MORPHO-TECTONIC ANALYSIS OF THE SURFACE OF MERCURY. F.C.Lopes[1], T. Barata[1]
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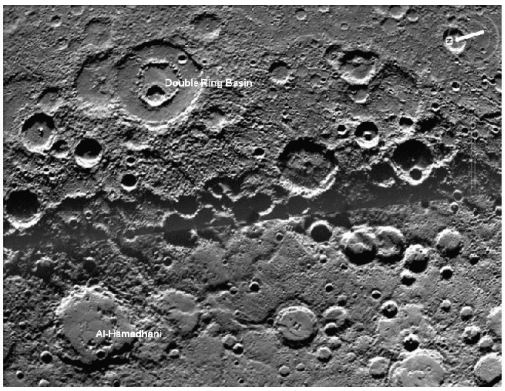
Introduction: The MESSENGER mission has revealed the surface of Mercury as never seen before. The instruments currently orbiting Mercury acquire digital images with great spatial resolution (18 meters), allowing extremely detailed analysis of geological features. The tectonic geomorphologic studies of Mercury surface can now be made for the entire planet at several scales, global, regional and local, and thus allows to understand better the geological history of Mercury.

Traditionally the analysis of planetary surfaces is based on the interpretation of remotely sensed images. The only exception is the Earth, where the image processing techniques developed and applied with distinct objectives to the study of digital images are normally validated with field work. In the last years digital image processing has been applied to to planetary imagery [1-7].

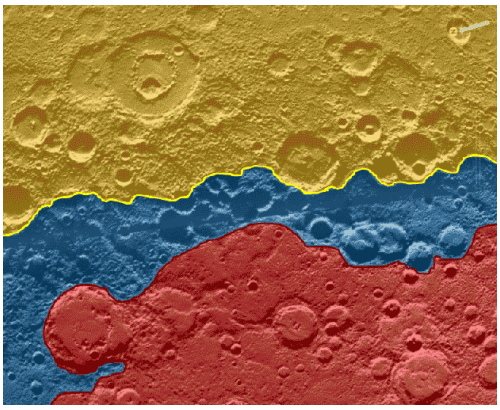
This paper intends to give a contribution to the tectonic geomorphologic studies of Mercury, by the identification of structural lineaments and possible cinematic criteria.

Methodology: For this work, two Messenger imagens were selected to perfom the morpho-tectonic analysis, based on visual photo-interpretation. The criteria used to identify the morpho-tectonic units were based on: differences in surface reflectance, rugosity of the surface and the relative number of impact craters.

Morpho-tectonic analysis: Area-1 (31º34' N and 87º03'W; Figure 1): include the Double Ring Basin and the Al-Hamadhani impact craters (Figure 1a). Three main morpho-tectonic units are identified in this area (Figure 1b): the yellow unit, located in the upper sector of the area, is a low reflectance surface characterized by high roughness and hight density of impact craters; the bleu unit is a narrow and depressed, NS tranding, linear shaped region, characterized by a very low reflectance, located in the central sector of the area; the red unit is a smooth surface, characterized by presenting a density of craters smaller than the yellow unit and a median reflectance, indicative of its relative youth. The area-1 is dominated by N40±10ºE (red system) and N30±10ºW (yellow system) trending main tectonic systems (Figure 1c) that run through the image. The red system is a major tectonic element that can be recognized elsewhere. There is geomorphic evidence of a predominant right-lateral strike-slip component (e,g. displaced crater edges). An alongated and curving, NNE-SSW trending scarp (green line; Figure 1c), can be identified through the red unit, as a result of a dip-slip near-surface fault.



a)



