

Opportunity rover driving between 'lily pads' in search of Martian sun and science

November 10 2015, by Ken Kremer



NASA's Opportunity rover peers outwards across to the vast expanse of Endeavour Crater from current location descending along steep walled Marathon Valley in early November 2015. Marathon Valley holds significant deposits of water altered clay minerals holding clues to the planets watery past. Shadow of Pancam Mast assembly and robots deck visible at right. This navcam camera photo mosaic was assembled from images taken on Sol 4181 (Oct. 28, 2015) and colorized. Credit: NASA/JPL/Cornell/Ken Kremer/kenkremer.com/Marco Di Lorenzo

Just shy of an unfathomable 4200 Sols traversing ravishing alien terrain on the Red Planet, the longest living 'Martian' – NASA's robot 'Opportunity' – is driving between "lily pads" down steep walled Marathon Valley in search of life giving sun that enables spectacular

science yielding clues to Mars watery past. All this as she strives to survive utterly harsh climate extremes, because 'winter is coming' for her seventh time on the fourth rock from the sun!

"Opportunity is driving east and southeast down Marathon Valley, bisecting the region in which we detect smectites [clay minerals] using CRISM [spectrometer] data," Opportunity Deputy Principal Investigator Ray Arvidson, of Washington University in St. Louis, told Universe Today.

The ancient, weathered slopes around Marathon Valley became a top priority science destination after they were found to hold a motherlode of 'smectite' [clay minerals](#), based on data obtained from specially targeted and extensive Mars orbital measurements gathered by the CRISM (Compact Reconnaissance Imaging Spectrometer for Mars) spectrometer on NASA's Mars Reconnaissance Orbiter (MRO) – accomplished earlier at the direction of Arvidson.

The water altered smectites form under wetter, milder conditions than most rocks at the Opportunity site and under environmental conditions more conducive to support Martian microbial life forms, if they ever existed past or present. Opportunity is investigating relationships among clay-bearing and neighboring deposits for clues about the history of flowing liquid water and environmental changes.

With winter now fast approaching, the ever resilient rover has shifted the focus of science investigations – 130 months into her planned 3 month expedition!

In mid-October she moved from the northern region to the southern side of Marathon Valley, where the life-giving solar arrays can soak up more of the sun's rays from the sunniest spots along the north-facing tilted slopes and thereby generate more power to continue research activities at

the tasty outcrops.

"Opportunity is about halfway down the [smectite] detection zone and biased toward north facing "lily pads" on the southern side of the valley for end of drive locations – for power reasons," Arvidson explained.

During the next few months of Martian fall and winter, the engineering team will intentionally park Opportunity at end of drive locations where her solar panels are advantageously tilted towards the sun.

"Winter solstice is coming up in early January 2016," Arvidson told me.

"Effectively we have entered the winter plan of staying along the southern margins of the valley to enjoy north facing slopes and associated increased sunlight. This is the plan for the next number of months, image the floor and gathering some limited MI and APXS data while on the 'lily pads'."

The shortest-daylight period of this seventh Martian winter for Opportunity will come on 11 January 2016.



NASA's Opportunity rover snaps panoramic view of rock outcrop and the sun facing southern wall of Marathon Valley from current location in early

November 2015. This pancam camera photo mosaic was assembled from images taken on Sol 4182 and 4183 (Oct. 29 and 30, 2015) and colorized. Endeavour crater floor seen at far left. Credit: NASA/JPL/Cornell/Ken Kremer/kenkremer.com/Marco Di Lorenzo

Marathon Valley measures about 300 yards or meters long and cuts downhill through the west rim of Endeavour crater from west to east the same direction in which Opportunity is driving. Endeavour crater spans some 22 kilometers (14 miles) in diameter.

Along the 'lily pad' route, the six wheeled rover is collecting a wealth of science data where no rover has gone before – in the form of Pancam and navcam camera imaging and spectroscopy – to place the regions outcrops of rocks in geologic context.

"At end of drives Opportunity is acquiring Pancam color and stereo images to map the valley floor to better understand the stratigraphy, structure, and color patterns," Arvidson said.

See our photo mosaics herein illustrating Opportunity's view around and about Marathon Valley and Endeavour Crater, created by the image processing team of Ken Kremer and Marco Di Lorenzo.

Opportunity is also snapping mosaics with the microscopic imager (MI) and gathering analysis of elemental abundances of rocks and soils with the Alpha Particle X-ray spectrometer (APXS).

However, the rovers engineering handlers back on Earth have to exercise added caution regarding exactly where they send Opportunity on science forays since she is descending into a step walled narrow valley that can occasionally hamper daily communications with NASA's orbiters flying

overhead which relay data back and forth.

The high walls to the north and west of the valley ridgeline has already caused several communications blackouts for the "low-elevation Ultra-High-Frequency (UHF) relay passes to the west," according to the JPL team controlling the rover.

Another issue that the team occasionally has to deal with is bouts of "amnesia" wherein Opportunity undergoes "unplanned computer resets when using the type of onboard memory that retains information when power is off: [flash memory](#)."

To avoid "amnesia" engineers successfully implemented a strategy whereby they routinely avoided use of the rovers flash memory by working in RAM-only mode (no Flash for storage). This requires all data collected to be transmitted back to Earth on a daily basis, otherwise it would be lost.



