Sedimentary Records from Another World: Exploring Gale Crater Basin with the Curiosity Rover

Presented by

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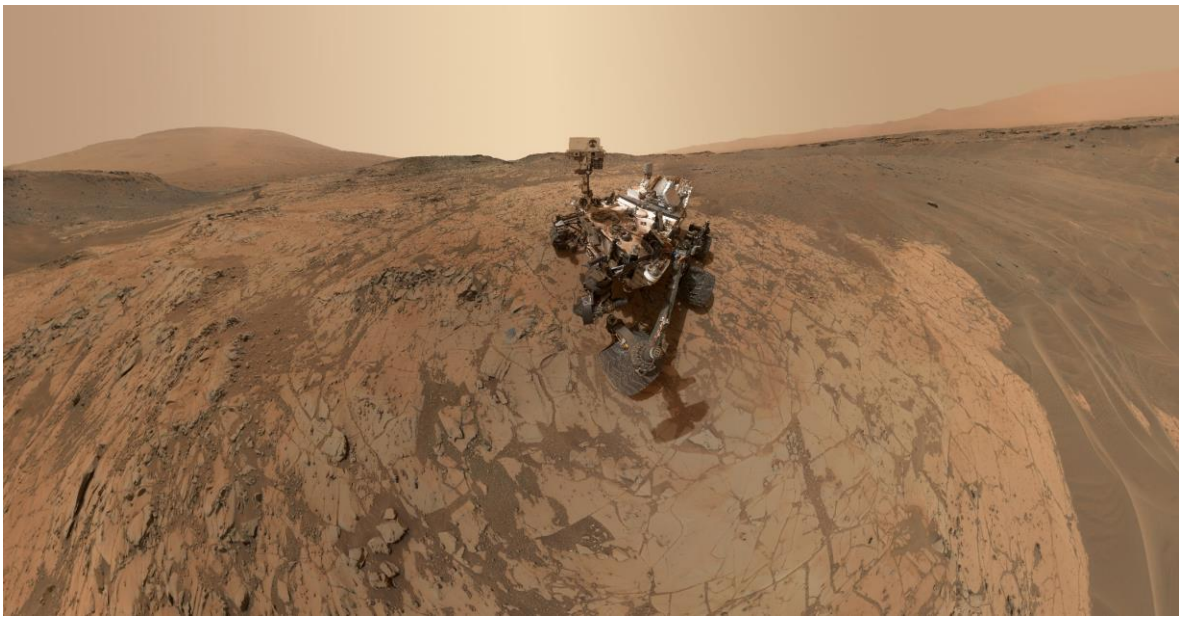
ABSTRACT

The Mars Science Laboratory rover, *Curiosity*, landed on the floor of Gale crater, Mars, on August 5, 2012. In the last 5.5 years, *Curiosity* has traversed over 11 miles (18 km) to explore 1200 ft (370 m) of basin-fill stratigraphy exposed as layered sediments preserved around the craters' central peak, a 16,000 ft (5 km) tall stack of sediments dubbed Mount Sharp.

