NSSDC

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PART I

DATA USERS' NOTE

APOLLO 14 LUNAR PHOTOGRAPHY

(NSSDC ID NO. 71-008A-01)

AUGUST 1971

NATIONAL SPACE SCIENCE DATA CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION · GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.

NSSDC 71-16a

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Prepared by

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August 1971

FOREWORD

The purposes of this Data Users' Note are to announce the availability of Apollo 14 pictorial data and to aid an investigator in the selection of Apollo 14 photographs for study. In addition, this Note can provide guidance in the interpretation of the photographs. As background information, the Note includes brief descriptions of the Apollo 14 mission objectives, photographic equipment, and photographic coverage and quality. The National Space Science Data Center (NSSDC) can provide all forms of photographs described in the section on Format of Available Data.

NSSDC will supply, as resources permit, limited quantities of photographs without charge where they are to be used, first, for specific scientific studies, and, second, for college-level science courses. All requesters should refer to the section on Ordering Procedures for specific ordering instructions. Scientists conducting an investigation that requires photographic data should inform NSSDC of their needs and should identify the nature of their study, their affiliation with a scientific organization, university, or company, and any government contracts they may have for performing the investigation. The Data Center seeks to keep informed of the results of any scientific investigations performed with the use of Apollo photographs. We therefore request that scientists submit reprints of any published papers to the Data Center so that the results of their studies can be made known to other users. It is also requested that in such papers NSSDC be acknowledged as the source of photographic data.

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APOLLO 14 LUNAR PHOTOGRAPHY

INTRODUCTION

Apollo 14 (1971-008A) was launched from Cape Kennedy, Florida, on January 31, 1971, on a 9-day lunar landing mission. The spacecraft reached the lunar environment on February 3, 1971, and returned the crew to earth on February 8. The Apollo spacecraft consisted of: a Command Module (CM), in which astronauts Alan B. Shepard, Jr., Stuart A. Roosa, and Edgar D. Mitchell traveled from the earth to lunar orbit; a Lunar Module (LM), which carried astronauts Shepard and Roosa to the lunar surface; and a Service Module, which contained the major propulsion units and fuel cells for the spacecraft.

The spacecraft attained Lunar Orbit Insertion (LOI) in a 57- x 170-n.m. orbit. The LM separated after Descent Orbit Insertion (DOI) in an orbit of 10 x 58 n.m. During the LM landing phase, the CM maintained a near circular orbit of 56 x 63 n.m.

Mission photography was accomplished from the Apollo 14 CM, which spent 67 hr in orbit both during DOI for high-resolution mapping photography and during its circular orbit for routine scientific photography; from the LM, which successfully landed at 3° 40' 24" south latitude, 17° 27' 55" west longitude, in the hilly upland region 15 miles south of the rim of Fra Mauro crater; and by the Apollo 14 astronauts during extravehicular activities (EVA) on the lunar surface.

The purposes of this fourth Apollo lunar landing mission were: (1) to explore the hilly upland Fra Mauro region of the moon; (2) to perform selenological inspection, survey, and sampling of material (possibly 5 billion years old) in the Fra Mauro formation; (3) to deploy and activate an Apollo Lunar Surface Experiments Package (ALSEP) that included a solar wind composition foil, a portable magnetometer, a passive seismograph, an active seismograph, a suprathermal ion detector and cold cathode ion gauge, a charged particle detector, and a laser ranging retroreflector; (4) to further develop man's capability and endurance to work in the lunar environment; (5) to obtain high-resolution mapping photographs of candidate lunar exploration sites; (6) to obtain orbital science photography of deep space phenomena such as zodiacal and galactic light and gegenschein; (7) to conduct communication tests using S-band and VHF signals to determine reflective properties of the lunar surface; (8) to determine variations in lunar gravity at orbital altitude by observing Doppler variations in S-band signals; and (9) to determine the meteoroid cratering flux of particles on the spacecraft windows.

PHOTOGRAPHIC OBJECTIVES

Both the surface and orbital photography of the mission served not only to document man's third lunar landing and the extravehicular activities of the astronauts, but also to identify scientific areas and experiments for study on future missions.

