

GEOLOGIC MAPPING OF PLANETARY BODIES (GMAP) – CURRENT STATUS, REQUIREMENTS AND PLANS. A. Naß¹, M. Massironi², A. P. Rossi³, L. Penasa², R. Pozzobon², C. Brandt³, and the GMAP Consortium ¹DLR Institute for Planetary Research (Andrea.Nass@dlr.de), ²Dipartimento di Geoscienze, Università di Padova, Jacobs University Bremen.

Introduction: Geological mapping is the basic tool to understand any kind of planetary surface. The geological map is the only way to describe and understand the distribution and meaning of the landforms/deposits, both vertically and laterally. As such, it represents the prerequisite for exploration, science development, risk management and resources exploitation. The interpretation of the genesis of the landforms/deposits represent the aim of the scientific investigations, but the science might provide information also on the different kinds of materials which in turn might become targets for future exploration projects aimed at the exploitation of some elements/minerals/rocks. Parallel to science investigations, in-situ exploration needs to take in account the risks associated with landing, navigation, and eventually with permanent or temporary infrastructures. Different purposes and different data availability result in different cartographic products, but all of them need to comply with the basic stratigraphic principles and geological laws just like it happens with the geological mapping process on Earth.

The Astrogeology Team at USGS provides coordination of NASA's planetary geologic mapping program [1] which is the first and so long only coordinated and standardizes geological mapping in Planetary sciences.

In order to address the major scientific and technological challenges facing modern planetary science and strengthen Europe's position and the forefront of space exploration the pan-EU infrastructure will provide by the *EUROPLANET 2024 Research Infrastructure* (EPN-2024-RI). One component of this 4-years-project is the *Geologic Mapping of Planetary bodies* (GMAP). This aims to serve the European planetary community through a solid infrastructure to foster, support and sustain the production of planetary geological maps and related products following standard procedures. [2]). In order to do so, GMAP directly built on a previous project *PLANetary MAPping project* (Planmap [3]) and several partners and institutions with previous experience in planetary geologic mapping are involved.

In doing so that means any planetary scientist can produce a geological map or a derived higher-level product through GMAP *Virtual Access* (VA) with the help and advice of the GMAP partner institutions, who will provide base-maps and technical aid as part of the *Joint Research Activity* (JRA). The maps will provide support for ongoing and future planetary missions, training activities and non-standard science-driven mapping projects.

The aim of this contribution is to present the current status of the GMAP efforts, describe what are the requested requirements within the European Mapping community, and finally to introduce the on which advancing evolutions we are focused on.

GMAP – the status quo: The focus is to streamline the processes which are involved in the production of geological and geomorphological maps of Planetary Surfaces. It mainly collects already existing approaches and related documents which handle the standardization of GIS-based mapping process to enable the European community in creating cartographic products. The aim is to describe, develop, store, combine (!), access, update, revise and, finally, visualize scientific cartographic products. As soon as these steps could be handled in one workflow and distributed among researchers and mappers, the highest possible level of homogenization and thus standardization, is reached. This is the essential step to finally use these research products for further studies as a basis [1] Activities in the coordination task during the first year targeted the planning and the initial setup of basic services that will be needed for supporting VA and JRA activities in terms of digital infrastructure. The domain europlanet-gmap.eu was acquired by GMAP and dedicated to the main website (Figure 1) that will serve as the entry point for presenting the GMAP initiative, collecting most notable resources in a single place for users access and providing basic guidance for publishing new maps, request support and contributing to the overall project. The website is built on the same open source Content Management System (wordpress) already employed for the main Europlanet website, on <https://europlanet-society.org>. The GMAP data portal [4] and additional services and tools are being setup.



Figure 1 The GMAP website (<https://europlanet-gmap.eu>), access point for upcoming documentation, data services and tools available to the community. The graphics for the website are in large part inherited from the PLANMAP project. The website now hosts basic presentation content for the GMAP activities and will serve to introduce the overall project to the end users, providing an easy-to-access and clear entry point..

GMAP – the requirements: In order to extract the requirements to support the European community to streamline their planetary geological mapping a document was produced out within the last year of JRA activities (see [1]). The document contains state of the art information in this field and addresses the geologic mapping and cartographic aspects of the various Solar System bodies.

Geologic Process-specific and body-specific best practice and exemplary published cases are included in [1]. The approaches for two-dimensional mapping and three-dimensional geologic mapping and modelling are introduced, as well as the range of non-standard map types that are envisaged within GMAP activities.

Mapping review directions are indicated, as well data sharing, distribution and discovery. Proposed standards, best practice, and tools are based on those existing, as well as on additional or new developments and adaptations [e.g. 5]. The document will be periodically updated.

GMAP – plans and evolution: The development of the GMAP data portal [4] was initiated, based on existing developments from PLANMAP. The availability of GMAP products and underlying datasets is going to be FAIR, as also recommended by the VA Review Board (see also [6]), and building on the practice of PLANMAP [7], see also e.g. [8]). The use of existing tools by NASA and USGS such as ISIS [9, 10], ASP will be promoted. Moreover, in addition to the community support by the GMAP VA, interaction with the community via OpenPlanetary [11] is also planned.

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References: [1] Astrogeology Team at USGS, <https://www.usgs.gov/centers/astrogeology-science-center>, [2] Nass, et al., (2020) Standard definition Document 1st iteration, available online at <https://www.europlanet-gmap.eu/about-gmap/deliverables>, [3] <https://planmap.eu/>, [4] GMAP data portal, available online at <https://data.europlanet-gmap.eu> [5] Penasa, L., et al. (2020) Europlanet Science Congress 2020, EPSC2020-1057, DOI: 10.5194/epsc2020-1057, 2020. [6] Rough et al., (2020), VAs 1st year External Board Review report, available online at <https://www.europlanet-society.org/europlanet-2024-ri/europlanet-2024-ri-deliverables/> [7] Brandt, C. H., et a., EGU General Assembly 2020, EGU2020-18839, DOI: 10.5194/egusphere-egu2020-18839, 2020 [8] Luzzi, E., et al. (2020). JGR-Planets, 125, e2019JE006341. DOI: [10.1029/2019JE006341](https://doi.org/10.1029/2019JE006341) [9] Gaddis, L., et al. (1997). An overview of the Integrated Software for Imaging Spectrometers (ISIS), in: Lunar and Planetary Science XXVIII. p. 1997. [10] Beyer, R. A., et al. (2018) *Earth and Space Science*, 5, 537– 548. DOI: [10.1029/2018EA000409](https://doi.org/10.1029/2018EA000409) [10] Manaud et al., (2019) EPSC-DPS Joint Meeting, EPSC Abstracts, Vol. 13, EPSC-DPS2019-1654-1