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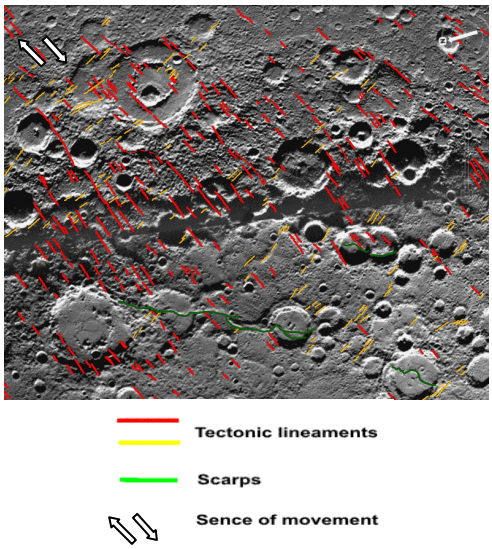
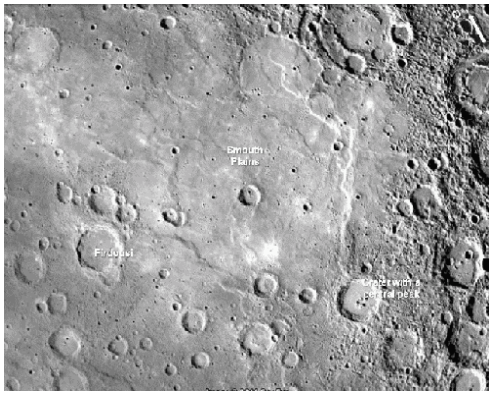
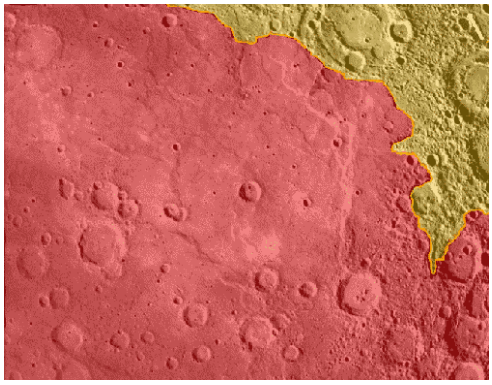


c)

Figure 1 – a) Messenger image of the area-1 located at 31º 34' N and 87º 3' W; b) interpreted morpho-tectonic units; c) interpreted morpho-tectonic elements.



a)



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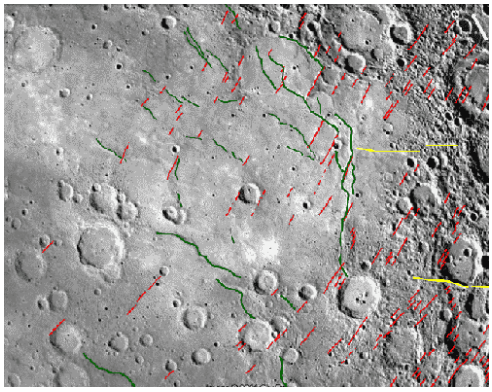
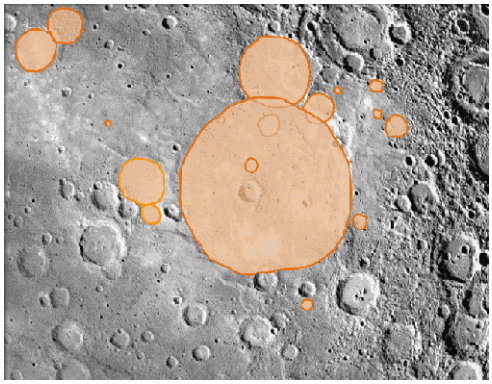


c)



d)

Figure 2 - a) Messenger image of the area-2 located at 1º 41' N and 72º 42' E; b) interpreted morpho-tectonic units; c) interpreted morpho-tectonic elements; d) interpreted ghost impact craters.

Area-2 (1º 41' N and 72º 42' E; Figure 2): include the Firdousi and the Crater with a Central Peak impact craters, and the Smooth Plains (Figure 2a). Two main morpho-tectonic units are identified in this area (Figure 2b): the yellow unit, located in the upper-right corner of the area-2 that displays characteristics closely resembling those of the yellow unit of area-1; the red unit, a large and smooth surface presenting a density of craters smaller than the heavily cratered yellow unit, and median to high reflectance zones, indicative of its relative youth. The area-2 is dominated by the N40±10ºE trending main tectonic system (red line; Figure 2c) that runs through the image. The red unit is also extensively deformed by curving scarps and "wrinkle ridges" (green lines; Figure 1c), geomorphic evidences of sub-surface dip-slip faults. Some ghost impact craters can be recognized in this unit (Figure 2d).

Expected results: We plan to further develop an approach for the automated detection of tectonic structures such as faults, wrinkle ridges, grabens and to delineate and extract morphometric caracteristics, such as directions, lenghs, sinuosity, based on morphological transforms[8].

References: [1] Moreels P. and Smrekar S. (2003) IEEE Trans. Image Processing, 12(7), 740-750 [2] Barata T. et al. (2004) LNCS, 3212, 489-496. [3] Pina P. et al. (2004) LPS XXXV, abs #1621. [4] Alves E.I. et al. (2007) Planet Mars Research Focus, Nova Science Publishers, NY. [5] Bue B.D. and Stepinski T. [9] Bandeira L. et al. (2009) LPS XL, abs #1288. [6] Barata M.T. et al. (2010) LPS XLI, abs #1025. [7] Vaz D. et al. (2011) LPS XLII, abs #1015. [8] Soille P., Morphological Image Analysis - Principles and Applications. 2nd Ed., Berlin: Springer-Verlag, 2002.

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