APOLLO 15 TRAVERSE MAPPING

Phil Stooke

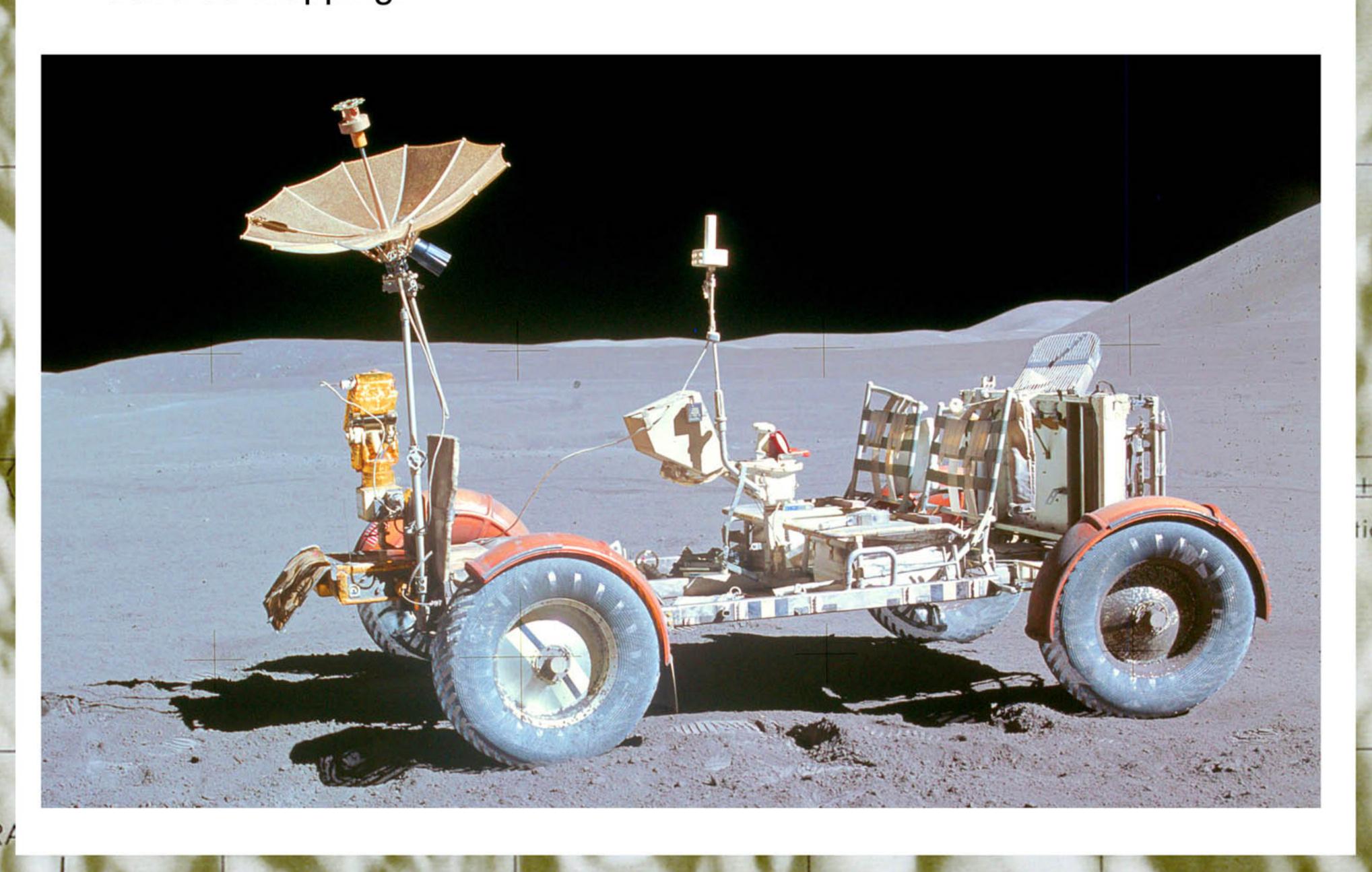
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Introduction

Apollo 15 landed at the Hadley-Apennine site on 30 July 1971. David Scott and Jim Irwin explored the site for three days using a lunar roving vehicle (LRV) before re-joining Al Worden in orbit.

