	18.7	15.5	17.38	13.1
FeO	10.4	13.4	11.65	16.2
MnO	0.13	0.16	0.16	0.18
MgO	9.09	11.3	10.36	13.2
CaO	11.9	10.6	11.52	10.1
Na_2O	0.55	0.60	0.39	0.44
K_2O	0.35	0.26	0.17	0.25

Sample No.	15301		63501		64501
	Soil [2]	Ave. Glass (61)	Soil [3]	Ave. Glass (62)	Ave. Glass (58)
SiO_2	45.91	45.8	45.02	44.8	46.2
TiO_2	1.17	1.74	0.53	1.09	1.06
Al_2O_3	14.53	12.9	27.72	24.4	25.0
FeO	14.05	15.8	4.72	7.23	7.38
MnO	0.19	0.17	0.07	0.10	0.12
MgO	12.12	12.9	5.25	7.23	6.52
CaO	10.70	9.80	15.87	14.6	13.0
Na_2O	0.35	0.53	0.47	0.52	0.95
K_2O	0.16	0.35	0.05	0.19	0.26

TABLE 10 (cont'd)

Sample No.	68501		74220		74241	
	Soil [3]	Ave. Glass (70)	Soil [1]	Ave. Glass (79)	Soil [4]	Ave. Glass (92)
SiO_2	45.18	44.8	38.57	41.1	41.55	44.2
TiO_2	0.58	1.09	8.81	7.10	7.44	2.82
Al_2O_3	26.65	24.5	6.32	9.81	13.35	19.2
FeO	5.48	7.15	22.64	19.1	14.89	10.9
MnO	0.07	0.12	0.30	0.26	0.22	0.14
MgO	6.28	7.01	14.44	13.9	9.19	9.61
CaO	15.35	14.0	7.68	7.83	11.54	13.0
Na_2O	0.47	0.74	0.36	0.64	0.48	0.56
K_2O	0.11	0.25	0.09	0.09	0.12	0.08

Sample No.	78421	Luna 20	
	Ave. Glass (40)	Soil [5]	Ave. Glass (20)
SiO_2	42.2	44.40	45.7
TiO_2	4.22	0.56	0.65
Al_2O_3	17.9	22.90	22.7
FeO	12.3	7.03	8.58
MnO	0.22		0.12
MgO	10.6	9.70	8.18
CaO	12.5	15.2	14.3
Na_2O	0.38	0.55	0.38
K_2O	0.08	0.10	0.17

[1] Apollo 17 Preliminary Examination Team (1973) Science 182, 659.

[2] LSPET (1972) Science 175, 363.

[3] Hubbard et al. (1973) Geochim. Cosmochim. Acta, Suppl. 4, 1297.

[4] Rhodes et al. (1974) Lunar Science V (Lunar Sci. Inst., Houston) p. 630.

[5] Vinogradov (1972) Am. Geophys. Un., Trans. 53, 820.

TABLE 11

Average Composition of High Al_2O_3 Bottle-Green Glasses and Apollo 16 Soils for Comparison

	Apollo 11 (10)	Apollo 12 (11)	Apollo 14 (15)	Apollo 15 (2)
SiO_2	46.2 ±1.0	44.7 ±0.4	45.1 ±0.5	45.9 ±0.6
TiO_2	0.4 ±0.07	0.34±0.06	0.36±0.04	0.48±0.02
Al_2O_3	25.1 ±1.0	24.8 ±0.7	25.2 ±0.8	24.8 ±0.9
FeO	5.77±0.34	5.74±0.58	5.80±0.43	6.32±0.18
MnO	0.07±0.01	0.09±0.05	0.07±0.01	0.08±0.01
MgO	7.65±1.04	8.94±0.92	8.40±0.95	8.50±0.40
CaO	14.5 ±0.4	15.8 ±1.0	14.8 ±0.4	14.2 ±0.1
Na_2O	0.20±0.11	0.15±0.06	0.22±0.07	0.12±0.04
K_2O	0.06±0.02	0.06±0.04	0.10±0.04	0.18±0.05

	Apollo 16 (6)	Apollo 17 (14)	Luna 20 (1)	Apollo 16 Soils+ (11)
SiO_2	45.8 ±0.5	45.6 ±0.7	45.5	45.1
TiO_2	0.25±0.23	0.22±0.15	0.44	0.56
Al_2O_3	26.2 ±1.1	25.5 ±1.5	24.7	27.25
FeO	5.44±0.75	5.58±1.06	6.66	5.25
MnO	0.09±0.10	0.13±0.04	0.08	0.07
MgO	7.38±1.14	8.99±1.15	8.53	5.66
CaO	14.8 ±0.7	13.5 ±0.3	14.8	15.7
Na_2O	0.40±0.24	0.70±0.13	0.21	0.42
K_2O	0.17±0.05	0.15±0.03	0.12	0.10

+ISPET (1973) Science 179, 23.

() Number of analyses.

± One standard deviation

TABLE 12

Percent Abundance of Major Glass Types in Each Sample

Sample No.	10084 (94)	12057 (118)	12070 (43)	14148 (38)	14149 (44)	14156 (34)	14163 (64)	14230, 82 (45)	15041 (89)
Group*									
1	30.6	14.4	34.9	28.9	11.4	26.5	25.0	31.1	11.2
2	12.9	31.6	7.0	39.5	56.8	50.0	57.8	44.5	33.7
3	56.5	54,7	58.1	31.6	31.8	20.6	17.2	24.4	55.1
4	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0

Sample No.	15101 (57)	15301 (61)	63501 (62)	64501 (58)	68501 (70)	74220 (79)	74241 (91)	78421 (40)	Luna 16 (20)
Group*									
1	8.8	4.9	77.9	68.5	75.4	15.2	62.1	27.5	75
2	24.6	36.1	11.4	24.6	17.4	6.3	5.7	37.5	10
3	66.6	59.0	9.8	5.2	7.2	78.5	32.2	35.0	15
4	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0

*Group 1 ($Al_2O_3 > 22\%$) = Maskylinite, anorthosite, gabbroic anorthosite and anorthositic gabbro.

Group 2 ($Al_2O_3 < 22\%$, $FeO < 13\%$) = KREEP and low-K, KREEP-like basaltic glasses.

Group 3 ($Al_2O_3 < 22\%$, $FeO > 13\%$) = Mare basaltic glasses.

Group 4 ($SiO_2 > 60\%$) = granitic glasses.

() Number of glass particles analyzed.