The photographic equipment and materials carried by Apollo 14 were designed specifically to: (1) photograph candidate exploration sites for potential Apollo landings; (2) obtain vertical mapping stereo strips of regions of scientific interest and future landing sites; (3) obtain photographs of the Lunar Module and lunar surface activities after LM landing; (4) record mission operational activities; (5) obtain photographic information to document the geologic samples; (6) photograph gegenschein and zodiacal light astronomical phenomena; and (7) acquire photographic supporting data for four orbits of Hasselblad photography and all of the Hycon Lunar Topographic Camera (LTC) photography.

PHOTOGRAPHIC EQUIPMENT

Cameras

The camera equipment carried by Apollo 14 included one 70-mm Hasselblad EL camera, three 70-mm Hasselblad data cameras, three 16-mm Maurer Data Acquisition Cameras (DAC), one 35-mm Kodak lunar surface closeup stereoscopic camera, and one Hycon Lunar Topographic Camera.

70-mm Hasselblad EL Camera. This camera, which was carried aboard the Command Module, featured a motor-driven mechanism, powered by two sealed nickel-cadmium batteries, that advanced the film and cocked the shutter whenever the camera was activated. The settings, ranges, and characteristics for the camera lenses were:

Lens Focal Length:	80 mm	250 mm	500 mm
Focus:	3 ft to infinity	8.5 ft to infinity	28 ft to infinity
Aperture:	f/2.8 to f/22	f/5.6 to f/45	f/8.0 to f/64
Shutter Speed:	1 sec to 1/500 sec	1 sec to 1/500 sec	1 sec to 1/500 sec

Field of View:	37.9° side, 51.8° diag.	12.5° side, 17.6° diag.	6.2° side, 8.8° diag.
Film Magazine Capacity:	190 frames B&W, thin base 160 frames color, thin base		

70-mm Hasselblad Data Cameras. The three electronically powered Hasselblad data cameras that were carried on the mission featured semi-automatic operation. Two 60-mm-lens Hasselblad cameras were carried on the LM, and an 80-mm camera was carried on the CM. The operating sequence was initiated by squeezing a trigger mounted on the camera handle. A 1-cm reseau grid was set in front of the 60-mm lens image plane to provide photogrammetric information in the analysis of the photography. The Lunar Module cameras were bracket-mounted on the front of the LM astronauts' EVA suits. The settings, ranges, and characteristics for these camera lenses were:

Lens Focal Length:	60 mm	80 mm
Focus:	7 ft and 10 ft	3 ft to infinity
Aperture:	f/5.6 to f/22	f/2.8 to f/22
Shutter Speed:	1 sec to 1/500 sec	1 sec to 1/500 sec
Field of View:	49.2° side, 66° diag.	37.9° side, 51.8° diag.
Film Magazine Capacity:	190 frames B&W, thin base 160 frames color, thin base	

16-mm Maurer Data Acquisition Cameras. Apollo 14 carried three Maurer Data Acquisition Cameras (DAC), one in the CM and two in the LM. The cameras were used for recording engineering data, continuous-sequence terrain photography, and lunar surface photography. The CM camera had lenses of 5-, 10-, 18-, and 75-mm focal lengths; one of the LM cameras was fitted with a 10-mm wide-angle lens, and one contained a battery power pack using a 5-mm lens. Accessories included a right-angle mirror, a power cable, a sextant adapter, and a CM boresight window bracket.

The Maurer cameras weighed 2.8 lb each, with a 140-ft film magazine attached. They had frame rates of 1, 6, and 12 fps automatic and 24 fps semiautomatic at all lens focal lengths and shutter speeds of 1/60, 1/125, 1/250, 1/500, and 1/1000 sec, also at all lens focal lengths. Other settings, ranges, and characteristics for camera lenses were:

Lens Focal Length:	5 mm	10 mm	18 mm	75 mm
Focus:	Fixed from front of lens to infinity	6 in. to infinity	12 in. to infinity	42 in. to infinity
Aperture:	f/2.0 to f/16	T/1.8 to T/22	T/2 to T/22	f/2.5 to f/32
Field of View:	117.5° hor. x 80.2° vert.; 160° diag.	54.9° hor. x 41.1° vert.; 65.2° diag.	32.3° hor. x 23.5° vert.; 39.2° diag.	7.9° hor. x 5.7° vert.; 10° diag.

