Six Month Progress Report

NASA Grant NSG-9051

Title: Electron Microprobe Study of Lunar and Planetary Zoned Plagioclase Feldspars

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U.S. Government

MEMORANDUM

NASA

Lyndon B. Johnson Space Center

REPLY TO:	DATE	INITIATOR
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Bob Smith

SUBJ: 6 Month Progress Report, NASA Grant NSG-9051

Electron Microprobe Study of Lunar and Planetary Zoned Plagioclase Feldspars Progress Report

1. Research Personnel

During the first six months the principal investigator, Robert K. Smith, was engaged in directing and implementing the overall project for 50% of his time during February-May, 1977 and 100% of his time during June and July, 1977. During this time Michael R. Florez and Gilbert X. Hernandez, both senior geology students, and Donald L. Whitley, a junior geology student, served as research assistants. In addition, Don Whitley accompanied Dr. Smith to the Johnson Space Center during July, 1977.

2. Equipment Acquired and Installed

The existing Leitz Ortholux-Pol petrographic microscope was upgraded to the present study by the addition of the following photographic accessories: aristophot stand with dust cover, shutter with carrier, adapter ring, light collars (upper and lower), bellows carrier, mirror reflex housing, magnifier 6x, film holder (polaroid), filter UG4, eyepiece 6.3x, vertical illuminator, objective 20x, and exposure meter.

3. Electron Microprobe Studies

While on a NASA-ASEE Summer Faculty Fellowship, during the summer of 1976, electron microprobe data was collected on K, Ca, and Na from 15 zoned plagioclases in 12 thin sections. Of these 12 thin sections, three were selected for analysis by a new technique for collecting and presenting areal electron microprobe data at the Colorado School of Mines. This new technique utilizes a computerized real-time data collection system that gathers x-ray photon counts from the microprobe spectrometers as the microprobe electron beam scans the specimen surface. After appropriate data processing the computer draws elemental concentration contour maps from two dimensional data matrices collected for each element. In most cases concentration contour maps were made of Ca, Al, Fe, Si, and Na. Typical elemental concentration contour maps (Appendix) of analyzed zoned plagioclase feldspars exhibit detailed information on: (1) irregular crystal face growth rate patterns, (2) major and minor zone boundaries, (3) lateral compositional variations within zones, (4) differential growth rates on various crystal faces, and (5) compositional variations along twin planes. Such maps will be utilized in comparing compositional variations between optical methods and traverse line microprobe data collected during the summer of 1976. In addition, all traverse line microprobe data have been plotted to scale with the original photomicrographs (Appendix).

4. Petrographic Studies

All 12 thin sections have been described petrographically and optical data on individual zoned plagioclases begun (Appendix A).

5. Summary

The following table summarizes all completed work to date.