TABLE 13

Major Element Compositions of High Silica Glass Particles from Sample 14259 Compared to High Silica Glasses in Crystalline Rocks and Breccias

	14259 [1] (29)	14259 [2] (17)	Apollo 11 [3] (35)	Apollo 12 [4]	14305 [5] (4)
SiO_2	76.5	77	75.8	76.3	75.8
TiO_2	0.2	0.5	0.53	0.68	1.3
Al_2O_3	11	12	11.4	11.5	13.8
FeO	2.6	0.5	2.5	3.0	0.85
MgO	0.1	0.1	0.25	0.07	0.10
CaO	1.2	0.5	1.8	1.6	0.89
Na_2O	1.8	1	0.35	0.14	0.70
K_2O	5.5	8	6.4	6.7	7.9

[1] High-Fe, low-K group. Note similarity to high SiO_2 interstitial or immiscible glasses in Apollo 11 and 12 rocks.

[2] Low-Fe, high-K group. Note similarity to high-Si, K mesostasis in clasts in breccia 14305,77.

[3] Apollo 11 high silica immiscible glasses from Roedder and Weiblen (1971) Geochim. Cosmochim. Acta, Suppl. 2, 522.

[4] Average high silica interstitial glass in Apollo 12 basalts. Lovering et al. (1972) Geochim. Cosmochim. Acta, Suppl. 3, 281.

[5] High-Si, K glass in mesostasis of clasts in breccia 14305,77. Lovering et al. (1972).

TABLE 14

Size Distribution of Lunar Glass Spherules and Microtektites

	Lunar Glass Beads		Microtektites	
	A-12	A-14	Australasian	Ivory Coast
Dia. (µm)	(205)	(175)	(264)	(621)
125 - 175	59	70	47	41
176 - 245	27	21	30	30
246 - 350	8	6	14	19
351 - 495	5	1	6	9
496 - 707	1	2	2	1
708 -1000	0	0	0.5	0.5

() Number

TABLE 15

Percent Abundance of Shapes of Lunar Glass Spherules and Microtektites

	Lunar Glass Beads			Microtektites	
	A-12	A-14	A-15	Australasian	Ivory Coast
	Ave. (%) (559)	Ave. (%) (515)	Ave. (%) (197)	Ave. (%) (854)	Ave. (%) (984)
Sphere	62	47	35	65	61
Oblate Sphere	25	31	51	27	25
Lens	<1	<1	6	3	3
Oval	8	14	5	3	2
Cylinder	1	2	1	<1	<1
Dumbbell	1	1	1	<1	1
Teardrop	2	4	1	2	4
Flat Forms	0	0	0	2	5

() Number

TABLE 16

Major Element Composition of High SiO_2 Apollo 14 Glass Spherule and Microtektites

	Apollo 14 Glass Sphere	North American Microtektites		Australasian Microtektites			
SiO_2	74.6	74.7	75.7	74.3	74.5	74.8	74.6
TiO_2	0.56	0.88	0.62	0.74	0.41	0.65	0.51
Al_2O_3	12.4	15.4	13.1	12.8	12.8	11.2	11.7
FeO	4.87	4.45	3.83	4.76	4.10	4.48	5.40
MgO	0.30	1.34	0.82	2.65	1.33	2.04	4.28
CaO	2.64	0.92	1.01	1.98	2.96	2.31	2.73
Na_2O	0.58	1.02	0.77	1.24	1.21	0.53	0.51
K_2O	3.35	2.80	2.73	3.01	3.49	2.10	1.27

Figure 1. SEM photomicrographs of lunar glass particles. A) Opaque black spherule (~240 µm dia.) from sample 12057. Note rock fragments embedded in surface, exposed vesicles (indicated by white halos caused by charging) and metallic beads (light colored) scattered over the surface. B) Ropy fragment (~580 µm long) with rock flour on surface from sample 14163. C) High magnification photomicrograph of ropy fragment with rock flour on surface from sample 14163. Note absence of rock flour on what appears to be a broken surface. Field of view ~80 x 100 µm. D) Splashed silicate material on end of ~410 µm long dumbbell from sample 14163.

Figure 2. SEM photomicrographs of metallic beads on lunar glass spherules. A) Group of randomly distributed metallic beads on surface of a black opaque spherule from 12057. The metallic beads range in size from <0.2 um to ~3 µm diameter. B) Opaque glass spherule (~320 µm dia.) from 10084 with metallic beads on its surface. The larger beads have coalesced to form an irregular mass. Electron microprobe analysis shows that they are composed predominantly of iron with a minor amount of nickel and a trace of cobalt and sulfur. Note the angular depression at the top of the spherule that was left when a mineral or rock fragment was dislodged during agitation with ultrasonic cleaner. C) High magnification photomicrograph of irregular metallic beads shown in B. Magnification ~1350X. D) High magnification photomicrograph of opaque glass spherule (~490 µm dia.) from sample 10084. The surface is covered with numerous small metallic beads in a geometric pattern. The larger beads (up to ~2.8 µm dia.) are surrounded by an area free of beads out to a distance from the central bead equal to about the diameter of the bead. At this distance there is a ring of smaller beads. Several of the larger beads have fallen out leaving depressions encircled by a ring of smaller beads.

Figure 3. Photomicrographs of impact pits and conchoidal fracture on lunar glass spherules. A) Simple glass-lined microcrater pit (~6 µm dia.) with slightly raised rim on surface of yellow-green translucent spherule from sample 12057. B) Glass spherule (~145 µm dia.) with large (~50 µm dia.) impact pit on surface. The impact pit is characterized by a central depression with a radial fracture pattern surrounding it. C) Luna 16 oblate glass spherule (~580 µm maximum dia.) with large micro-impact crater. The crater has a central melted area with a diameter of approximately 65 µm. Adjacent to the central melted pit is a radial fracture zone half of which has spalled off. D) Conchoidal fracture on surface of deep-red glass spherule from the Apollo 17 orange soil sample 74220,89. Magnification ~500X.

Figure 4. Histogram of refractive indices for 491 lunar glasses: 404 from this study and 87 from Chao *et al*. (1970).

Figure 5. Refractive index versus SiO_2 content for 538 lunar glasses. Symbols used to denote color of the glass: ○= colorless, ⦶= pale green, ⊗= yellow and greenish yellow, ◒ = yellowish brown, reddish brown or brown, ◑ = deep emerald green, ● = deep red.

