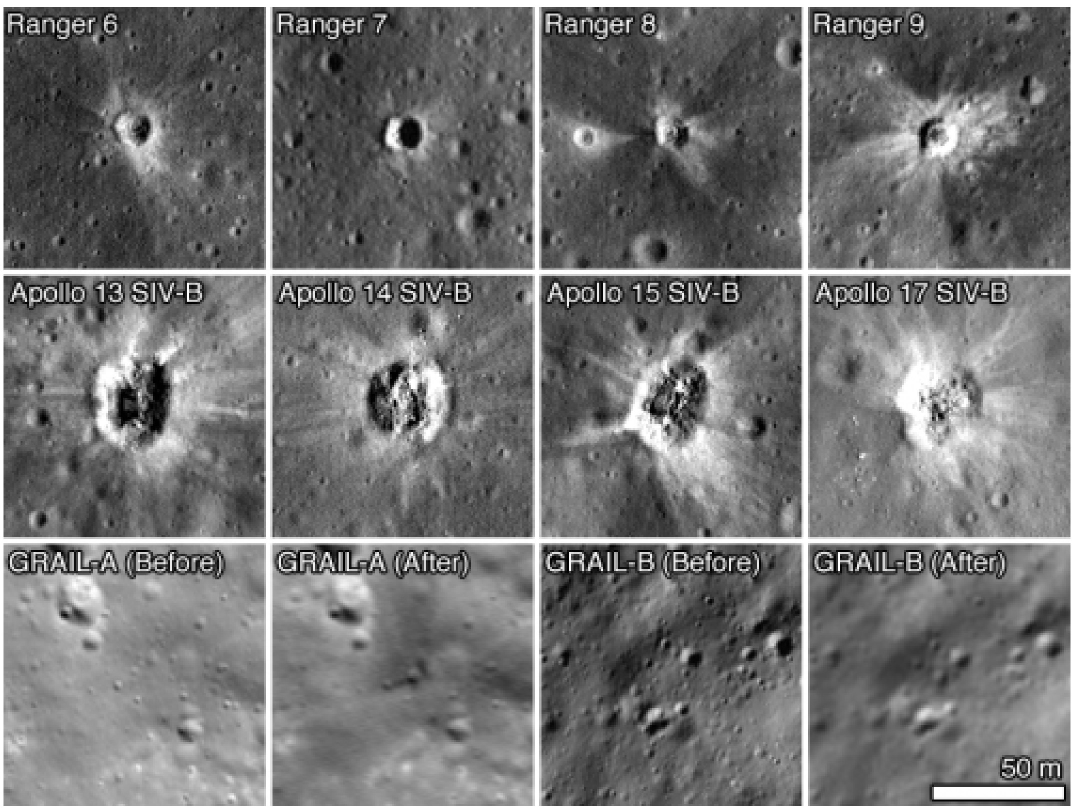
LROC coordinates of robotic spacecraft 2013 update

