

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
Center of Astrogeology  
601 East Cedar Avenue  
Flagstaff, Arizona 86001

July 30, 1966

MEMORANDUM

TO : Assistant Chief Geologist for Engineering Geology  
FROM : Chief, Branch of Astrogeology  
SUBJECT: Monthly report for Director and Secretary

1. Highlights and noteworthy results

The five-year program was presented to the National Aeronautics and Space Administration on July 21, 1966.

4. Outside publications reported during month

Brett, Robin, 1966, Cohenite in meteorites--A proposed origin:  
Science, v. 153, p. 60-62.

Milton, Daniel J., 1966, Drifting organisms in the Precambrian  
Sea: Science, v. 153, p. 293-294.

M'Gonigle, J. W., 1966, Structure of the Maiden Peak area,  
Montana-Idaho [abs]: Dissertation Abstracts, v. 26, no. 8.

5. Personnel

The following employees entered on duty:

Flagstaff, Arizona

Charles R. Miller, Photographer  
Rose Lea Pfefferbaum, Engineering Aid  
Betty Jane Pfefferbaum, Engineering Aid  
Shirley A. Pino, Student Aid  
Barbara A. Shields, Clerk Stenographer  
Billy G. Tinnin, Mechanic  
Susan E. Werner, Geologic Field Assistant

Tucson, Arizona

Allen V. Shaw, Geologic Field Assistant

Pasadena, California

Thomas B. McCord, Geologic Field Assistant  
Stephen H. Wolfe, Geologic Field Assistant

Denver, Colorado

Charles A. Ross, Geologist

Albuquerque, New Mexico

Eugene I. Smith, Geologic Field Assistant

Austin, Texas

William R. Muehlberger

Transfers:

Edith C. Corey, Clerk Typist, transferred from GSA, Denver, Colorado, to Branch of Astrogeology, Flagstaff, Arizona.  
Jerry Harbour, Geologist, transferred from Military Geology, Washington, D.C., to Branch of Astrogeology, Washington, D.C.  
Grace A. Bennett transferred to Williams Air Force Base, Arizona.

Ralph P. Christian transferred to Regional Geology, Denver,  
Colorado.

Lenora A. Hogan transferred to Navajo Army Depot, Bellemont,  
Arizona.

Violet M. Merritt transferred to Experimental Geology, Denver,  
Colorado.

Letha E. Parmeter transferred to Pearl Harbor Naval Shipyard,  
Hawaii.

James A. Thomas transferred to Experimental Geology, Denver,  
Colorado.

Mary I. VanGaasbeek transferred to the Veterans Hospital,  
Tucson, Arizona.

Yukio Yamamoto transferred to Topographic Division, Menlo  
Park, California.

Resignations:

Flagstaff, Arizona

Thomas S. Atkins

L. Jeanette Crary

M. Elizabeth Dobrinski

James A. Hart

James A. Palomino

Robert W. Savidge

Manuel E. Vega

Lee A. Ward

Tucson, Arizona

Richard K. Reed

6. Scientific meetings and conferences attended at home or abroad

E. C. T. Chao and Harold Masursky attended the Gordon Research Conference on the Physics and Chemistry of Space at Tilton, New Hampshire. E. C. T. Chao was vice-chairman of the conference and Harold Masursky chaired a session on the Moon and planets. Chao was elected chairman for next year's conference.

M. J. Grolier attended the Lunar Orbiter Simulation Test at Langley Research Center, National Aeronautics and Space Administration, Hampstead, Virginia.

M. J. Grolier visited the Institute of Densitometry, Rochester, New York.

M. J. Grolier visited the Ohio State Department of Highways, Columbus, Ohio, to do geologic mapping on Ranger stereoscopic models.

E. M. Shoemaker, Frank Press, and Harold Masursky conducted a seminar on aims and rationale of advance lunar exploration for George Mueller, Office of Manned Space Flight, National Aeronautics and Space Administration, Washington, D.C.

Kenneth Watson visited Dan Snider concerning the IBM Surveyor digital computer programming.

Frank Cuttitta visited Thomas Loomis, Bell Telephone Research Laboratory, Murray Hill, New Jersey, to discuss construction, application, and performance of the x-ray milliprobe.

E. C. T. Chao attended a review meeting of the progress and design of the Lunar Receiving Laboratory (LRL), Manned Spacecraft Center, Houston, Texas, as a member of the LRL working group.