Film Magazine Capacity: 140 ft, thin base

35-mm Lunar Surface Closeup Stereoscopic Camera. This camera, which was carried on the LM Modular Equipment Storage Assembly (MESA), was designed for the highest possible resolution for a stereo pair area with a flash illumination and fixed distance. Photography was accomplished by holding the camera on a walking stick against the object to be photographed. The camera was powered by four nickel-cadmium batteries that operated the motor drive mechanism and an electronic flash strobe light. The capabilities, settings, and characteristics for equipment on this camera were:

Area Photographed:	72 mm x 82.8 mm
Camera Lens:	Diffraction limited to 46.12 mm at f/17 using Kodak M-39 copy lens focused for object distance of 184.5 mm
Focus:	Fixed range
Fixed Aperture:	f/22.6
Film:	30-ft SO-368 - 112 stereo pairs

Surface Particle Identification:	As low as .004 in.
Resolution:	Approximately 40 microns
Magnification:	0.33 times
Base-Height Ratio:	0.16 for stereoscopic photos
Stereo Angle:	9° convergent
Cycling Time:	10 sec
Object Plane Coverage:	9 sq in.

Hycon Lunar Topographic Camera. This electrically operated camera, which was carried aboard the Command Module, was a modified KA-7A Aerial Reconnaissance Camera, which, when used, was mounted in the crew access hatch window. A remote control box and interconnecting cable provided automatic mode for strip photography or manual mode for single frames. Variable Forward Motion Compensation (FMC) allowed for the spacecraft orbital motion. For each frame exposed, a small clock showing the day and time was simultaneously exposed to the side of the frame. This photography was intended to support the objective of obtaining high-resolution photography of future landing sites and areas of scientific interest. The settings, ranges, and characteristics of this modified aerial reconnaissance camera were:

Lens Focal Length:	18 in. (coated with antireflection coating)
Fixed Aperture:	f/4.0
Focal Plane Shutter Speeds:	1/50, 1/100, and 1/200 sec exposure (Only the 1/200 sec was used during the mission.)
Field of View (Angular Coverage):	14° 7.5'. Swath width was 1-3/4 mi at an altitude of 8 mi, and 14 mi at 60-mi orbit altitude at the NADIR
Frame Format:	4.5 x 4.5 in.

Resolution:	
1. Static Target Contrast 1000:1	AWAR 150 lines/mm
2. Actual	15 to 25 ft from 60 n.m. 3 to 5 ft from 8 n.m.
Filter:	Wratten 12
Cycling Rate:	Automatic from 4 to 75 frames/min; single framing
Film Flattening:	Vacuum platen
Forward Motion Compensation (FMC):	Rocking mount, servo-controlled
Data Recording:	Fiducial marks: time in hr, min, sec; date; magazine number; and shutter speed
Power:	28 v, DC - 1.4 amp peak, 30 w average
Camera Weight, Less Film:	65 lb
Film Capacity:	5 in. x 100 ft, standard base (5.2 mil) 5 in. x 200 ft, thin base (2.5 mil)
Camera Size:	Length 28-1/8 in. Width 10-1/2 in. Height 12-1/4 in.

A camera malfunction part way into the mission caused the shutter to operate continually. This resulted from a transistor failure caused by a sliver of aluminum that became lodged and shorted the system on the shutter pulse switching circuit. Also, the lack of a continuous pulse, which activated the focal plane shutter, caused an intervalometer anomaly resulting in multiple exposure of the same scene. In addition, this same region of the film was overexposed approximately two stops. The latter malfunction is still being investigated to determine any possible connection with the original failure.

Films

The films used throughout the mission were as follows.

