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LATE ACCRETION ONTO TERRESTRIAL PLANETS

A New Map of Mercurian Smooth Plains

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INTRODUCTION

Smooth plains (SPs) are flat, smooth to gently rolling deposits, that are sparsely cratered with numerous surface features (i.e., wrinkle ridges) and have sharp contacts with adjacent terrains [1-2], covering about 27% of the surface [3]. In Mariner 10 era, the origin of all SPs centered around 3 hypothesis:

1) Volcanic [4-6];
2) Analogous to lunar LPs [7-8];
3) Impact-triggered volcanism [9], with at least some SPs having an impact origin [10-11].

With the MESSENGER mission instead, and the evidence for widespread effusive and pyroclastic volcanism, a volcanic origin for most SPs started gaining concensus amoung the scientific community. However, origins for deposits without volcanic features remains unclear. In this work, we used high-resolution images from the Mercury Dual Imaging System (MDIS), in combination with other data sets, to study SPs in detail with particular focus on:

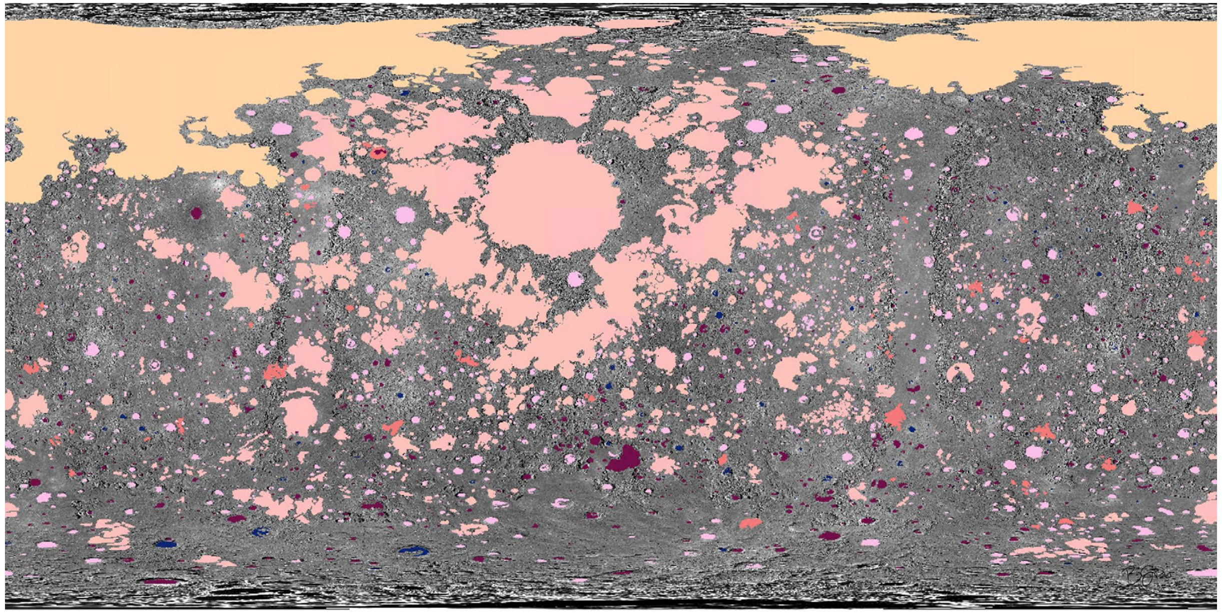
1. Previously unmapped small-scale deposits;
2. Crater floors down to 20 km in diameter.

Thus, we present a new and independent global map of smooth plains.

RESULTS AND DISCUSSION

We find that the SPs in our new map, including scf_c, cover about 33.5% of the globe, slightly more than found by [16]. While large scale deposits are generally similar to previous maps [1; 3; 17], small scale deposits, some previously unmapped, appear sparse and globally distributed – mostly within crater floors and of higher density compared to previous work [1; 3; 16-17]. Out new more detailed map, provides a more complete depiction of the global distribution of SPs and provides a basis for examining alternative hypotheses for deposits of uncertain origin, including emplacement as:

1) distal impact ejecta;
2) proximal impact material or impact melt deposits; or
3) a combination of all of the above.



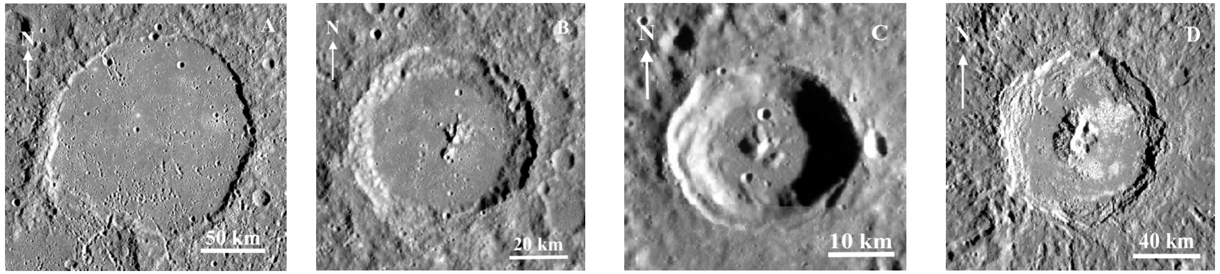


Fig. 1: A) Phidias crater; B) Thoreau crater; C) Unnamed crater SW of Phidias crater; and D) Tyagaraja crater, all south of Budh Planitia.

DATA AND MAPPING APPROACH

In this study, we used:

- The global mosaic basemap (MDIS, 166 m/p) for manually mapping SPs in ArcGIS 10.5 at a scale of 1:1.25 M;
- The latest regional geologic maps from PlanMap [12-15];

to visually identify SPs based on flatness, smoothness, sharpness of contact with adjacent terrains, and low crater density as per definition by [1].
Unit boundaries are defined by the continuity and sharpness between smooth and more rugged terrain alone. From the map below, we find:

a) SPs deposits in pink;
b) Northern SPs in beige:
c) Possible SPs in coral red, for which a classification is ambiguous.

In addition, due to the large heterogeneity of plains units within craters, we classified these as:

A. Ghost-like craters, almost or completely filled by SP (scf_c; Fig. 1A), also in pink;
B. Smooth crater floors 1 (scf_1; Fig. 1B), which are craters with visible peaks, remnants of a ring structure and terraces, with the floor or fill resembling SP-like deposits of uncertain composition, in lilac color;
C. Smooth crater floors (scf; Fig. 1C), which represent the rest of crater floors of uncertain origin, in purple color; and
D. A class we called, impact melts (IM; Fig. 1D) morphologically different from the previous classes, brighter and often exhibiting hollows, in navy blue.

CONCLUSION AND FUTURE WORK

Our new map of SPs occupy 33% of the surface of Mercury, showing a higher density of small-scale isolated deposits spread around the globe and within craters down to 20 km in diameter, increasing of 6% the global surface area distribution of SPs. We are now in the process of finalising our study by consulting roughness maps for available quadrangles in order to improve the completeness of our map even further.

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