SAMPLE NUMBER	# OF GRAINS ANALYZED PER SAMPLE	# OF TRAVERSES PER GRAIN: GRAIN #	# OF TRAVERSES PER GRAIN: QUANTITY	COMPOSITION COMPARISON BY OPTICAL METHODS	CROSSED NICHOLS PHOTOS: QUANTITY	CROSSED NICHOLS PHOTOS: MAG.	UNCROSSED NICHOLS PHOTOS: QUANTITY	UNCROSSED NICHOLS PHOTOS: MAG.	REFLECTED LIGHT PHOTOS: QUANTITY	REFLECTED LIGHT PHOTOS: MAG.	GRAPHS OF PROBE DATA AT 208X PER TRAVERSE		PETROGRAPHY OF THIN SECTIONS	PROBE DATA CONTOUR MAPS: QUANTITY	PROBE DATA CONTOUR MAPS: ELEMENT MAPPED	PROBE DATA CONTOUR MAPS: UNSMOOTHED MAG.: QUANTITY	PROBE DATA CONTOUR MAPS: UNSMOOTHED MAG.: MAG.	PROBE DATA CONTOUR MAPS: SMOOTHED MAG.: QUANTITY	PROBE DATA CONTOUR MAPS: SMOOTHED MAG.: MAG.	COMMENTS
-603	2	I	2	WILL BE DONE LATER	1	40X	1	40X	1	208X	T-1	1	X	23	Ca	16	200X	3	200X	Andesite; Chile
																7	400X			T1 An 90.1 max. 26.4 min.
																5	1000X			
																5	2000X			
		II									T-2	1		2	Fe	2	200X	0	200X	T2 An 64.1 max. 29.3 min
														3	Al	3	200X	0	200X	
-714-A	2	I	1	HAS BEEN DONE	2	40X	2	40X	1	208X	T-1	1	X	NOT WILL BE DONE TO THIS SAMPLE						Basalt; Guatemala
		II	1		1	40X	1	40X	1	208X	T-2	1								T1 An 90.8 max. 42.2 min
																				T2 An 90.2 max 48.9 min
-714-B	1	I	2	WILL BE DONE LATER	1	60X	1	40X	1	208X	T-1	1	X	MIGHT BE DONE LATER						Basalt; Guatemala
											T-2	1								T1 An 96.4 max. 35.5 min
																				T2 An 62.5 max. 35.1 min
-714-C	1	I	1	D.O.	1	60X	1	40X	1	208X	T-1	1	X	MIGHT BE DONE LATER						Basalt; Guatemala An 70.4 max. 42.7 min.
-735	3	I	1	D.O.	1	60X	1	60X	1	208X	T-3	1	X	WILL BE DONE LATER						Latite; Colo.
					1	100X														T1 An 99.8 max. 27.8 min
		II	1		1	100X	1	60X	1	208X	T-1	1								T2 An 39.1 max. 25.0 min
					1	200X	1	200X												
		III	1		1	40X	1	40X	1	208X	T-2	1								T3 An 47.7 max. 25.8 min.
-756-B	1	I	1	D.O	1	60X	1	40X	1	208X	T-1	1	X	WILL BE DONE LATER						Latite; Colo. An 46.9 max. 25.6 min

SAMPLE NUMBER	# OF GRAINS ANALYZED PER SAMPLE	# OF TRAVERSES PER GRAIN: GRAIN #	# OF TRAVERSES PER GRAIN: QUANTITY	COMPOSITION COMPARISON BY OPTICAL METHODS	CROSSED NICHOLS PHOTOS: QUANTITY	CROSSED NICHOLS PHOTOS: POWER	UNCROSSED NICHOLS PHOTOS: QUANTITY	UNCROSSED NICHOLS PHOTOS: POWER	REFLECTED LIGHT MOSAICS: QUANTITY	REFLECTED LIGHT MOSAICS: POWER	GRAPHS OF PROBE DATA AT 208X PER TRAVERSE	PETROGRAPHY OF THIN SECTIONS	PROBE DATA CONTOUR MAPS: QUANTITY	ELEMENT MAPPED	UNSMOOTHED: QUANTITY	UNSMOOTHED: POWER	SMOOTHED: QUANTITY	SMOOTHED: POWER	COMMENTS
M-229	3	I	1		1	40X	1	40X	1	208X	1	X	NONE WILL BE DONE						Trachyte; Ariz.
		II	1		1	40X	1	40X	1	208X	1								T1 An 47 max [illegible] min
		III	1		1	40X	1	40X	1	208X	1								T2 An 60.7 max 14.0 min
M-206	1	I	1		1	40X	1	40X	1	208X	1	X	NONE WILL BE DONE						Latite; Cal. An 55.1 max. 40.0 min.
M-598	1	I	3		1	40X	1	40X	1	208X	T-1 1	X	4	Ca	2 1	40X 1000X	1	400X	Basalt, Chile
											T-3 1		1	Na	1 0	400X 1000X	0		T1 An 59.6 max 33.1 min
											T-4 1		5	Al	[illegible] 1	[illegible]	1	400X 1000X	T4 An 75.7 max 5.7 min
													6	Fe	4 2	[illegible] 1000X	0		
													2	Si	2 0	400X 1000X	0		
M-600	1	I	8		1	60X	1	40X	1	208X	T-1 T-2	X	15	Ca	10 5	200X 400X	3	200X	Basalt, Chile
					1	100X					T-3 T-4		6	Ca	2 4	100X 200X	0		T1 An 55 max 30.9 min
					1	250X					T-5 T-6		1	Al	1	200X	0	200X	T2 An 54.4 max 5.0 min
											T-7		1	Fe	1	200X	0		
											T-8			Si					

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Appendix

Photomicrograph, Petrographic Description, Plotted Microprobe Traverse Line Data, and Ca Elemental Concentration Contour Map of M-600 Thin Section.