SO-368 Film (CEX) - 70, 35, and 16 mm

Description:	Ektachrome MS, color reversal, ASA 64; haze filter required
Resolution:	80 lines/mm for 1000:1 test object contrast
Use:	Terrain and general photography

SO-168 Film (HCEX and CIN) - 70 and 16 mm

Description:	Ektachrome EF, high-speed color reversal, ASA 160 for surface and interior photography; no filter required; HCEX exposed and developed at ASA 160, and CIN exposed and developed at ASA 1000
Resolution:	80 lines/mm for 1000:1 test object contrast
Use:	Surface and interior photography at low light levels

3400 Film (B&W) - 70 mm and 5 in.

Description:	Panatomic-X, black and white, ASA 80
Resolution:	160 lines/mm for 1000:1 test object contrast
Use:	High-resolution terrain photography

3414 Film (B&W) - 70 mm

Description:	Plus-X, slow-speed black and white, AEI 2.5
Resolution:	630 lines/mm for 1000:1 test object contrast
Use:	High-resolution terrain photography

SO-267 Film (HBW) - 70 mm

Description:	Plus-XX, high-speed black and white thin base film, ASA 278
Use:	Terrain photography

2485 Film (VHBW) - 70 mm

Description:	Very high-speed black and white, ASA 6000
Use:	Earthrise and dim light photography

SO-349 Film (B&W) - 5 in.

Description: Medium speed, AEI 6
Use: LTC experiment

Accessories

Standard accessories for the Apollo 14 photographic equipment included the following.

- A light meter, used on the CM, was an automatic spot meter with a narrow angle of acceptance (limited to 1°). The scales on the meter were automatically rotated to give the correct aperture and shutter speed settings.
- A right-angle mirror was used on the front of the 16-mm data acquisition cameras (when the 18-mm and 75-mm lenses were used) for bracket-mounted photography.
- A folding ring sight - an optical aiming device - was used on the 70-mm data cameras to correct for Newton interference in which light rays interfere in a spherically varying mode.
- A camera bracket pitched up 10° from the X axis was used on the 70-mm EL camera with the 500-mm lens, pitched up 12° for the 80-mm lens, and aligned along the X axis with the 250-mm lens.
- A Hasselblad adapter bracket was used to mount the EL camera in the CM rendezvous window. With the 80-mm lens, the camera was aligned along a line pitched up 12° from the X axis; with the 250-mm lens, the camera was aligned along the X axis.
- Camera bracket mounts were used on the front of the LM astronauts' suits to hold the 70-mm data cameras.
- A 108-in. power cable was used in the CM to provide power for the 16-mm Maurer camera.
- A boresight bracket was used on the CM rendezvous window for the 16-mm Maurer camera.
- A sextant adapter was used with the 16-mm Maurer cameras.
- An intervalometer was used to activate the Hasselblad EL camera every 20 sec using camera battery power.

- Three types of filters were used: (1) a haze filter (Photar 2A), which had a cutoff of 3400 A and less, a transmittance of 100% in the visible spectrum, and which needed no exposure correction, was used with the SO-368; (2) a red filter (Photar 25A), which had a cutoff of 6000 A and less, a transmittance of 90% for 6500 A and longer, and an exposure correction of 2.5 stops (needed added exposure) was used with black and white film to reduce atmospheric haze; and (3) a polarizing filter was used on the Hasselblad data cameras for the photogeology and light polarizing studies.

PHOTOGRAPHIC SUPPORTING DATA

Supporting data, which are being prepared at the Mapping Sciences Branch, Manned Spacecraft Center, are in the form of a computer listing for the appropriate photographic frames for four orbits (27, 28, 30, and 34) of 500-mm Hasselblad photography, for one orbit of 80-mm strip photography on orbit 26, and for orbit 4 (Magazine W) of the Hycon topographic camera photographs. The parameters for the supporting data are being determined for the time of exposure for the photographs included and are complete only for the Hycon photography at present. The computer output lists the parameters for identification of a single frame. These parameters include: (1) time of exposure, (2) spacecraft position, (3) spacecraft and camera orientations, (4) photo illumination angles, (5) photo coordinates and side lengths, and (6) other factors to assist in photographic analysis. The Apollo 14 supporting data will be in the format shown on the following pages.