Panoramic view from NASA's Opportunity rover looking down the floor of Marathon Valley and out to the vast expanse of Endeavour Crater. Marathon Valley holds significant deposits of water altered clay minerals. This composite photo mosaic shows the rover's robotic arm reaching out at left to investigate

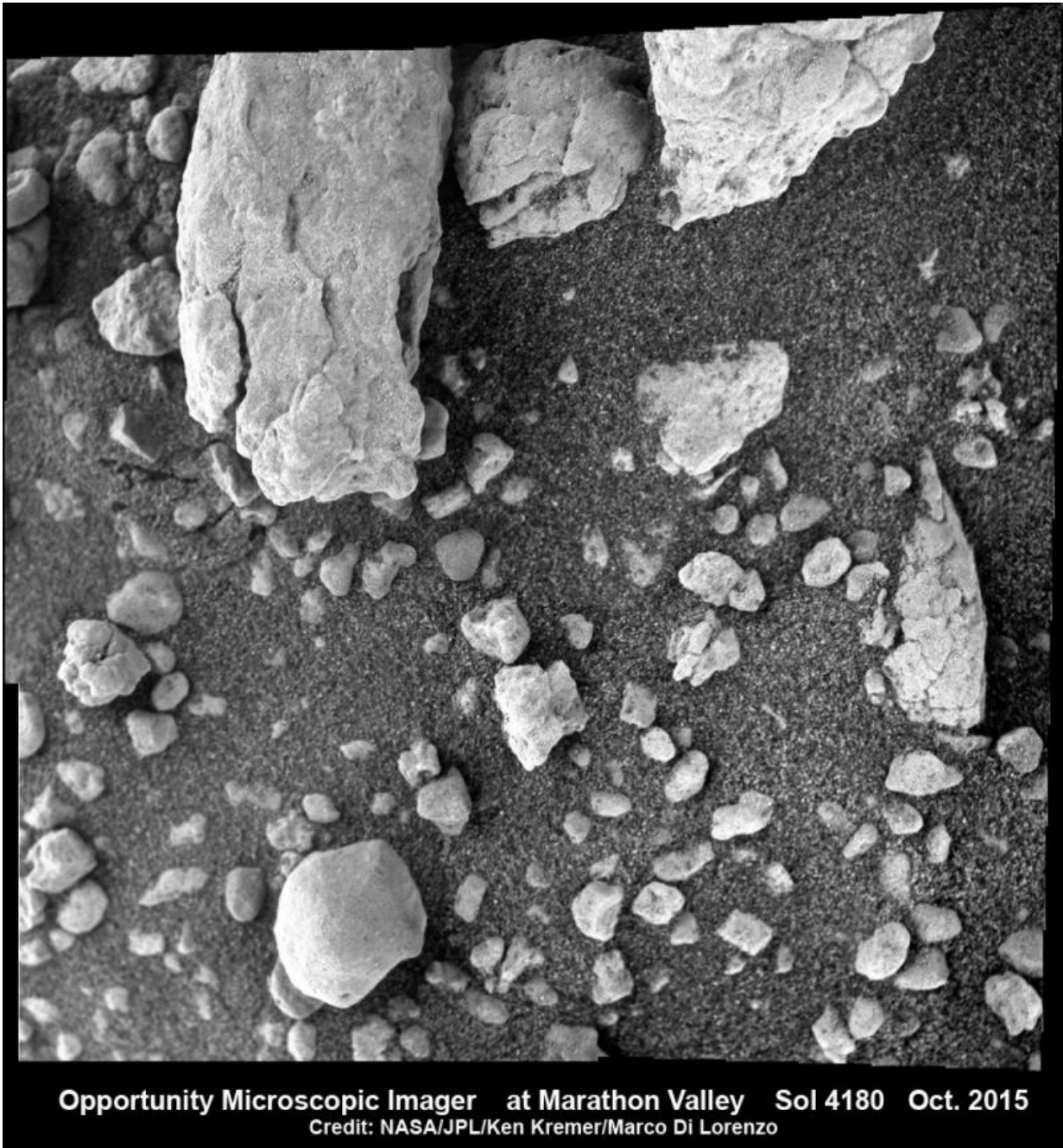
Martian rocks holding clues to the planets watery past, and robot shadow and wheel tracks visible at right. The mosaic combines a flattened fisheye hazcam image at left with a trio of navcam camera images taken on Sol 4144 (Sept. 20, 2015) and colorized. Credit: NASA/JPL/Cornell/Ken Kremer/kenkremer.com/Marco Di Lorenzo

"This is being done in RAM mode, where the data are lost if not transmitted down before the rover goes to sleep," Arvidson elaborated.

Meanwhile engineers are still trouble shooting the flash memory issue.

"Might try to mount FLASH again sometime over the next several weeks."

Indeed the team has tested various workarounds and has reinstituted use of flash memory mode. But resets are still occurring infrequently so more investigatory work remains.



4 image mosaic of microscopic images from Opportunity rover at pebbles at Marathon Valley. This 2 x 2 microscope imager (MI) mosaic was assembled from images taken on Sol 4180 (Oct. 27, 2015). Credit: NASA/JPL/Cornell/Ken Kremer/kenkremer.com/Marco Di Lorenzo

Overall Opportunity remains healthy with sufficient power to continue operations. The solar arrays produced 344 watt-hours of energy as of Nov. 3, 2015.

As of today, Sol 4192, Nov. 9, 2015 Opportunity has taken over 206,560 images and traversed over 26.48 miles (42.62 kilometers).



Mosaic view from Opportunity rover looking along the high walls and down the floor of Marathon Valley with deposits of water altered clay minerals and out to the vast expanse of Endeavour Crater. This navcam camera photo mosaic was assembled from images taken on Sol 4159 (Oct. 5, 2015) and colorized. Credit: NASA/JPL/Cornell/Marco Di Lorenzo/Ken Kremer/kenkremer.com

Meanwhile Opportunity's younger sister rover Curiosity traverses and drills into the basal layers at the base of Mount Sharp.

And NASA's newest orbiter MAVEN just confirmed that the solar wind stripped away Mars ancient atmosphere in the absence of a global