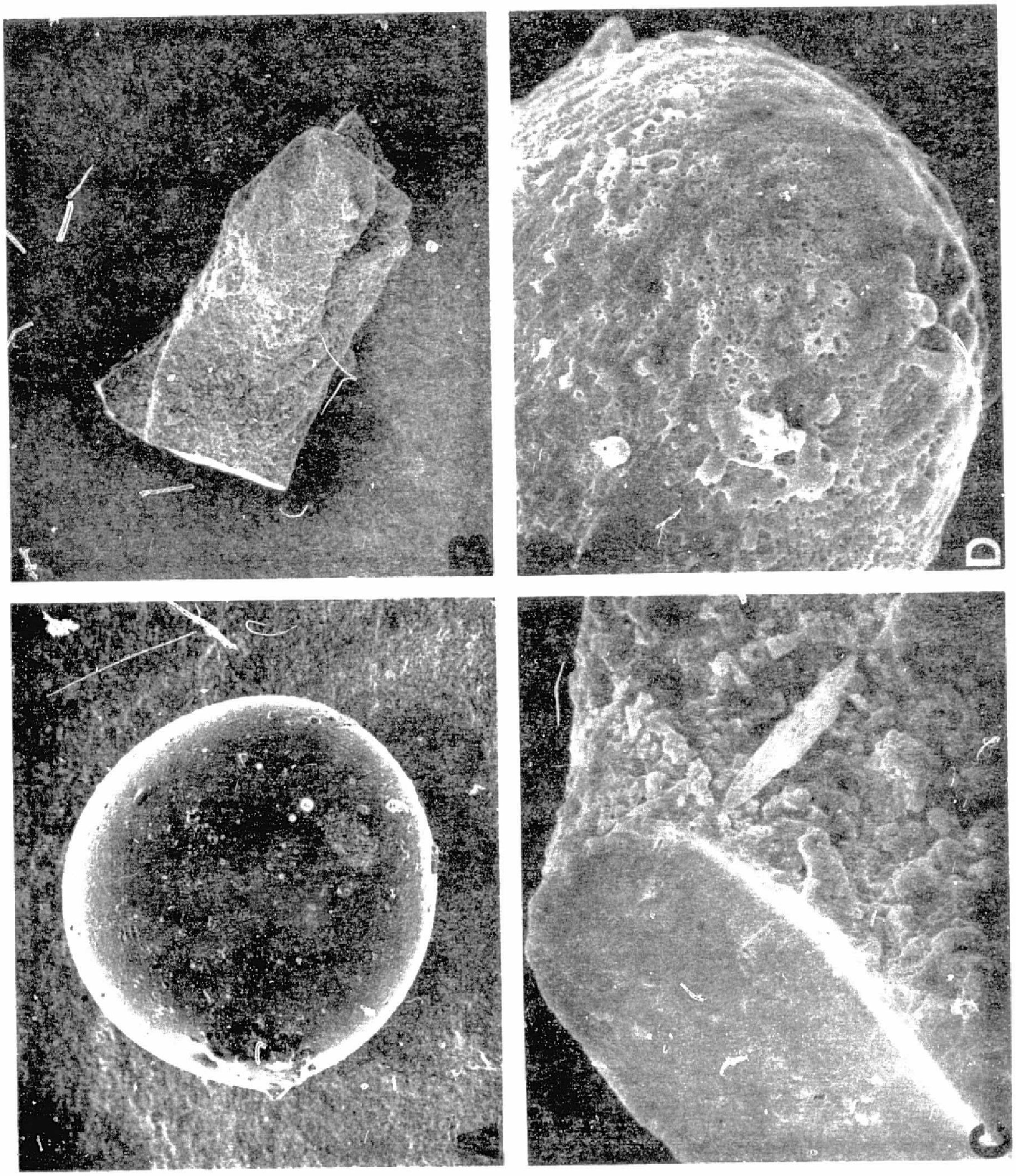
Figure 6. Refractive index versus FeO content for ~580 lunar glasses.

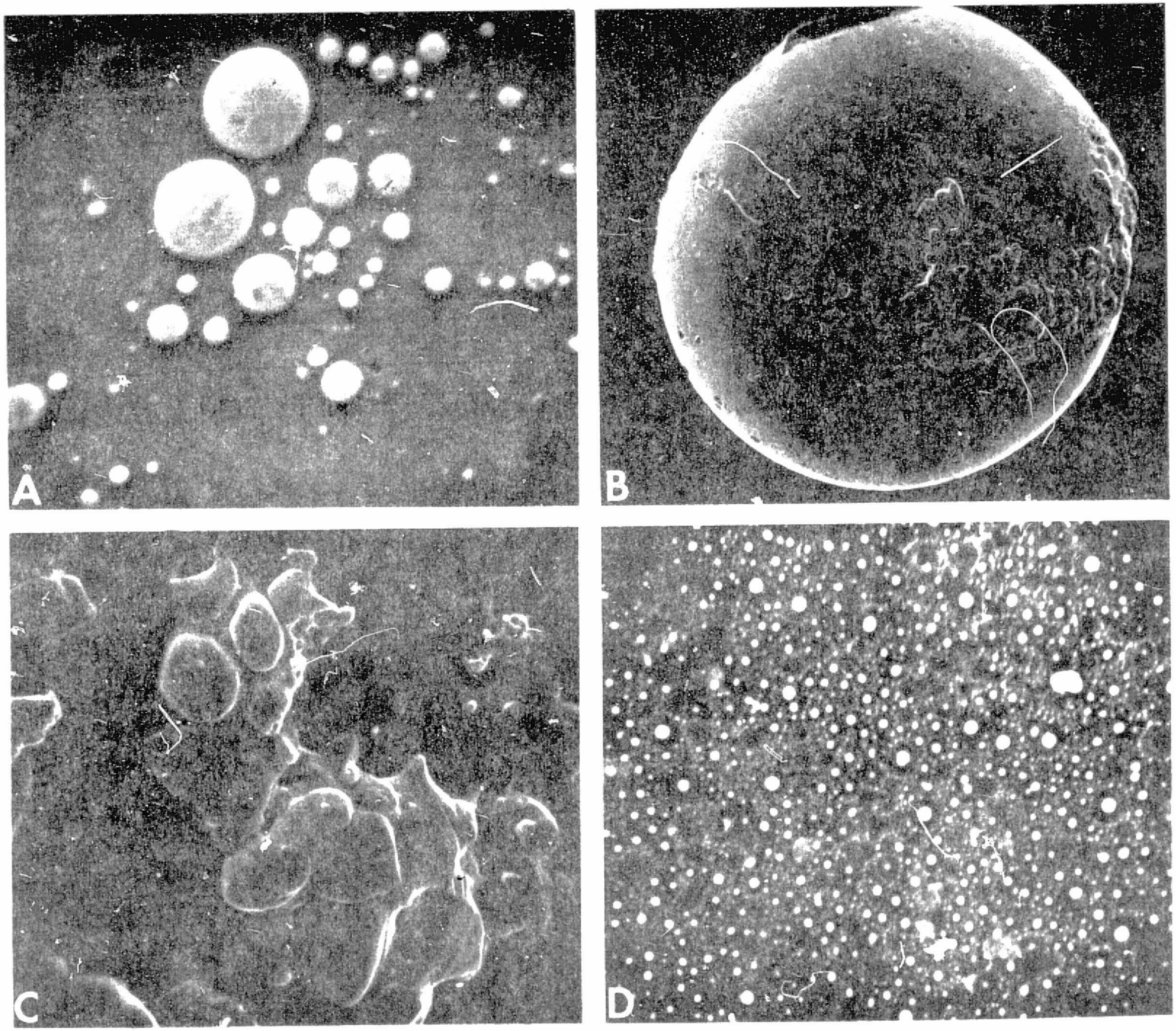
Figure 7. Photomicrographs of polished surfaces of lunar glass spherules. A) Irregular opaque grey spherule (~240 µm dia.). Note numerous relict crystals, vesicles and small metallic beads (light-colored dots). See analysis number 188 Table 9 for composition. B) Irregular transparent pale green glass

