Briefing Topic:

EVA Capability from Lunar Surface Rovers – An Initial Assessment of an ISECG Architecture

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ISECG Lunar Surface Architecture discussion

- Use two Small Pressurized Rovers to extend traverses to distances beyond the 10 km walk-back distance and provide additional safety
- Replace LER-style suit ports with an airlock on the Small Pressurized Rover
- The airlock configuration would limit the number of EVA from the SPR to 1 (possibly 2) per day.

Initial assessment

- That would create a productivity problem.
- For example, that type of architecture would not allow crew to accomplish the same activities that Apollo 17 crew accomplished.
- We should be more productive, not less productive, than Apollo.

Recall the Apollo 17 traverse details

- Lunar surface stay-time was 75 hours.
- Three EVAs were conducted with a total duration of 22 hours, 04 minutes.
  - EVA-1: ~2 km
  - EVA-2: 18 km
  - EVA-3: 10 km
- LRV traverse total 30.5 km.
- 110.4 kg (243 lbs) of material gathered.

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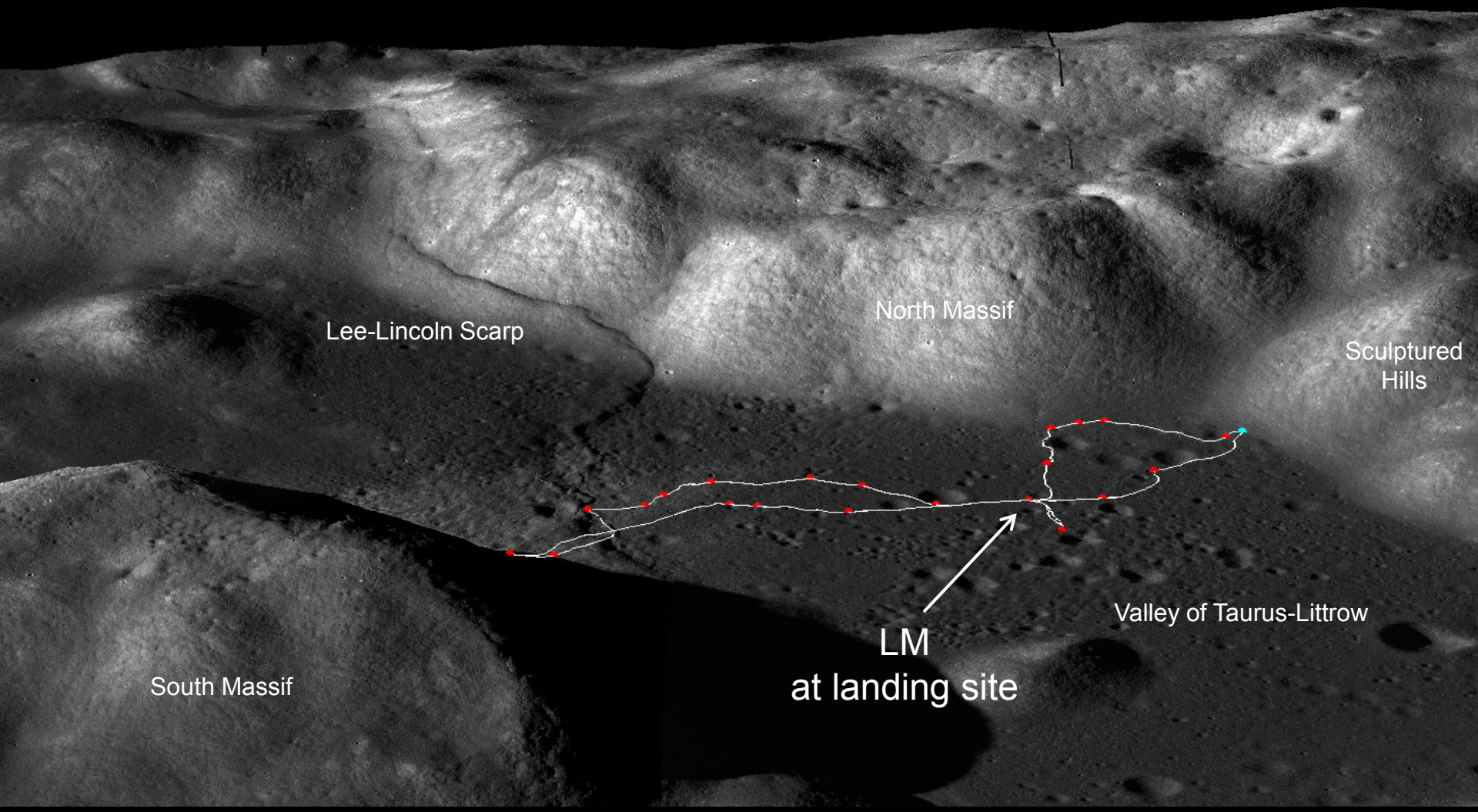

