



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

LUNAR CRYSTALLINE ROCKS - PETROGRAPHY, GEOLOGY, AND ORIGIN

IN REPLY REFER TO:

by

Jeffrey L. Warner and Daniel H. Anderson

Thin sections from all available Apollo 11 and 12 crystalline rocks (185 sections) were studied petrographically. The rocks fall into three rather well defined groups:

1. Porphyritic Basalts - Apollo 12 only.
2. Granular and Ophitic Basalts - Apollo 11 and 12; corresponds to James and Jackson's (1970) ophitic basalts.
3. Intersertal Basalts (James and Jackson) - Apollo 11 only.

PORPHYRITIC BASALTS (12002, 12004, 12008, 12009, 12011, 12012, 12014, 12015, 12017, 12018, 12019, 12020, 12021, 12022, 12031, 21045, 12052, 12053, 12055, 12065, 12075, 12076). The matrix of these rocks display a textural continuum ranging from 1) glass; through 2) very fine grained (0.01 mm.) acicular and feathery pyroxene and plagioclase; 3) feathery pyroxene and plagioclase; 4) acicular pyroxene and plagioclase; to 5) sub-ophitic pyroxene and plagioclase. The phenocryst mineralogy follows the matrix textures as: 1) olivine; 2) mostly olivine; 3) mostly pyroxene; 4) olivine and pyroxene; and 5) pyroxene. Types 1 through 4 all contain skeletal ilmenite, irregular cavities, and less than 2% cristobalite and no tridymite. Type 5 contains equant and skeletal ilmenite, no cavities, and 3-5% cristobalite plus tridymite.

GRANULAR AND OPHITIC BASALTS (10003, 10020, 10044, 10045, 10047, 10050, 10058, 10062, 12006, 12035, 12036, 12038, 12039, 21040, 12044, 12046, 12047, 12051, 12056, 12062, 12063, 12064). These rocks contain subhedral to anhedral pyroxene, euhedral plagioclase, equant and skeletal ilmenite, scattered olivine crystals, interstitial cristobalite, and no cavities. Plagioclase occurs partially to completely enclosed by pyroxene in all the Apollo 11 and some of the Apollo 12 rocks, whereas in six of the Apollo 12 rocks plagioclase is almost completely interstitial to pyroxene and olivine phenocrysts.

INTERSERTAL BASALTS (10022, 10024, 10049, 10057, 10069, 10071, 10072). These rocks contain a network of subhedral pyroxene, skeletal and equant ilmenite, and scattered olivine crystals. The ilmenite crystals contain cores of armalcolite. Euhedral plagioclase anhedral cristobalite, and anhedral glass fill the interstices of the pyroxene-ilmenite-olivine network. Spherical vesicles are abundant.

The existence of similar groups in widely separated localities implies an origin by differentiation or partial melting of large volumes of source material rather than by small pockets of locally impact-melted material. Although some of this material may have been remelted, we believe that the primary separation took place by partial melting in the moon's interior.

The geologic map of the Apollo 12 traverse reveals a hitherto unrecognized order on the scale of a kilometer. This distribution of rock types is interpreted in terms of lava stratigraphy.