SAMPLE RE-EXAMINATION

BINOCULAR DESCRIPTION PROCEDURE

In general, the largest remaining subsample was selected for the description of the lithology. Special emphasis was placed on the mineral and clast components of the rock.

Breccia clasts were measured, classified and described (see Table 4) and abundances of the various clast types were visually estimated. The identification, abundances and grain sizes of the basalt components were coordinated with the thin section description. The orientations used in the photographs and in the binocular descriptions are arbitrary and do not reflect the orientation on the moon.

For the most part, information contained in the binocular description was generated during re-examination. However, sample descriptions generated during PET were reviewed and any information that conflicted with, or could not be observed during re-examination was annotated by placing a semi-colon (;) between the re-examined descriptive and the PET descriptive. For example: If the part of the rock restudied had no fractures, but a note in the Preliminary Examination stated that fractures were present parallel to an elongated face, it would be presented in the following manner in the binocular descriptions:

Fracturing – Absent; Few fractures parallel to elongated face (PET).

All terms used in the binocular descriptions are listed below:

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Cavities		Not to include merely surface related features such as clast mold.
	vugs	
	vesicles	projecting or lining materials
	crystals	
Coherence		
Intergranular:		grain-to-grain coherence
	very friable	crumbles under manual pressure
	friable	crumbles under manual pressure
	coherent	must be struck to disaggregate grains
	tough	breaks across grains rather than around them
CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Fracturing:		terms combined as needed for a full description
	absent	
	few	
	numerous	
	non-penetrative	
	penetrative	visible on opposing sides

Component		igneous rocks, breccia and fines as applicable
	mafic silicate	all colored translucent minerals; mainly pyroxene and olivines
	plagioclase	light grey and white (if shocked)
	ilmenite	black opaque submetallic
	opaque	used when opaques other than ilmenite are present but quantitatively inseperable
	pyroxene	amber to honey brown to dark brown
	mafic	aphanitic material (under binocular microscope) <.05 mm; sometimes referred to as mesostasis
	clast	see clast description for details of various clast lithologies
	glass	dark green to black noncrystalline silicate material
Fabric		to include texture
	isotropic	
	anisotropic	
	laminated	
	equigranular	
	inequigranular	
	porphyritic	
	seriate	
	microbreccia	<1mm average clast size
	fine breccia	1-5mm average clast size
	breccia	>5mm average clast size

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Surface		specific faces may be referenced by the laboratory orientation cube face designation
	irregular	
	granulated	
	smooth	
	hackly	generally a freshly broken surface
	glass covered(%)	e.g., glass 30% of E and 10% of T
	grooved	for slickenside-like surfaces
Variability*		any difference in any characteristic from one part to another, e.g.,grain size, lithology, mineralogy
Zap Pit	none	none seen in quick scan
	few	$<10/cm^2$
	many	$>10/cm^2$

**The variability term homogeneous, when used in reference to breccias, refers to no major variation between distribution and abundance of clast material or major components.*

Table –4- BRECCIA CLASTS

Clast Type	Examples Found In	Abundance(%)	Clast Size Range(mm)	Minerals (app) %	Grain Size (mm)	Grain Shape
White (Fig.15)	10009, 10018, 10019, 10021, 10023, 10025, 10026, 10027, 10028, 10046, 10048, 10056, 10059, 10060, 10061, 10063, 10064, 10065, 10066, 10067, 10068, 10070, 10073, 10074, 10075, 10082, 10093, 10094	<1% - 20%	<.1mm-4mm	Plagioclase 100%	<.1-.3	Euhedral to aphanitic
Basalt (Fig.16)	10018, 10019, 10021, 10023, 10026, 10027, 10030, 10048, 10056, 10060, 10061, 10063, 10064, 10065, 10066, 10067, 10068, 10070, 10073, 10075, 10082, 10093, 10094	<1-10	.3-40	Pyroxene 40% Plagioclase 40% Ilmenite 10% Mesostasis 10%	.08-.4	Euhedral to subhedral (pyroxene, Elongated platy (ilmenite)
Salt & Pepper (Fig.17)	10009, 10018, 10019, 10021, 10023, 10026, 10027, 10030, 10048, 10056, 10061, 10064, 10065, 10067, 10068, 10070, 10073, 10075, 10093, 10094	<1-5 Avg=8	.3-3 Avg=2	Plagioclase 75% Ilmenite 25%	<1-.2 plagioclase)	Elongated platy (ilmentite) Crushed aphanitic (plagioclase)
Grey (Fig.18)	10046, 10060, 10063, 10064, 10065, 10066, 10067, 10068, 10070, 10075, 10093, 10094	<1-5	2-3	Pyroxene 60% 40%	<.1-.3	Euhedral to subhedral

