BELLCOMM, INC.
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B70 02078

SUBJECT: Implications of Revised EVA Capabilities on Traverse Envelopes - Cases 320 and 340

DATE: February 26, 1970

FROM: P. Benjamin
J. W. Head

MEMORANDUM FOR FILE

The material in Attachment A was prepared and provided to ASPO/MSC and NASA Headquarters as a suggested basis for trade-offs reflecting the changed lunar surface EVA capabilities resulting from the approval of the OPS/buddy system and the -7 PLSS with a 7.5 hour battery. Using the MSC constraints shown on Page 2 of Attachment A the traverses shown in Attachment B were designed. The lengths and sampling/science instrumentation/ operations times of the 18 traverses constructed are plotted as points on Pages 5 and 6 of Attachment A for the 10 km/hr and 5 km/ hr LRV cases, respectively. The spreads indicated show the probable range of time and distance combinations for the given constraints for each site. The dashed lines reflect the 1-1/2 hour overhead and 1 hour ALSEP deployment metabolic cost. EVA times and distances are summarized on the following two pages.

The added capability of the -7 PLSS at Marius Hills allowed an extended traverse along the narrow ridge in the S.W. quadrant, previously not possible, and permitted the objectives of two old traverses to be accomplished on one new one. This permitted the design of an extensive traverse to the north, not previously possible. The new constraints permitted a very long traverse to Hadley C crater to be constructed at the Hadley-Apennines landing site, and the combined length of the three traverses was over 57 km. Since the LRV is used to transport the astronauts to the central peaks at Copernicus, the form of these traverses remained essentially the same, with the added -7 PLSS capacity being used to provide extra sampling time at the peaks. The 5 km/hr and 10 km/hr LRV traverses to the peaks were identical, with the faster LRV speed used to increase sampling time available. Alternatively this extra time could be used to provide more mobility around the base of the peaks.

Page 14 of Attachment A shows the types of changes which could be made in adapting to the new EVA capabilities - extending sampling time, extending travel distance, or combining the two.

(NASA-CR-112695) IMPLICATIONS OF REVISED EVA CAPABILITIES ON TRAVERSE ENVELOPES (Bellcomm, Inc.) 24 p

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CR-112695
(NASA CR OR TMX OR AD NUMBER) (CATEGORY)
[redacted]

For the traverses planned here, those at Copernicus Peaks extended sampling time, the Hadley-Apennines ones increased the distance traveled, and at Marius Hills the combination was used, as illustrated on Page 15. This material was used by MSC at the February 24 Mission Review.

Peter Benjamin
P. Benjamin

James W. Head
J. W. Head

2015-JWH
2032-PB -tla

Attachments A & B

ATTACHMENT A

IMPLICATIONS OF REVISED EVA CAPABILITIES

REVIEWED DESIGN OF EARLIER TRAVERSES.