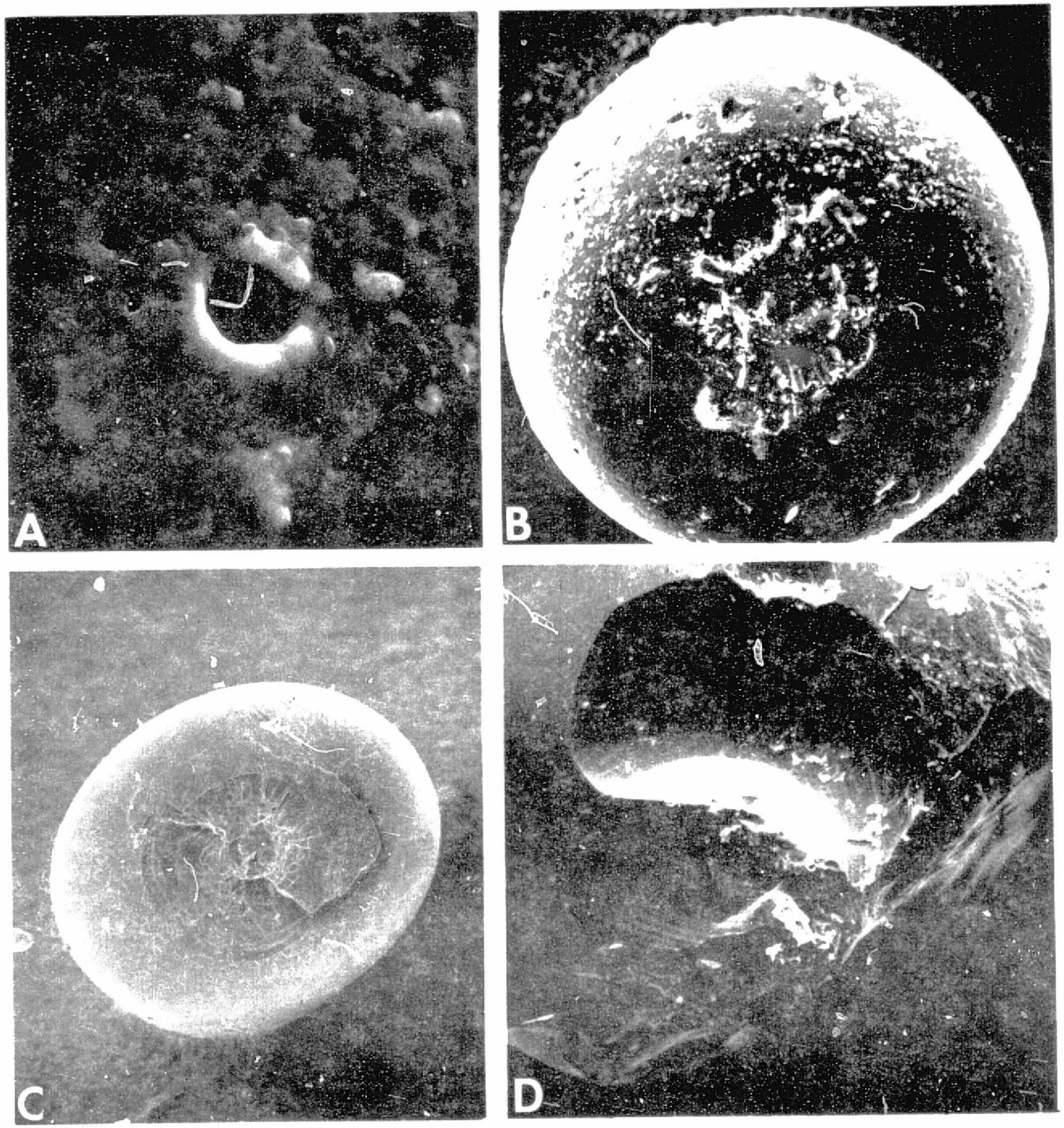
spherule (~230 µm dia.) from sample 10084 containing ~25 small (~4 µm dia.) black, opaque octahedral crystals distributed in a plane through the spherule, taken in transmitted light. Insert is a high magnification photomicrograph of one of the crystals showing one of the octahedral faces in reflected light. Electron microprobe analysis indicates that the crystals are composed of ~94% iron and 6% nickel. C) Plagioclase laths (dark) in a glass fragment (~800 µm across) from sample 12057. For composition of glass see Table 9, analysis number 176. D) Devitrified light grey, translucent spherule (~180 µm dia.) from 12057. E) SEM photomicrograph of polished surface of glass bead from the Apollo 17 orange soil (sample 74220) showing olivine laths bordered by ilmenite (light-colored areas). F) Transparent yellow-green glass spherule (~140 µm dia.) with large (24 x 32 µm) rounded, centrally-located lechatelierite particle (dark grey) from sample 12057. Photographed in reflected light.