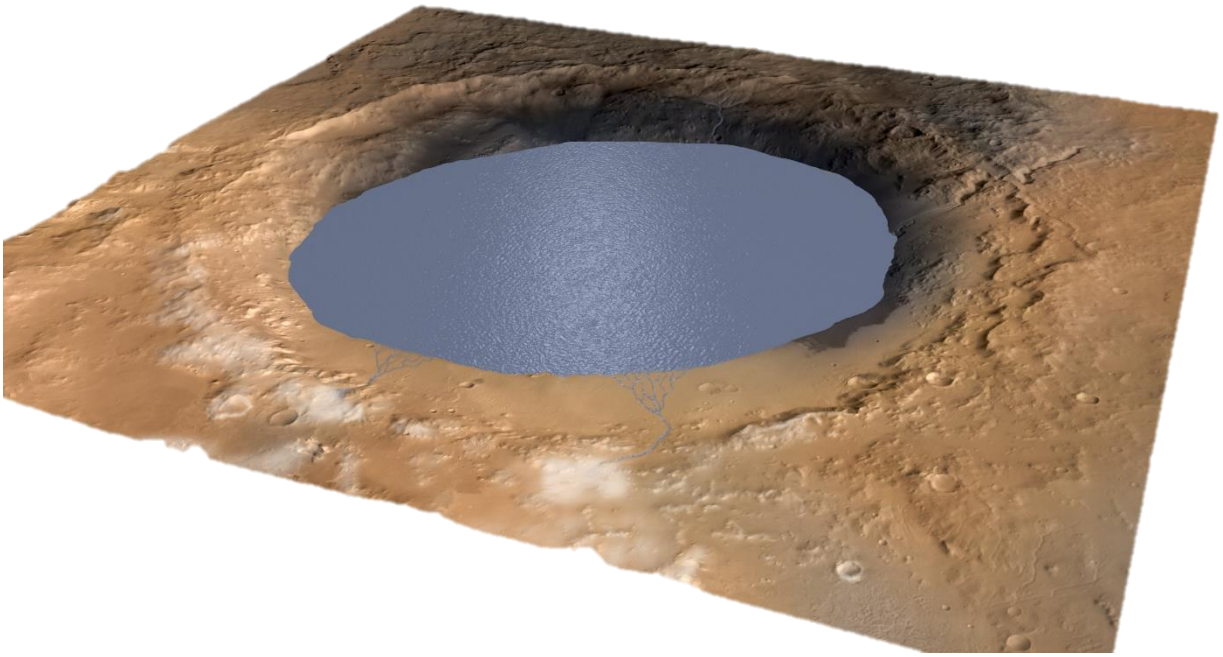
A portion of Mount Sharp, the preserved mound of sedimentary rocks in Gale crater [NASA/JPL/MSSS]

Along this traverse, *Curiosity* has not only collected tens of thousands of images of the Martian surface, but has also collected 500,000 laser shot-based chemistry analyses, 600 bulk chemistry analyses, and 15 drilled samples observed with both a mass spectrometer and an x-ray diffractometer, sending the data back to Earth on a daily basis. The instrument suite onboard *Curiosity* has enabled the highest resolution ever achieved in in-situ imaging of planetary surface samples, the first age date on another planet, ongoing chemostratigraphy based on multiple scales of compositional measurements, and ten robotic Martian selfies.



Selfie taken by Curiosity 1941 sols (Martian days) after landing, with sand dunes and Mount Sharp [NASA/JPL/MSSS].

Far beyond the numbers*, Curiosity's* findings have revolutionized our understanding of Mars. Whereas it was once thought that Mars may have only had intermittent short-lived periods of relatively clement atmospheric conditions, *Curiosity* has investigated over 300 m of mudstone deposited in a lake of liquid water that would have had habitable conditions for life ~3.5 billion years ago, which seem to have been sustained for at least 3 million years. These lake (and associated fluvial and deltaic) sediments underwent multiple episodes of diagenesis, showing that groundwater was present for even longer durations. Furthermore, the presence of cemented sedimentary rocks above angular unconformities show that significant fractions of the 152-km-diameter crater were filled with water-cemented sediments and then largely evacuated by wind at least twice prior to ~3 billion years ago.



Simulation of lake in Gale crater [NASA/JPL].

Curiosity has also shown that early Mars had more igneous diversity than previously predicted, that eolian bedforms with distinct wavelengths form under different atmospheric conditions, and that Mars today has active sand dunes and seasonal variations in atmospheric methane.

Professor Siebach will present the developing story of the history of the Gale crater basin, and the basin analysis work she has done to understand source-to-sink processes by separating chemical effects from source rock diversity, sediment transport, and diagenetic influences for multiple sedimentary cycles.

BIOGRAPHY

Kirsten Siebach is an Assistant Professor in the Rice University Department of Earth, Environmental, and Planetary Sciences. Her work focuses on understanding the history of water interacting with sediments on Mars and early Earth through analysis of sedimentary rock textures and chemistry. She is currently a member of the Science and Operations Teams for the Mars Exploration Rovers and the Mars Science Laboratory. Kirsten completed her PhD in Geology at Caltech with Professor John Grotzinger with a dissertation titled “Formation and Diagenesis of Sedimentary Rocks in Gale Crater, Mars”, and then did postdoctoral research in geochemistry of Martian sediments with Professor Scott McLennan at Stony Brook University. Prior to Caltech, she attended Washington University in St. Louis, where she graduated summa cum laude with a B.A. in Earth & Planetary Science and Chemistry.

She is also actively engaged in promoting education and outreach related to Earth and Planetary science and regularly presents at schools and outreach events. Outside of professional interests, she loves travel and photography (on Earth as well as Mars), and enjoys swimming, hiking, and social dancing.