Data from Apollo 17 Mission Report, JSC-07904, March 1973.

Oblique perspective view generated with LRO data by Hurwitz & Kring (2016)

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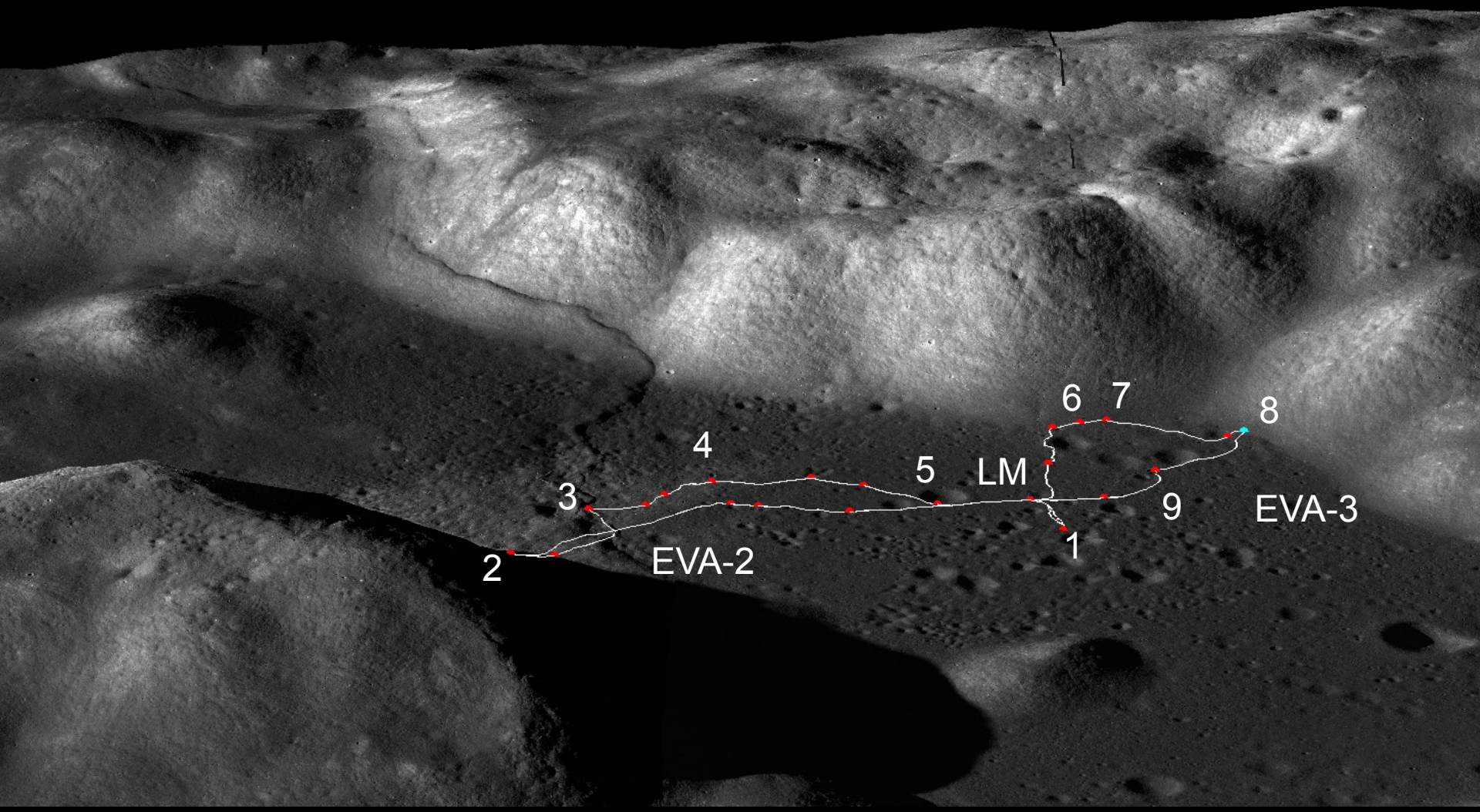

