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Six Month Progress Report

NASA Grant NSG-9051

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

Submitted by: Dr. Robert K. Smith
Principal Investigator
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To: Dr. Gary Lofgren
NASA Technical Officer
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Houston, Texas 77058

Grant Period: February 1, 1977 - July 1, 1977

Date: July 15, 1977

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-NSF 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.
<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th># OF GRAINS ANALYZED/PER SAMPLE</th>
<th># OF TRAVERSE PER GRAIN</th>
<th>COMPOSITION COMMISSION OF Criteria METHODS</th>
<th>CROSSED NICHOLS PHOTOS</th>
<th>UNREFLECTED NICHOLS PHOTOS</th>
<th>REFLECTED LIGHT PHOTOS</th>
<th>STAINS OF PROBE DATA AT 20X Rrper TRAVERSE</th>
<th>PETROGRAPHY OF THIN SECTIONS</th>
<th>PROBE DATA</th>
<th>CONTOUR MAPS</th>
<th>COMMENTS</th>
</tr>
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<tbody>
<tr>
<td>M-603</td>
<td>2</td>
<td>I 2</td>
<td>WILL BE DONE LATER</td>
<td>1 40X 1 40X 1 208X</td>
<td>T-1 1</td>
<td>X</td>
<td>23 Ca</td>
<td>2 Fe 2 200x 0 200x</td>
<td>T-2 An 64.1 max 20.1 min</td>
<td>Andesite, Chile</td>
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<tr>
<td></td>
<td></td>
<td>II</td>
<td></td>
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<td>T-1 1</td>
<td>X</td>
<td>NOT Will Be Done To This Sample</td>
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<td>II 1</td>
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<td>X</td>
<td>MIGHT BE DONE LATER</td>
<td>2 Fe 2 200x 0 200x</td>
<td>T-2 An 64.1 max 20.1 min</td>
<td>Basalt, Guatemala</td>
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<td>MIGHT BE DONE LATER</td>
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<td>T-2 An 64.1 max 20.1 min</td>
<td>Latite, Colo.</td>
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<td>III 1</td>
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Appendix

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

PETROGRAPHY

BASALT FROM IAN, CHILE (ANDES MTNS.)

TEXTURE - HYDROCRYSTALLINE, PORPHYRITIC, PLAGIOCLASE, OLIVINE AND PYROXENE PHENOCRACTS IN A FINE-GRAINED TO MICROCRYSTALLINE GROUNDMASS OF PLAGIOCLASE, OLIVINE, PYROXENE AND GLASS.

MAJOR CONSTITUENTS ON ESSENTIAL MINERALS

PLAGIOCLASE - OCCURS AS EUHERAL TO SUBHEDRAL PHENOCRACTS 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 EUHERAL TO SUBHEDRAL PHENOCRACTS AND SMALLER GRAINS IN THE GROUNDMASS. MOST GRAINS SHOW CORRODED RIMS AND/OR EMBAYMENT.

PYROXENE - OCCURS AS EUHERAL PHENOCRACTS AND AS EUHERAL TO SUBHEDRAL GRAINS IN THE GROUNDMASS. WELL DEVELOPED CLINRIMES. TWINNING IS PRESENT IN SOME GRAINS.
MINOR CONSTITUENTS OR VARIETAL MINERALS

MAGNETITE - occurs as euhedral to subhedral grains. Some weathering has occurred to form small amounts of HEMATITE.

APATITE - occurs as rod shaped inclusions in most of the larger phenocrysts.

GLASS - light brown interstitial material.

PETROGRAPHIC SEQUENCE

Crystallization with time →

<table>
<thead>
<tr>
<th></th>
<th>Plagioclase</th>
<th>Apatite</th>
<th>Magnetite</th>
<th>Olivine</th>
<th>Pyroxene</th>
<th>Glass</th>
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</thead>
</table>

Note: Conglomerate grain(s) occur in this sample containing plagioclase (distinguished by its zones of resorption), olivine, pyroxene, and magnetite phenocrysts.