All of the supporting data that will become available are on 16-mm microfilm. These data have been extracted from the mission computer tapes and keyed to the individual frames. These data will be filed at NSSDC to fill requests for supporting data for the specific frames, and they will be supplied with the Hycon frames in the near future.

PHOTOGRAPHIC COVERAGE AND QUALITY

The orbital and surface lunar photographs obtained during the Apollo 14 mission were of good quality, resolution, and contrast except for those photographs affected by the Hycon malfunctions. There were 1336 frames on 14 magazines of 70-mm photography, 17 pairs of 35-mm lunar surface stereoscopic photographs, 15 magazines of 16-mm photography, and 469 frames of 5-in. photography from the Hycon Lunar Topographic Camera. (See Appendixes A and B for photographic summary.)

APOLLO 12 R40,41 SS2 SEXT 9/70 FIN FRAME - 1

	YEAR	MONTH	DAY	HOUR	MINUTE	SECCND
GMT	69	11	21	9	23	60.000
GET			6	17	1	59.993

STATE VECTOR	X	Y	Z	X DOT	Y DOT	Z DOT
1950.0	1331.0720520	-1094.6841736	-658.2903900	-1.1327318	-.9627199	-.6727624
SELENOGRAPHIC	-745.5907440	1676.4182281	-192.7403946	1.4838042	.6221302	-.2716598
SIGMA(SELENO)	.00	.00	.00	.000	.000	.000

LONGITUDE OF NADIR POINT	113.9772091 DEG	LATITUDE OF NADIR POINT	-5.9969447 DEG
SIGMA NADIR LONGITUDE	.0000000 DEG	SIGMA NADIR LATITUDE	.0000000 DEG
LONG OF CAMERA AXIS INTERSECT	114.6377153 DEG	LATI OF CAMERA AXIS INTERSECT	-5.7125070 DEG
SPACECRAFT RADIUS	1844.8394012 KM	SPACECRAFT ALTITUDE	106.7493744 KM
SIGMA SPACECRAFT RADIUS	.0000000 KM	AZIMUTH OF VELOCITY VECTOR	260.3407784 DEG
MEAN ALTITUDE RATE	-.0059627 KM/SEC	HORIZONTAL VELOCITY	1.6316853 KM/SEC
TILT AZIMUTH	66.6264620 DEG	TILT ANGLE	11.4861556 DEG
SIGMA TILT AZIMUTH	.0670379 DEG	SIGMA TILT ANGLE	.1303114 DEG
SUN ELEVATION AT PRIN GRND PNT	11.4121056 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	269.6374092 DEG
LONGITUDE OF SUBSOLAR POINT	35.9601512 DEG	LATITUDE OF SUBSOLAR POINT	-1.4822432 DEG
ALPHA	11.1243134 DEG	SWING ANGLE	74.9783525 DEG
EMISSION ANGLE	12.2021408 DEG	SIGMA SWING ANGLE	.0328947 DEG
PHASE ANGLE	67.4185791 DEG	NORTH DEVIATION ANGLE	187.9451466 DEG
PHI	-11.1035665 DEG	X-TILT	2.9584396 DEG
SIGMA PHI	.0306974 DEG	SIGMA X-TILT	.0036646 DEG
KAPPA	171.3604832 DEG	Y-TILT	11.0085803 DEG
SIGMA KAPPA	.0345376 DEG	SIGMA Y-TILT	.0268000 DEG
OMEGA	2.9584396 DEG	HEADING	-98.0591860 DEG
SIGMA OMEGA	.0036646 DEG	SIGMA HEADING	.0321386 DEG
SCALE FACTOR	.0000000 M/KM		

Sample Format for Apollo Photographic Supporting Data

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.22568490	-.95724767	.18095083	109.069443

FRAME CORNER POSITIONS

LONG 114.6377 DEG LATI -5.7125 DEG		LONG 114.6377 DEG LATI -5.7125 DEG
* (1)	.00000 KM	* (2)
.00000 KM		.00000 KM
(4) *	.00000 KM	(3) *
LONG 114.6377 DEG LATI -5.7125 DEG		LONG 114.6377 DEG LATI -5.7125 DEG

