EPSC Abstracts
Vol. 11, EPSC2017-976, 2017
European Planetary Science Congress 2017

The Intermediate Plains of Mercury: considerations on a debated unit

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Abstract

The ongoing production of a 1:3M-scale geological map of Mercury has permitted a deepened study of a debated terrain unit: the Intermediate Plains. It was introduced during the past Mariner 10 1:5M-scale geological mapping campaign, and lately it has been discarded and encompassed into either the Smooth Plains unit or the Intercrater Plains unit by the MESSENGER team. However, our studies show that for some limited areas, this unit has a distinct age, morphology, evolution and possibly composition.

1. Introduction

On Mercury 'surface morphology reflects the age, composition, lithology, and mode of formation of the underlying rock unit' [1] and Mercury's *geological provinces* must be 'characterized by a similar inferred origin or a distinctive history' [2, 3]. Based on these statements, three main morphologically recognizable units historically characterize the surface of Mercury: Smooth Plains (SP), Intercrater Plains (ICP) and Intermediate Plains (IMP). The latter, form 'planar to undulating surfaces that have higher crater density than smooth plains material, but are less heavily cratered than intercrater plains material' [4]. However, recent works conclude that there is no clear contrast between IMP and the adjacent terrains, such that they can be encompassed into either SP or ICP units [5], and that the age of IMP and ICP seem to overlap [6]. For these reasons, the IMP unit has been lately discarded from some geological maps [5, 7]. The recent production of a series of 1:3M-scale geological maps [e.g. 8, 9], however, led to the re-introduction of this unit due to evident morphological peculiarities that are visible at the used mapping scale (~1:400k). This is particularly clear in the area encompassed between the Holbein, Geddes and Vlaminck craters mapped by [8], where a distinct crater density and different structures characterize an IMP terrain patch (Fig. 1). The probable distinct evolution of this area of Mercury is also corroborated by a peculiar composition when compared to the geochemical terrains detected by [10]. With this work we look forward to better characterizing the mapped IMP regions by means of photo-interpretation, relative and absolute age determination, spectral and colour analysis, and correlation with element ratio composition in order to understand which events determined their evolution.

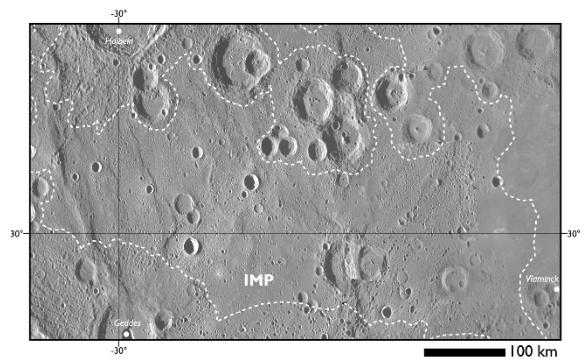

Figure 1: The Intermediate Plains of Mercury in the area encompassed between Holbein, Geddes and Holbein craters (inside the dashed line, marked with IMP). Unit boundaries mapped by [8]. Equirectangular projection.

2. Data and methods

We mainly use the data collected by the Mercury Dual Imaging System (MDIS) on-board the MErcury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) mission. We selected some photo-interpreted IMP areas from the map of [8] and made a thorough analysis of their morphology and features. We estimated the relative and absolute age of IMP and its overlapping features by means of crater counting techniques. We aim at correlating these results to the updated chemical information derived by the MESSENGER X-Ray Spectrometer (XRS) [11] and the available MDIS colour basemaps (MDR, MD3) or self-produced higher-resolution colour mosaics [12].

3. Results and future work

Current results show that the analysed IMP areas (Fig. 2) have an average crater frequency of 80±17 (normalized to an area of 10^6 km^2) for craters larger than 20 km, while SP and ICP crater frequencies are 40±10 and 114±13, respectively. Their absolute age results to be ~3.9±0.1 Ga, almost overlapping with the age of ICP, which is ~4.0±0.1 Ga in the studied area. Thus, they seem to remain a distinct unit both for their morphology and for their age. However, they pertain to two different geochemical terrains detected by [10]. One is characterized by high-Al abundance that stands out with respect to the adjacent plains and approximately corresponds to an area previously mapped as SP by [5]; the other, is encompassed in the high-Mg region, denoting a probable different origin. This compositional variability should reflect a different rock-forming mineralogy, which could be evidenced also by spectral variability in MDIS data.

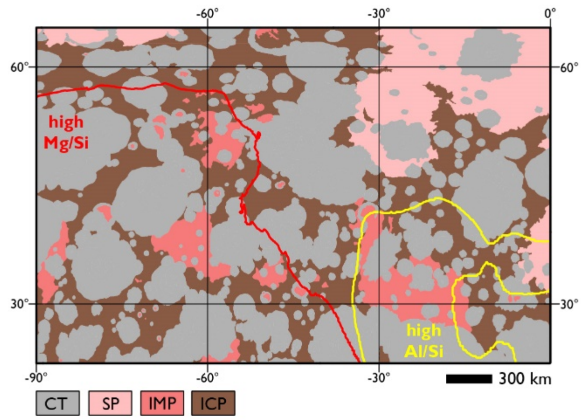

Figure 2: Simplified geological scheme of the Victoria quadrangle derived from the geological map of [8] showing the contour lines of the High-Mg region (Mg/Si > 0.5 in red) and of the high-Al region (Al/Si > 0.3 in yellow) [11]. Equirectangular projection centered at lat. 43.75°N, lon. -45°E. CT=Cratered Terrain, SP=Smooth Plains, IMP=Intermediate Plains, ICP=Intercrater Plains.

Finally, this evidence might lead to detect two distinct sub-units to obtain local- to regional-scale advanced geological maps that will rely on both surface morphology and mineralogy. In this view, our observations lead to the retention of Intermediate Plains as an official unit of Mercury, but further work is needed in order to contextualize their controversial nature.

Acknowledgements

This research was supported by the Agenzia Spaziale Italiana (ASI) within the SIMBIOSYS project (ASI-INAF agreement n. I/022/10/0).

References

[1] Trask, N. J. & Guest, J. E., Journal of Geophysical Research, 80, 2461–2477, 1975.

[2] Spudis, P. D. & Guest, J. E., In: Vilas, F., et al. (eds), Mercury, 118–164, University of Arizona Press, 1988.

[3] McCauley, J. F. & Wilhelms, D. E., Icarus, 15, 363–367, 1971.

[4] Spudis, P. D. & Prosser, J. G., US Geological Survey, Map I-1659, 1984.

[5] Denevi, B. W. et al., Journal of Geophysical Research: Planets, 118 (5), 891–907, 2013.

[6] Whitten, J. L. et al., Icarus, 241, 97–113, 2014.

[7] Prockter, L. M. et al., Lunar and Planetary Science Conference, 47th, #1245, 2016.

[8] Galluzzi, V. et al., Journal of Maps, 12, 227–238, 2016.

[9] Guzzetta, L. et al., Journal of Maps, 13, 227–238, 2017.

[10] Weider, S. Z. et al., Earth and Planetary Science Letters, 416, 109–120, 2015.

[11] Nittler, L. R. et al., Lunar and Planetary Science Conference, 47th, #1237, 2016.

[12] Zambon, F. et al., Geophysical Research Abstracts,19, EGU2017-16900, 2017.