Grey & White (Fig.19)	10028, 10030, 10060, 10061, 10065, 10068, 10074, 10082, 10093	<1-8	2-3	Pyroxene 50% Plagioclase 50%	<.1-.3	Euhedral (pyroxene) (plagioclase)
Brown	10019, 10023, 10027, 10046, 10048, 10060, 10063, 10067, 10070, 10074, 10075	<1-2	<1-2	Honey Brown Pyroxene 100	<.1 aphanitic	Crushed appearance
Green (Fig.20)	10063, 10068		<1-1.5	Olivine-100	<.1-.4	Euhedral to crushed
Black	10064, 10067	<1		Aphanitic glass	<.01	
Lithic Clast Type	Examples Found In	1	Abundance(%)	Clast Size Range(mm)	Minerals (app) %	Grain Size (mm)	Relic Clast (Fig.21) Grain Shape
	10075		<1-2	Aphanitic	<.01	Aphanitic	
Brown & White	10093	2	2.5X3.5	Honey Brown Pyroxene (50%) Plagioclase (50%)	.4-.9	Euhedral pyroxene (Fig.22) and plagioclase
		<1				
		<1				

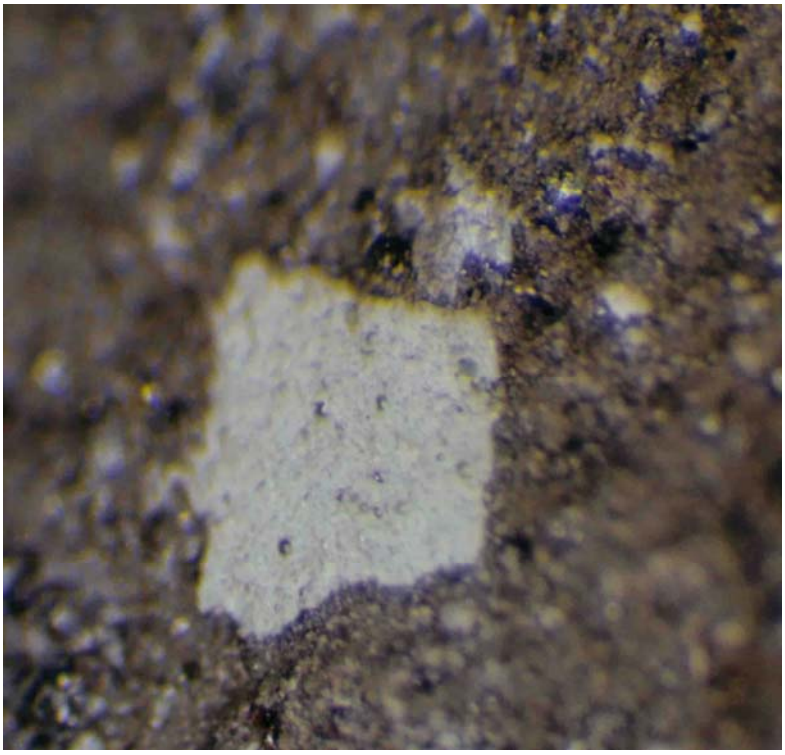

Fig. 15: White clast from 10060,5. Width of field 7.3 mm (S-76-25890)

