NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: MAL

MAY 25 1970

TO : Distribution

FROM : MA/Apollo Program Director

SUBJECT: Apollo Site Selection Board Minutes of Meeting

Attached are the minutes of the Apollo Site Selection Board meeting held on May 7, 1970.

Rocco A. Petrone

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MINUTES OF THE APOLLO SITE SELECTION BOARD MEETING

Held at the

Manned Spacecraft Center

May 7, 1970

The Apollo Site Selection Board met at MSC (see Attachment 1) to select the site for Apollo 14 and consider the site selection plans for Apollo 15 and 16.

Mr. A. Calio reported on the Group for Lunar Exploration Planning (GLEP) Meeting held on April 30, 1970. The GLEP group was near unanimous (one vote for Littrow) to reprogram the site for Apollo 14 from Littrow to the Apollo 13 target of Fra Mauro (see Attachment 2, letter from TA to PA for the detailed rationale and discussion).

The GLEP group also recommended that, of the available sites for Apollo 15 viz Davy, Littrow, Censorinus, plus some consideration of the J sites Descartes, Copernicus, Marius Hills, and Hadley, Davy should be prime for Apollo 15.

However, several of the scientists had reservations after being told that the highest priority landing point on Davy which was close to the Davy crater wall could not be reached (25,000 ft. from wall).

An attempt to get the GLEP group to propose a back-up site for Davy in the event of a contingency such as loss of the required bootstrap photography failed, and it was decided that the Subpanel of GLEP would be called to study this problem and to report back to GLEP prior to July.

Mr. J. Sevier gave a discussion of the Apollo 14 and 15 missions. The presentation material is attached (Attachment 3). Major points made are as follows:

Apollo 14:

1. Current DPS margin is 39 sec. of hover as compared to Apollo 12's 45 sec. This assumes no additional scientific equipment over that originally planned prior to the Apollo 13 flight.

2. Fra Mauro is accessible from October through May, although a different approach azimuth is used for the January through May period implying a change in CSM ground track and hence different mission planning.

3. Because the approach azimuths are different, the capability to perform bootstrap photography of Davy, Descartes and Censorinus has changed.

   (a) In October to January it is not possible to bootstrap Censorinus.

   (b) In October to January Descartes can be photographed at 32° sun elevation (SEA) and 56° while Davy can be photographed at SEA of 51°.

   (c) In February to June we can get Censorinus on Rev 27 at a SEA of 74° and Descartes and Davy on Rev 42 at SEA of 71° and 51° respectively.

After considerable discussion the Board gave the following priority to bootstrap photography sites:

1. Descartes (prime objective of the bootstrap).

2. Davy (high interest).

3. Censorinus (lower interest).

The Board entered a lively discussion on the schedule relationships between Apollo 14 launch and return of bootstrap photography, the generation of the required mapping products, operational trajectories and training aids, and the timing of the Apollo 15 mission in such a way as to avoid dominoing Apollo 16. It was the concensus of the Board that if we are not to impact the Apollo 16 window, then the Apollo 15 site has to be picked well in advance of the Apollo 14 launch and from sites for which the required photography is available.

Mr. Calio was asked to call the GLEP group to consider a site for Apollo 15 for which the required photography was available. Mr. Calio proposed calling the Subgroup to meet in early June with a GLEP group one week later to support an ASSB meeting by early July. Mr. Calio further proposed that the GLEP group should also make a recommendation for the Apollo 16 site at the same time.

Recommendations

The Board recommended that the Fra Mauro site be used for the Apollo 14 mission and that the GLEP group (and Subgroup) be called to consider the sites for Apollo 15 and 16.

The Board approved a requested additional seat for MSFC.