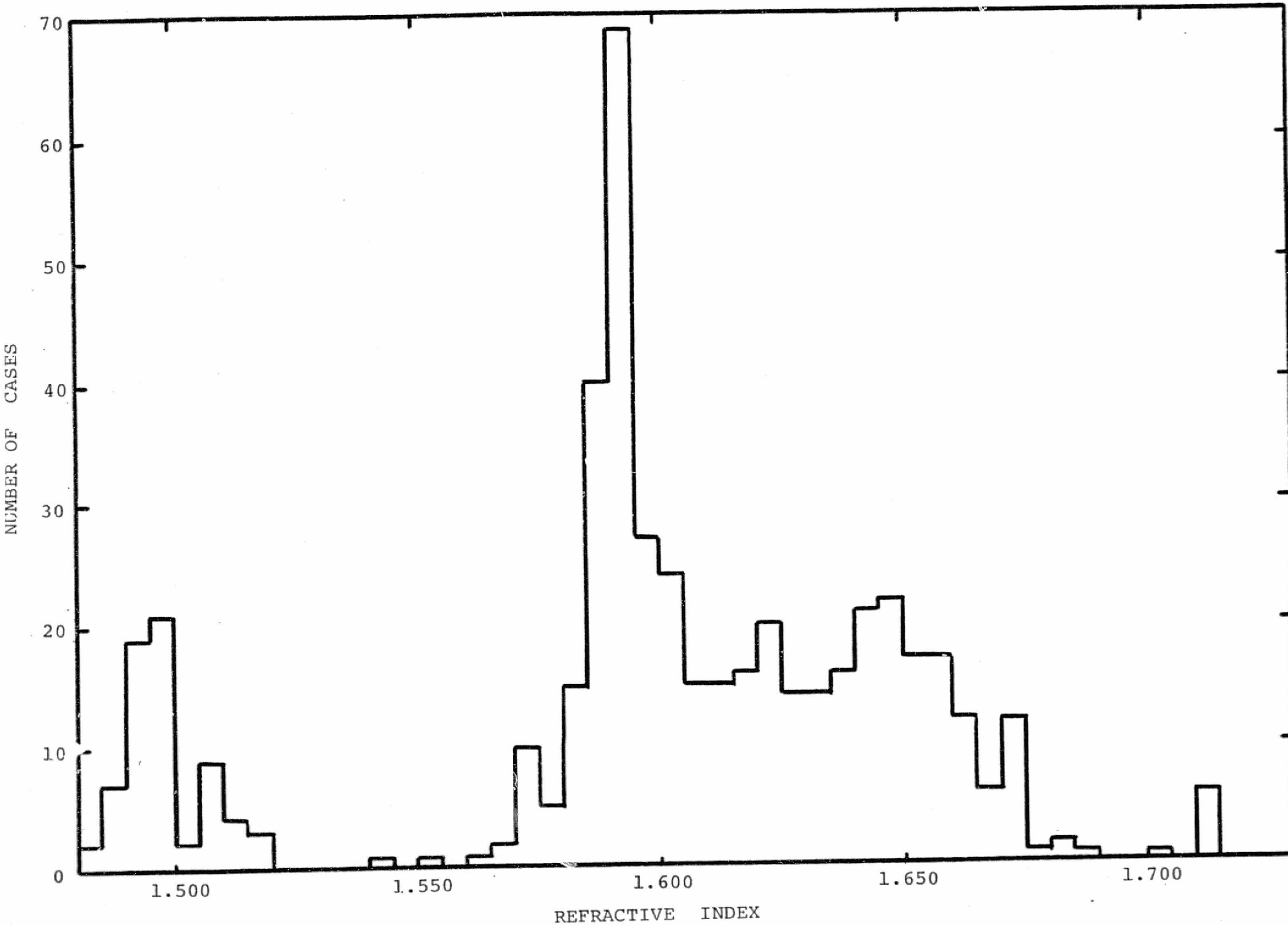
Figure 8. Percent glassy agglutinates in the 149-295 µm size fraction versus percent of sample (<1 mm fines) less than 149 µm.

Figure 9. Histograms of Al_2O_3 and FeO contents of glasses for each mission.




