LATEST RESULTS FROM THE MARS SCIENCE LABORATORY MISSION AND CURIOSITY ROVER.
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Introduction: NASA's Mars rover *Curiosity* has been exploring Gale Crater since arriving at Mars in August 2012 (L_s=151°). In June 2014, *Curiosity* completed its first Mars year. After driving nearly nine kilometers over fifteen months, in September 2014 *Curiosity* reached the first outcrop of rocks that are mapped from orbit as part of the Murray formation, the ~200 m thick basal layer of Aeolis Mons (Mt. Sharp). The rover then began a multi-month campaign to study the Pahrump Hills site, where a ~12 m vertical section of the Murray formation is exposed.

This presentation will cover the latest results from the Pahrump Hills campaign, including the analysis of samples expected to be drilled there in early 2015. It also will cover recent results based on atmospheric measurements and ongoing analyses of previously acquired samples. Some examples known at the time of abstract submission are given below.

Formation of Mt. Sharp: In the latter half of *Curiosity*'s nearly 15-month drive across Gale Crater's plains, the team began noting a pattern of southward-dipping, roughly east-west trending sandstone beds, interstratified with flat-lying sandstone and conglomerate beds. Similar sedimentary structures were seen as the rover headed southward and uphill. After extensive study, these structures are interpreted as stream and delta deposits with a transport direction *toward* the current (uphill) slope of Mt. Sharp. A model that the team currently employs proposes that when the fluvio-deltaic systems were active, the crater floor was a broad, closed basin (plus or minus a central uplift), and that sediment from the southward fluvial system and probably other sources progressively built the lower rock layers that now are exposed at the flanks of the mountain. In this model, the crater was partially filled with vertically stacked river, delta, and lake sediments. During this phase, the lake depth need not have been more than a few meters at any one time, and likely varied in areal extent and/or disappeared during dry intervals. Later undefined processes brought additional sediment to create the upper portions of the mountain and subsequently eroded the crater infill to its present, mound shape.

Although it is still in the early stages of examination, this working model fits many of *Curiosity*'s observations on the plains and made a prediction that, as the rover drove further southward, there would be a facies transition to flat-lying, fine-grained lacustrine deposits. In fall 2014, *Curiosity* reached the first rocks that are mapped as the Murray formation, the basal layer of Mt. Sharp. Examination of these sediments in a ~12 m section at the Pahrump Hills site found them to be flat-lying (although precise dip measurements are forthcoming) and predominantly fine-grained, but also stratified in beds varying in thickness (mm to cm) and interspersed with more erosion-resistant facies. The rhythmic nature of some of the finely laminated facies adds another dimension to the implications for paleoclimate.

Pahrump Hills Stratigraphy, Chemistry, and Mineralogy: Upon arriving at Pahrump Hills, *Curiosity* acquired a drilled sample from the base of the section from a target called Confidence Hills. The ChemCam, APXS, CheMin, and SAM instruments found the composition to fall into a new class relative to other rocks and soils studied at Gale Crater. While basaltic with some alteration products (e.g., phyllosilicates), the Confidence Hills sample also contains ~8% hematite. Hematite, a completely ferric oxide, had not been detected in this abundance by *Curiosity* before. MRO-CRISM observations of the Murray formation did predict hematite, providing *Curiosity*'s first such comparison with orbital measurements.

After the initial drilling effort, the MSL Science Team began a campaign to study the Pahrump Hills section in detail using a novel multi-pass strategy. The first pass surveyed the stratigraphy and chemistry with the rover's mast and body-mounted science cameras (Mastcam and MARDI) and laser spectrometer (ChemCam). These data were used to select sites where the arm-mounted hand-lens imager (MAHLI) and alpha-particle X-ray spectrometer (APXS) would measure the physical and chemical attributes of specific strata in a second pass. Efforts were made to capture both the "background" recessively eroding mudstone present throughout the section, as well as laminar, massive, and cross-stratified mudstone or siltstone facies present within resistant intervals. Finally, after these physical and chemical data were assembled into stratigraphic profiles, sites were selected for additional drill sampling and analysis with the SAM and CheMin laboratories.

The next drill site is expected to be the Mojave target at the Pink Cliffs site within Pahrump Hills, where MAHLI images revealed the rock to contain mm-scale lenticular-shaped crystal laths or pseudomorphs of unknown origin. Unlike for other rocks with diagenetic features observed in the section (veins and clusters of erosion-resistant material), here APXS measurements show no concentration of mobile elements (e.g., Ca, S, Mg) suggesting that the initial crystal-forming minerals may have been removed or replaced. Drilling and analysis may help address this.

Detection and Variability of Atmospheric Methane: Measurements over a 20-month period with the SAM suite's tunable laser spectrometer have resulted in a detection of CH_4 at a background level of 0.69 ± 0.25 ppbv, with elevated levels of approximately ten times that amount observed over a 60-sol period [1]. The latter is consistent with the episodic release of CH_4 from a local, unknown source.

D/H of Water Evolved from Hesperian Clay Minerals: The SAM suite was used to measure the D/H ratio of strongly bound water or hydroxyl groups in ancient clays from the Sheepbed mudstone at Yellowknife Bay [2]. The D/H value is ~ 3 times the ratio in Standard Mean Ocean water (which is representative of water in very early Mars) and half that of the present martian atmosphere. This measurement provides a snapshot during the early Hesperian of ongoing atmospheric escape and the desiccation of Mars.

Detection of Organics of Martian Origin: The SAM suite has performed evolved gas analyses of each of the five samples of rock or soil collected by *Curiosity*. Fines from the Cumberland drill hole within the Sheepbed mudstone at Yellowknife Bay have produced a definitive identification of chlorobenzene and C_2 to C_4 dichloroalkanes [Freissinet et al., *J. Geophys. Res. Planets*, in review]. When combined with the GCMS and EGA data from all other solid samples, blank runs, and supporting laboratory analog studies (including those that address sources of possible contamination), it is shown that these detections cannot be solely explained by known instrument background sources. The chlorinated hydrocarbons are instead the reaction products of martian chlorine and organic carbon originating on Mars or delivered by meteorites, comets, or interplanetary dust particles.

References: [1] Webster, C. R. et al. (2014) *Science,* doi:10.1126/science.1261713. [2] Mahaffy, P. R. et al. (2014) *Science,* doi:10.1126/science.1260291.