DETERMINED GENERAL CHANGES THAT RESULT FROM NEW CONSTRAINTS

DETERMINE CHARACTERISTICS OF NEW TRAVERSE ENVELOPES

NEW CONSTRAINTS

-7 PLSS

6000 BTU @ 7.0 HOURS

OVERHEAD TIME

1.5 HOURS @ 1000 BTU/HR

ALSEP DEPLOYMENT

1.0 HOUR @ 1000 BTU/HR

RIDING

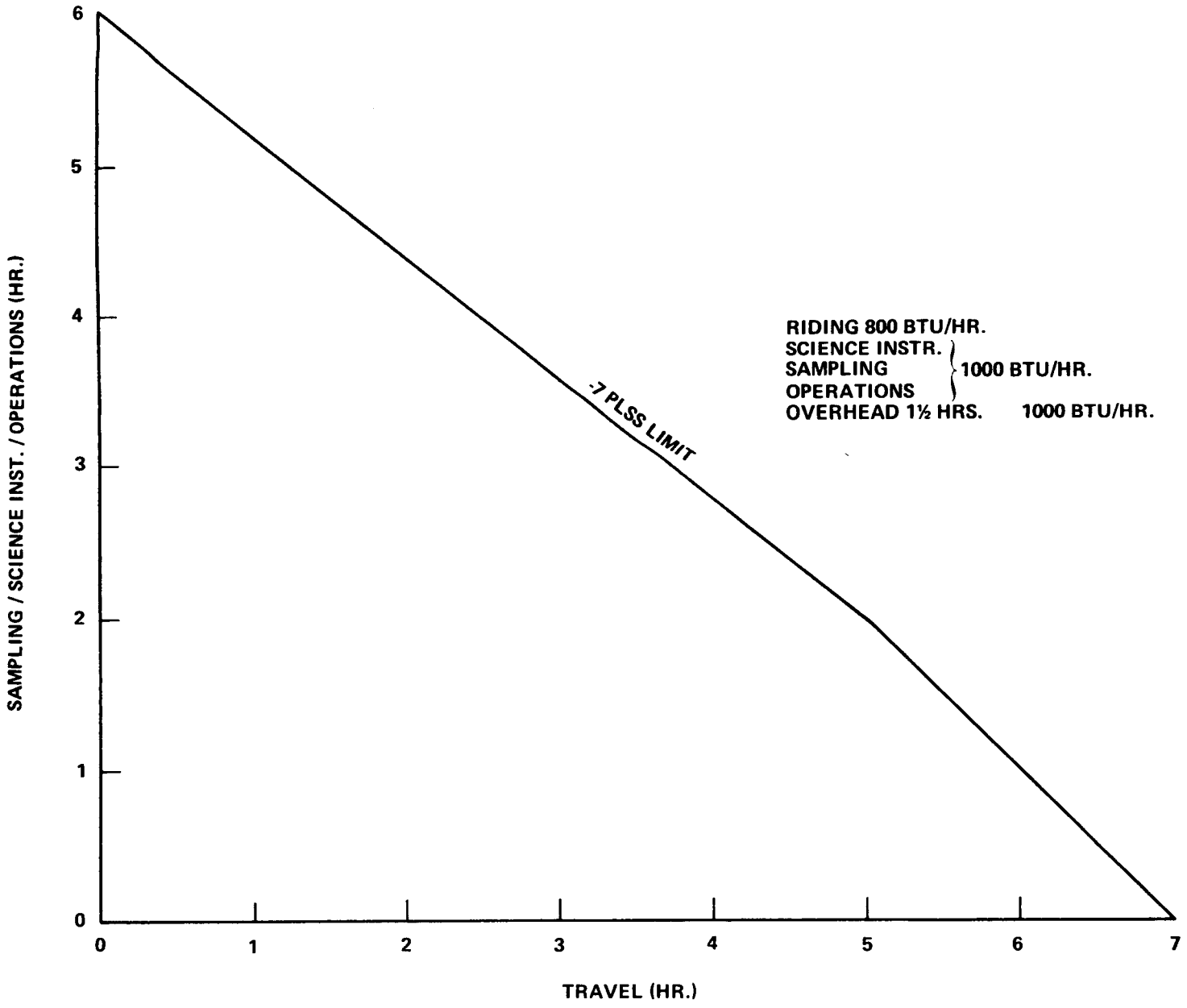
5, 10 KM/HR @ 800 BTU/HR

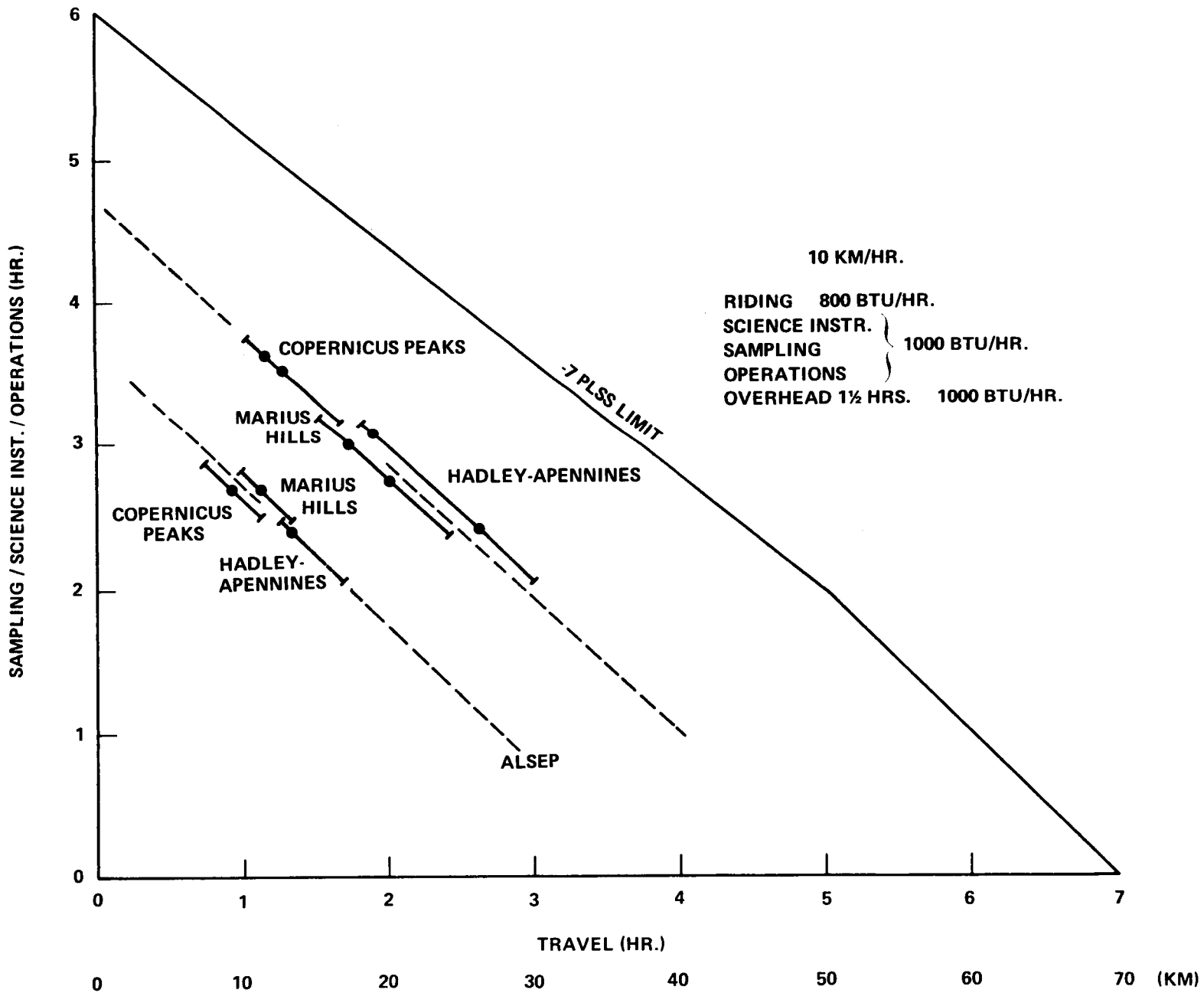
MAXIMUM RETURN DISTANCE

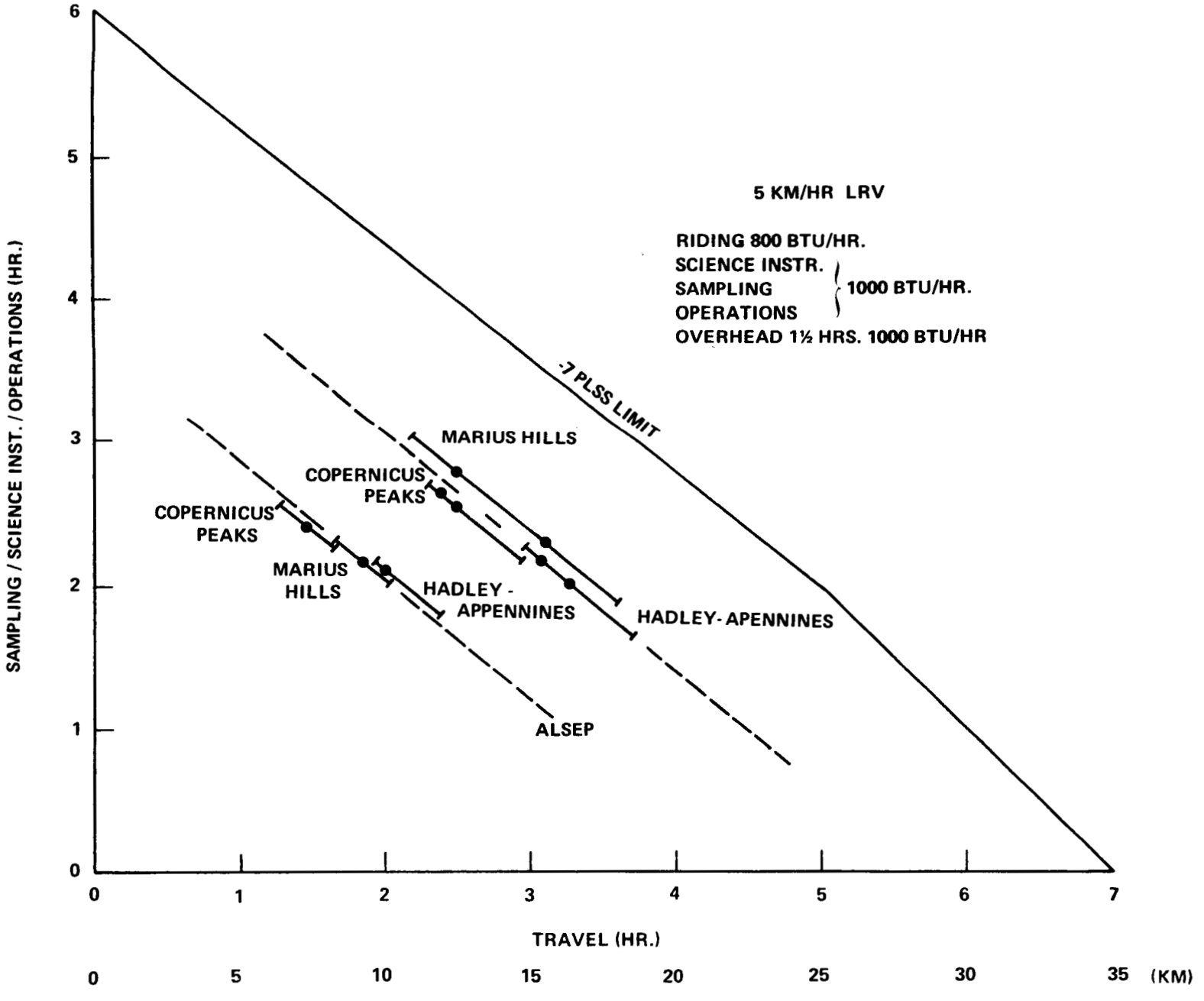
OPS/BUDDY SYSTEM - 9.5 KM (PLSS FAILURE, RIDE BACK)