Attachments 1-3

ATTACHMENT 1

ASSB Members

R. A. Petrone - NASA/MA
L. R. Scherer - NASA/MAL
C. M. Lee - NASA/MA
W. E. Stoney - NASA/MA
J. D. Stevenson - NASA/MO

E. R. Mathews - KSC/AP

A. J. Calio - MSC/TA
J. A. McDivitt - MSC/PA
E. Simmons - MSC/TA
D. K. Slayton - MSC/CA
S. A. Sjoberg - MSC/FA

F. A. Speer - MSFC/PM-MO-MGR

Other Attendees

J. K. Holcomb - NASA/MAO
E. W. Land, Jr. - NASA/MAO
T. H. McMullen - NASA/MA
R. B. Sheridan - NASA/MAO

R. E. Moser - KSC/LO-PLN

C. A. Berry - MSC/DA
R. L. Berry - MSC/FM5
S. M. Blackmer - MSC/PD
W. M. Bolt - MSC/FM2
J. R. Gurley - MSC/FM13
R. H. Kohrs - MSC/PD7
R. W. Kubicki - MSC/PA
R. S. Johnston - MSC/AC
G. S. Lunney - MSC/FC13
W. J. North - MSC/CF
J. M. Peacock - MSC/PD
J. H. Sasser - MSC/TJ
J. R. Sevier - MSC/PD4
L. D. Spence - MSC/NA

L. B. Bell - MSFC/PM-SAT

A. P. Boysen, Jr. - Bellcomm
D. B. James - Bellcomm
K. E. Martersteck - Bellcomm

UNITED STATES GOVERNMENT

Memorandum

Attachment 2

TO : PA/Manager, Apollo Spacecraft Program DATE: MAY 6 1970

FROM : TA/Chairman, Group for Lunar Exploration Planning

SUBJECT: Site selections for Apollo missions 14 and 15

The Group for Lunar Exploration Planning (GLEP) met at MSC on April 30, 1970, to reconsider the site assignments of Apollo 14 and 15 in view of the aborted Apollo 13 flight. An agenda of that meeting is enclosed.

The GLEP has recommended the following sites for Apollo 14 and 15:

Apollo 14 - Fra Mauro
Apollo 15 - Davy

The recommendation for the Davy site is made with the knowledge that the landing point would be placed near the most scientifically useful maar (crater) within Davy Y which is 25,000 feet (or more) from the east rim of the Davy Y crater. This follows the operation recommendation of MPAD.

Rationale

The rationale for these selections was developed by posing sets of alternatives and weighing the effect of each set upon the objectives of experiments and upon the goals of the program. The enclosed table indicates the site preferences of Principal Investigators concerned with ALSEP experiments and those concerned with analysis of lunar material.

Fra Mauro - Apollo 14

The GLEP recommended the Fra Mauro site for Apollo 14 virtually unanimously. The variety of material apparently available at this site will provide the following:

1. Age and composition of pre-Mare Imbrium material of non-Mare type.

2. Time of excavation of Mare Imbrium.

3. The character of deep seated material excavated from the Mare Imbrium basin.

4. Eruptive material produced during a Mare Imbrium eruptive phase may be present.

5. The Fra Mauro formation may be dated and established as a chronological marker.

6. The nature of the lunar regolith in a non-mare region will be established.

In addition, the Fra Mauro site offers certain advantages for several lunar surface experiments which are site dependent. Enclosures 1, 2, and 3 detail these points.

Placing a passive seismometer on the Fra Mauro site will increase the probability of recording the same event by the Apollo 12 and Apollo 14 seismometers because of the relatively small station separation. With the small station separation and additional impacts it may be possible to determine the structure in the Fra Mauro region to a depth of several hundred kilometers (see enclosure 1).

The Fra Mauro site offers several advantages for the active seismic experiment (enclosure 2). These include the opportunities to determine the thickness of the regolith, determine in situ the seismic velocities of near surface lunar material plus velocities which might be representative of deep lunar materials, assuming that the Fra Mauro formation is predominantly composed of such material.

