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Curiosity Sends Curious Water Data from Mars

NASA/JPL-Caltech/MSSS

A portion of a photo snapped by NASA's Curiosity rover while traversing the Kimberley formation on its journey south toward the center of Gale crater. New spectroscopy data indicate that the water equivalent hydrogen makes up 1.5% to 2.5% of the weight of subsurface soils in this region.

On 6 August 2012, NASA's Curiosity rover landed on a Martian plain in the northern part of the 154-kilometer-wide Gale crater. Equipped with diverse instruments for imaging, sampling, and measuring, the rover immediately set to work, seeking clues to the planet's past climate as well as signs of chemicals necessary for life.

Curiosity collected data as it rolled slowly across the plain toward Aeolis Mons, a mountain at the center of Gale crater. One leg of the journey traversed an area known as the Kimberley formation, which features exposed layers useful for studying the Red Planet's past. *Litvak et al.* now report on estimates of water-associated hydrogen in Kimberley subsurface soil, specifically those made by the rover's Dynamic Albedo of Neutrons (DAN) instrument.

Scientists believe that much of the shallow subsurface of Mars—not just the polar caps—contains water in different forms, either water ice, physically absorbed water, or water bound in clay minerals. Funded by the Russian Federal Space Agency, DAN is a neutron spectrometer sensitive to the abundance of hydrogen in the Martian subsurface, regardless of what the hydrogen is bound to.

The hydrogen observed by DAN is assumed to be bound in water, based on the amount observed, soil samples, and similar observations from other Curiosity instruments. According to the authors, this indicates that the water equivalent of this hydrogen makes up 1.5% to 2.5% of the weight of subsurface soils in the Kimberley formation. This hydrogen is likely held in small quantities as adsorbed water in pores or in clay minerals formed during a warmer and wetter period of Mars's past.

DAN also found evidence of chlorine variations in the Kimberley formation. Both the water and the chlorine measurements made by DAN match well with those made by other Curiosity instruments for the same study site and by DAN for other similar sites. Chlorine is especially significant because variability of its bulk concentration might be related to volcanic activity, chemical weathering, water transport, hydrothermal activity—or perhaps the complex water history of an ancient lake.

As Curiosity drove southward across Kimberley, both water equivalent hydrogen and chlorine content derived from DAN were shown to decrease. The changes observed in DAN data correlate well to the observed bedrock stratigraphy of the Kimberley formation. Both water equivalent hydrogen and chlorine content also vary with depth. Curiously, DAN detected more water-associated hydrogen toward the surface than deeper down, opposite of what geological principles would predict. Further studies of Martian geology could reveal the reasons for these variations. (*Journal of Geophysical Research: Planets*, doi:10.1002/2015JE004960, 2016)

—Sarah Stanley, Freelance Writer