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WASHINGTON, D. C. 20024

SUBJECT: GLEP Site Selection Subgroup,
Fourth Meeting, June 17, 1969

DATE: August 4, 1969

FROM: N. W. Hinners

ABSTRACT

The Fourth GLEP Site Selection Subgroup Meeting was held at MSC, Houston, Texas on June 17, 1969.

Participants agreed to recommend to the GLEP that:

1. a prime mission assignment set of sites be

G-1 Site 2
H-1 Site 5 (or 4)
H-2 Fra Mauro Fm.⁽¹⁾
H-3 Rima Bode II⁽²⁾
H-4 N to W of Censorinus
J-1 Copernicus Peaks
J-2 Marius Hills⁽³⁾
J-3 Tycho Rim⁽³⁾
J-4 Rima Prinz I
J-5 Descartes

Science Alternates:

- a. Hyginus - Meets some objectives of Rima Bode II and Fra Mauro Fm.
- b. Littrow - Meets some objectives of Rima Bode II
Should not be considered after H-3.

⁽¹⁾ Consider for H-3 if not flown on H-2.

⁽²⁾ Consider for H-4 if not flown on H-3.

⁽³⁾ Prefer to reverse sequence if no mobility on J-2.

CASE FILE
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- c. Hipparchus - Meets some objectives of Fra Mauro Fm. Should not be considered after H-2.
- d. Abulfeda - Meets some of Descartes objectives. Consider for J-2 → J-5 missions.
- e. Schroter's Valley - Meets many of Rima Prinz I objectives. Consider for J-2 → J-5 missions.

Recycle Alternates:

G-1: Sites 3,5

H-1: Site 3, assuming G-1 lands at Site 2; Site 2 if G-1 lands at Site 3.

H-2: Sites 4R and 6.

- 2. Descartes, an upland volcanic site representative of large areas of the Highlands, be recommended to the ASSB for inclusion in the Set B Lunar Exploration Site List;
- 3. a "caldera -type" site be considered for possible future addition to Set B and that candidates for such a site be, in priority order,
 - a. Gaudibert
 - b. Lassell
 - c. GambartRitter/Sabine
- 4. photography of the caldera-type sites and of other candidate sites be upgraded from target-of-opportunity status in order to affect mission planning, particularly as regards CSM Science and orbit ground-tracks;
- 5. for the second lunar landing, the Surveyor III site not be considered as a candidate landing site.

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Fourth Meeting, June 17, 1969

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MEMORANDUM FOR FILE

The fourth meeting of the Site Selection Subgroup of the Group for Lunar Exploration Planning (GLEP) met at MSC on June 17, 1969. There were two prime objectives for the meeting, the first being to come up with a proposed site mission assignment for the ten lunar landings and the second being to make a recommendation regarding the Surveyor III as a second mission landing site. The attendees at the meeting are listed in Attachment A.

Mission Assignments

N. Hinners gave the background on the request by NASA for a selection of sites for the proposed manned lunar landings. He noted that in the past few months, activity on the Lunar Exploration Program has increased to the point that operations personnel are spending significant effort on spacecraft changes and operational procedures. Key to their work is a knowledge of landing site locations and flight sequence. They cannot handle an unstructured "pot" of sites such as the 21 now in Set B. They, and specifically the Apollo Site Selection Board (ASSB), as stated at their June 3, 1969 meeting, asked the GLEP to recommend mission assignments for the sites. Such a list, once accepted by the ASSB, would form the basis for planning. Changes, although possible, would be controlled, i.e., random, whimsical changes would not be allowed. Proposed changes would have to be extensively documented and supported by demonstrably significant reasons.

As background material to be used for planning, J. H. Sasser presented a status of the mapping of the Set B sites. The current science site map production status is shown in Attachment B. Sasser also presented preliminary photographic requirements for the science sites. Those requirements, 3-4m stereo coverage of the 30 site and ~30m stereo coverage of the approach path (70 nm) would, if accepted, require significant additional photography (See below).

