

CONSTRAINING SOURCE(S) OF CIRCUM-CALORIS SMOOTH PLAINS MATERIAL THROUGH MAPPING, MERCURY.

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Introduction:

Vast expanses of smooth plains deposits on Mercury have been identified, characterized by sparse cratering, level or gently rolling terrain, distinct geomorphic boundaries with adjacent landforms, and embayment of older units [1,2]. These deposits were interpreted to have been emplaced by relatively young regional-scale effusive volcanism [e.g., 2-4] or impact melt [5]. Smooth plains units are concentrated in three locations: the northern smooth plains (NSP), Caloris basin interior plains (CIP), and circum-Caloris exterior plains (CEP) [2], which form a nearly continuous annulus around the Caloris basin [6; Figure A inset]. These units are distinct from the more heavily degraded intercrater plains (IP), which are interpreted as an older volcanic unit [7].

The focus of our study is an expanse of CEP material northwest of Caloris [Fig. A]. This location is of interest because of the presence of both high-reflectance red plains (HRP) and low-reflectance blue plains (LBP), which had previously been mapped globally [e.g., 8-11]. The complex interweaving of these two spectral units is not found in other locations of the annulus surrounding Caloris. By mapping the boundaries of these units, based on morphological and color differences [Fig. A insets], and age-dating them through crater counts, we seek to unravel their emplacement history, and evaluate whether these units are lava [2-4] or impact melt [5].

Hypotheses:

Hypothesis 1a: The exterior plain northwest of the Caloris impact basin was filled by a single lava flow, based on the apparent flow paths from the NSP [12].

Hypothesis 1b: The exterior plain northwest of the Caloris impact basin was filled by multiple lava flows, based on the color variations between units in the CEP.

Hypothesis 2: The exterior plain northwest of the Caloris impact basin was filled by impact melt, based on the annular deposits in relation to Caloris.

Methods:

Geomorphological and Color/Compositional Mapping: Regional mapping was performed using the MDIS WAC monochromatic and MDIS 8-band composite basemaps at a scale of 1:1M, enabling the discrimination of morphological contacts, tectonic structures, and color differences. Embayment relationships were mapped using MDIS NAC images.

Crater Counting: Crater counting was used to refine the emplacement ages of the plains through the calcu-

lation of absolute model age. Crater counts were performed in five locations (Fig. A), and model ages were determined using Craterstats2.

Spectral Analyses: Characterization of the spectral properties of the HRP and LBP units were performed in the ENVI image processing software suite using the 8-band color basemap. These spectral characterizations were used to assess the degree of compositional variability between the smooth plains units identified in the morphological mapping, and then were compared to spectra from the surrounding CIP and NSP to investigate provenance.

Initial Results and Interpretations:

The morphological characteristics of units within the CEP range from smooth plains with few large features to the heavily disrupted Caloris rim unit [Fig. A]. Two distinct smooth plains units, of interest to this investigation, were identified in the CEP [Fig. B] based on morphology and color. The presence of at least two distinct smooth plains units in the CEP was further supported by their spectral characteristics (see below).

Model crater ages overlap for the five count locations chosen [Fig. B], suggesting contemporaneous emplacement, subsequent to the formation of the Caloris basin at ~3.8 Ga. In view of the small count areas (~10-20 x 10⁴ km²), we chose to count craters below the diameter range (8-10 km) expected to be dominated by secondaries [e.g. 13]. However, the shape of the cumulative size frequency distributions [Fig. B] are similar to those identified for crater populations at larger diameters on Mercury [4], and suggest the craters represent primary rather than secondary populations.