M-600, 208X

SAMPLE M-600 PETROGRAPHY

BASALT FROM IAN, CHILE (ANDES MTNS.)

TEXTURE - HYPOCRYSTALLINE, PORPHYRITIC; PLAGIOCLASE, OLIVINE AND PYROXENE PHENOCRYSTS IN A FINE-GRAINED TO MICROCRYSTALLINE GROUNDMASS OF PLAGIOCLASE, OLIVINE, PYROXENE AND GLASS.

MAJOR CONSTITUENTS OR ESSENTIAL MINERALS

PLAGIOCLASE - OCCURS AS EUHERAL TO SUBHEDRAL PHENOCRYSTS AND SMALL GRAINS IN THE GROUNDMASS. MOST GRAINS EXHIBIT CONTINUOUS AND DISCONTINUOUS OSCILLATORY ZONING. ALBITE, PERICLINE, AND/OR CARLSBAD TWINNING CAN BE OBSERVED IN MOST GRAINS. MANY GRAINS EXHIBIT SECONDARY GROWTH UPON ROUNDED CORRODED BORDERS. SEVERAL GRAINS SHOW MOTTLED INTERGROWTHS OF PLAGIOCLASE WITHIN THE MAIN PLAGIOCLASE GRAIN ("PATCHY" ZONING). SEVERAL GRAINS ARE STRAINED.

OLIVINE - OCCURS AS EUHEDRAL TO SUBHEDRAL PHENOCRYSTS AND SMALLER GRAINS IN THE GROUNDMASS. MOST GRAINS SHOW CORRODED RIMS AND/OR EMBAYMENT

PYROXENE - OCCURS AS EUHEDRAL PHENOCRYSTS AND AS EUHEDRAL TO SUBHEDRAL GRAINS IN THE GROUNDMASS. WELL DEVELOPED CLEAVAGE. TWINNING IS PRESENT IN SOME GRAINS,

SAMPLE M-600 (cont.) PETROGRAPHY

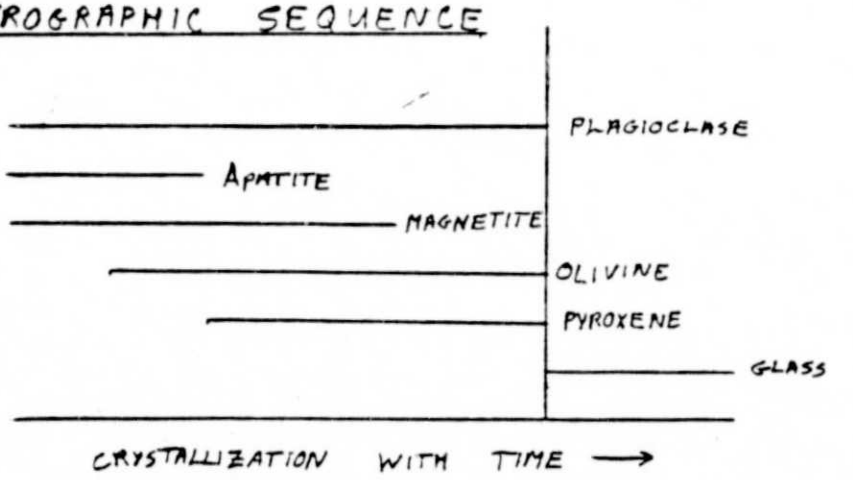
MINOR CONSTITUENTS OR VARIETAL MINERALS

MAGNETITE - OCCURS AS EUHEDRAL TO SUBHEDRAL GRAINS. SOME WEATHERING HAS OCCURRED TO FORM SMALL AMMOUNTS OF HEMATITE.