Stu Davis and Jim Blahnik briefly discussed the expected evolution in operational capability and hardware. Specifically Mission G-1, the first landing, carries an EASEP, and is limited to 1 EVA period. The landing ellipse is large, ~9.4 x 2.4 km semi-axes. The H-series (mission 2-5) all carry ALSEP's and allow for 2 EVA's per mission. Redesignation is a possibility on H-2 and may be

planned for H-3 and H-4. An evolution in landing accuracy is expected such that by H-4 a 1 km target is feasible. Evolution towards using a single target per monthly launch opportunity is expected but nobody is yet ready to say when recycle requirements will be relaxed. The J-series (missions 6-10) entails use of the 3-day LM with 4 EVA's per mission, accurate landings, CSM science, modified ALSEP's (possibly not on all missions), constant volume EVA suits and a manned roving vehicle on J-2+5 or J-3+5. The effective radius-of-operations is expected to be ~5 km with the rover.

After much debate the participants agreed to recommend the following prime mission assignment:

<u>Date</u>	<u>Apollo</u>	<u>Mission</u>	<u>Site</u>
7/69	11	G-1	Site 2
11/69	12	H-1	Site 5 (or 4)
3/70	13	H-2	Fra Mauro Fm. ⁽¹⁾
7/70	14	H-3	Rima Bode II ⁽²⁾
11/70	15	H-4	N to W of Censorinus
4/71	16	J-1	Copernicus Peaks
9/71	17	J-2	Marius Hills ⁽³⁾
2/72	18	J-3	Tycho Rim ⁽³⁾
7/72	19	J-4	Rima Prinz I
12/72	20	J-5	Descartes

One should note that the list contains mostly sites which have been in high priority lists for the last several years. Some specific comments are needed, however. With regard to footnote (3) above, the group felt that Tycho would make a better non-mobility mission than Marius Hills. The reason that Tycho is now in the J-3 slot is that operational considerations (abort, payload) dictate that a Tycho mission be flown early in a given calendar year. On the current schedule of four-month centers for H-missions and 5-months thereafter, J-3 is the only possibility (H-2 is too early from an operational viewpoint).

The highlands impact crater site Censorinus has been changed slightly to read N to W of Censoninus. Our initial landing site location was about 1 km north of the crater rim. Reports from Apollo 10 indicated that the rim area looks extremely rough. In response

(1) Consider for H-3 if not flown on H-2.

(2) Consider for H-4 if not flown on H-3.

(3) Prefer to reverse sequence if no mobility on J-2.

to that and in view of the fact that the primary objective is to sample highlands material rather than an impact crater (secondary objective) we agreed to designate the area to the N or W of Censorinus for the site. From such a location one would be able to sample the highlands and a goodly amount of the ejecta blanket from Censorinus even if unable to do a complete radial traverse to the rim.

Science Alternates

In view of potential problems in getting to certain sites, we also recommended a list of science site alternates to be used only if compelling reasons exist. Those sites are:

- a. Hyginus - Meets some objectives of Fra Mauro Fm. and Rima Bode II.
- b. Littrow - Meets some objectives of Rima Bode II. Should not be considered after H-3.
- c. Hipparchus - Meets some objectives of Fra Mauro Fm. Should not be considered after H-2.
- d. Abulfeda - Meets some of Descartes objectives. Consider for J-2 → J-5 missions.
- e. Schroter's Valley - Meets many of Rima Prinz I objectives. Consider for J-2 → J-5 missions.

Alternates Abulfeda and Schroter's Valley warrant mention because they have previously been considered as prime candidates. Abulfeda has been replaced by Descartes for the reason that study of the Orbiter IV photography indicates that Descartes is representative of a much larger highlands region than is Abulfeda. Whether it represents as good a site to obtain "deep-seated" volcanics is debatable. The site has been described briefly by F. El-Baz, H. Masursky and D. Wilhelms:

"The area of the southern highlands north of the crater Descartes is characterized by hilly, groovy, and furrowed deposits. It is bound on the west by a hilly and pitted stratigraphic unit and on the east by rugged hills which bound Mare Nectaris. The Descartes region, which is very similar to an area to the west and northwest of Mare Hunorum, is thought to include a distinctive pattern of morphological manifestations of volcanism in the lunar terra. Many of the elongate grooves and furrows are reminiscent of terrestrial volcanos. It is believed that a mission to a region of intensive and prolonged volcanism within the lunar terra is most important, from both the

geological and geochemical viewpoints. An alternative to this area would be, first, the Zupus region in the west and, second, the Abulfeda area to the east."