The laser ranging retro-reflector team recommends carrying an LR^3 on Apollo 14 (enclosure 3). This would achieve the required longitudinal separation and establish three reflectors on the lunar surface early in the program.

Davy - Apollo 15

The GLEP recommended that the Apollo 15 site should be the crater chain of Davy Y. Three locations of the landing ellipse were considered: the floor of Davy Y near one of the maars, the rim of Davy Y near the eastern-most maar of the rille, and a landing at the highland-Davy Y floor contact. The first was recommended by the MPAD and adopted by the committee. The committee therefore recommended landing adjacent

to a large maar approximately mid-way in the crater chain rille and approximately 25,000 feet or more from the east rim of Davy Y.

The GLEP recognized that a final decision on the feasibility of a Davy landing would have to await analysis of bootstrap photography of the Davy area taken during the Apollo 14 mission.

The GLEP recommended the Davy site for the following reasons:

1. The Davy Rille appears to be a chain of volcanic pipes of the maar type from which deep seated material may have been ejected. The Davy Rille is a representative of the Davy/Hyginus/Rima Bode type of volcanic pipe structure, and appears to offer the highest probability of sampling deep seated ejecta. Such sampling may provide material from deeper within the moon than that available at any other site.

2. Upland type fill, intermediate between typical mare and typical highland and forming the floor of Davy Y, may be sampled. Such material is common in highland regions and is distinct from both mare and highland material.

3. Highland debris may be a component of the regolith at the landing point because of the proximity to the highland rim of Davy Y of the probable target ellipse.

It was the opinion of the GLEP that these points, particularly the first, are most unambiguously satisfied at the Davy site as compared to other sites of similar nature, and that the criteria of multiple objectives are best satisfied by the Davy site. Copernicus, the Marius Hills, and Descartes were also considered as Apollo 15 candidates; however, the GLEP considered these sites to be more appropriate for the J-mission series.

Alternate Site for Apollo 15

The GLEP recognized that Apollo 13 bootstrap photography would have to be successfully accomplished, and that a suitable landing found by analysis of such photography before the Davy site could be confirmed for Apollo 15. In the event that photography is unsuccessful or no suitable area can be targeted, an alternate site will be required. The Site

Selection Subcommittee of GLEP, therefore, was charged with examining possible sites and recommending an alternate for the Davy site. The subcommittee was directed to report to the GLEP in July. At that time a recommendation of an alternate site will be forwarded to the Manager, Apollo Spacecraft Program.

A. J. Calio

Anthony J. Calio

Enclosures 4

cc:
AA/Dr. Gilruth
AB/C. Kraft

TA:DMorrison:kh 5/7/70

ATTACHMENT 1

PSE RATIONALE FOR SITE SELECTION FOR MISSIONS 14 AND 15

Preference is for:

Mission 14 - Fra Mauro

Mission 15 - Littrow

Rationale:

1. Assuming that the Apollo 12 station is functioning at the time of mission 14, the probability of recording the same seismic event on two stations is greatly increased by having the relatively small station separation between Apollo 12 and Fra Mauro, rather than the very large separation which would exist between Littrow and Apollo 12 or Davy and Fra Mauro.

2. Returning to Fra Mauro for 14, allows data from three more impacts to be recorded in this region. This will permit us to achieve a good understanding of lunar structure in this region to depths of several hundred km.

3. Littrow is the only mascon basin site now planned which allows geophysical study of such a basin, particularly by impacts.

G. Latham
Principle Investigator
Passive Seismometer Experiment

ATTACHMENT 2

F R A M A U R O

I have studied geological data and maps for the Fra Mauro site - data which I did not have earlier.

The Fra Mauro formation is covered by a relatively thin veneer of unconsolidated particulate debris - estimated to be 5-10 meters thick.

An active seismic experiment at Fra Mauro has the potential contributing answers to the following programs:

1. How thick is the regolith at the Fra Mauro site?

2. At what depth is the Fra Mauro formation? - it is possible that geologically one cannot sample Fra Mauro formation directly at the chosen landing site.