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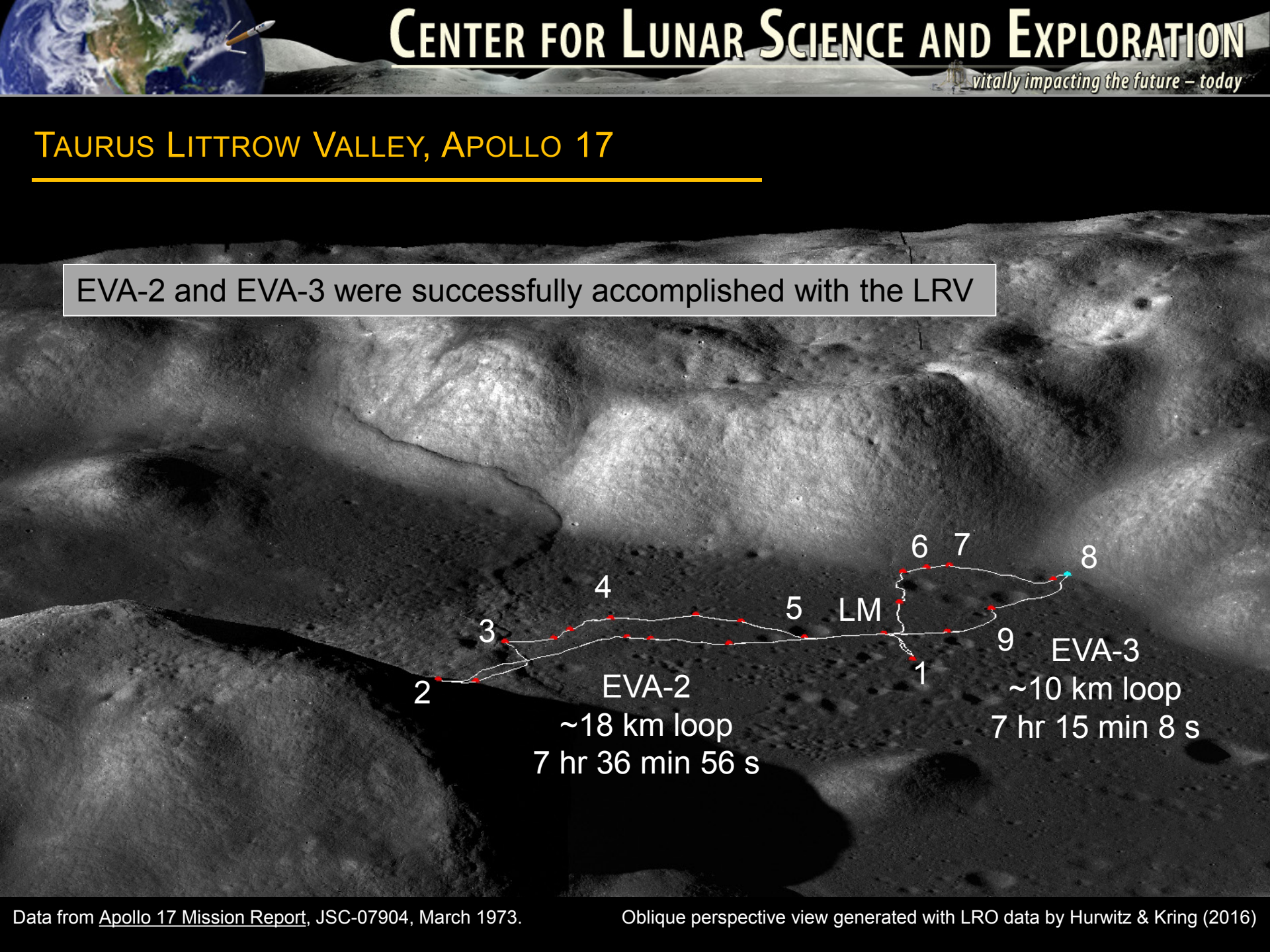
EVA-2 and EVA-3 were successfully accomplished with the LRV