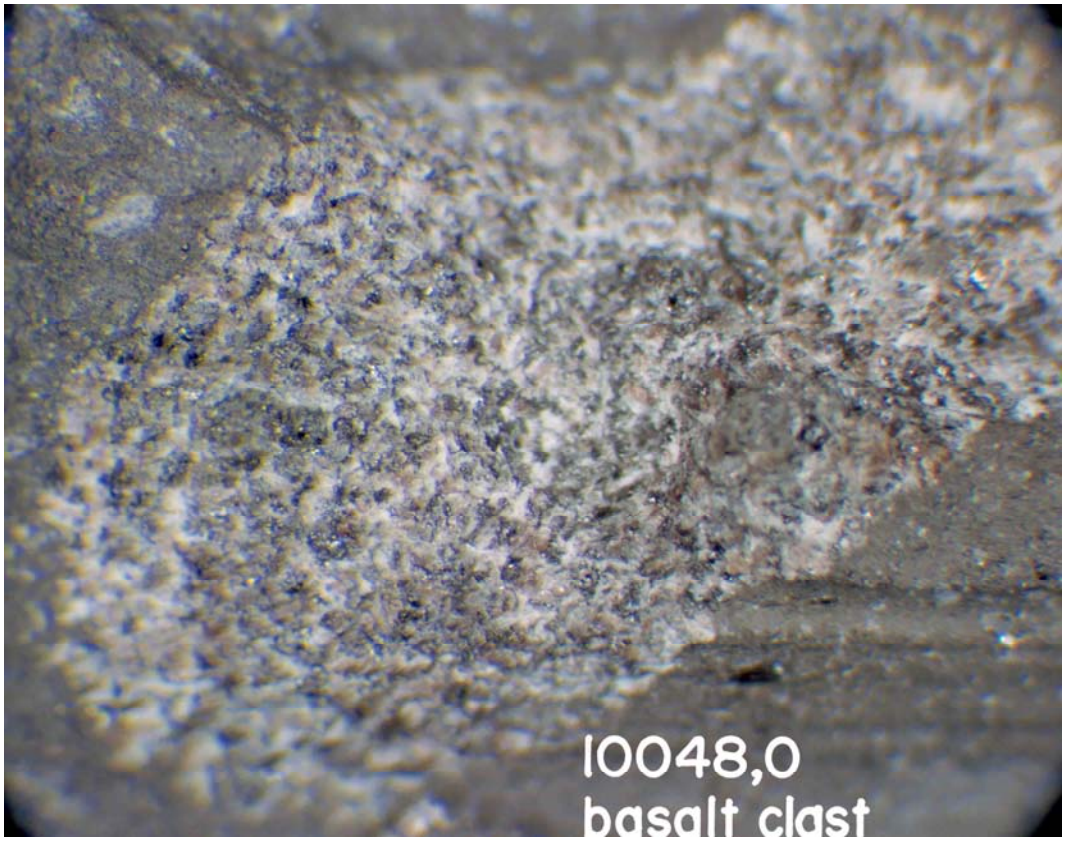

Fig. 16: Basalt clast from 10048,0. Width of field 7.3 mm (S-76-25618)