A
B
C
D

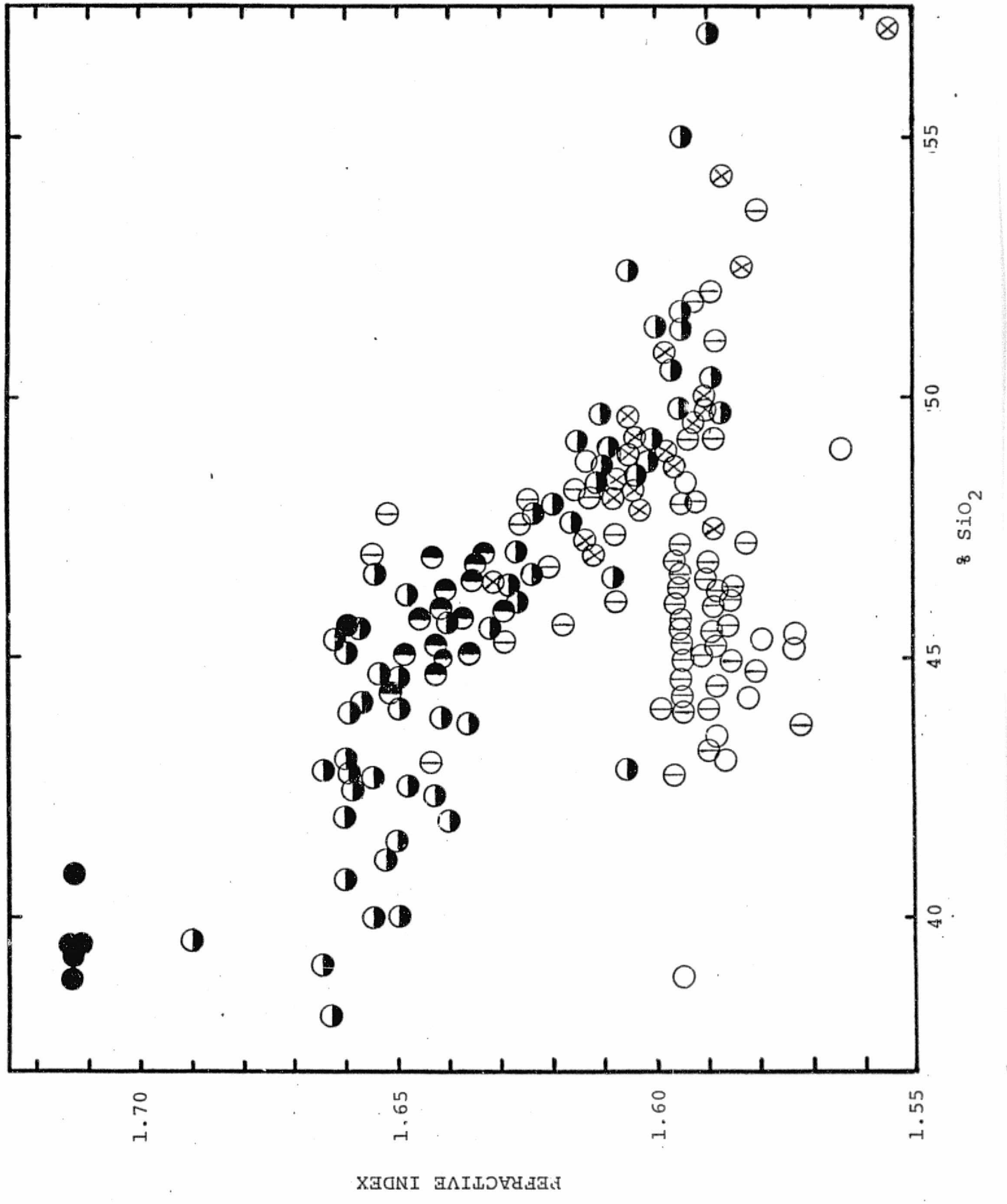


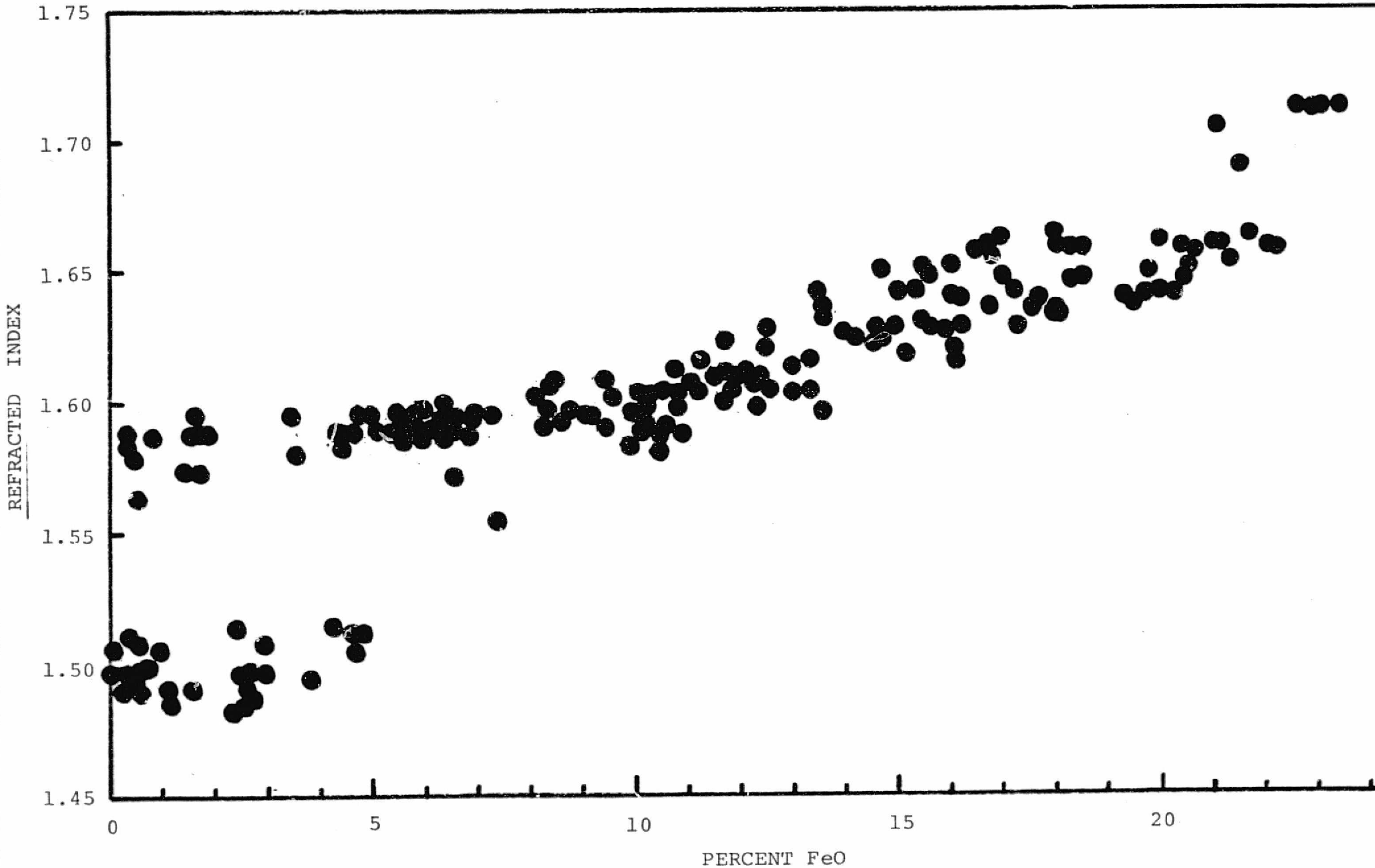


70
60
50
40
30
20
10
0
NUMBER OF CASES
1.500
1.550
1.600
1.650
1.700
REFRACTIVE INDEX

Fig. 4