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97163917+00	-.13757861+00	-.19232637+00
.15001710+00	-.98733535+00	-.51611569-01
-.18278998+00	-.79000071-01	.97997285+00

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.81808686+00	-.48170923+00	-.31414981+00
-.15458673-01	.56447966+00	-.82530220+00
.57488687+00	-.67031254+00	-.46923998+00

* DIVIDE CHECK AT 032556

* DIVIDE CHECK AT 032556

* CIVIDE CHECK AT 036164

Sample Format for Apollo Photographic Supporting Data

Although only two near-vertical stereo strips were obtained, excellent low- and medium-oblique photographs were taken. Photos taken from the LM and on the lunar surface of the Cone Crater area traverse and during deployment of the ALSEP were also of good quality.

Although the Apollo 14 coverage included photographs of the earth, only the lunar photographs are described in this Data Users' Note. For information on obtaining the photographs of the earth, refer to the section on Ordering Procedures.

The photographic coverage from the Command and Lunar Modules is illustrated in map form in the "Apollo Mission 14 Lunar Photography Indexes," which accompanies this Data Users' Note. On the index maps, photographic coverage is depicted on a mercator projection with an approximate scale of 1:7,500,000 at the equator. The index consists of three separate sheets that indicate coverage as follows:

Sheet 1 - Four magazines of 16-mm color photography
Sheet 2 - Three magazines of 70-mm color photography
Sheet 3 - Five magazines of 70-mm and 5-in. (HYCON) B&W photography

An index of all photography taken during the Apollo 14 mission is contained in Part II, "Apollo 14 Photography Index: 70-mm, 35-mm, 16-mm, and 5-in. Frame Index." For each 70-mm and 5-in. (LTC) frame, the index presents information on: (1) the revolution (orbit) number, (2) the focal length of the camera, (3) the photo scale at the principal point of the frame, (4) the selenographic coordinates at the principal point of the frame, (5) approximate tilt angle and azimuth, (6) the percentage of forward overlap of the frame, (7) the sun angle, (8) the quality of the photography, (9) photo index area, and (10) a brief description of each frame.

The index also describes briefly the pictures taken using the lunar surface closeup stereoscopic camera. For the 16-mm sequence photography, the index includes information on the approximate surface coverage of the photographic sequence, the location, and a brief description of principal features shown. A "remarks" column also indicates the quality and detail of the photography.

This photographic data package contains two Photo Index Area Location Diagrams, one for the lunar nearside and one for the lunar farside. On these diagrams, areas of the lunar surface have been numbered to facilitate and standardize the identification of lunar photography.

Also included with this photographic data package is the "Apollo 14 70-mm and 5-in. (LTC) Photographic Catalog." The catalog contains proof prints of the 70-mm and 5-in. photography exposed during the Apollo 14 mission. These prints are sorted by magazine and frame number. Lunar surface uncontrolled EVA panorama mosaics are shown at the end of the catalog.

FORMAT OF AVAILABLE DATA

The Apollo 14 films on file at NSSDC include master positive copies of the original 70-mm, 35-mm, 16-mm, and 5-in. films that are stored at the NASA Manned Spacecraft Center, Houston, Texas. These films were processed by the MSC Photographic Technology Division and constitute the NSSDC master copies. To satisfy requests for photographs, additional (second generation) working copies have also been prepared. An indication of the standard formats and sizes of Apollo 14 photography available follows.

70-mm Photography

Reproductions of complete magazines of 70-mm photography can be obtained either (1) as positive or negative film copies on 70-mm black and white roll film or (2) as positive contact black and white paper prints on 70-mm roll paper. Selected frames of 70-mm photography will be processed in limited quantities as 8- x 10-in. black and white paper prints or as contact black and white positive or negative film copies on 4- x 5-in. film sheets. Color reproductions in the form of contact positive or negative film copies on 4- x 5-in. film sheets or as 8- x 10-in. prints can be obtained for selected frames. However, the color reproductions will be provided only to those persons performing specific detailed scientific investigations.