The LRV traverses were portrayed in a map by the Defense Mapping Agency in 1975 [1], but that representation has long been known to be somewhat inaccurate (see the Apollo Lunar Surface Journal coverage of Apollo 15, [2]). In particular the map showed EVA 2 passing west of the crater Earthlight when evidence suggested it passed to the east. Rover navigation system readings were too sparse to help very much, and the crucial 16 mm camera which was to record the traverse did not operate for most of the surface mission.

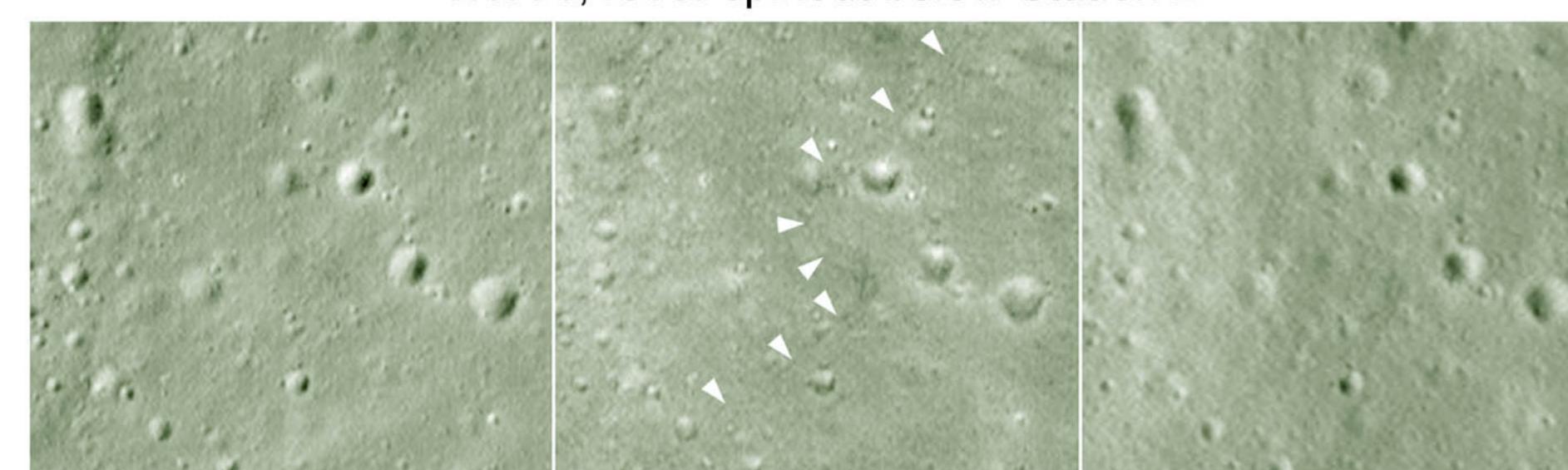
This study uses LROC images to map traverses, but even these show no tracks in many areas. Three other methods are used to improve traverse mapping.