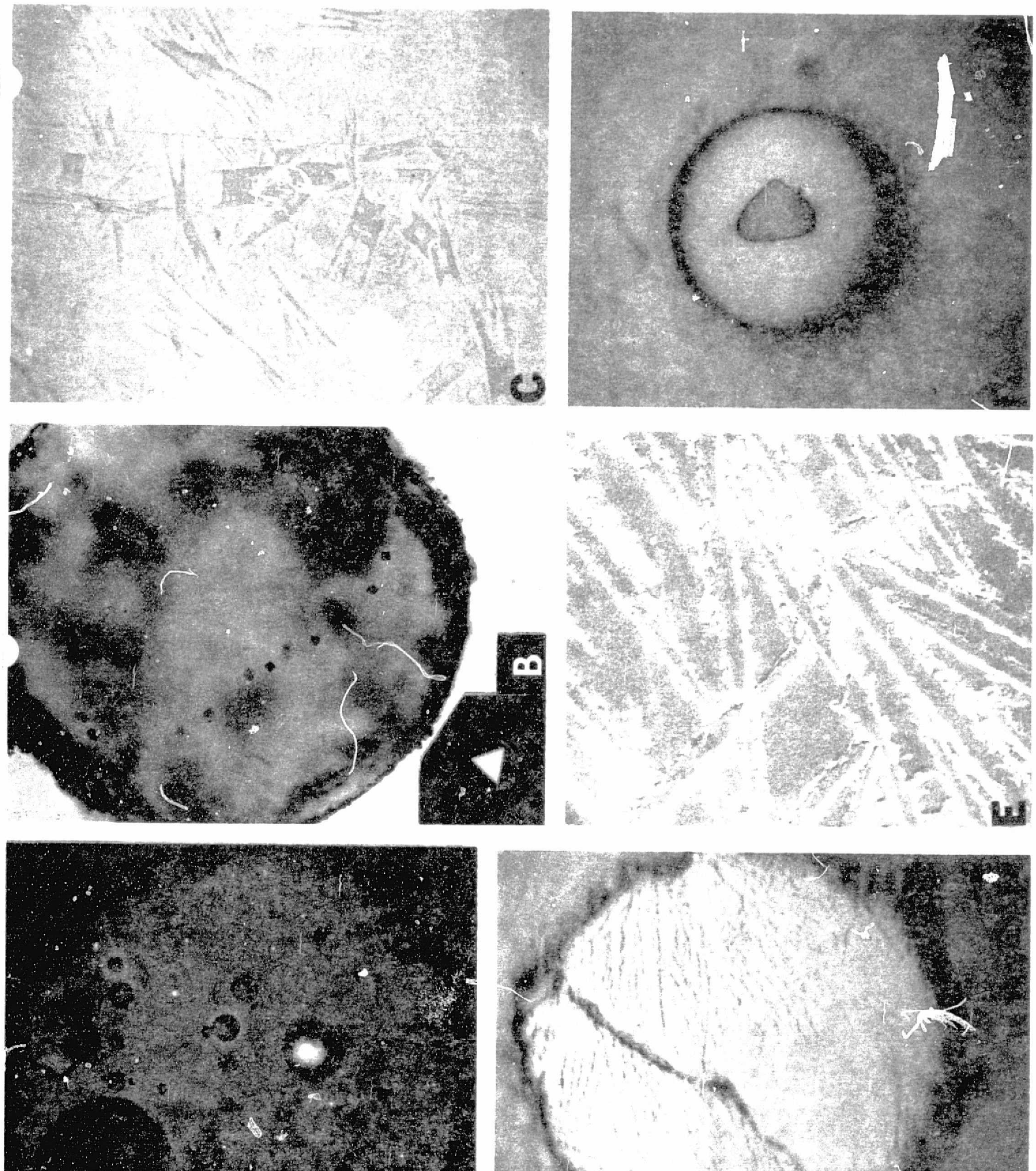
Fig. 5





1.75
1.70
1.65
1.60
1.55
1.50
1.45
REFRACTED INDEX
0
5
10
15
20
PERCENT FeO

Fig. 6


A
B
C
E

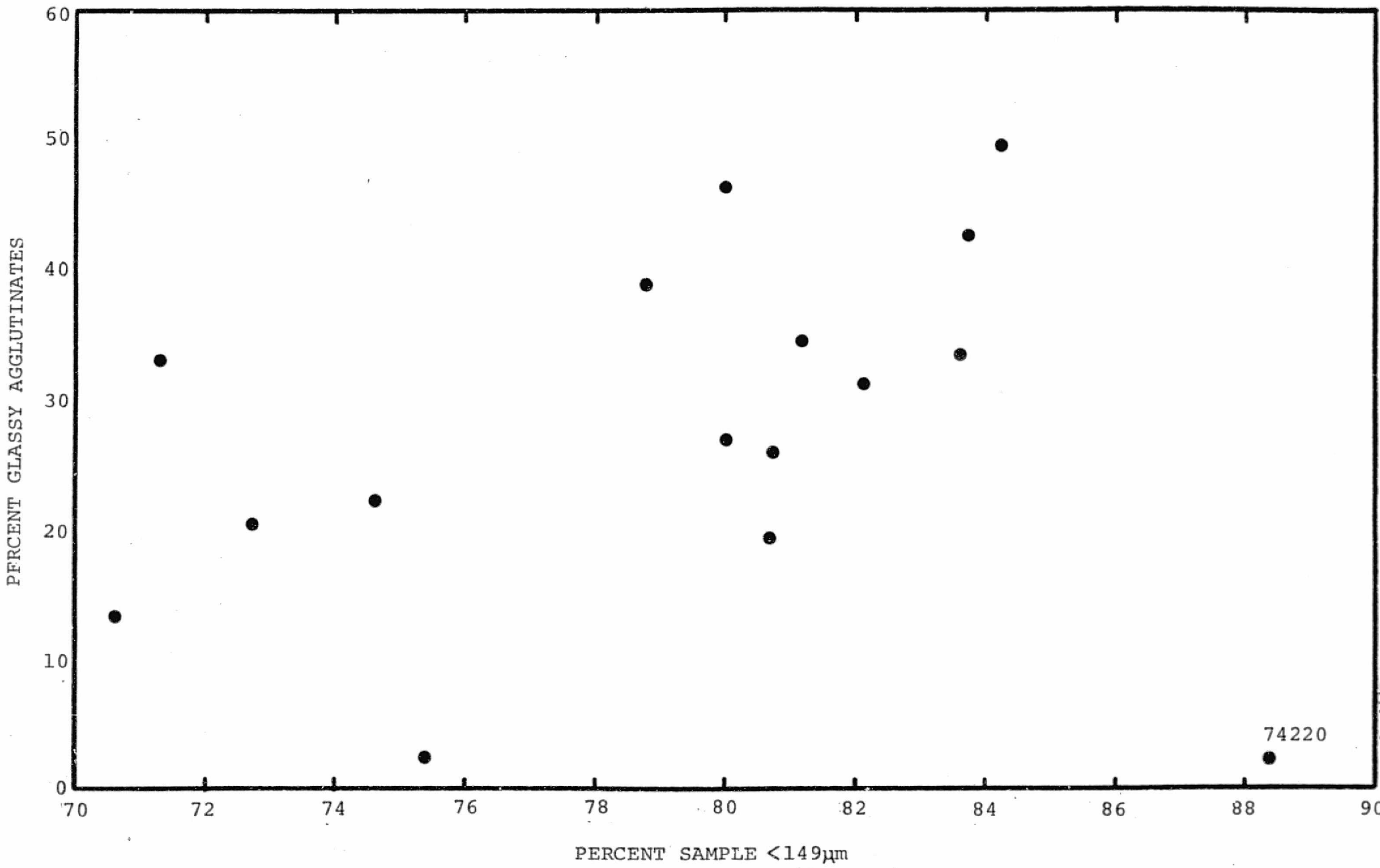
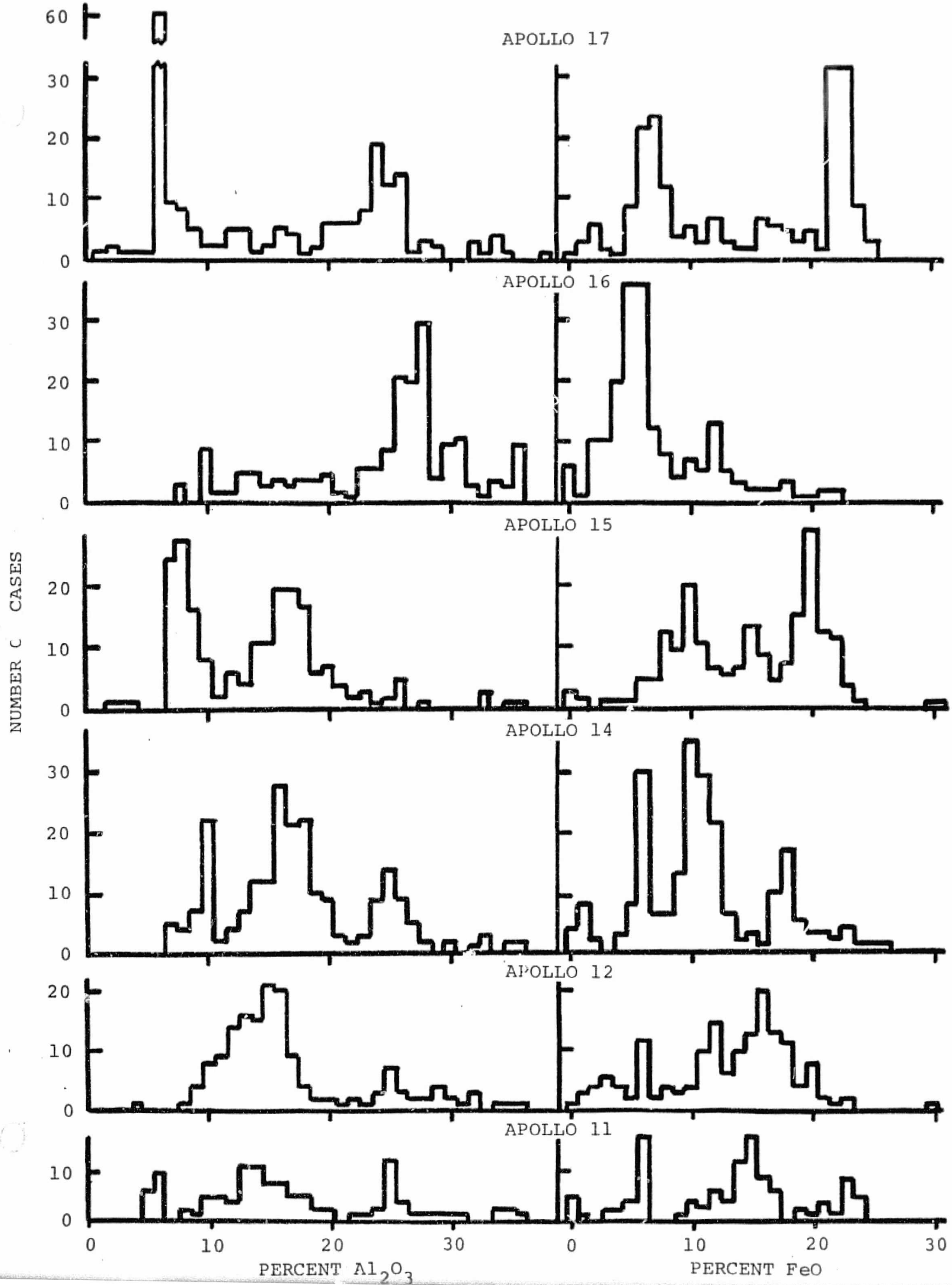