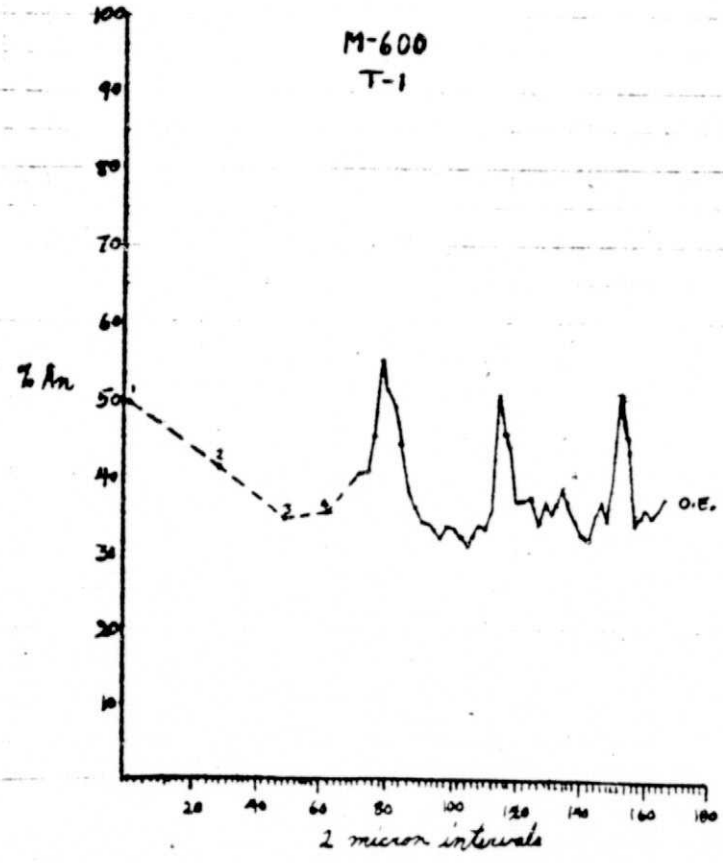
APATITE - OCCURS AS ROD SHAPED INCLUSIONS IN MOST OF THE LARGER PHENOCRYSTS.

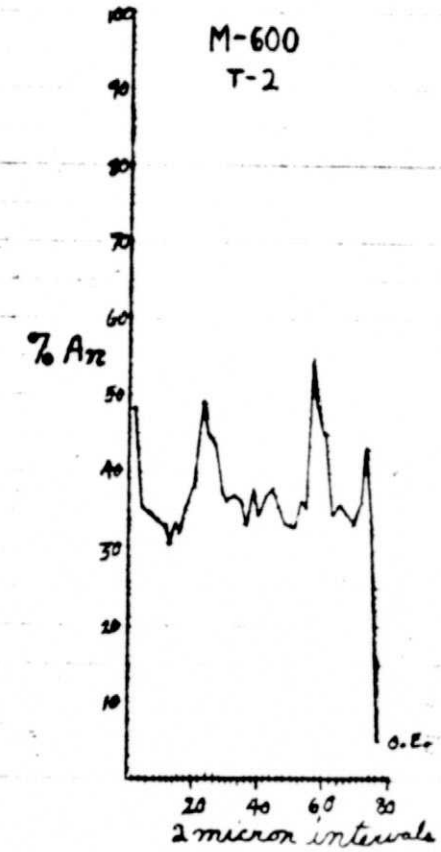
GLASS - LIGHT BROWN INTERSTITIAL MATERIAL.