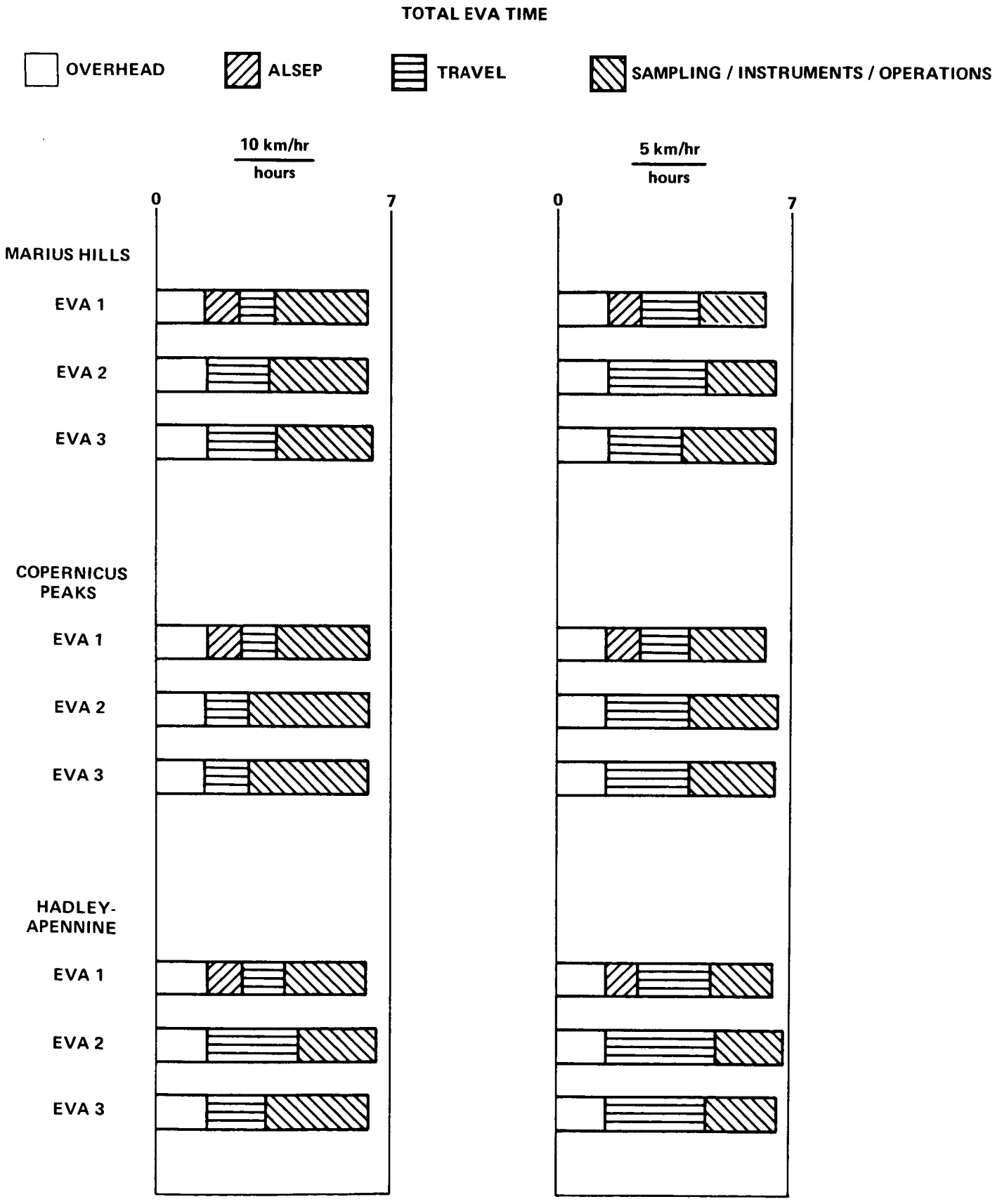
TRAVERSE CHANGES

- SITE DEPENDENT AND EVA DEPENDENT
  - NEW LANDING POINT AT HADLEY-APENNINE
  - ORIGINAL TRAVERSES HAD VARIABLE SCIENCE RETURN EFFECIENCY
    - SOME LINEAR TRAVERSES WERE OPTIMIZED
    - SOME AREAL TRAVERSES WERE COMBINED
- ALLOWANCE MADE FOR S-I-O TIMES
  - S - SAMPLING (GEOLOGY, ETC)
  - I - INSTRUMENTATION (MAGNETOMETER, ETC)
  - O - OPERATIONS (LRV NAV SYSTEM, TV, ETC)
- ALLOWANCE MADE FOR ALSEP TIME ON FIRST EVA

