EPSC Abstracts
Vol. 8, EPSC2013-404, 2013
European Planetary Science Congress 2013

An Overview of the Compositional Results from the LRO Diviner Lunar Radiometer

I.R. Thomas (1), N.E. Bowles (1), D.A. Paige (2), B.T. Greenhagen (3) and the LRO Diviner Lunar Radiometer Team
(1) University of Oxford, Oxford, UK, (2) UCLA, Los Angeles, California, USA, (3) Jet Propulsion Laboratory, Pasadena, California, USA (thomas@atm.ox.ac.uk)

Abstract

The Diviner Lunar Radiometer is a nine-channel radiometer currently orbiting the Moon onboard NASA's Lunar Reconnaissance Orbiter (LRO) satellite [6]. In addition to thermal channels for measuring surface temperature and solar reflectance channels to measure albedo, Diviner also has three 8-micron channels to determine lunar composition [6]. These three channels map the spectral location of an emissivity maximum known as the Christiansen Feature (CF), the peak wavelength of which is an important diagnostic of surface composition [4]. A unique dataset, made over three and a half years of near-constant operation, has revealed new insights into lunar surface constituents and processes. This presentation will highlight results from the analysis of Diviner compositional data from many members of the LRO Diviner Science Team.

1. Diviner Lunar Radiometer

The instrument is a nine-channel, pushbroom mapping radiometer that has operated onboard LRO since July 2009. During the 50km LRO circular mapping orbit, Diviner's spatial resolution was approximately 200m [6]. For the extended mission, LRO is now in an elliptical orbit to reduce fuel consumption, causing Diviner's resolution to vary between 150-1300m [7]. Calibrated Diviner data and global maps of visible brightness temperature, bolometric temperature, rock abundance, nighttime soil temperature, and silicate mineralogy are available through the PDS Geosciences Node. The three shortest wavelength thermal infrared channels (7.55-8.05µm, 8.1-8.4µm and 8.38-8.68µm) were specifically designed to characterize the CF, an emissivity maximum sensitive to silicate composition [4].

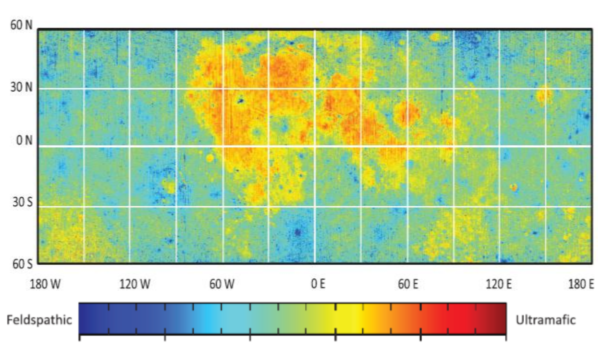

Figure 1: Diviner CF peak wavelength map of the lunar surface from ±60º latitude (from [4]).

2. Compositional Results

The CF is related to the fundamental SiO_2 vibration band, which with increasing silicate polymerization shifts to a shorter wavelength. Diviner is sensitive to the presence of silicic minerals such as quartz or alkali feldspar and has been used to localize these minerals on the lunar surface [2]. From observations of Apollo sites and laboratory measurements of Apollo soils, geochemical abundances e.g. FeO [1] and Al_2O_3 (Figure 2), have been able to be inferred.

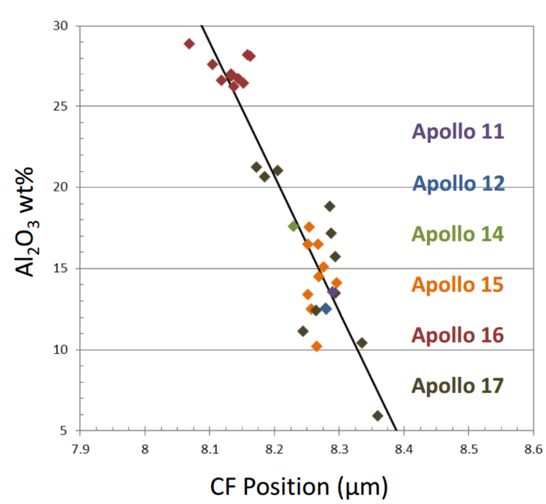

Figure 2: CF wavelength versus Al_2O_3 abundance at the Apollo landing sites (from [5]).

The compositional dataset has also provided important constraints on plagioclase abundance that can be used to derive the magnitude of rock mixing [4] and when combined with near-infrared datasets can reveal more than either dataset can individually. Ongoing investigations are also examining olivine and pyroclastic deposits [1], in addition to the composition of lunar swirls [3] and crater central peaks [8] (Figure 3).

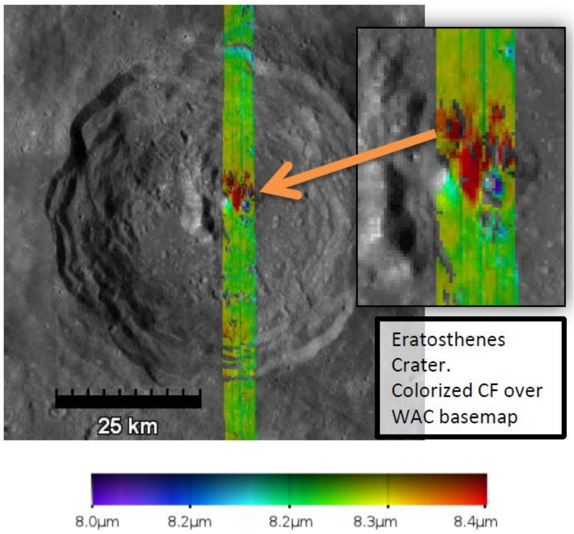

Figure 3: CF wavelength map of Eratosthenes crater, stretched from 8-8.4µm on an LROC Wide Angle Camera basemap (from [5,8])

Acknowledgements

Many thanks to everyone on the LRO Diviner Operations and Science Teams for all their work on the project.

References

[1] Allen C.C. et al. (2012) Analysis of lunar pyroclastic deposit FeO abundances by LRO Diviner, JGR, 117, E12.

[2] Glotch T.D. et al. (2010) Highly Silicic Compositions on the Moon, Science, 329, 1510.

[3] Glotch T.D. et al. (2012) Observations Of Lunar Swirls By The Diviner Lunar Radiometer Experiment, LPSC XLIII, Abstract # 1951

[4] Greenhagen, B.T. et al. (2010) Global Silicate Mineralogy of the Moon from the Diviner Lunar Radiometer, Science, 329, 1507.

[5] Greenhagen B.T. et al. (2012) Thermal, Thermophysical, and Compositional Properties of the Moon Revealed by the Diviner Lunar Radiometer, LEAG Meeting October 2012.

[6] Paige, D.A. et al. (2009) The Lunar Reconnaissance Orbiter Diviner Lunar Radiometer Experiment, SSR, 150.

[7] Paige D.A. et al. (2013) Diviner Lunar Radiometer Experiment Extended Mission Results: Thermal, Thermophysical, And Compositional Properties, LPSC XLIV, Abstract #2492.

[8] Song, E. et al (2013) Bulk mineralogy of lunar crater central peaks via thermal infrared spectra from the Diviner Lunar Radiometer: A study of the Moon's crustal composition at depth, JGR, 118, 1.