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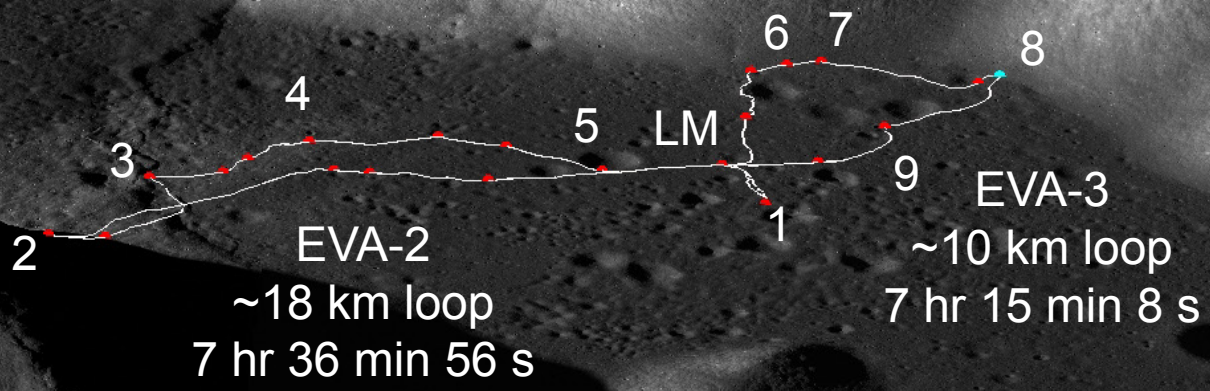
The multiple stations of EVA-2 and EVA-3 would not, however, be possible with an SPR if crew were limited to a single EVA per day.

Initial assessment: If an airlock configuration on an SPR limits crew to a single EVA, then future missions will not be able to do what our grandparents did over 40 years ago.



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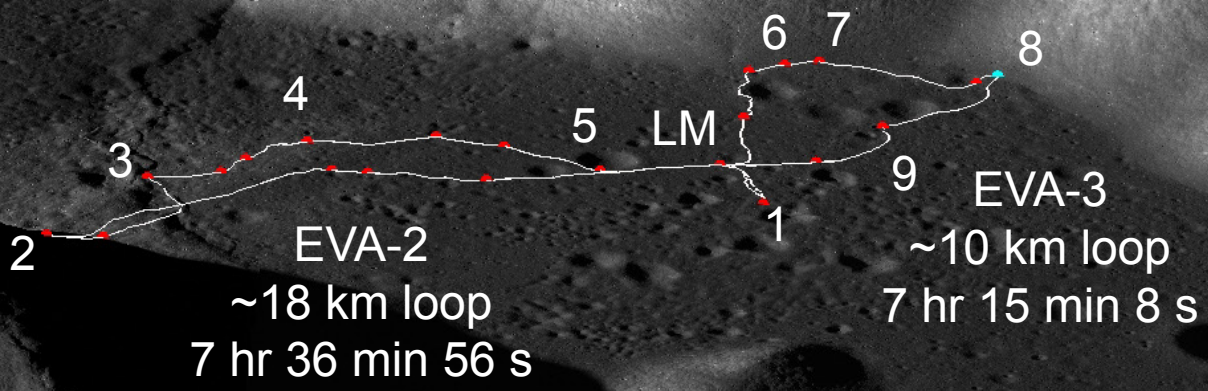
Taking a closer look:

While crew could potentially walk between stations spaced relatively close together, crew could not walk the entire distance of either EVA-2 or EVA-3, much less carry tools and samples over those distances.