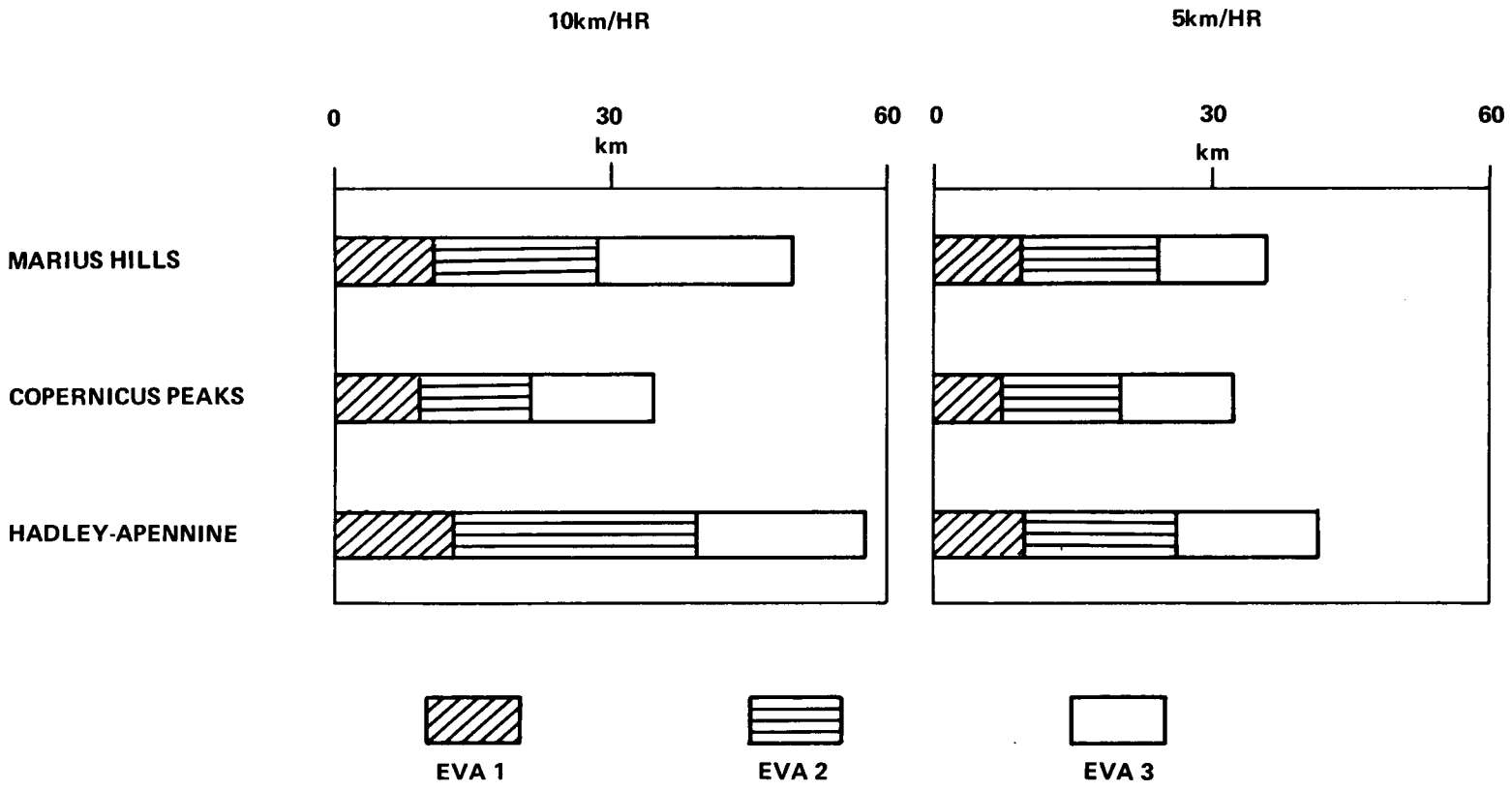

SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
6
5
4
3
2
1
0
0
1
2
3
4
5
6
7
TRAVEL (HR.)
-7 PLSS LIMIT
RIDING 800 BTU/HR.
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR.
OVERHEAD 1½ HRS. 1000 BTU/HR.


SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
6
5
4
3
2
1
0
10 KM/HR.
RIDING 800 BTU/HR.
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR.
OVERHEAD 1½ HRS. 1000 BTU/HR.
-7 PLSS LIMIT
COPERNICUS PEAKS
MARIUS HILLS
HADLEY-APENNINES
MARIUS HILLS
COPERNICUS PEAKS
HADLEY-APENNINES
ALSEP
0
1
2
3
4
5
6
7
TRAVEL (HR.)
0
10
20
30
40
50
60
70
(KM)


5 KM/HR LRV
RIDING 800 BTU/HR.
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR.
OVERHEAD 1½ HRS. 1000 BTU/HR
-7 PLSS LIMIT
MARIUS HILLS
COPERNICUS PEAKS
COPERNICUS PEAKS
MARIUS HILLS
HADLEY - APPENNINES
HADLEY- APENNINES
ALSEP
SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
TRAVEL (HR.)
(KM)
0
1
2
3
4
5
6
7
0
5
10
15
20
25
30
35

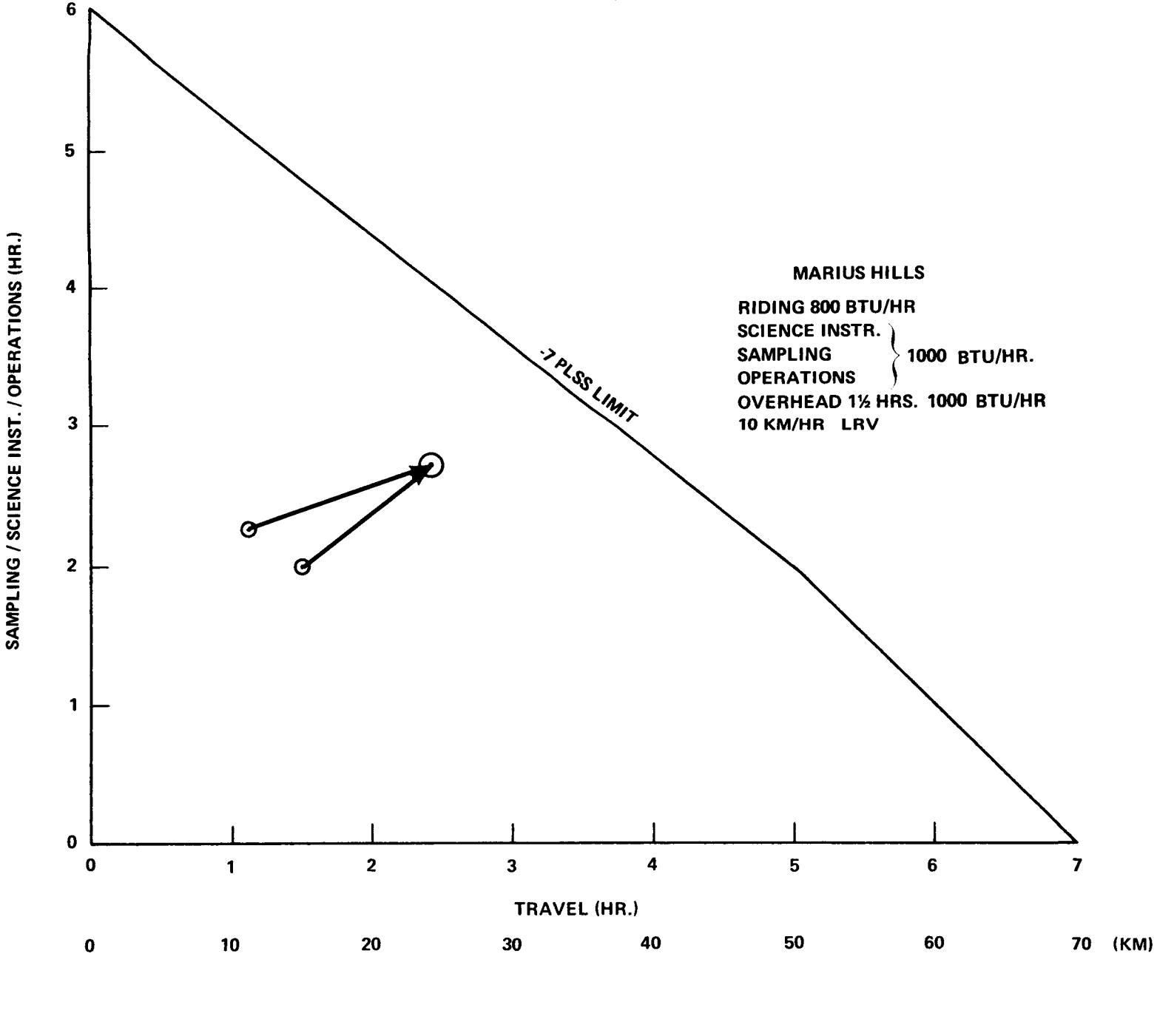

TOTAL EVA TIME
OVERHEAD
ALSEP
TRAVEL
SAMPLING / INSTRUMENTS / OPERATIONS
10 km/hr
hours
5 km/hr
hours
0
7
0
7
MARIUS HILLS
EVA 1
EVA 2
EVA 3
COPERNICUS PEAKS
EVA 1
EVA 2
EVA 3
HADLEY-APENNINE
EVA 1
EVA 2
EVA 3