35-mm Photography

Reproductions of the 35-mm stereo photography can be obtained as 35-mm color stereo slides in glass mounts.

16-mm Photography

The 16-mm sequence films are available as 16-mm positive color film duplicates. For convenience, the individual 16-mm lunar magazines have been spliced together and are available on one reel. It should be pointed out that this photography is suitable only for scientific investigation. These films are not intended for general class-

room teaching purposes because of the variable shutter speeds and technical nature of this type of photography. These films will be provided on a 3-month loan basis although, in special instances, arrangements can be made for permanent retention.

5-in. Photography

Reproductions of complete magazines of 5-in. lunar topographic photography can be obtained either (1) as positive contact black and white paper prints on 5-in. roll paper, as contact prints on 8- x 10-in. paper, or as 8- x 10-in. enlarged black and white paper prints, of selected frames in limited quantities, or (2) as positive or negative film copies on 5-in. black and white roll film.

ORDERING PROCEDURES

When ordering photographic data, please refer to the index maps, "Apollo Mission 14 Lunar Photography Indexes," and to Part II of this data package, "Apollo 14 Photography Index: 70-mm, 35-mm, and 5-in. Frame Index," and indicate:

- Apollo mission number
- Complete frame number(s), e.g., AS14-64-9046
- Form and size of reproduction, e.g., 8- x 10-in. B&W print or 4- x 5-in. color positive transparency
- Other identifying information such as crater or feature name

The Apollo Lunar Photography Order Form enclosed within this Note is provided for the requester's convenience. All parts of the form must be completed to ensure satisfactory request fulfillment. If the photographs are to be used in an ongoing or planned study, this should be indicated in the appropriate place on the form, and some indication of the nature of the study and of whether it is being performed under contract to the government should be given. To assist NSSDC in processing requests for reproductions, please identify all required photography in a single order.

NSSDC will provide reproduction support to individuals and organizations only when the data requested are needed for specific scientific research projects or for use in college-level space science courses, in that order. The current policy in satisfying such requests is to furnish limited quantities of reproductions without charge. Nominal charges

will be imposed for large orders. When charges are deemed necessary, the requester will be advised of the exact charge and the procedure for making payment before the request is filled. The price list provided on the order form is intended to give the reader an indication of the per item cost of reproductions in the event charges are necessary.

In order to firmly establish the validity of the Data Center function, NSSDC needs to know what scientific use is being made of the data provided. With this in mind, the Data Center would appreciate receiving copies of all publications resulting from studies in which data supplied by NSSDC have been used. It is further requested that NSSDC be acknowledged as the source of data in all publications using its data.

The Apollo 14 pictures may be reviewed at NSSDC. Inquiries about or requests for photographs from U.S. scientists should be addressed to:

National Space Science Data Center
Code 601.4
Goddard Space Flight Center
Greenbelt, Maryland 20771

Telephone: (301) 982-6695

Requests for photographs from researchers outside the U.S.A. should be directed to:

World Data Center A for Rockets and Satellites
Code 601
Goddard Space Flight Center
Greenbelt, Maryland 20771 U.S.A.

The World Data Center A (WDC-A) for Rockets and Satellites is now assisting scientists located outside the United States in acquiring space science data held in U.S. national archives. Since January 2, 1969, this WDC-A subcenter has been located contiguous to NSSDC.

Individuals or organizations that wish to obtain Apollo 14 photographic reproductions for purposes other than use in specific scientific research projects or college-level space science courses should address their requests to:

Public Information Division
Code FP
National Aeronautics and Space Administration
Washington, D.C. 20546

Printed materials to satisfy general information requests are also available from this division.

Representative sets of Apollo photographs suitable for framing can be obtained (at cost) as full-color lithographs from:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Requests should specify NASA picture sets as follows.