September 25 2013

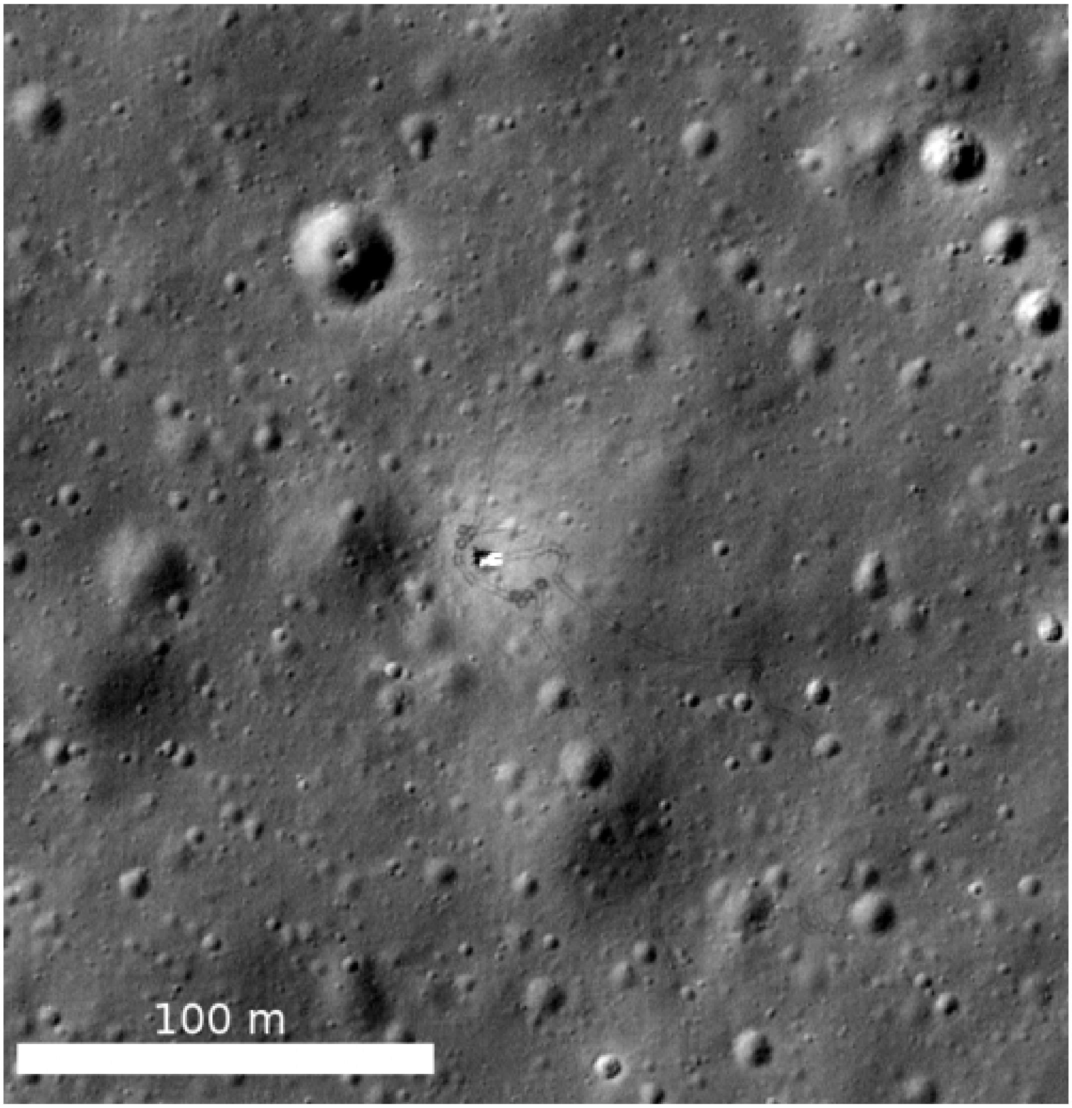


A selection of spacecraft impact sites imaged by LROC, all images to same scale. Credit: NASA/GSFC/Arizona State University

Repeat imaging of anthropogenic (human-made) targets on the Moon remains a Lunar Reconnaissance Orbiter Camera (LROC) priority as the LRO Extended Science Mission continues. These continuing observations of historic hardware and impact craters are not just interesting from a historical standpoint - each image adds to our knowledge of lunar science and engineering, particularly cartography, geology, and photometry.

Making sure that the lunar cartographic network is accurate is a critical component for planning future lunar missions for both human and robotic exploration of the Moon. The historic spacecraft serve as benchmarks (especially the laser retroreflectors). When new images arrive and final ephemeris is in hand we can check if the hardware has moved - well, actually we see the level of uncertainty in computing latitude/longitude coordinates (currently about ± 15 meters (yards)).

Currently the United States has no near-term plans to land humans or robotic spacecraft on the Moon, however China is scheduled to launch the Chang'e 3 mission in December. If we are lucky, the LROC team might have a before picture to compare to any after pictures of the Chang'e 3 landing site (the exact planned landing coordinates have not yet been released). Currently all LROC Narrow-Angle Camera (NAC) investigations must rely solely on "after" images of landing sites. Obtaining a before and after set of images of the Cheng'e 3 will facilitate a much better understanding of the delicate processes involved in regolith (dust and rock) redistribution due to lander rocket plumes.



Luna 17, the Soviet Union spacecraft that carried the Lunokhod 1 rover to the surface. You can make out the rover tracks around the lander. This is LROC NAC image M175502049RE. Credit: NASA/GSFC/Arizona State University

When a spacecraft lands on the Moon in a powered descent, exhaust gases from the descent engine disrupt the surface resulting in visible changes around the landed vehicle. These changes can be better understood with photometric studies using using LROC NAC images taken with different illumination geometries. Close to (or right under) the lander the soil is most disrupted, leading to reduced reflectance. Interestingly a zone of increased reflectance surrounds the lander. This "blast zone" ranges from a few meters for the Surveyor spacecraft, to a few tens of meters for Luna, and a few hundred meters for Apollo. Photometric modeling indicates possible causes for the increased reflectance zones from smoothing of the surface by the exhaust flow, the destruction of micro-scale regolith structure, and/or the redistribution of fine particles from the area beneath the lander to its surroundings. Modeling the dynamics of rocket exhaust plumes and studying the exhaust plume effects of previous landed spacecraft on the Moon are defining safe operational practices for future landing sites and outposts.

Careful retracing of the Lunokhod 2 traverse dramatically improved our understanding of the surface activities of that intrepid rover. In addition, by accurately determining the locations of the Luna 23 and Luna 24 landers, the LROC team determined not only how the Luna 23 spacecraft failed, but also that the Luna 24 sample was collected on the rim of a small impact crater, providing an explanation for the discrepancies that existed for the past three decades between samples and remote sensing of the Mare Crisium surface.

More information: wms.lroc.asu.edu/lroc_browse/view/lander_locations

Provided by NASA's Goddard Space Flight Center