

REINER GAMMA FORMATION: OPTICAL, SPECTROSCOPIC AND POLARIMETRIC PROPERTIES FROM CLEMENTINE AND EARTHBASED DATA.

P. C. Pinet¹, V.V. Shevchenko², S. Chevrel¹, F. Bellagh¹, C. Rosemberg¹ ((1) OMP/GRGS, 14 Av. E. Belin, Toulouse, 31400 France; (2) Sternberg Astronomical Institute, Moscow, 119899, Russia).

The Reiner Gamma Formation is an unusual high-albedo morphological lunar feature, with no topographic expression, approximately 30x60 km in extent, located in western Oceanus Procellarum. It correlates with the strongest magnetic anomaly detected with Apollo magnetometers and its origin is still unresolved. A detailed remote sensing survey of the region by means of earth-based telescopic (1) and Clementine (2) CCD spectro-imaging and polarimetric imaging techniques has been made in the UV-visible-near infrared domain and the distribution of the main types of materials is proposed on the basis of their spectral/polarimetric characteristics.

The different spectral datasets have been instrumentally calibrated. Then a radiometric calibration has been made using telescopic and Galileo spectra (3,4,5). It results in the production of absolute reflectance spectra and relative reflectance spectra scaled to unity at 1.02 μ m. The consistency between the different datasets is within 2%. The two telescopic datasets (CCD1 (THX 384x576 array) and 2(THX 1024x1024 array)) comprise respectively 10 and 7 (noted by a star) narrow spectral bands (0.4, 0.56*, 0.73*, 0.91*, 0.95*, 0.97, 0.98*, 0.99, 1.02*, 1.05* μ m), with a 100 Å bandwidth and a 1km true spatial resolution (1). The Clementine data (CCDTHX 384x288) comprise 5 bands (0.41, 0.75, 0.90, 0.95, 1.00 μ m), with a 50 to 200 Å bandwidth and a 200 m spatial resolution (2). The respective image locations are shown in fig. 1a where the global frame corresponds to CCD2 frame, frame A to CCD1 and B to Clementine image.

A principal component analysis (PCA) is carried out on each dataset (6); for all cases, the first two principal axes bear 99% or more of the spectral variance (figs. 1b, 2b, 3b). From this multidataset analysis, mean spectra are produced for the main spectral components which are showed with their spatial distribution. It reveals that:

i) the Reiner Gamma Formation (RGF) is composed of three types of material (figs. 1,2,3), all of them (spectra 1,2,3) close to immature mare crater spectral characteristics, with variations however existing in the UV(0.4-0.56 μ m slope) and the 1 μ m range; their spatial distribution correlates with the photometric anomaly previously mapped (7);

ii) the RGF immediate surroundings show the presence of a specific intermediate-albedo spectral component (figs. 1,2,3), in agreement with the proposition made previously of the existence of a "red halo" unit (8). It is also distributed in a more diffuse way in the surrounding mare region, with local patches mainly southward the formation. It has general characteristics of a mature mare soil, but with a redder continuum slope and a slope change in the visible (spectra 4,5);

iii) the general background is composed of mare mature soils (figs. 2,3; spectrum 6);

iv) the PCA plot (fig. 1b) corresponding to CCD2 image (fig. 1a) demonstrates that there is no component from Cavalierius crater ejecta (lower left corner in fig. 1a and lower right wing in fig. 1b; spectrum and unit not shown) present in Reiner Gamma formation (fig. 1b: upper right wing);

v) the detailed Clementine image evidences that the dark lanes inside the general RGF outline contains mature mare soils (fig. 3a), undisturbed by the occurrence of Reiner Gamma event;

CCD-Polarimetric images produced in total light and at wavelengths 0.56, 0.73 μ m also reveal the specific behavior of RGF unit. Again, the "red halo" unit has polarimetric properties which differ from both the mare surroundings and RGF. Local patches spatially associated with bright areas considered above to be part of the Reiner Gamma swirls have polarimetric properties identical to the "red halo" unit, some of these patches having in their central part polarimetric properties close to the RGF anomaly. Observed variations appear related with soil maturity and/or grain size distribution (9).

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