TOTAL DISTANCE OF TRAVERSES
FOR 3 EVA'S



MARIUS HILLS:

- –7 PLSS CAPACITY ALLOWS EXTENDED TRAVERSE ALONG NARROW RIDGE IN SW QUADRANT
- EXTEND BOTH TRAVERSE DISTANCE AND SAMPLING TIME
- CAN COMBINE OBJECTIVES FROM TWO OLD TRAVERSES INTO ONE NEW TRAVERSE
- ALLOWS NEW (NORTH) TRAVERSE

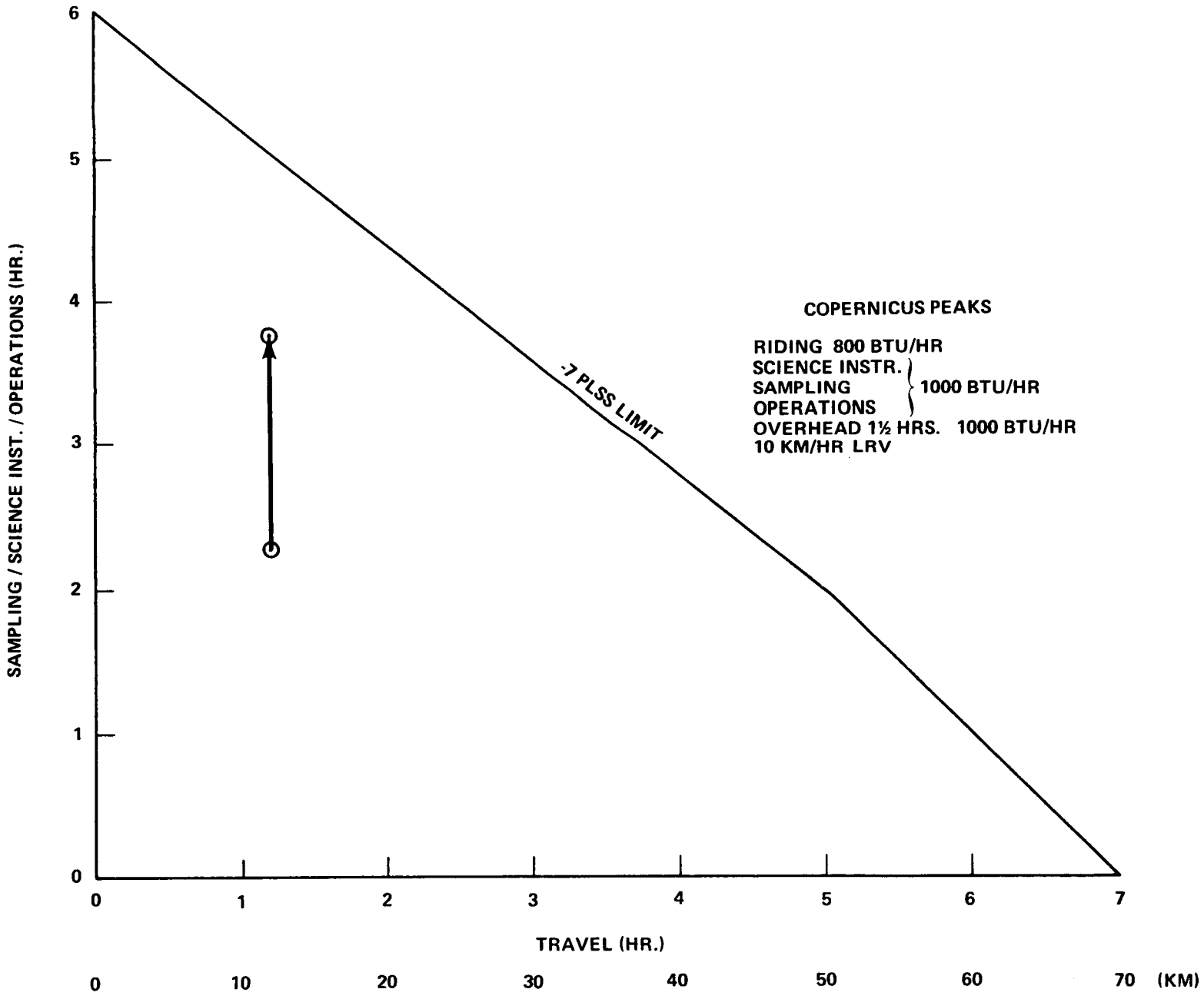

MARIUS HILLS
RIDING 800 BTU/HR
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR.
OVERHEAD 1½ HRS. 1000 BTU/HR
10 KM/HR LRV
-7 PLSS LIMIT
SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
0
1
2
3
4
5
6
TRAVEL (HR.)
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
(KM)