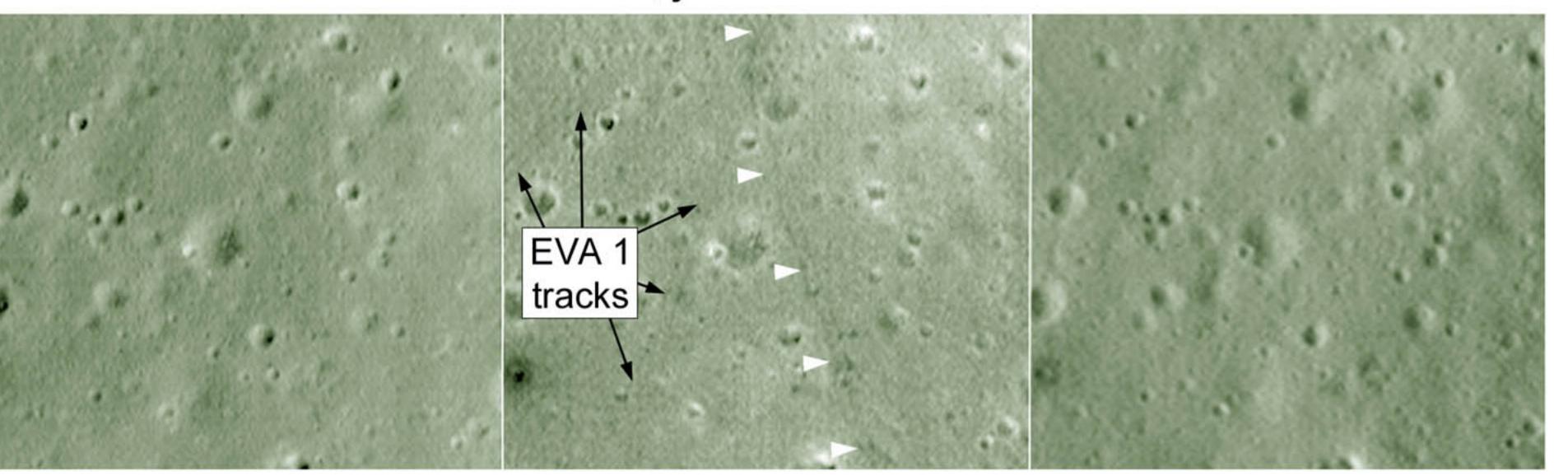
Shadow suppression

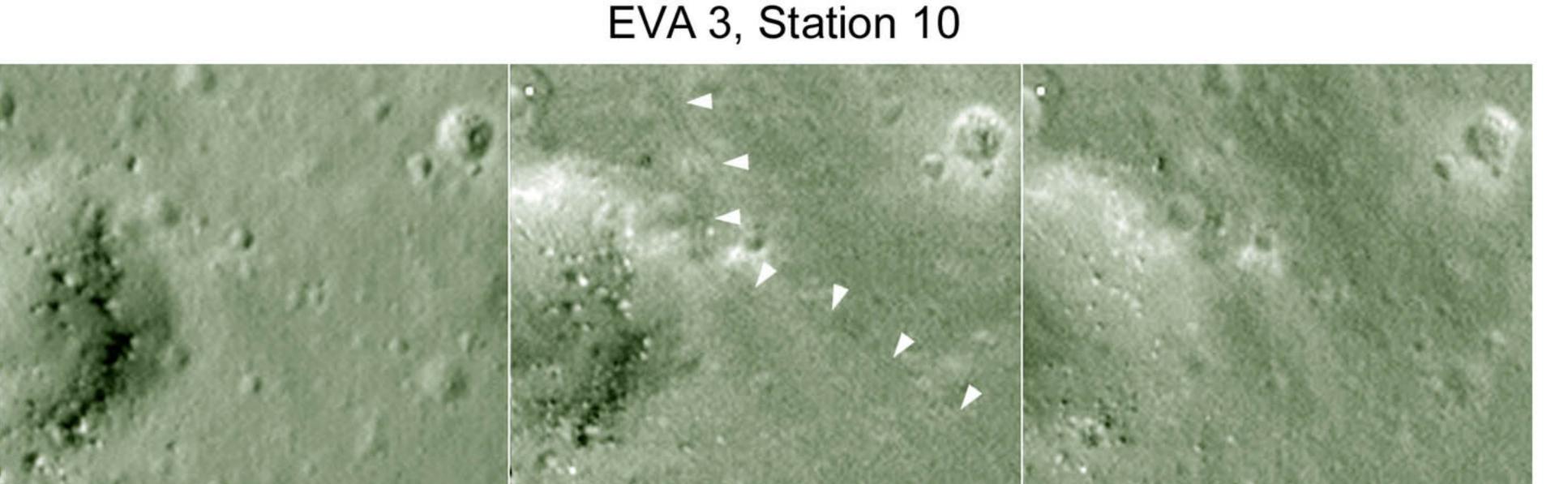
This method merges two images with opposite (morning and afternoon) lighting. The rationale is that topography-related shading and highlights will cancel each other out (if only partially) while albedo markings are reinforced. These examples show the results, revealing tracks almost invisible in the individual images. Good results can be obtained, but not in every situation. Apollo 15 is not the best case because it is far from the equator and shadows do not cancel out as effectively as (for example) Apollos 12 or 14.