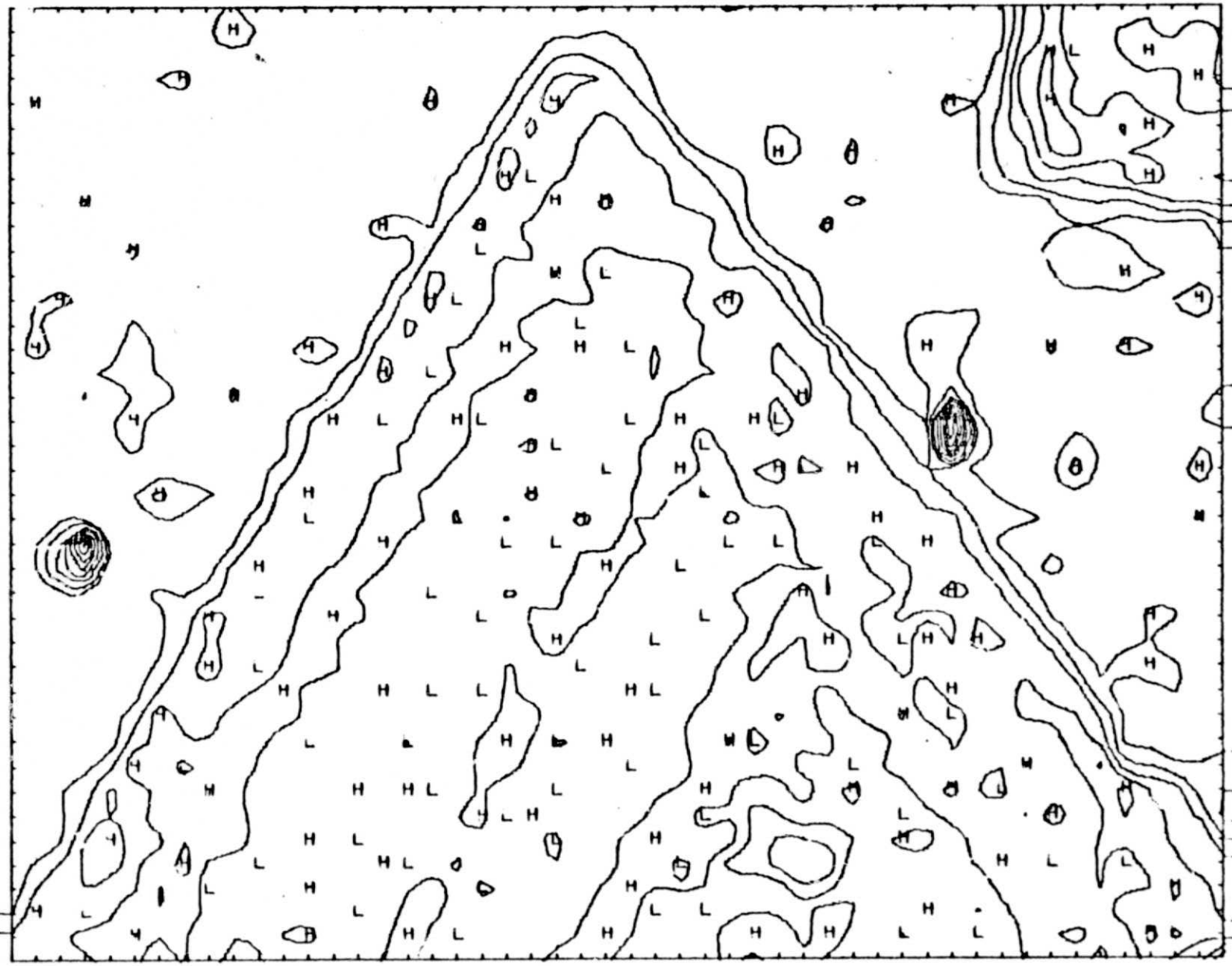
PETROGRAPHIC SEQUENCE



NOTE: CONGLOMERATE GRAIN(S) OCCUR IN THIS SAMPLE CONTAINING PLAGIOCLASE (DISTINGUISHED BY ITS ZONES OF RESORPTION), OLIVINE, PYROXENE, AND MAGNETITE PHENOCRYSTS.


M-600
T-1
% An
100
90
80
70
60
50
40
30
20
10
1
2
3
O.E.
20
40
60
80
100
120
140
160
180
2 micron intervals


M-600
T-2
% An
100
90
80
70
60
50
40
30
20
10
O.E.
20
40
60
80
2 micron intervals


313.60
313.60
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235.20
156.80
78.40
78.40
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78.40
156.80
235.20
313.60
92.00
78.40
156.80
CONTOUR FROM .000 TO 784.00 CONTOUR INTERVAL 78.40