PFRCENT GLASSY AGGLUTINATES
60
50
40
30
20
10
0
70
72
74
76
78
80
82
84
86
88
90
74220
PERCENT SAMPLE <149μm

Fig. 8


APOLLO 17
APOLLO 16
APOLLO 15
APOLLO 14
APOLLO 12
APOLLO 11
NUMBER OF CASES
60
30
20
10
0
0
10
20
30
PERCENT Al_2O_3
PERCENT FeO

APPENDIX A

List of publications (and papers in press or preparation) resulting from NASA grant NGR-08-001-029-040

1. "Investigation of Glass Recovered from Apollo Sample No. 12057", J.G.R. 72, 5649-5657 (1971).

2. "Investigations of Glass Particles Recovered from Apollo 11 and 12 Fines: Implications Concerning the Composition of the Lunar Surface", NASA Goddard Space Flight Center Doc. X-644-71-414 (1971).

3. "Apollo 14 Glasses", Revised Abstracts of the Third Lunar Science Conference, Lunar Science Institute Contribution No. 88, Houston, Texas, pp. 312-314 (1971) (abstract).

4. "Comparison between Lunar Glass Spherules and Microtektites", Transactions American Geophysical Union 53, 428 (1972) (abstract).

5. "Micrometeorite Craters on Lunar Glass Particles: The Relationship between Radial Fracture Zones and Spall Zones", Meteoritics 7, 47-49 (1972).

6. "Chemistry and Fission-Track Studies of Apollo 14 Glasses", with D. Storzer and G.A. Wagner, in Proc. Third Lunar Sci. Conf., Geochim. Cosmochim. Acta Suppl. 2, vol. 1, 927-937, MIT Press (1972).

7. "Major Element Composition of Apollo 15 Glasses", in The Apollo 15 Lunar Samples, ed. J.W. Chamberlain and C. Watkins (Houston: Lunar Science Institute) pp. 73-77 (1972) (expanded abstract).

8. "Major Element Compositions of Luna 20 Glass Particles", Geochimica et Cosmochimica Acta 37, 841-846 (1973).

APPENDIX A (cont'd)

9. "Major Element Analysis of Glass Particles from the Apollo 17 Orange Soil (Sample 74220,89)", <u>Transactions American Geophysical Union 54</u>, 590-591 (1973).

10. "Investigation of a Luna 16 Glass Bead" in Vinogradov, A.P. (Ed) <u>Lunar Soil from Sea of Fertility</u>. Nauka Publishing House, Moscow, (1974) pp. 236-238.

11. "Major Element Composition of Glasses from Apollo 11, 16 and 17 Soil Samples" (submitted to <u>J.G.R.</u>).

12. "High Silica Lunar Glasses" (in preparation).

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