EVA 1, rover spinout below Station 2

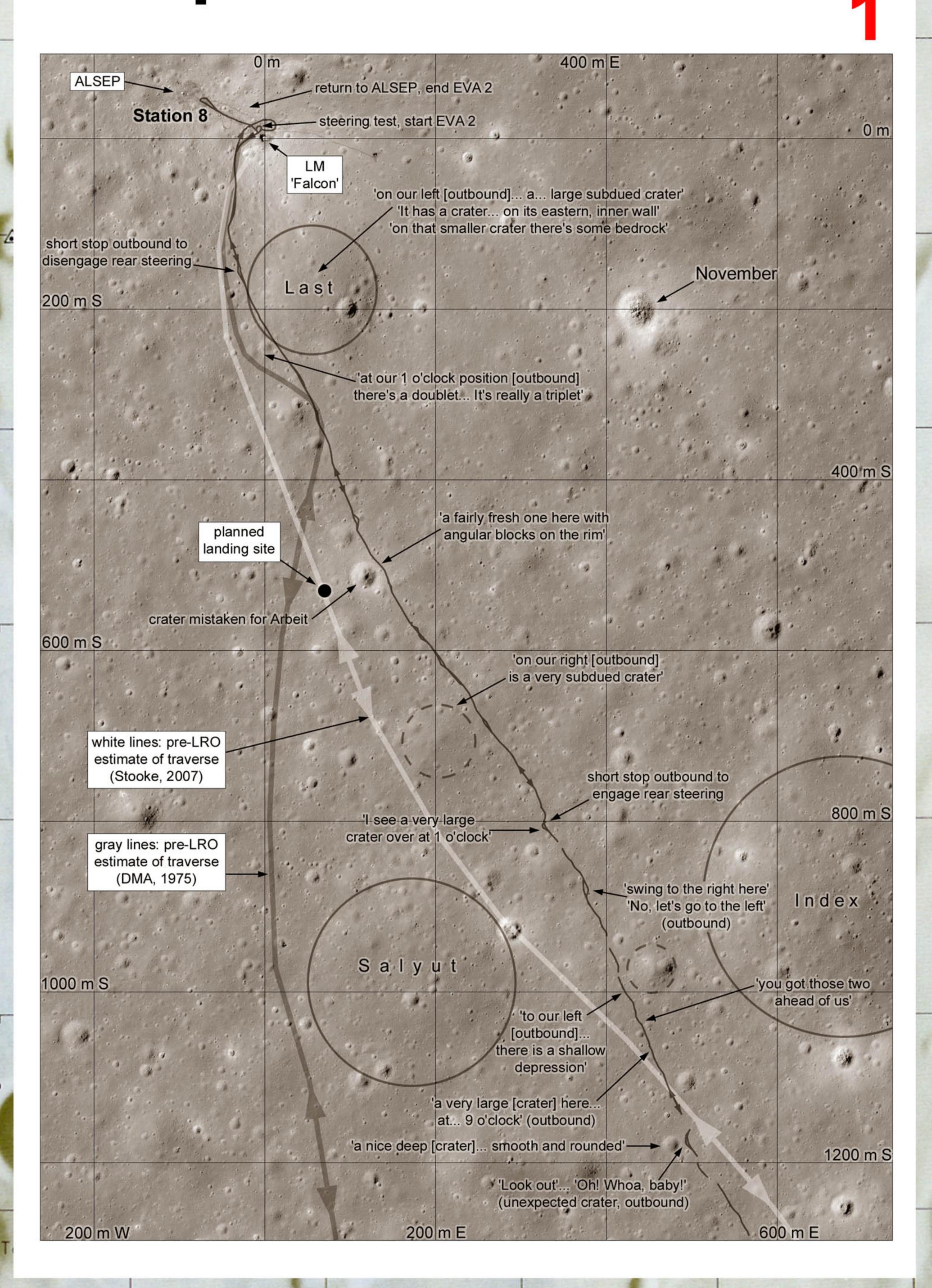


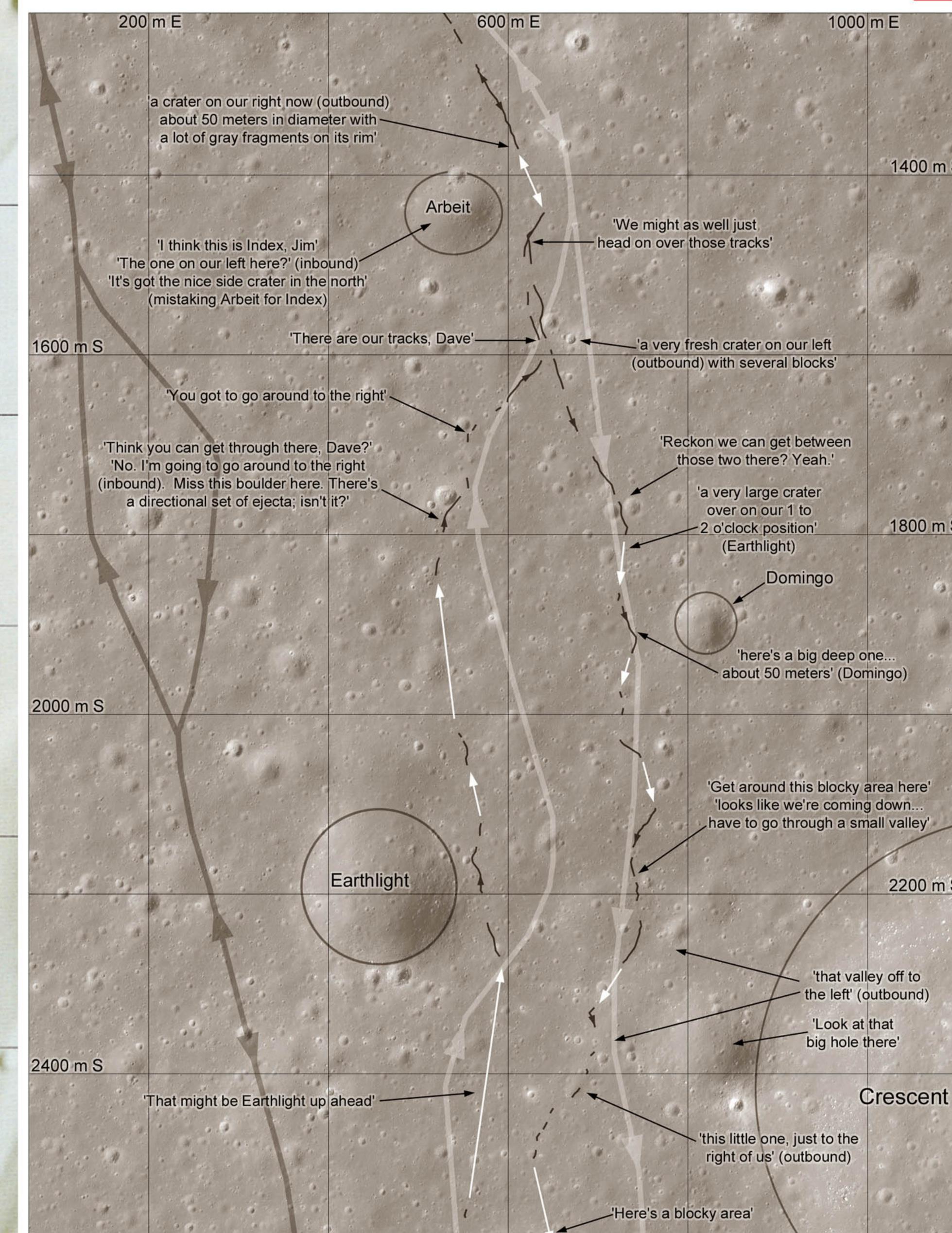
EVA 2, just south of LM





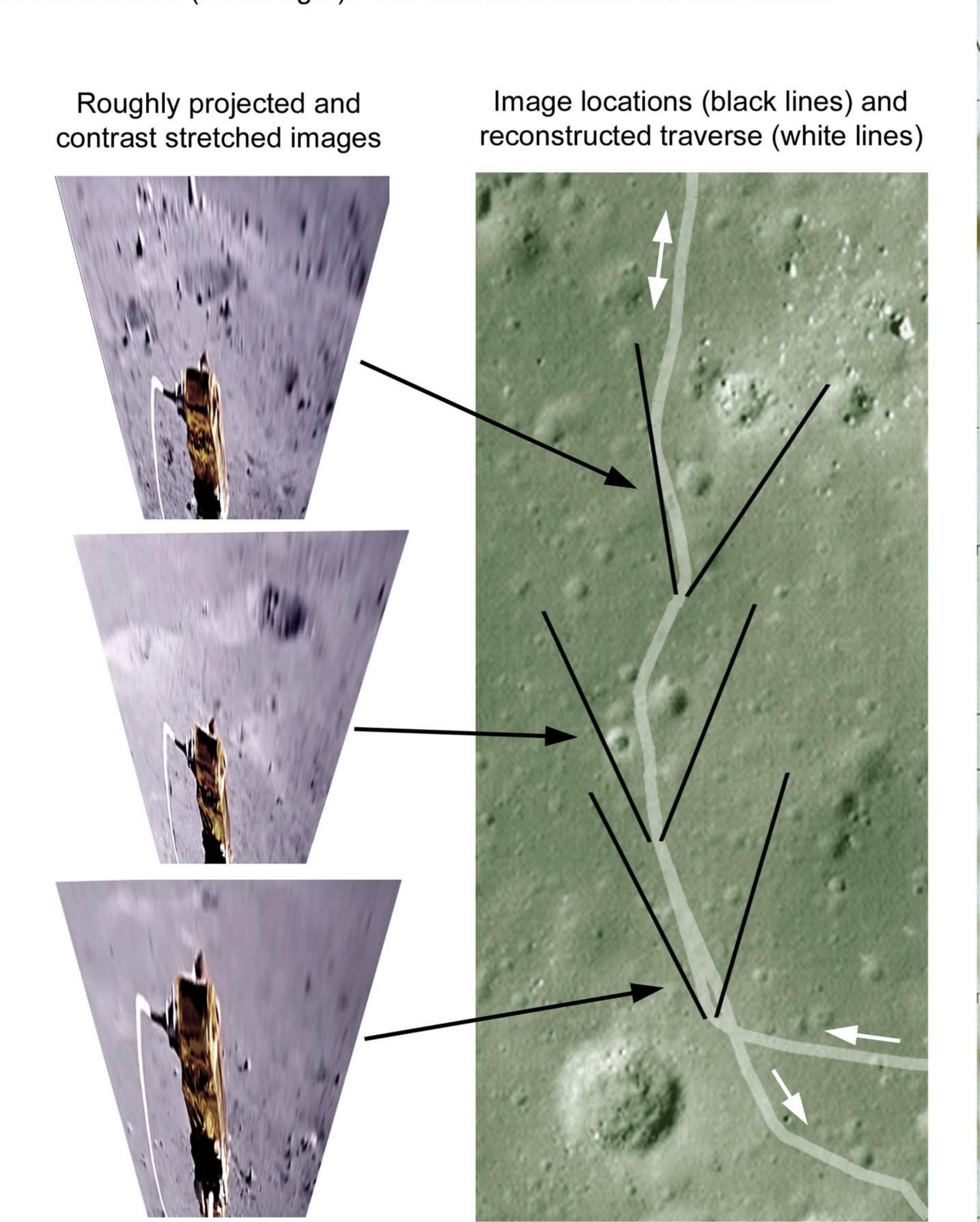
Apollo 15 - EVA 2





2. 16 mm image mapping

While northbound on the western rim of Dune crater, the 16 mm camera mounted on the rover worked for a short time, providing a video record of the drive. Individual frames were extracted, contrast-stretched, and roughly reprojected (below left) to compare with LRO images. This enabled detailed mapping of an otherwise completely invisible section of the traverse (below right). The outbound tracks are also visible.



3. Crew description

Step by step comparison of the voice transcript and the LRO images often reveals details of the path. Some examples are plotted on the map below. Other examples include statements such as 'a rather large [crater] out at 1 o'clock [outbound]... a lot of angular blocks on the rim of it' [just south of Elbow, EVA 1], and 'A very large depression here... let's go north of it' [EVA 3].