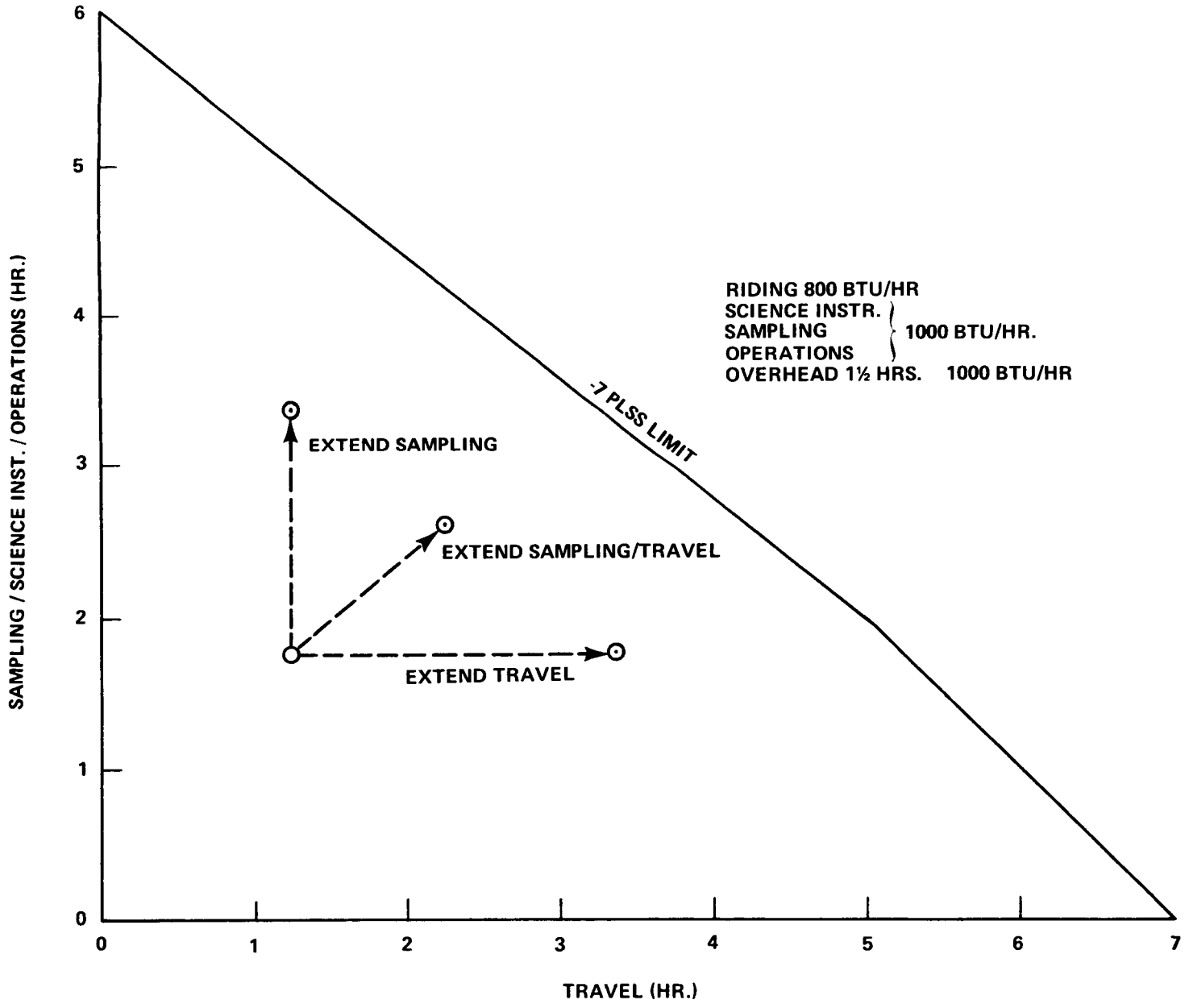
HADLEY-APENNINES:

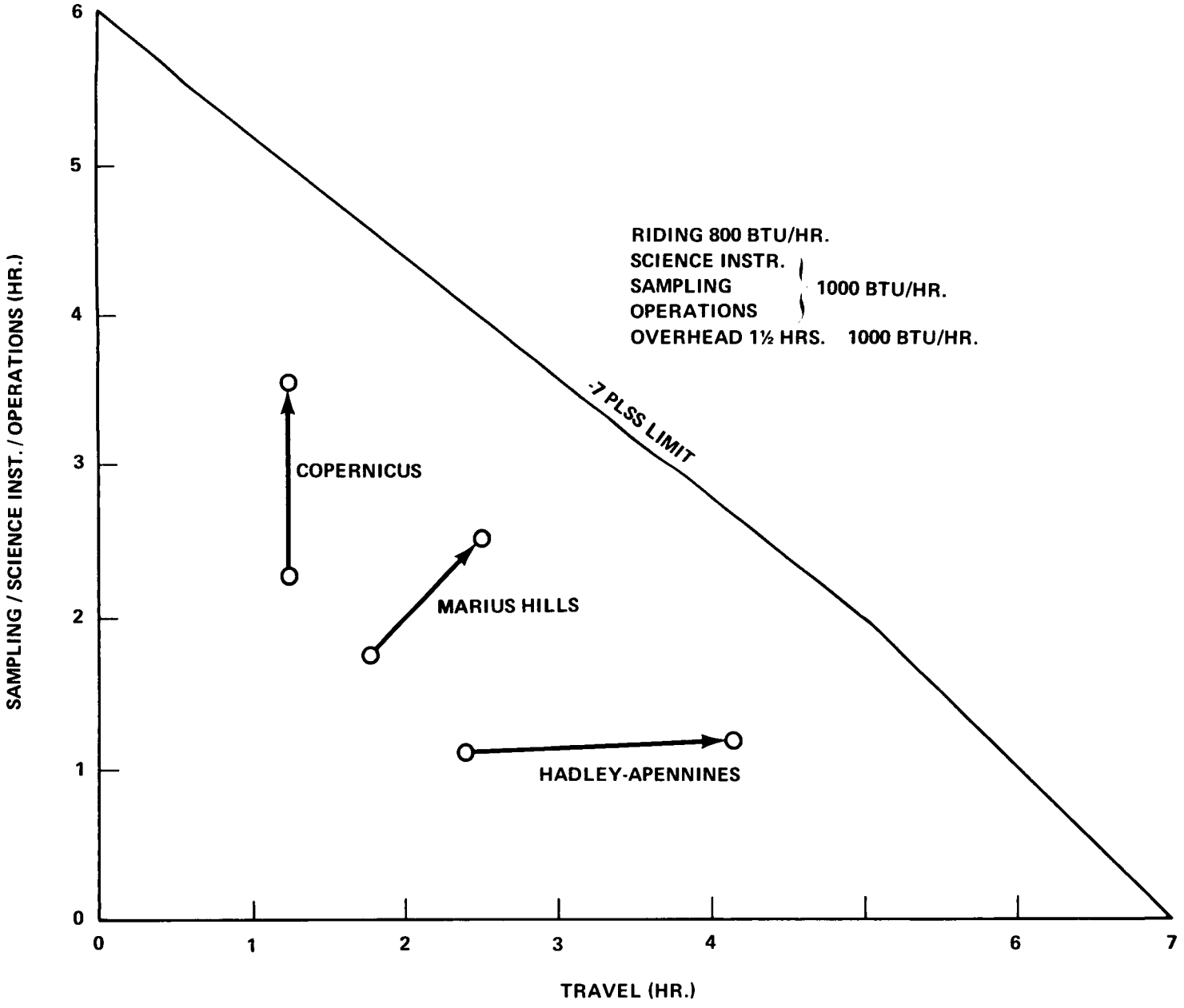
- NOT STRICTLY COMPARABLE, SINCE NEW LANDING POINT.
- VERY LONG TRAVERSE TO HADLEY C AND ALONG APENNINE FRONT POSSIBLE BECAUSE OF EXTENDED –7 PLSS CAPABILITY.

COPERNICUS PEAKS:

- TRAVERSES TO PEAKS ESSENTIALLY UNCHANGED
- –7 PLSS CAPACITY USED TO PROVIDE EXTENDED TIME AT PEAKS (COULD PROVIDE EXTRA DISTANCE ALONG PEAKS)
- –7 PLSS CAPACITY ALLOWS BOTH 10 KM/HR AND 5 KM/HR TRAVERSES TO BE ESSENTIALLY IDENTICAL, WITH EXTENDED SAMPLING TIME FOR 10 KM/HR CASE.


SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
6
5
4
3
2
1
0
-7 PLSS LIMIT
COPERNICUS PEAKS
RIDING 800 BTU/HR
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR
OVERHEAD 1½ HRS. 1000 BTU/HR
10 KM/HR LRV
0
1
2
3
4
5
6
7
TRAVEL (HR.)
0
10
20
30
40
50
60
70
(KM)


SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
TRAVEL (HR.)
0
1
2
3
4
5
6
7
RIDING 800 BTU/HR
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR.
OVERHEAD 1½ HRS. 1000 BTU/HR
-7 PLSS LIMIT
EXTEND SAMPLING
EXTEND SAMPLING/TRAVEL
EXTEND TRAVEL


SAMPLING / SCIENCE INST. / OPERATIONS (HR.)
TRAVEL (HR.)
0
1
2
3
4
5
6
7
RIDING 800 BTU/HR.
SCIENCE INSTR.
SAMPLING
OPERATIONS
1000 BTU/HR.
OVERHEAD 1½ HRS. 1000 BTU/HR.
-7 PLSS LIMIT
COPERNICUS
MARIUS HILLS
HADLEY-APENNINES

RESULTS

DIFFERENT EFFECTS AT EACH SITE

HADLEY

- ALL NEW TRAVERSES
- LONGER TRAVEL TIME AND INCREASED DISTANCE

COPERNICUS PEAKS

- LONGER SCIENCES TIMES AT THE DISTANT OBJECTIVES (TWO EVAS)
- INCREASED SCIENCE AND TRAVEL ON FLOOR TRAVERSE

MARIUS HILLS

- INCREASED SCIENCE AND TRAVEL ON ALL NEW TRAVERSES

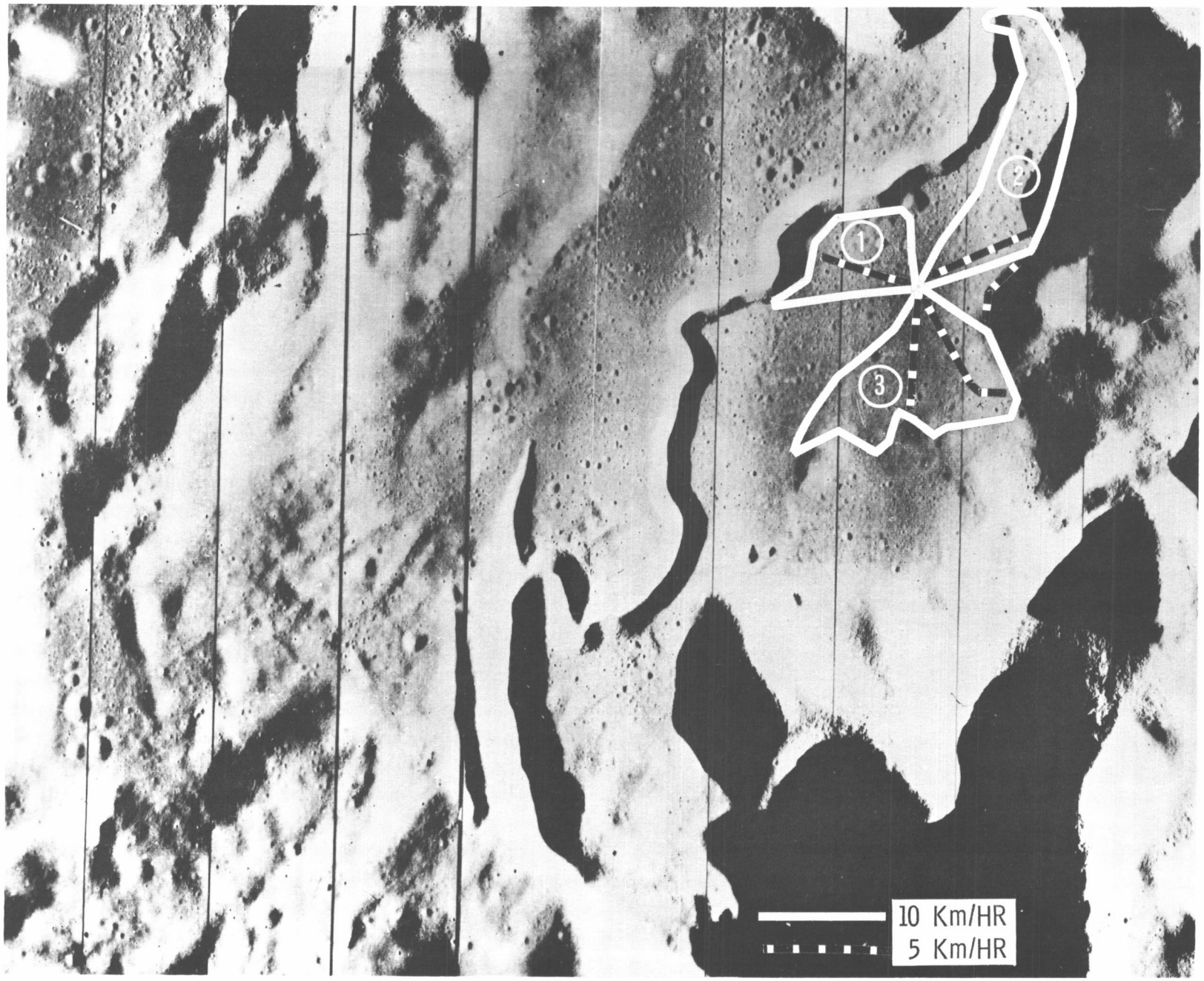
LONGER EVAS POSSIBLE WITH NEW PLSS

- SIX TO SEVEN HOURS

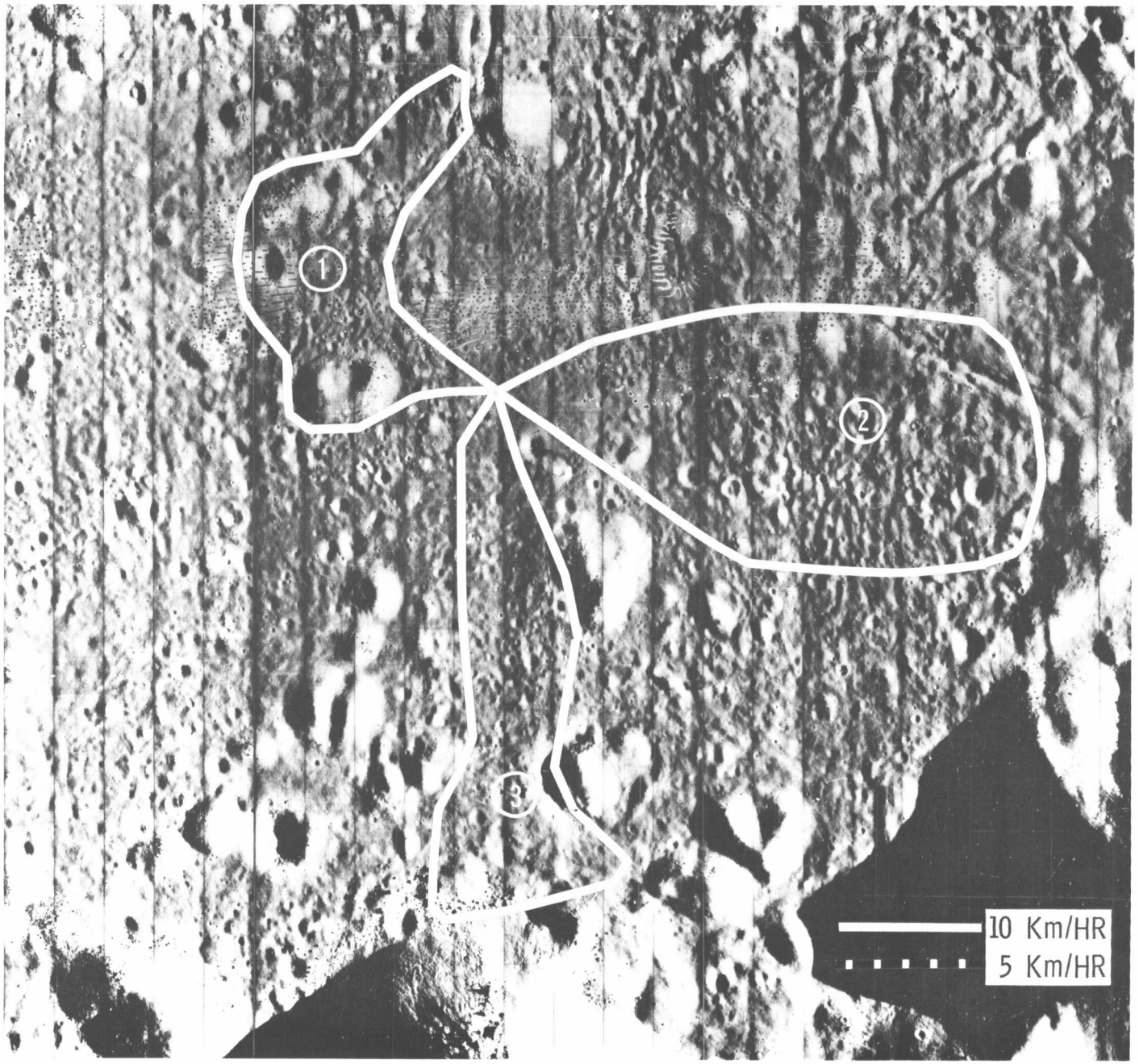
LARGER RANGE OF TOTAL DISTANCE TRAVELED FOR 3 EVAS

- 30 TO 60 KM
- 60 TO 120 KM FOR GENERAL CONTINGENCY
    - 4 EVAS, TERRAIN EFFECTS, OVERHEAD

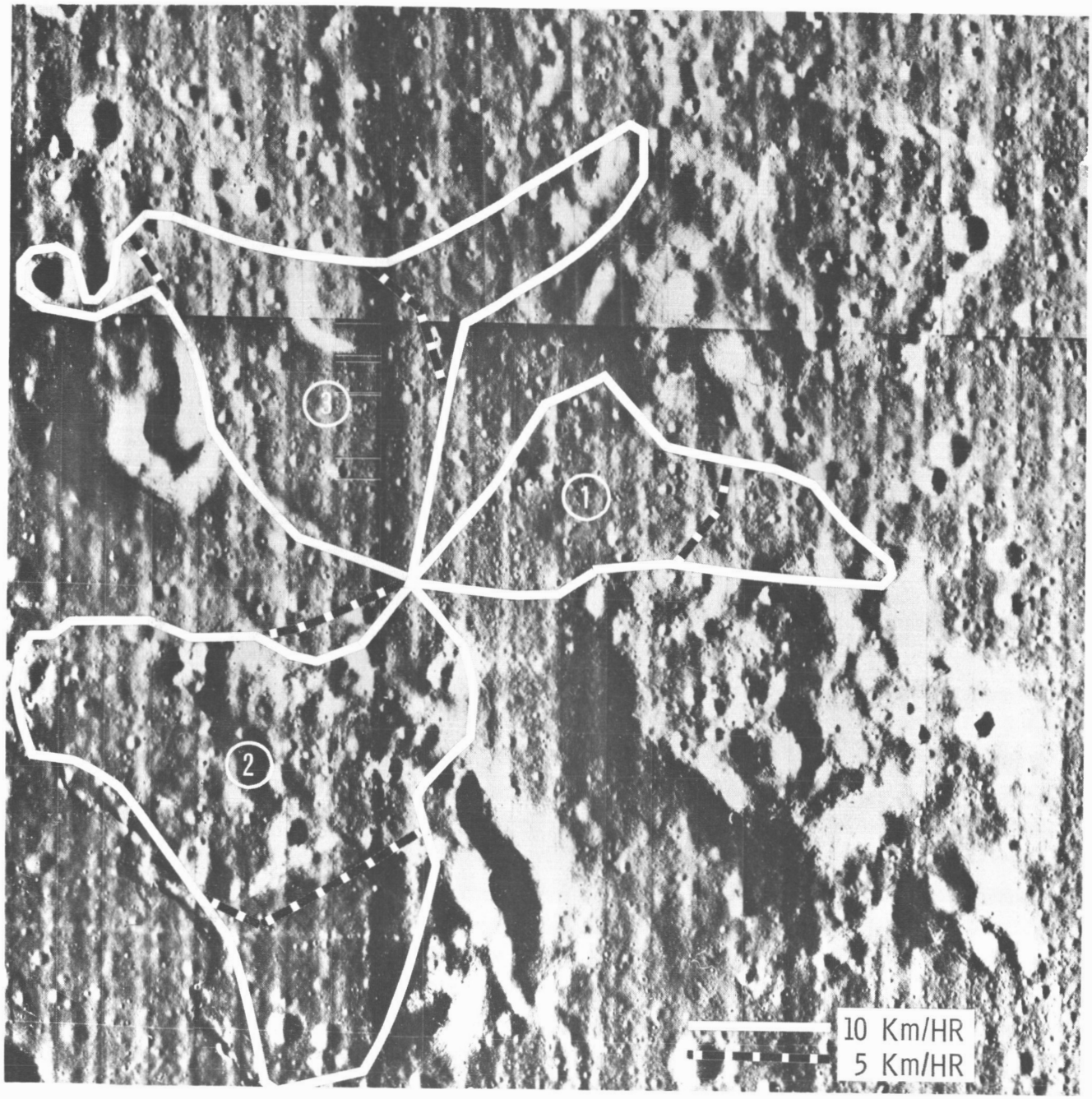
ATTACHMENT B



HADLEY-APENNINE



COPERNICUS PEAKS



MARIUS HILLS

BELLCOMM, INC.

Subject: Implications of Revised EVA Capabilities on Traverse Envelopes - Cases 320 and 340

From: P. Benjamin
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