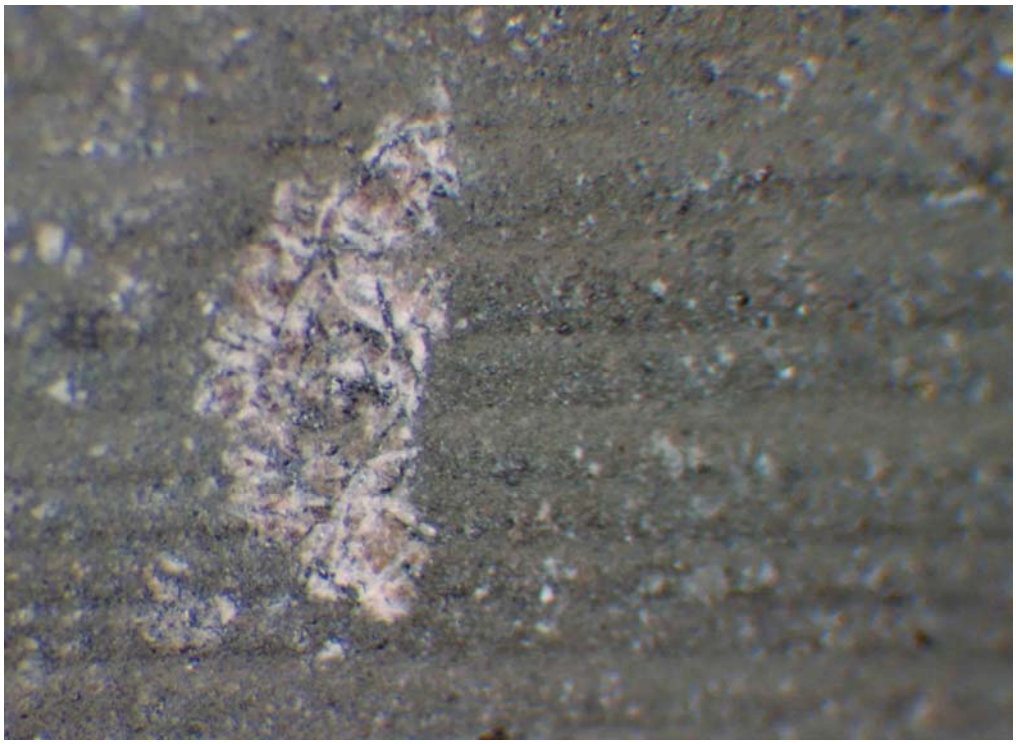

Fig. 17: Salt & Pepper Clast from 10048,0. Width of field 7.3 mm (S-76-25619)

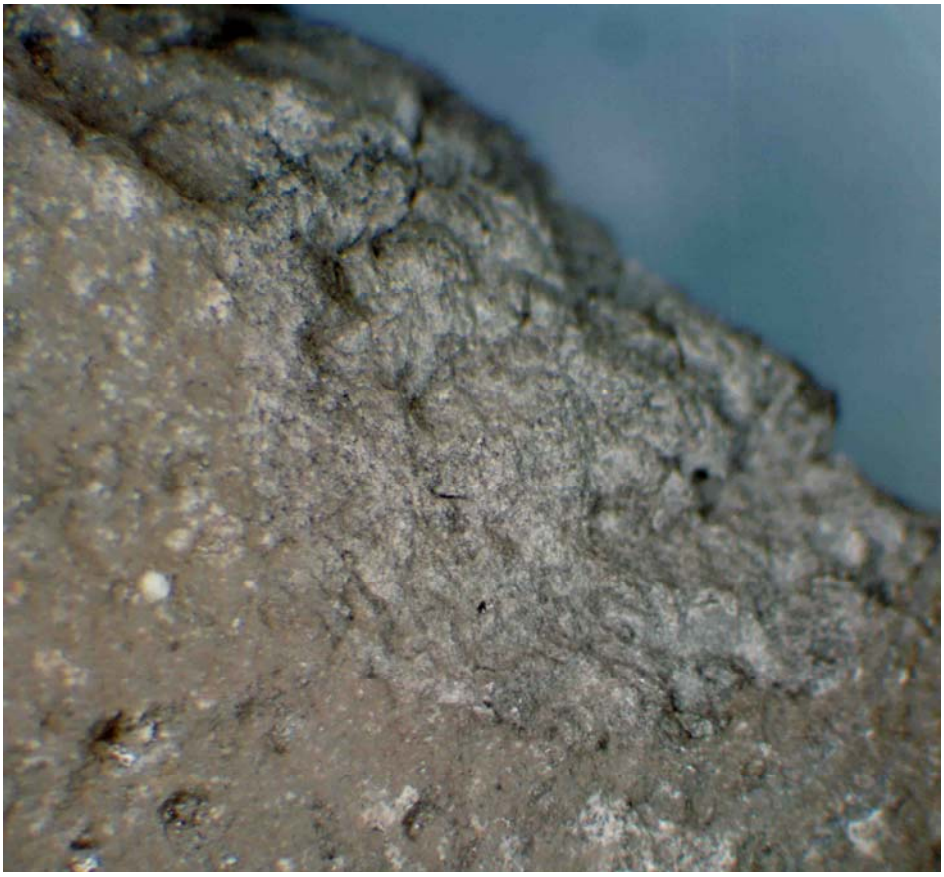

Fig. 18: Grey clast from 10063,1. Width of field 14.8mm (S-76-26838)