Descartes (Orbiter IV photo coverage only of $\sim 60\text{m}$ resolution) was placed on the last mission in order to obtain photographic coverage adequate for site certification from either the Tycho or Marius Hills mission.

Schroter's Valley has been of great interest on account of its volcanics, double sinuous rille and transient event sightings. It was felt, however, that to do an adequate exploration in the Cobra Head region requires vertical mobility - not available on the ten missions. Rima Prinz I, however, is fresher appearing and is also a double sinuous rille. Available photography covers the mouth area of the rille, thus it was proposed that the landing be at the mouth and that the roving vehicle then be used to traverse up the canyon.

Recycle Alternates

On account of the unknowns regarding giving up recycle opportunities and targeting to a single site per monthly opportunity, recycle alternates were selected for the first three missions. (G-1 is, of course now academic and Site 3 emerges as preferred for H-1). The recycle sites are:

G-1: Sites 3, 5

H-1: Site 3, assuming G-1 lands at Site 2; Site 2 if G-1 lands at Site 3.

H-2 Sites 4R and 6.

Calderas

It was noted that possible calderas represent a class of lunar features not represented in Set B. Several candidates were identified and a priority established based primarily on their expected value in establishing a seismic net.

a. Gaudibert (11°S , 37°E)

b. Lassell (16°S , 8°W)

c. Gambart (1°N , 16°W)

Ritter/Sabine (2°N , 20°E)

Most of the sites are not covered by high resolution photography or by stereo medium resolution photography of site certification quality. Emphasis needs to be put on acquiring such photography if these and other sites are ever going to be real candidates for landing (see next section). It was decided that it is premature to recommend a caldera for inclusion in Set B until further photo-geologic study is carried out.

Candidates for further photography

The caldera sites listed above were added to the list of candidates for further photography.

Discussion indicated that there is need to upgrade our previously derived list of candidates for further photography in order to get the sites out of the targets-of opportunity category and into one which might force such photography into mission planning. It was agreed that a recommendation to do such would be made to the GLEP and to the Apollo Site Selection Board.

The current list of candidates for further photography is shown in Attachment C.

Considerations of Surveyor III Site for Apollo 12 (H-1)

N. W. Hinners gave background on the Apollo 12 (H-1) Site selection and noted that the Site Selection Subgroup initially recommended that Sites 1, 2, 3R, 4R, and 6 be H-1 candidates with 4R and 6 higher priority if the G-1 mission lands at Site 1, 2, or 3. Subsequently, MSC determined that they could not recommend relocated Sites 3R, 4R, and 6 as H-1 candidates on account of a desire to keep an Apollo-type ellipse for H-1. They therefore proposed to the ASSB on June 3 that Surveyor Sites S-I and S-III be H-1 candidates. At the ASSB meeting it was decided that Sites 2, 3, and 5 would be the H-1 candidate sites and that MSC would investigate Fra Mauro and Hipparchus as possible additions or as a substitute for Site 3. MSC subsequently said that they could not recommend either Fra Mauro or Hipparchus for H-1 and suggested again that the Surveyor III site be considered. The Apollo Program Office then asked that the Site selection Subgroup consider the merits of Site S-III. Considerable discussion resulted in a unanimous recommendation against S-III as an H-1 candidate. The reasons, primarily scientific, and in order of significance are:

1. Site S-III appears to offer little, if any, geological or geochemical improvement over Sites 2 and 3 in that it is the same ("eastern" or "older") mare type. Site 5 (or 4) would be preferred, of course, to either Site 2 or 3. The geophysicists did not view S-III as a major improvement over Site 3 for ALSEP deployment.
2. Investigation of Surveyor-III would detract from the attention which could be placed on the conduct of S-059, the geological experiment, which has already suffered on G-1.
3. The public, justifiably or not, would probably view getting to the Surveyor spacecraft as the prime objective. Failure to do so, highly probable, would detract from the overall enthusiasm for continuing lunar exploration.

4. Surveyor III is on the east slope ($\sim 13^\circ$) of a 200 m crater and may be obscured from the view of an astronaut during descent or on the surface. It appears to be 4 to 5 m below the local mare level and thus might present a slope stability or a line-of-sight communication problem for an astronaut in the crater.

