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DAN measures water in the soil of the Gale crater: new results from Curiosity

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The Gale crater was selected as the landing site for NASA's rover Curiosity (1). Since the landing in the August 2012, the neutron active instrument DAN (2) is performing active testing measurements of ground water and chlorine content along the traverse of the rover. The best model for the water content in the subsurface was found to be the 2-layer one, with the traverse-averaged contents of water in the top and bottom layers 1.51±0.42 wt% and 2.97±1.16 wt%, respectively. The traverse-average thickness of the top layer is about 18.5±8.0 cm, and the traverse-average content of chlorine is about 1.14±0.25 wt%. The uncertainties of the values above represent the physical dispersion of measurements along the traverse, while the uncertainties of individual measurements are much smaller for each tested spot.

These values are not consistent with the predictions for the ground water and chlorine in the Gale, which were based on the orbital measurements by GRS suite onboard Mars Odyssey (3). The average content of water around Gale, provided it is depth independent, was found to be about 5 wt%. More accurate estimations based on 2-layer model provide even much more water in the subsurface. The content of chlorine was determined from the orbit, about 0.5 wt%. The difference between water content estimations based on the orbital and surface data are larger than the statistical uncertainty, and one cannot explain the difference by different depth of neutron sensing by DAN and GRS. Therefore, one should consider the physical reason for depletion of ground water and enhancement of chlorine in Gale in comparison with the content in the soil of the surrounding area.

The Gale was not the natural site of soil hydratation, the soil around the crater has the water at higher content. During the epoch of wet Mars, the transport of soil by creeks and rivers into the Gale lake was probably associated with some selection process, which predominantly supply particles with larger sizes and less content of chemically bound water. Also, the wind erosion of Gale during the layer dry epochs was probably also associated with some size-selection process, when lighter particles were predominantly removed. As the result, a soil with less chemically bound water has been deposited in the Gale sediments, and more water has evaporated to the atmosphere from this soil. Such simple consideration could be suggested for explaining, why the soil at the Gale floor contains less water and more chlorine, than the area around the crater, as it is requested by the surface and orbital observations.

References

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