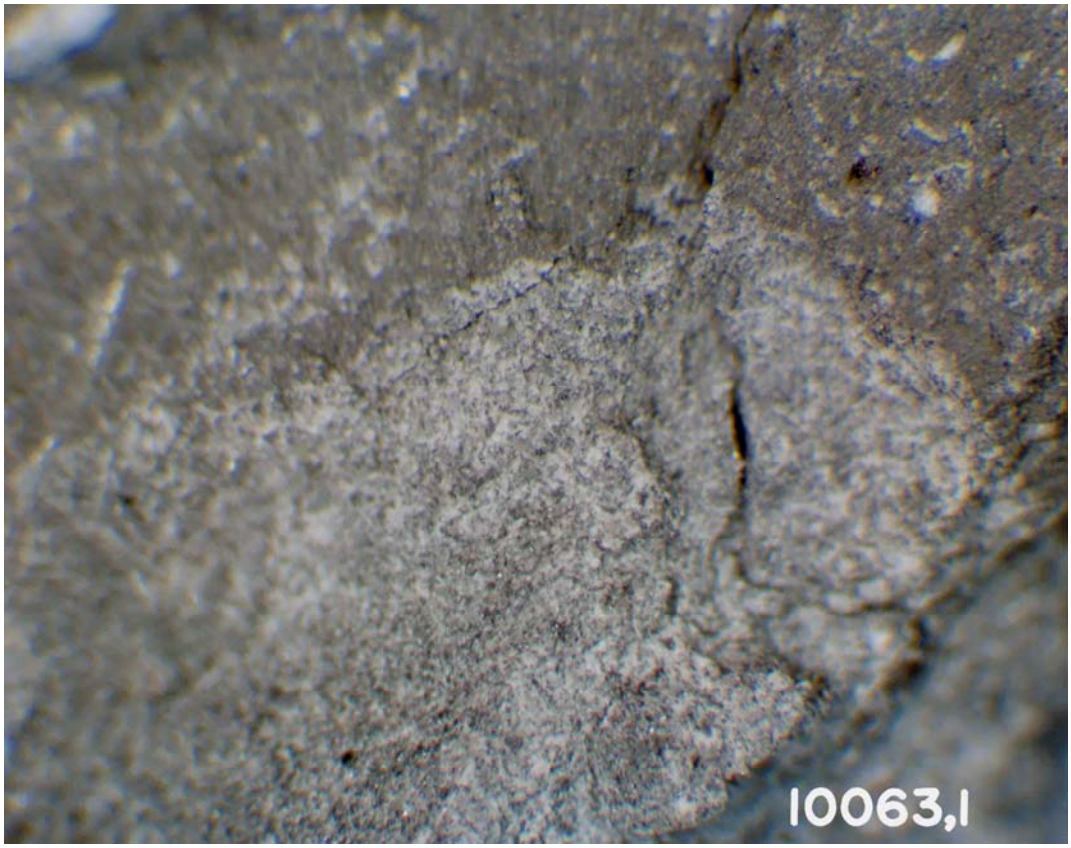

Fig. 19: Grey & White clast from 10063,1. Width of field 7.3 mm (S-76-26839)

Fig. 20: Green clast from 10063,1. Width of field 7.3 mm (S-76-26837)