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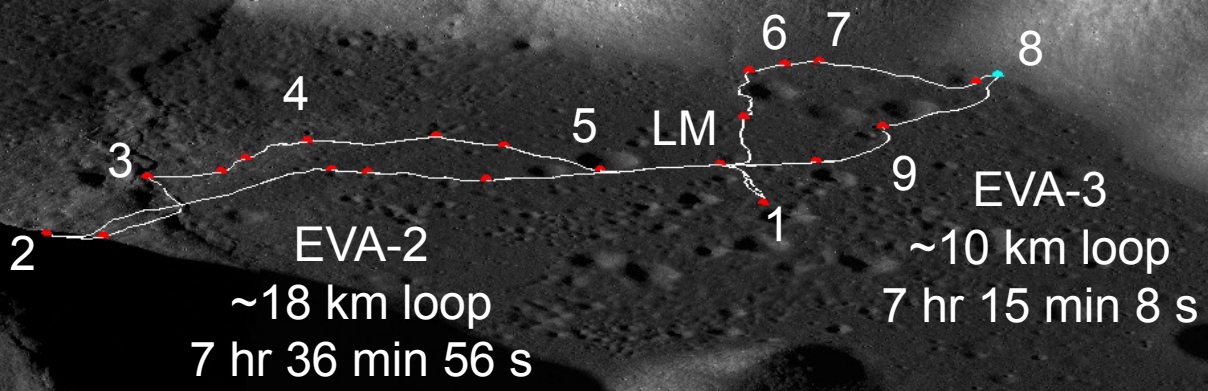
Taking a closer look:

Crew would also have to walk back to the vehicle, doubling their walking distance, unless the rover was tele-operated from Earth or from lunar orbit and driven on a path that trailed the walking crew.



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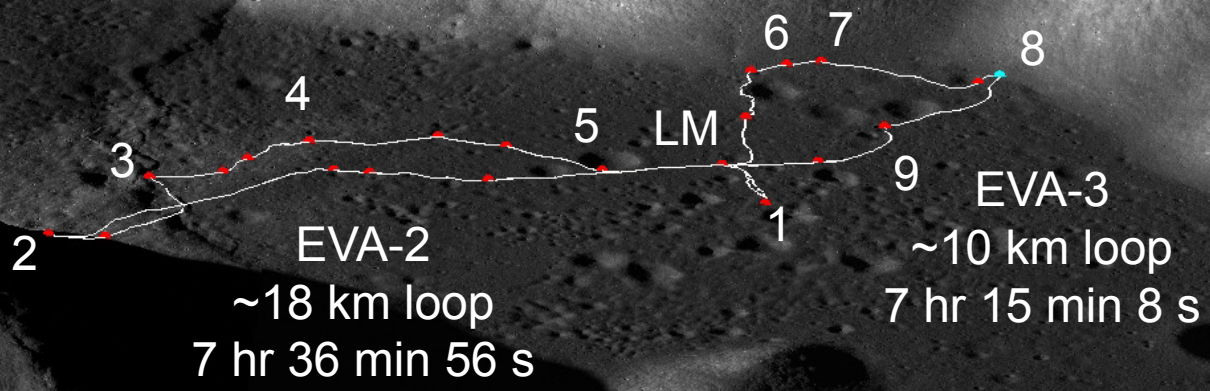
Thus:

A single EVA per day scenario would effectively limit crew to a single station.

Crew would not be able to explore complex geologic terrains with the same fidelity as Apollo crew, nor as efficiently.



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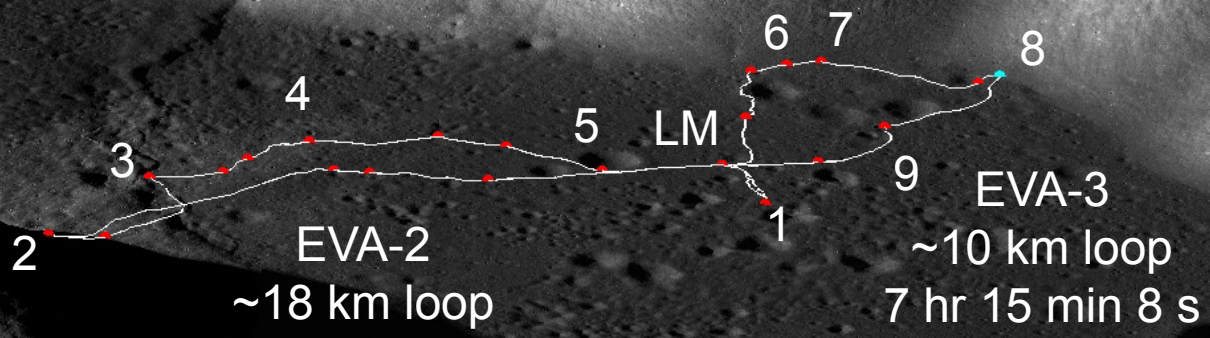
Suit ports, on the other hand, provide multiple-EVA/day capability.