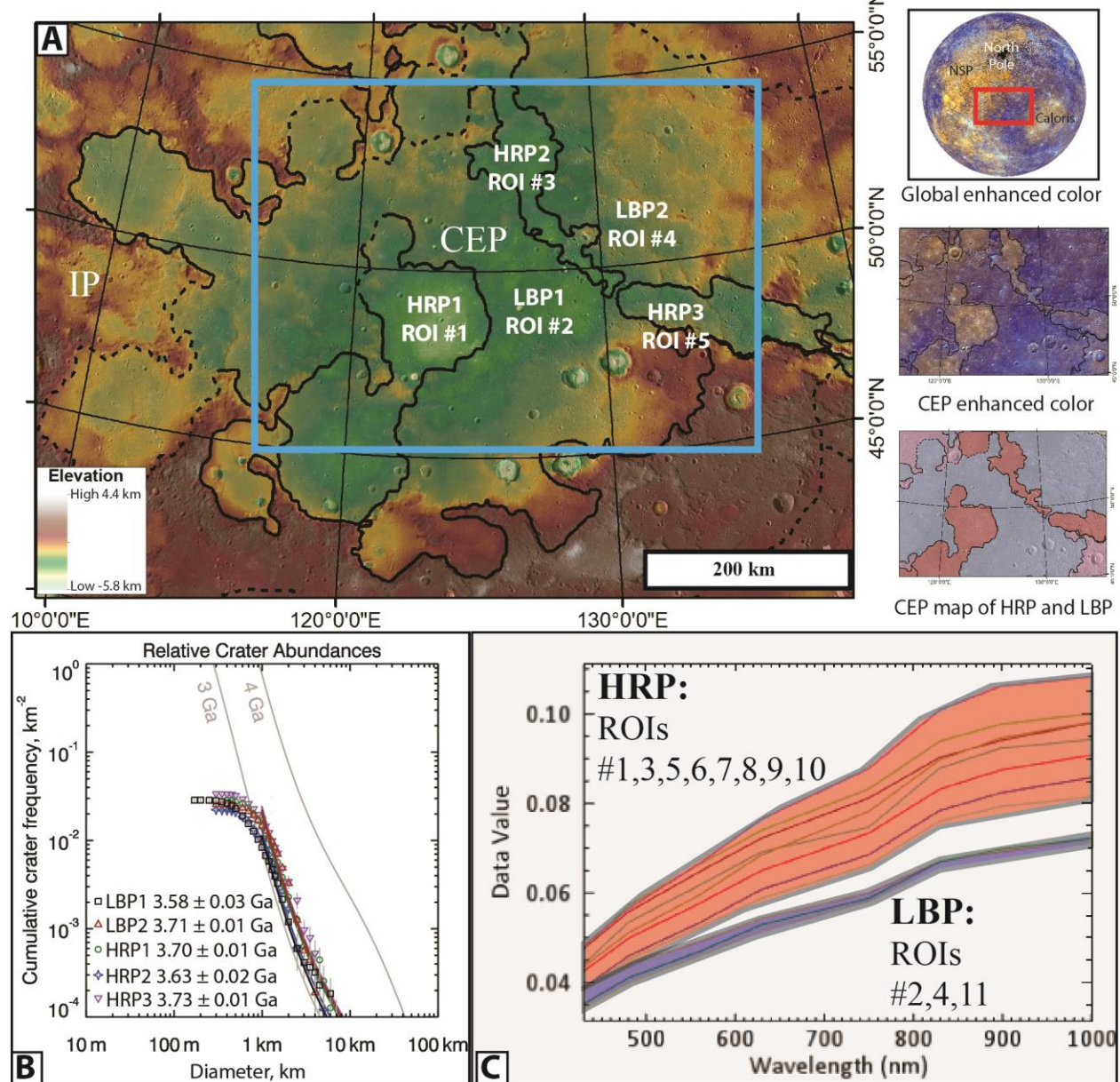
HRP and LBP units in the CEP are self-similar [Fig. C], and are consistent with previous investigations of global HRP and LBP deposits [8-11]. The HRP units within the CEP are similar to those in the NSP (ROIs #6-7) and CIP (ROIs #8-10) [Fig. C]. The LBP units in the CEP are nearly identical to the LBP unit (ROI #11) in the CIP [Fig. C]. This exposure is likely excavated LBP material buried beneath HRP material within the Caloris basin [11]. Further investigations of these spectra will involve principle component analyses [14], to characterize the apparent compositional differences between these units.

Morphology, color, and spectra support Hypothesis 1b, whereas crater count model ages are more consistent with Hypothesis 1a. None of our results support

Hypothesis 2, particularly the crater count derived ages, which post-date the formation of the Caloris basin. Our results tentatively support multiple lava flows, possibly originating from different magma sources. In further investigation, we will consider how to reconcile the morphological, color, and spectral data with the crater count model ages to derive a self-consistent emplacement history of these enigmatic plains.

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A: Regional context centered on the northwest CEP. *Insets:* Global enhanced color (top), enlarged (fit to blue box) enhanced color covering CEP interior (center), and enlarged map of HRP (red) and LBP (blue) units in the CEP interior (bottom).

B: Relative crater abundances with corresponding absolute model age estimates.

C: Spectral comparison of the CEP ROIs to HRP and LBP ROIs in the NSP and CIP. All HRP and LBP ROI spectra cluster together, suggesting similar compositions. The gray bands were used to group together the HRP and LBP units from the CEP, CIP, and NSP. ROIs #6-11 are not shown on the map, ROIs #6-7 are located in the NSP and #8-11 are located within the CIP.