3. One of the interesting results from the acoustic velocity determinations on returned lunar samples is the strong dependence of seismic velocity on pressure as the rocks are squeezed. However, all measurements have been made in air and show a high value of attenuation (low Q) in contradistinction to the low value of attenuation (high Q) for lunar rocks suggested by the impact data from Apollo 11 and 12.

An ASE would give in situ measurements of seismic velocity and the Q of the near surface lunar material - parameters which are vitally needed for further seismic interpretations on the Moon.

4. The Fra Mauro formation is rpesumably material which has been ejected from the very deep lunar interior. It would be interesting to measure the in situ velocities of the Fra Mauro formation. The velocities measured might be representative of truly deep lunar materials. From velocity-density relations on rocks we may be able to say something about gross composition at depth. i.e., are the in situ measured seismic velocities significantly different from that measured on returned crystalline lunar samples?

R. L. Kovach
Principle Investigator
Active Seismic Experiment

ATTACHMENT 3

DISCUSSION OF LASER RANGING RETRO REFLECTOR
WITH RESPECT TO APOLLO 14 AND 15

The laser ranging retro reflector team recommended that an LR^3 be carried on Apollo 14 when it was scheduled for Littrow because of the desirable latitude spread with respect to the Apollo 11 site (a spread of approximately 20°). It is desirable that we have, as soon in the sequence as possible, three emplaced LR^3's forming a triangle as large and as open as possible. The resolution in the measurement of the physical librations is proportional to the length of the sides of the triangle.

Since the interface is now developed for carrying an LR^3 on Apollo 14 we recommend that this mission carry the LR^3 even though it goes to Fra Mauro since this would satisfy the longitudinal spread. Subsequent programming of flights should then allow for an LR^3 to accomplish the latitude separation.

C. O. Alley, Chairman
Laser Ranging Retro
Reflector Team

SITE PREFERENCES BY EXPERIMENT

EXPERIMENT	14	15	1st Preference
S-031 - Passive Seismic	Fra Mauro	Littrow	Littrow (Davy preferred over Censorinus)
S-036 - Suprathermal Ion Detector	Fra Mauro	Littrow	
S-033 - Active Seismic	Fra Mauro	-	
S-034 - Magnetometer	-	Littrow/ Censorinus	
S-198 - Lunar Handheld Magnetometer	Fra Mauro	-	
S-037 - Heat Flow	Not Censorinus		
S-059 - Lunar Geology Investigation	Fra Mauro?	Davy?	
S-078 - Laser Ranging Retro-reflector	Littrow/Fra Mauro		
S-038 - Charged Particle Lunar Environment	Fra Mauro		
Bootstrap	(Fra Mauro) Descartes Davy or Censorinus	(Fra Mauro) Descartes Davy Censorinus	

Attachment 3

APOLLO 14 & 15
MISSION SUMMARY

some pages not copied

J. R. SEVIER

ASPO

OUTLINE OF PRESENTATION

- LM WEIGHT SUMMARY
- APOLLO 14 MISSION SUMMARY - FRA MAURO
- APOLLO 15 MISSION SUMMARY - DAVY
- LEADTIME REQUIREMENTS TO ACCOMMODATE DAVY ON APOLLO 15
- ABILITY TO ACCOMMODATE SCHEDULE SLIPS FOR THE APOLLO 16 CANDIDATE SITES

RECOMMENDATIONS

- APOLLO 14 TO FRA MAURO WITH DAVY/DESCARTES BOOTSTRAP
- ASSESS CAPABILITY TO ACCOMMODATE DAVY ON APOLLO 15 IN LIGHT OF APOLLO 14 SCHEDULE AND APOLLO 16 CONSTRAINTS
- ASSESS SCIENTIFIC SUITABILITY OF BACK-UP SITE (e.g. HYGINUS) IN PLACE OF DAVY