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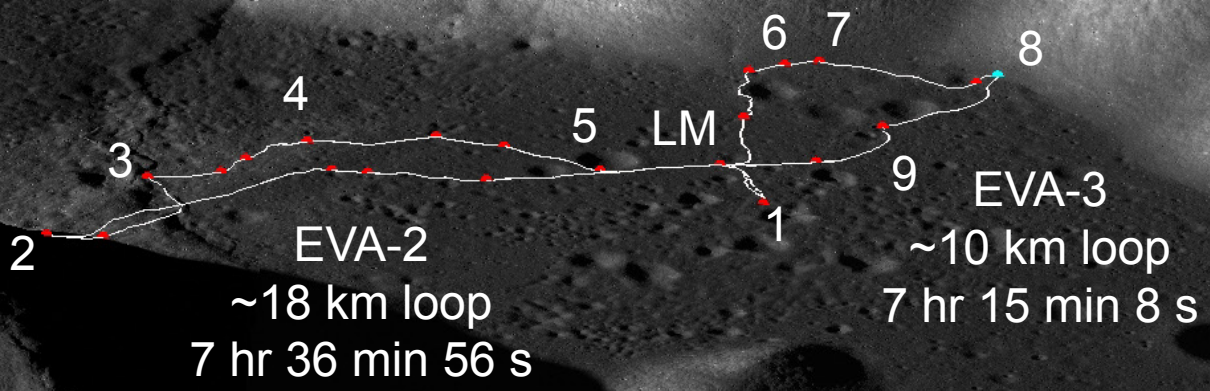
Conclusion:

If one utilizes an SPR to extend traverse distances beyond the 10 km walk-back limit, then it needs to have a rapid egress/ingress capability (e.g., suit ports) to match (and potentially exceed) the capabilities of Apollo crew in an LRV.



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Additional slide(s)

Unpressurized Rover (UPR) versus Small Pressurized Rover (SPR)

NASA Desert Research and Technology Studies in 2008 and 2009 compared a UPR and SPR.

Traveling within the SPR was easier on crew than spending an entire day in a spacesuit. Crew had more energy at stations when traveling in the SPR and were, thus, more productive.

(See a 2-page summary by Kring (2017) and references therein.)

The SPR could also provide shelter during any suit malfunction, radiation event, or medical emergency.

Simulations of 14- and 28-Day-Long Lunar Surface Missions

Through NASA Desert Research and Technology Studies in 2009 through 2011, several mission simulations were conducted with the Lunar Electric Rover (LER), which was an analogue for a Small Pressurized Rover (SPR) with suit ports.

In those simulations, science and exploration objectives generally required 3 to 4 EVA stations per day and 2 to 3 hours per day of boots on the ground.

(See a 2-page summary by Kring (2017) and references therein.)

Productivity would decrease dramatically if crew were limited to 1 EVA per day.

Recent studies of the Apollo 17 landing site

Debra Hurwitz and David A. Kring (2016) Identifying the geologic context of Apollo 17 impact melt breccias. Earth and Planetary Science Letters, 436, 64-70.

H. H. Schmitt, N. E. Petro, R. A. Wells, M. S. Robinson, B. P. Weiss, and C. M. Mercer (2017) Revisiting the field geology of Taurus-Littrow. Icarus, in press.

Other reference

David A. Kring (2017) The Lunar Electric Rover (aka Space Exploration Vehicle) as a Geological Tool. European Lunar Symposium, submitted.

Acknowledgement

I thank Debra Hurwitz Needham for assistance with the imagery and lengthy discussions of the Apollo 17 landing site.

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