FLOWING WATER WITH A PHOTOSYNTHETIC LIFE FORM IN GUSEV CRATER ON MARS. T. A. Krupa
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Introduction: In black and white images from orbititing spacecraft most of Columbia Hills in Gusev Crater on Mars has a high albedo. But a few anamolous regions have an extremely low albedo, including a region also photographed by the Spirit Rover, dubbed Larry's Outcrop/Larry's Lookout. Rover images of Larry's Lookout were analyzed to determine the cause of its very low albedo. For example, the following images from Sol 490 were analyzed:
2P169853362MRLAAE0P2422L2M1.img - red filter
2P169853538MRLAAE0P2422L5M1.img - green filter
2P169853678MRLAAE0P2422L7M1.img - blue filter
These Pancam images were radiometrically corrected with the radiance correction parameters found in the image file header using this equation:

CorrectedImagePixelValue = RADIANCE_SCALING_FACTOR x ImagePixelValue + RADIANCE_OFFSET

To preserve maximum dynamic range for maximum image detail, these 32-bit images were converted to 8-bit images with this equation:

8bitImagePixelValue = CorrectedImagePixelValue x (255.0/MAX) +0.5
(MAX is the maximum pixel value in the entire set of 3 red, green and blue filter images)

The 3 images were combined to form a true color RGB image suitable for display on a computer monitor. A color analysis revealed the cause of the low albedo on Larry's Lookout.

This same region was analyzed with SAGA, a computer Geographic Information System (GIS). The 3D (x,y,z) topographic (ground elevation) coordinates corresponding to this region, derived at JPL, were used for this analysis. The coordinates are encoded in this image: 2P169853362XYLAAE0P2422L2M1.img
A computer program was written to reformat the coordinates into a DEM (Digigal Elevation Model) format for input into SAGA. SAGA performed a channel network analysis with catchment area determined by a parallel processing algorithm. The channel network analysis determined the pathways where water flows, if water is present in the region.

Results: The true color image from Sol 490, and other true color images from adjacent areas created as described above, reveal the cause of this region's very low albedo in black and white photographs taken from orbit: the hillside at Larry's outcrop is covered by a very thin layer of green material on top of the soil.

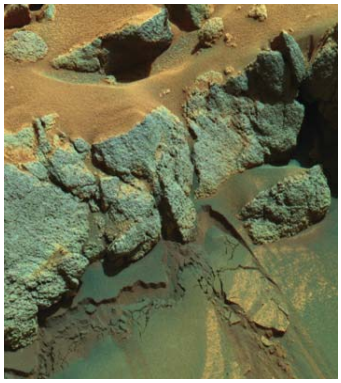

Fig. 1 Hillside is covered with green material.

Fig. 2 Enhanced closeup: green material in thin layer on top of the soil.

An image from Sol 503 with the camera closer to the hillside shows that this green material is composed of spherules that are approximately the size of the head of a pin, arrayed adjacent to each other in a single layer.

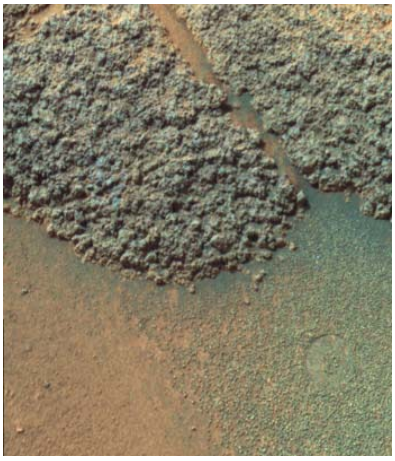

Fig. 3 Green material is composed of spherules in a single layer on top of soil.

The channel network analysis of the region with the landslide shows that many channels that originate above the landslide continue straight into the soil that was excavated by the landslide.

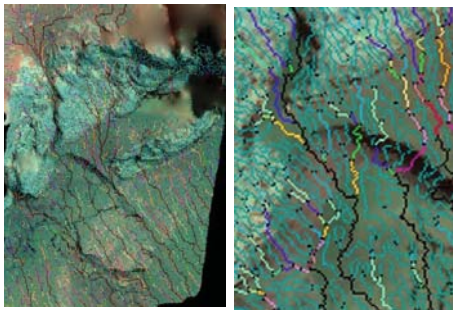

Fig. 4 Some channels are straight contiguous pathways extending from the region above the landslide into the landslide.

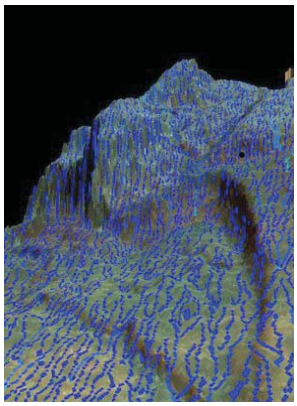

Fig. 5 Rendering in 3D

The region above the landslide and the region within the landslide were formed by completely different processes - so the topography of these two regions should be very different. Therefore, the channels where water would flow in the region above the landslide would not be expected to connect in straight contiguous pathways with the channels within the landslide. But many of these channels do form straight contiguous pathways between these two regions.

In a 2nd channel network analysis the SAGA computer algorithms only analyzed the region within the landslide, and the remainder of the region was deleted (set to null values). In a 3rd analysis SAGA only analyzed the region outside the landslide, and the landslide region was deleted. In both cases, the channel networks determined by SAGA appeared the same as the channel networks in the original case with no deletions. This indicates that the straight contiguous channels connecting the two regions are not artifacts of the channel detection algorithms.

Conclusion: The straight contiguous channels connecting these two regions are evidence that these channels were caused by water that flowed down the hillside above the landslide, and then entered the landslide, to erode channels into both regions.

The green spherules on this same hillside with intermitantly flowing water, suggests that these spherules are a life form supported by that water. Their green color suggests that the spherules contain a photosynthetic compound similar to green chlorophyll.

That the green spherules appear only above the ground is consistent with this hypoyhesis - since green photosynthetic life forms are typically found above ground, to absorb sunlight.

The distribution of these spherules in a single layer indicates that they aren't particles of sand - since particles of sand would be expected to accumulate in piles on top of one another. This is also consistent with the hypothesis that the spherules are photosynthetic life forms.