E. M. Shoemaker attended the second meeting of the planning group for Early Apollo mission simulations, Manned Spacecraft Center, Houston, Texas.

G. E. Ulrich and M. H. Hait visited the Crew Systems Division, Manned Spacecraft Center, Houston, Texas.

D. C. Lamb conferred with personnel of the Tech Ops Corporation, Burlington, Massachusetts discussing optical processes.

E. M. Shoemaker and J. W. M'Gonigle attended a meeting concerning the fabrication of Early Apollo geological hand tools at the Manned Spacecraft Center, Houston, Texas.

7. Talks

<u>Speaker and organization</u>	<u>Subject</u>
N. J. Trask Summer Institute in Earth Science Hayward State College, California	Geologic exploration of the Moon.
Harold Masursky Gordon Research Conference Tilton, New Hampshire	New evidence for lunar volcanism.
H. J. Moore II Palo Alto Lions Club Palo Alto, California	The Moon's surface.
H. J. Moore II Boy Scout Troop Las Cruces, New Mexico	The geology of the Moon.
H. J. Moore II Staff White Sands Missile Range, New Mexico	The geology and surface properties of the Moon.
Frank Cuttitta Stephens Institute Hoboken, New Jersey	Geochemical applications of x-ray fluorescence analysis.

8. Visitors

<u>Visitor</u>	<u>Visited and purpose</u>
John T. Milek Santa Monica City College Santa Monica, California	Russell Wahmann--discussed organizing an audio-visual map tracking project.
Ninety Scientists American Chemical Society Central Arizona Section	Tour of Branch facilities conducted by Russell Wahmann, J. T. O'Connor, J. A. Dushek, and R. A. Mills.
Edward A. Elston Sales Engineer General Precision Inc. Palo Alto, California	M. J. Grolier--discussed fast data reduction techniques.
Thomas McCord California Institute of Technology Pasadena, California	D. E. Wilhelms and Harold Masursky--discussed program of photoelectric measurements through color filters of selected lunar areas.
T. J. Ahrens and D. D. Keough Stanford Research Institute Menlo Park, California	D. J. Milton and Harold Masursky--discussed mechanisms for plane-wave generation to conduct field shock-phase studies in the Sierra Nevada.
Arthur Karp Stanford Research Institute Menlo Park, California	Harold Masursky--discussed multi-band images, photography, and television.
Dr. Peter Signer Zurich Tech Hochschule, Switzerland	E. C. T. Chao--discussed rare-gas studies of impact metamorphosed specimens from the Ries crater.
Robert Jones Goddard Space Flight Center Greenbelt, Maryland	D. H. Dahlem--discussed data transmission to Goddard Space Flight Center during Apollo Applications Program and Advanced Systems tests.
John M. Patten Sperry-Rand Corporation Huntsville, Alabama	R. D. Regan, R. H. Barnett, D. H. Dahlem, W. A. Mason, and R. D. Regan--discussed Surface Planetary Exploration telemetry requirements.

LUNAR GEOLOGIC MAPS

REPORT FOR MONTH OF July

	PRELIMINARY MAPS						FINAL MAPS									
	ACIC Bases Received	Author's Geological Work in Progress	Cartography - Scribing & Assembly in Progress	1st Composite Completed	1st Explanation Completed	Map in Technical Review (Branch)	2nd Composite Completed	2nd Explanation Completed	Geology Revision in Progress	Cartography - Final Map Prep	Map in Technical Review (Branch)	Submitted to APU	Director's Approval Received	Map Materials Transmitted to BFI	Transmitted to BMR	Published
Equatorial Belt																
ARISTARCHUS LAC 39	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BYRGIUS LAC 92	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CLEOMEDES LAC 44	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
COLOMBO LAC 79	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
COPERNICUS LAC 58	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRACASTORIUS LAC 97	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRIMALDI LAC 74	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HEVELIUS LAC 56	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
JULIUS CAESAR LAC 60	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
KEPLER LAC 57	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LANGRENUS LAC 80	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LETRONNE LAC 75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MACROBIUS LAC 43	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MARE HUMORUM LAC 93	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MARE SERENITATIS LAC 42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MARE UNDARUM LAC 62	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MARE VAPORUM LAC 59	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MONTES APENNINUS LAC 41	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MONTES RIPHAeus LAC 76	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PETAIVIUS LAC 98	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PITATUS LAC 94	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PTOLEMAEUS LAC 77	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PURBACH LAC 95	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RUPEs ALTAI LAC 96	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SELEUCUS LAC 38	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TARUNTIUS LAC 61	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
THEOPHILUS LAC 78	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TIMOCHARIS LAC 40	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Northern Hemisphere (32°N - 64°N)																
ARISTOTELES LAC 13																
CASSINI LAC 25		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EUDOXUS LAC 26																
GEMINUS LAC 27																
J. HERSCHEL LAC 11		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PLATO LAC 12		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RUNKER LAC 23		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SINUS IRIDUM LAC 24		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Southern Hemisphere (32°S - 64°S)																
CLAVIUS LAC 126		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HOMER LAC 127																
NAUROLYCUS LAC 113		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RHEITA LAC 114		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SCHICKARD LAC 110																
SCHILLER LAC 125																
TYCHO LAC 112		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WILHELM LAC 111																
North Polar Cap																
ARXINANDER LAC 2																
BAILLAUD LAC 1																
BEYON LAC 4																
PHILOLAUS LAC 3																
South Polar Cap																
BAILY LAC 13																
CASEY LAC 14																
CASEYUS LAC 15																
DETON LAC 13																
DETON LAC 13																