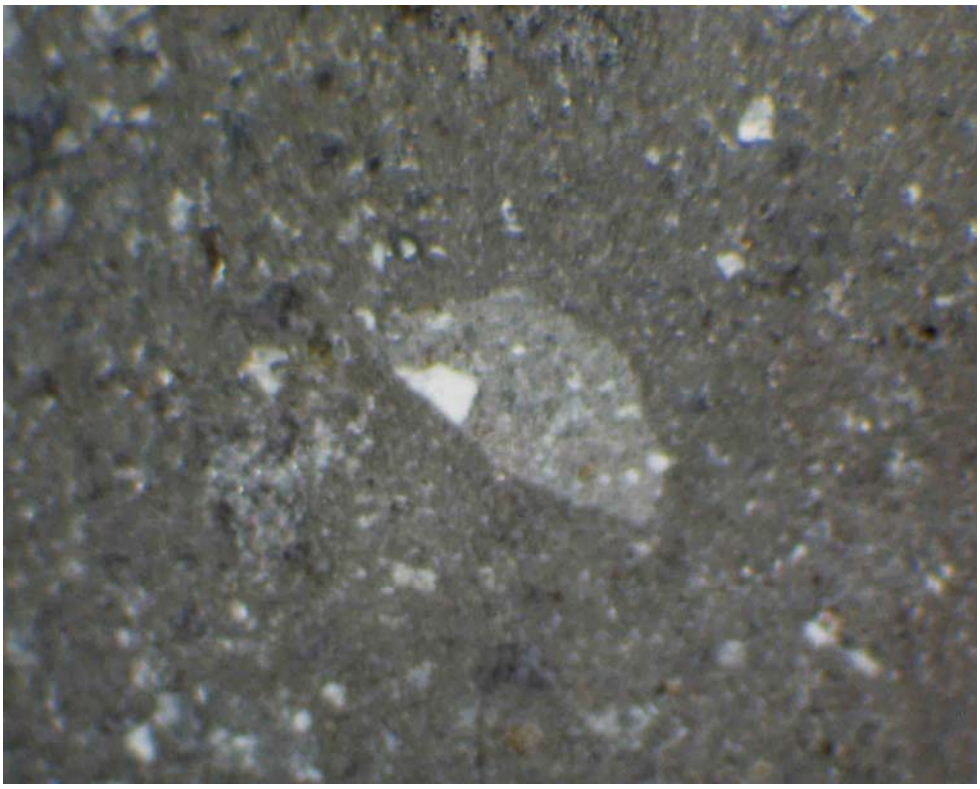

Fig. 21: Lithic clast from 10060,5. Width of field 7.3 mm (S-76-25891)

Fig. 22: Brown & White clast from 10093,0. Width of field 7.3 mm (S-76-25991)

THIN SECTION DESCRIPTION PROCEDURE

Each thin section description and modal analysis appearing in this catalogue is given for specific section but the summary and comments are based on examination of all available sections. The modal analyses are based on 200-400 point counts, the number depending on the apparent heterogeneity of the sample. The modal analyses reported always represent void-free analyses owing to the variability in the number, size, and distribution of voids.

For the size characterization the maximum dimension of each crystal was used. Identification of the phases was solely by optical properties. No attempts were made to identify the specific pyroxene or plagioclase composition present. No oil immersion microscopy was done and no attempt was made to identify any of the very fine grained materials.

GENERAL DESCRIPTION OF AN APOLLO 11 BRECCIA THIN SECTION

Since the overall characteristics of all Apollo 1 breccias are very similar, a generalized description and definition of terms is given below. For specific samples, only those characteristics that deviate from the general description will be noted.

Apollo 11 breccias are characterized by having a dark to light brown matrix which is rich in slightly to moderately devitrified glass. In most cases the material is very turbid and contains small crystallites, many too small to be resolved.

The following definitions will be used in describing all breccia samples:

Matrix – The matrix of the section is that material in which the glass-rich phases occurs along with small (<0.001mm) crystalline products. No attempts were made to resolve the phases present in the matrix.

Mineral Clasts – Those shards of crystalline material which contain one mineral phase plus or minus exsolution lamellae, zoning, etc. Grains with two or more phases are considered a crystalline lithic clast rather than a mineral clast.

Lithic Clasts – In order to simplify the designation of the various types of lithic clasts possible in any one section, they are divided into two groups. The first group is designated small (<1mm) and are not further defined. The second group is designated large (>1mm) and each has a few remarks to better define the clast components and any other pertinent information. The exact number of the large clasts is given, whereas only a relative abundance is given for the small class.