Results

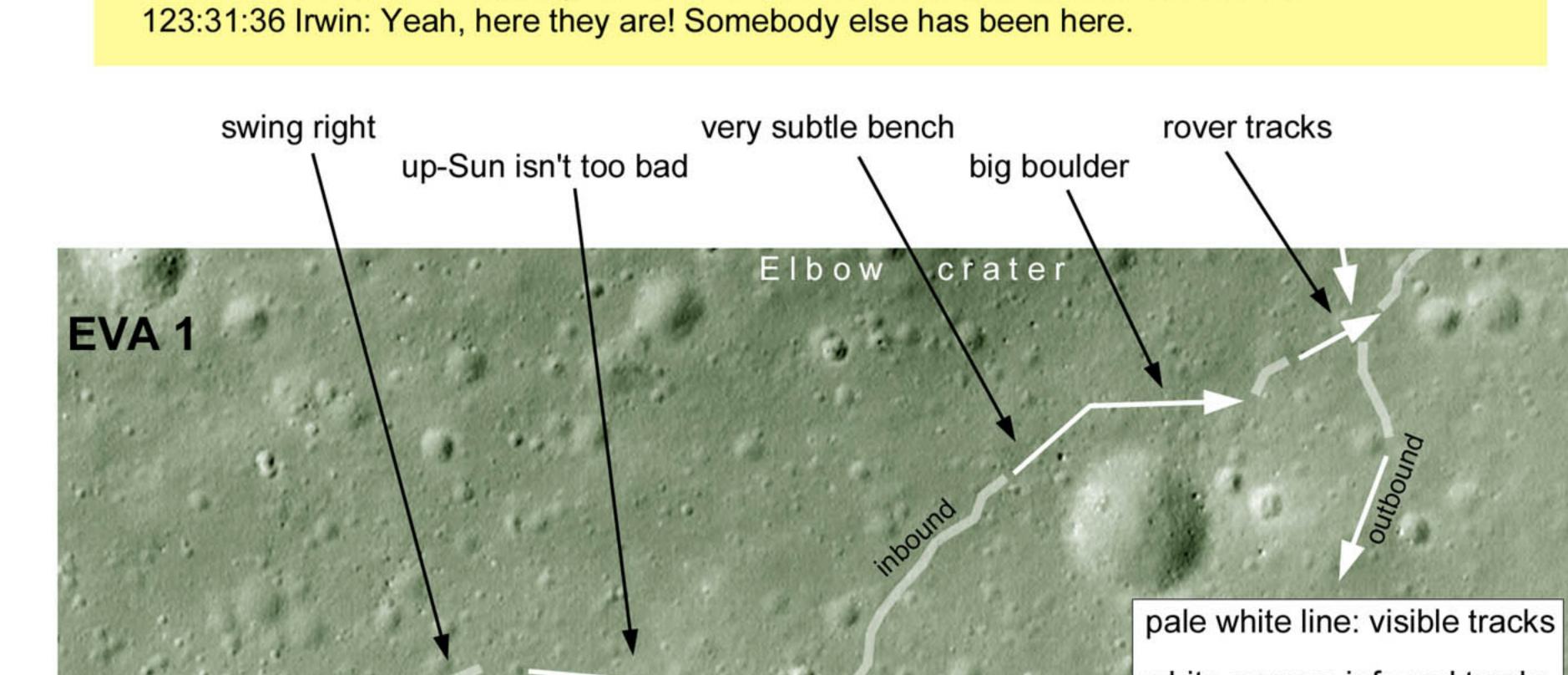
The three EVAs have been mapped with only short gaps, and though not perfect, and still uncertain in places, the results are an improvement on contemporary mapping. The method has now been applied to Apollo 16 and will be used for Apollo 17 later in 2018. The new maps will be made available to the Apollo Lunar Surface Journal and also published in an updated version of [3].

References

[1] Defense Mapping Agency, 1975. Apollo 15 Traverses. Lunar Photomap, scale 1:25000. Washington, DC, April 1975. [2] Apollo Lunar Surface Journal. https://www.hq.nasa.gov/alsj/. [3] Stooke, P., 2007. The International Atlas of Lunar Exploration. Cambridge University Press, 2007 (US date: 2008).

Apollo Lunar Surface Journal transcript (condensed):

- 123:30:24 Irwin: ... you have to swing to the right here, Dave, whenever you can. 123:30:31 Scott: Yeah. We want to get up on the ridge line here.
- 123:30:35 Scott: And also stay away from up-Sun ... 123:30:44 Scott: ... Up-Sun isn't too bad though, you know? ...
- 123:30:58 Scott: Have you noticed here on Elbow, it seems like there's a very subtle bench ... ? 123:31:03 Irwin: Yeah ... several subtle benches ... particularly on the eastern wall. 123:31:15 Scott: Oh, there's a big boulder! We just crossed over a buried, rounded boulder ..
- 123:31:24 Irwin: Gets pretty rough up ahead, Dave.
- 123:31:25 Scott: ... No kidding. ... There are some Rover tracks! How about that?



About 4 meters across and... a big block in it... on the south side' (unidentified) 'I think that's probably Earthlight that we see at 12 o'clock' (inbound) 'We could probably save some time going back by not following the tracks' Dune 'Maybe a little to the right?' (inbound) brief rest stop (outbound), partial panorama