An argument sometimes advanced in favor of S-III is that the astronauts could use the Surveyor as a redesignation target. The Subgroup felt that abundant redesignation targets which could be used to test the system if all goes well, already exist in Sites 2, 3, and 5. Such points, most likely concentric-ring or blocky craters, will be delineated by the USGS in conjunction with MSC. (Newell Trask responded to the request on June 19, 1969. This response, with a list of redesignation points, is enclosed as Attachment D).

N. W. Hinners

N. W. Hinners

2015-NWH-gmr

Attachments

Participants in Fourth GLEP-SSS Meeting

Subgroup Members

J. W. Dietrich, MSC/TH2
F. El-Baz, Bellcomm (Secretary)
N. W. Hinners, Bellcomm (Chairman)
R. L. Kovach, Stanford University
H. Masursky, U. S. Geological Survey
H. H. Schmidt, MSC/TB
G. Simmons, M.I.T.
D. Wilhelms, U. S. Geological Survey

Absent: D. A. Beattie, NASA HQ/MAL
L. W. Frederick, University of Virginia
P. Gast, Lamont-Doherty Geological Observatory
W. N. Hess, MSC/TA

Others

D. R. Anselmo, Bellcomm
R. A. Bass, Bellcomm
S. M. Blackmer, MSC/PD
P. R. Brett, MSC/TH2
R. P. Bryson, NASA HQ/MAL
J. D. Burke, JPL
S. L. Davis, MSC/HD
J. W. Head, Bellcomm
J. A. Herbaugh, TRW
J. Holmes, NASA HQ/MCL
Q. A. Holmes, MSC/FM5
V. S. Mummert, Bellcomm
J. H. Sasser, MSC/TJ
J. H. Suddath, MSC/EG23
N. J. Trask, U. S. Geological Survey

CURRENT SCIENCE SITE PRODUCTION
STATUS

<u>Site</u>	<u>Name</u>	<u>Product</u>	<u>Scale</u>	<u>Estimated Completion</u>	<u>Remarks</u>
1) III S-18	Mosting C	Mosaic	1:250,000	June 69	200m C. I.
		Mosaic	1:25,000	June 69	
		Photomap	1:250,000	Nov 69	
2) III S-23	Fra Mauro	Mosaic	1:250,000	June 69	200m C. I.
		Mosaic	1:25,000	June 69	
		Photomap	1:250,000	Nov 69	
3) V-12	Censorinus	Mosaic	1:250,000	June 69	Monoscopic coverage only
		Mosaic	1:25,000	June 69	
4) V-14	Rimae Littrow	Mosaic	1:250,000	June 69	400m C. I.
		Mosaic	1:25,000	June 69	
		Photomap	1:250,000	Sept 69	
5) V-30	Tycho	Mosaic	1:250,000	Aug 69	800m C. I.
		Mosaic	1:25,000	Aug 69	
		Photomap	1:250,000	Oct 69	
6) V-23.1	Rima Hyginus	Mosaic	1:250,000	Aug 69	400m C. I.
		Mosaic	1:25,000	Aug 69	
		Photomap	1:250,000	Nov 69	
7) V-26.1	Rima Hadley	Mosaic	1:250,000	Aug 69	300m C. I.
		Mosaic	1:25,000	Aug 69	
		Photomap	1:250,000	Jan 70	
8) V-24	Hipparchus	Mosaic	1:250,000	Oct 69	400m C. I.
		Mosaic	1:25,000	Nov 69	
		Photomap	1:250,000	Dec 69	
9) V-37	Copernicus	Mosaic	1:250,000	Feb 70	300m C. I.
		Mosaic	1:25,000	Feb 70	
		Photomap	1:250,000	Mar 70	
10) V-51	Marius F	Mosaic	1:250,000	Feb 70	300m C. I.
		Mosaic	1:25,000	Mar 70	
		Photomap	1:250,000	Apr 70	