Due to the heterogeneous nature of breccias, one or even several thin sections cannot give precise percentages of phases present. Therefore, in order not to stress unduly the measure values of the phases present in the sections, semi-quantitative values are used. These values are defined below:

Relative Value	Approximate % of Type Present in Section
Very abundant	>50%
Abundant	30-50%
Moderate	20-30%
Few	10-20%
Present	<10%

In the majority of the breccias, the matrix forms a more or less continuous array and hosts all other phases present. The matrix is a semi-opaque glass-rich phase that shows no flow structure but always shows some degree of devitrification. Included in the matrix are numerous rounded and irregular lithic clasts. These clasts are randomly located and isolated from on another. Many breccias have a wide variety of clasts while others have a very limited representation. Inter-dispersed with lithic clasts are mineral clasts. The major phase represented is usually clinopyroxene. It occurs as irregular to blocky shards which usually show some degree of shock deformation. The crystals, for the most part, show only slight to no evidence of reaction with the enclosing matrix. Plagioclase and ilmenite also occur in most sections, but usually to a lesser degree. The third major phase is the glass shards which occur as spherical to irregular masses. Many contain bubbles, flow lines and fractures. The color usually is some shade of yellow or orange, but colorless, white and greenish-brown masses also occur. Some glass coatings on vesicle walls and near the outer surfaces also occur.

GENERAL DESCRIPTION OF AN APOLLO 11 BASALT IN THIN SECTION

The designation and classifications of the basalts follow the following scheme. Five major types of basalts are recognized. A generalized description is given in the table below along with the samples which fall under each of the groups:

TYPE	GENERAL DESCRIPTION	SAMPLES
Intersertal- one population of plagioclase	Intergrown network of pyroxene and ilmenite with plagioclase, mesostasis interstitial to network. High mesostasis content.	10017 10049 10057 10069
TYPE	GENERAL DESCRIPTION	SAMPLES
Intersertal- Two populations of plagioclase	Network of pyroxene phenocrysts intergrown with large anhedral ilmenite. Interstitial to the network are tablets of plagioclase, anhedral plagioclase, and mesostasis. High mesostasis content.	10022 10024 10032 10071 10072
Subophitic	Plagioclase laths are interstitial to and enclosed in the pyroxene host.	10029 10044 10047 10050 10058
Ophitic	Plagioclase laths occur enclosed in the pyroxene host with minor plagioclase as interstitial void fillings.	10020 10045 10062
Intermediate Ophitic/Subophitic	In part typical ophitic plus grading to subophitic.	10003

Grain size and minor mineralogy can vary within each type, but the major characteristics remain the same. No attempts were made to determine any of the phases in the mesostasis.

SAMPLE HISTORIES

A summary of the processing, laboratories and operation, special handling and any unusual contaminating conditions is presented for each generic sample. In addition, an abbreviated sequence of laboratory destinations is presented for each pristine subsample. This indicates which laboratory and hence type of potential contaminants could be associated with the existing sample. More detailed information may be found in the Curator's files.

CHEMICAL DATA

These values were obtained by using all valid data available in the lunar data base.* The data base was checked for accuracy and a number of errors were eliminated. Before averaging, redundant and suspect values were removed according to the general rules:

Preliminary examination data were removed.

1. Runs at temperatures other than ambient were removed.
2. Results after acid leaching were removed.
3. Analyses of individual mineral fractions or phenocrysts were removed.
4. Data for samples listed by the author as probably contaminated were removed.
5. Where the same data was repeated by the same author or other authors only the most recent value was retained.
6. Possible decimal errors were checked and corrected if sufficient information was available to make a valid change.
7. Element to oxide calculations were checked and corrected where this type of an error was indicated.

Unusual values that were not removed by at least one of these rules were kept. In some cases the range of two values was large, but there was no obvious reason for eliminating either of the values.

**Compiled by and available from the Curator's Office. The data base contains published chemical, isotopic, modal, and age data for all lunar samples.*