EPSC Abstracts
Vol. 12, EPSC2018-486-1, 2018
European Planetary Science Congress 2018

Water Content and Mineral Abundances at Gale Crater, Mars as Inferred from OMEGA and CRISM Observations

Y. Liu (1) & F. Stachurski (2); (1) Lunar and Planetary Institute, Houston, TX, USA (liu@lpi.usra.edu), (2) University of Glasgow, Scotland, UK

Abstract

Here we present the water content and mineral abundances at Gale crater as derived from the remote sensing observations. The results can help better understand the aqueous history of the region.

1. Introduction

Gale crater is a 154 km diameter crater on Mars where Curiosity rover started its exploration and investigation since 2012. Previous studies using orbital remote sensing data have revealed the presence of hydrated minerals such as hydrated sulfates and clay which record the aqueous alteration at Gale crater [1]. In-situ analysis of material properties of rocks and soils by Curiosity rover has found numerous evidence for water activities at Gale crater which has raised the possibility of Mars' past habitability [2]. In this work, we use hyperspectral visible/near-infrared (VNIR) data from the Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA) instrument onboard Mars Express and the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument onboard Mars Reconnaissance Orbiter (MRO) to quantitatively analyze the hydration state (i.e., water content) and mineral abundances at Gale Crater.

2. Methodology

We use the Discrete Ordinate Radiative Transfer (DISORT) model to simulate I/F values at the top of the atmosphere and retrieve surface reflectance with spectral corrections for gases and aerosols from OMEGA and CRISM I/F data. Thermal correction is performed on OMEGA data using the OMEGA-derived surface temperature map. The thermal corrected reflectance spectra allow us to evaluate the strength of the 3 μm absorption feature and thus derive the water content. The methodology has been well established in the previous work [3]. For CRISM data, we retrieve surface single scattering albedos (SSAs) using the DISORT model, and then we perform linear unmixing analysis over the SSAs to derive mineral abundances over Gale crater using the method developed in the previous work [4].

3. Results and Conclusions

We will report the water content at Gale crater as derived from OMEGA observations at the meeting. The derived water content from orbital data will allow us to directly compare the results from in situ heating experiments of regolith materials by Curiosity, which in turn helps validate our approach to retrieve water content using orbital datasets. Also we will report the mineral abundances at Gale crater as inferred from CRISM data. The derived mineral abundances will help test and constrain the formation mechanisms of hydrated minerals at Gale crater in a region scale, which will also help route planning to geologically-interesting sites for Curiosity, and for comparison to rover-based results.

References

[1] Milliken, R., J. Grotzinger, and B. Thomson: The paleoclimate of Mars from the stratigraphic record in Gale Crater. Geophysical Research Letters, 37, L04201, doi:10.1029/2009GL041870, 2010

[2] Grotzinger, J. P.: Deposition, Exhumation, and Paleoclimate of an Ancient Lake Deposit, Gale Crater, Mars.Science, 350, n. 6257, 2015

[3] Liu, Y., R. E. Arvidson, M. J. Wolff, M. T. Mellon, J. G. Catalano, A. Wang, and J. L. Bishop: Lambert albedo retrieval and analyses over Aram Chaos from OMEGA hyperspectral imaging data, J. Geophys. Res., 117, E00J11, doi:10.1029/2012JE004056, 2012

[4] Liu, Y., T. D. Glotch, N. A. Scudder, M. L. Kraner, T. Condus, R. E. Arvidson, E. A. Guinness, M. J. Wolff, and M. D. Smith: End-member identification and spectral mixture analysis of CRISM hyperspectral data: A case study on southwest Melas Chasma, Mars, J. Geophys. Res. Planets, 121, 2004–2036, 2016.