11)	V-46	Prinz Prinz	Mosaic	1:250,000	Apr 70	
			Mosaic	1:25,000	Apr 70	
			Photomap	1:250,000	May 70	400m C. I.
12)	V-43.2	Gassendi	Mosaic	1:250,000	Mar 70	
			Mosaic	1:25,000	Apr 70	
			Photomap	1:250,000	May 70	400m C. I.
13)	V-29	Rima Bode II	Mosaic	1:250,000	20%	assigned but
			Mosaic	1:25,000	"	no dates estab.
			Photomap	1:250,000	"	400m C. I.
14)	V-48	Aristarchus	Mosaic	1:250,000	15%	assigned but
			Mosaic	1:25,000	"	no dates estab.
			Photomap	1:250,000	"	400m C. I.
15)	V-18	Dionysius			Has not	400m C. I.
16)	V-19	Abulfeda			been	
17)	V-21	Alexander			assigned	Monoscopic
18)	V-28	Alphonus			for	coverage only
19)	V-33	Copernicus CD			produc-	700m C. I.
20)	V-40	Tobias Mayer P			tion	400m C. I.
21)	V-49	Schroters' Valley				500m C. I.

ATTACHMENT C

CANDIDATES FOR FURTHER PHOTOGRAPHY

<u>SET B SITES</u>	<u>ORBITER REFERENCE</u>	
MOSTING C	III	S-18
ABULFEDA	V	V-19
RIMA HADLEY	V	V-26
COPERNICUS CD	V	V-33
CENSORINUS	V	V-12
 <u>OTHERS</u>		
GAMBART	I	S-13
GAMBART C	II	S-10.2
MOSTING	III	S-16
HEVELIUS	III	S-31
GAUDIBERT	IV	FRAME 72
RITTER/SABINE	IV	FRAME 85
POSIDONIUS	IV	FRAME 86
DESCARTES	IV	FRAME 89
BOSCOVICH	IV	FRAME 97
DAVY	IV	FRAME 108
LASSELL	IV	FRAME 113
DAWES	V	V-15.1
VITELLO	V	V-41



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Branch of Astrogeologic Studies
345 Middlefield Road
Menlo Park, California 94025

June 19, 1969

Mr. James H. Sasser, TJ
NASA Manned Spacecraft Center
Houston, Texas 77058

Dear Jim:

The enclosed lists show those points selected for possible re-designation on missions after G-1 in sites 2, 3 and 5. Most are fresh, young craters. I tried to pick them large enough to be visible and not so large as to constitute serious hazards in themselves. If these points are not satisfactory, let me know, and I will try again. I am sending copies of the list to several members of the Lunar Geology Experimenters.

Sincerely,

Newell Trask
Geologist

Enclosure

cc:
T. N. V. Karlstrom, USGS
H. H. Schmitt, MSC
N. Hinners, Bellcomm ✓
G. A. Swann, USGS

Site 2

All Mission II

<u>Frame</u>	<u>Framelet</u>	<u>Cm from Data Edge</u>	<u>Cm from Top</u>
84	450	24.3	1.6
84	439	27.5	1.7
85	572	6.3	1.5
85	575	12.0	.4
85	573	12.8	.6
85	565	9.1	.5
85	565	13.4	1.6
85	568	19.4	.4

Site 3

All Mission II

<u>Frame</u>	<u>Framelet</u>	<u>Cm from Data Edge</u>	<u>Cm from Top</u>
121	284	11.0	1.8
121	288	20.0	1.8
121	279	32.8	1.5
122	416	10.8	1.2
122	409	12.2	1.0
122	403	10.5	1.5
122	408	17.6	1.8
122	410	27.8	0.5

Site 5

All Mission III

<u>Frame</u>	<u>Framelet</u>	<u>Cm from Data Edge</u>	<u>Cm from Top</u>
166	592	18.1	1.8
166	594	20.8	1.0
166	584	8.8	1.7
166	588	28.1	.4
166	589	18.5	.3
167	717	10.8	.5
167	716	7.8	1.7
167	726	4.2	.8
167	721	14.5	1.2

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Fourth Meeting - June, 1969

From: N. W. Hinners

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H. H. Schmitt/CB
J. R. Sevier/PD12
L. C. Wade/TJ

California Institute of Technology

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University of Arizona

Mr. E. M. Whitaker

University of California/San Diego

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R. L. Kovach

Mass. Institute of Technology

Drs. F. Press
E. Simmons

Lamont Geological Observatory

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Dr. C. Lundquist

TRW/Houston

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J. A. Herbaugh

U. S. Geological Survey/Flagstaff

Messrs. A. H. Chidester
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H. Masursky

U. S. Geological Survey/Menlo Park

Messrs. N. J. Trask
D. E. Wilhelms

Bellcomm, Inc.

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From: N. W. Hinnners

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