- NASA Picture Set 1, "Apollo - In the Beginning" ($1.25)
- NASA Picture Set 2, "Men of Apollo" ($1.00)
- NASA Picture Set 3, "Eyewitness to Space" ($2.75)
- NASA Picture Set 4, "First Manned Lunar Landing" ($1.75)
- NASA Picture Set 5, "Man on the Moon" ($1.00)

Inquiries or requests regarding pictures of the earth taken during the Apollo missions should be directed to:

Technology Application Center
University of New Mexico
Albuquerque, New Mexico 87106

Some Apollo publications of general interest that are available from the U.S. Government Printing Office are:

"In This Decade/Mission to the Moon" (NASA EP-71), outlines the complex steps of the manned Apollo 7, 8, 9, and 10 missions that led to the first manned lunar landing; 46 pages, $1.25 per copy.

"Log of Apollo 11" (NASA EP-72), documents the first landing on the moon, which has been called the greatest voyage in the history of mankind; 12 pages, 35 cents per copy.

"Apollo 12 - A New Vista for Lunar Science" (NASA EP-74), tells the scientific significance of the second moon landing; 24 pages, 65 cents per copy.

"Apollo 13 - Houston, We've Got a Problem" (NASA EP-76), documents the Apollo 13 oxygen tank rupture which prevented a lunar landing and tells how the crew returned to earth safely in an emergency mode; 25 pages, 75 cents per copy.

"Apollo 14 Science at Fra Mauro" (NASA EP-91) is a color illustrated booklet in which 42 of the 58 photos are in color. The 10,000-word text on the Apollo program is on sale at the U.S. Government Printing Office at $1.25 per copy.

Orders for the publications are available only at, and must include payment in check or money order to, the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Postage stamps cannot be accepted as payment, but all prices stated include mailing.

A discount of 25% is given on an order of 100 or more copies of a single title publication.

ACKNOWLEDGMENTS

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APPENDIX A

APOLLO 14 PHOTOGRAPHIC SUMMARY, 70 MM, 35 MM, AND 5 IN.

MAGAZINE	ID (AS14-)	FRAME NUMBERS	TOTAL FRAMES	FILM TYPE	GENERAL DESCRIPTION - LENS/CAMERA
LL	64	9046-9201	156	B&W SO-267	Lunar Surface EVA - 60-mm f.l./Hasselblad
KK	65	9202-9215	14	"	"
II	66	9216-9360	145	Color SO-168	"
JJ	67	9361-9393	33	"	"
MM	68	9394-9492	99	B&W SO-267	"
P	69	9493-9656	164	B&W 3400	Descartes - 500-mm f.l./Hasselblad
Q	70	9657-9840	184	"	Descartes - 80-mm f.l./Hasselblad
T	71	9841-9917	77	B&W 3414	TEC - 80-mm f.l./Hasselblad
L	72	9918-10039	122	Color SO-368	Mare Smythii - 500-mm f.l./Hasselblad
M	73	10040-10204	165	"	Fra Mauro - 250-mm f.l./Hasselblad
N	74	10205-10222	18	"	LM Separation - 80-mm f.l./Hasselblad
R	75	10223-10320	98	B&W 3414	Eastern Farside - 80-mm f.l./Hasselblad
O	76	10321-10356	36	Color SO-368	Spacecraft Interior - 80-mm f.l./Hasselblad
	77	10357-10374	18	Color SO-368	Closeup Stereo Surface - 46-mm f.l./Stereo Camera
S	78	10375-10399	25	B&W 2485	Earthshine - 18-in. f.l./Hasselblad
V	79	10400-10435	36	B&W SO-349	Double Exposed - 18-in. f.l./Hycon
W	80	10436-10868	433	B&W 3400	Stereo Strip of Theophilus and Descartes - 18-mm f.l./Hycon

APPENDIX B

APOLLO 14 PHOTOGRAPHIC SUMMARY OF 16-MM COLOR (SO-368 and SO-168) MAGAZINES A THROUGH GG

MAGAZINE	DESCRIPTION
A	Transposition and Docking
B	Landmark Tracking
C	LM Undocking
D	Docking, LM Jettison
E	Interior Activity
F	Waste Water Dump
G	Inflight Demonstration - Heat Flow
H	Inflight Demonstration - Liquid Transfer Interior Activity
I	Reentry
X	Interior Activity
AA	LM Descent
BB	LM Ascent
CC	Lunar Surface
EE	Placement of ALSEP
GG	Predocking Approach