photomosaic to author

photomosaic to author

## General information

### Regional planetary investigations

#### Geologic mapping

Relative "normal albedo" maps of the nine Unmanned Lunar Orbiter Mission-A sites have been prepared at the scales of 1:500,000, 1:1,125,000, 1:2,500,000, and 1:5,000,000 approximately. Scanning resolution is 1.875 km. Isodensity levels on these maps are indexed and correlated from site to site. Absolute albedo calibration of the nine sites is in progress.

#### Crater and solid state investigations

H. J. Moore II reported that the lunar surface shown in mosaics of Surveyor I are remarkably similar to the surface of Mare Exemplum (Mare Carborundum III). Mare Exemplum is an experimental simulation, conducted jointly by Ames Research Center and the U.S. Geological Survey, of the effects of repeated projectile impacts on the lunar surface. In the simulation, 30-06 and .22 caliber bullets, BB no.2, and birdshot were fired into a target of carborundum powder and loose sand along with free fall drops of no.8 and no.12 shot. These projectiles impacted the target surface with frequencies closely approximating those expected on the lunar surface. The experimental craters ranged in size from 30 to 0.5 cm. The final steady-state surface reached after repeated impacts was covered with craters of all sizes in all states of preservation much like the lunar surface.

A modified mousetrap explosive plane-wave generator has been designed by T. J. Ahrens and D. D. Keough of Stanford Research Institute for joint experiments with D. J. Milton on shock metamorphism of crystalline rocks.

## Surface planetary exploration

### Surveyor television investigations

Two copies of each of the 10,300 frames taken by Surveyor I have been printed. These prints were made from 35-mm kinescope recordings and will be used to catalog the photographic parameters of all pictures taken.

The Surveyor Television Investigations staff participated in operations of Surveyor I during its second lunar day, which ended July 14. Over 800 pictures were taken, including several narrow angle sectors to the northeast at a sun elevation of about 6°, and a sequence of wide angle photographs of the spacecraft shadow at regular intervals for computation of topographic profiles.

### Astronaut training

An astronaut training trip was held in the Big Bend Area, West Texas. Another training trip was held near Bend, Oregon.

### Early Apollo investigations

New map compilations are being made from the Early Apollo field test, May 23-27 for each of the suited subjects to determine if significant gaps exist in the reporting or real-time compilation of the geologic data.

### Advanced systems investigations

Set-up and alignment of the Picker nuclear diffraction equipment is complete and is now available for general use in the rock laboratory.

Arrangements are being made to transmit  $\alpha$ -K $\alpha$  spectrometer data from Flagstaff to Goddard Space Flight Center so that during field testing of the spectrometer, analytical data can be had on a near "real time" basis.

## Geophysics

Magnetic intensity surveys over Meteor Crater show a definite low associated with the crater. The gravity program used in total reduction of field data has been modified for more general use. Long refraction data was reanalyzed and depth profiles prepared.

Analyses of reflection survey north of Williams, Arizona, for Division of Water Resources was begun.

## Supporting projects

W. A. Lowry completed a one week (40 classroom hours) course of instruction in aerospace telemetry conducted by Aeroscience Electronics, Incorporated, Atlanta, Georgia.