Ref. Ares (2020)192262 - 13/01/2020

EPN 2024 RI

EUROPLANET 2024 Research Infrastructure

H2020-INFRAIA-2019-1

Europlanet 2024 RI has received funding from the
European Union's Horizon 2020 Research and Innovation Programme under

Grant agreement no: 871149

Deliverable D8.14

Deliverable Title:	GMAP Community Mapping Project Report 3
Due date of deliverable:	31/07/2024
Actual submission date:	10/07/2024
Nature:1	R
Dissemination level2	PU
Work package:	WP8
Lead beneficiary:	UNIPD
Contributing beneficiaries:	Constructor, WWU, CBK-PAN, UNICH
Document status:	Final

Start date of project: 01 February 2020. Duration: 54 months
Project Co-ordinator: Prof Nigel Mason, University of Kent

1. **Nature:** R = Report, P = Prototype, D = Demonstrator, O = Other
2. **Dissemination level:**

PU	PP	RE	CO
Public	Restricted to other programme participants (including the Commission Service)	Restricted to a group specified by the consortium (including the Commission Services)	Confidential, only for members of the consortium (excluding the Commission Services)

Executive Summary / Abstract:

This is the final status of the GMAP Community Mapping Projects as of June 2024.
A variety of individual mapping projects started with some deriving from earlier projects and some kickstarted from the 2021, 2022 and 2023 GMAP Winter Schools. The topics and locations are the surface of the Moon, Mars, Mercury and terrestrial planetary analogues. Of these, 33 are published as abstracts and 22 are also published in peer-reviewed international journals or are currently under review.
Current information on GMAP community mapping projects is available on the GMAP wiki.

Table of Contents

- ## List of acronyms and abbreviations

Table 1: Acronyms and abbreviations

Acronym	Description
ASP	Ames Stereo Pipeline
DFG	Deutsche Forschungsgemeinschaft
DoA	Description Of Action
ISIS	Integrated Software for Imagers and Spectrometers

IRSPRA	Istituto Superiore per la Protezione e la Ricerca Ambientale
JRA	Joint Research Activity
NA	Networking Activity
MOST	Ministry Of Science and Technology
USGS	United States Geological Survey
VA	Virtual Access

- **Introduction**

The GMAP VA work package (WP8) engaged with the community through various activities, such as the yearly GMAP Winter School (reaching almost a thousand individuals over three years) documentation (see Rossi et al., 2022a, 2022b, and ref. therein) and standards (Naß et al., 2020; 2023, D91., D9.7), as well as inputs and guidance from the external VA Review Board (e.g. Raugh et al, 2020, 2022).
Community mapping projects are a key component of GMAP's activities in which individuals and groups are engaged in specific geologic mapping efforts on Solar System bodies of their choice.

1. Community mapping involvement

Different engagement levels for project results exist for GMAP: the VA's users are wide-ranging, from those using training materials, to participants of Winter/Summer schools and workshops, to mappers, more or less actively engaged in GMAP activities.

Exemplary levels of engagement include (see also D8.5, Rossi et al. 2020):

- **Level 0** - Occasional users at the very beginning of their career, curious about planetary geology, casual participants to informal monthly calls, active on social media and consuming GMAP content.
- **Level 1** - Participants to yearly/periodic schools and workshops, users of GMAP materials, e.g. registered to the GMAP website to access Winter School videos, GitHub users (e.g. via stars, forks, other measurables) and casual participants to informal monthly calls.

- **Level 2** - Geologic mappers with published maps that make them discoverable via the GMAP portal (i.e. maps hosted and published elsewhere but linked/listed from the portal (**no datasets** in repository upon publication or earlier).
- **Level 3** - Geologic mappers with published papers or other products who share data on the GMAP Portal / Zenodo, using the portal but not complying to all standards (**dataset** on repo upon publication or earlier).
- **Level 4** - Geologic mappers with or without published papers who engage with GMAP and develop their project (from scratch or from a certain point) with GMAP, adhering to standards and joining calls/seminars where relevant/possible (**dataset** on repo upon publication or earlier).

The community involved at level 0 is represented by the activity documented in the virtual winter school social accounts.
The community involved at level 1 is reported in the VA yearly report within the description of each Geology and Planetary mapping Winter School edition. For details of the first two Winer Schools, see Rossi et al. (2023).

The community mapping projects in Table 2 are currently from level 2 to 4, although the ones for levels 3 and 4 are in varying stages of development, with some just started.

- **Current community mapping projects**

An updated list of current community mapping projects is recorded on the GMAP wiki[1]. A summary with links to individual mapping projects, at various stages of maturity, is included in Table 2.

Table 2: Summary of community mapping projects, as of June 2024. ✓ Pub: published in peer-reviewed journals; ⟳ Pub: submitted/under review/pending publication in peer-reviewed journals; ✓ Abs: abstract at international conferences

Mapping project title	Project lead	GMAP contacts	Details	Status
Moon				
Geological evolution of the Sinus Iridum basin (2020) Planetary and Space Science, 194, 105134.	Teng Hu	CUGB: Kang (MOST)		✓ Pub
China's Chang'e-5 landing site: Geology, stratigraphy, and	Yuqi Qian	Uni Münster: van der Bogert,	A geological map of the Chang'e-5 lunar landing site for use in	✓ Pub

[1] https://wiki.europlanet-gmap.eu/bin/view/Main/community%20mapping%20projects/

Mapping project title	Project lead	GMAP contacts	Details	Status
provenance of materials (2021) Earth & Planetary Science Letters 561, 116855.		Hiesinger	interpretation of the returned samples	
Geologic Mapping and Age Determination of Tsiolkovskiy Crater (2021) Remote Sensing 13, 3619.	Gloria Tognon	UNIPD: Tognon, Massironi	Geologic, color-based and spectral mappings aimed at characterizing the lunar far side Tsiolkovskiy crater	✓ Pub
Timing and origin of compressional tectonism in Mare Tranquillitatis (2023) Journal of Geophysical Research Planets, 128, e2022JE007533	Thomas Früh	Uni Münster: Hiesinger, van der Bogert	Tectonic mapping of wrinkle ridges in Mare Tranquilitatis	✓ Pub
Possible sites for a Chinese International Lunar Research Station in the lunar south polar region (2023) Planetary and Space Science 227, 105623	Teng Hu	CUGB: Zhizhong Kang (MOST) Uni Münster: van der Bogert, Hiesinger	Geological maps for potential landing sites at Amundsen and Malapert craters	✓ Pub
Geological mapping and chronology of the lunar landing sites:Apollo 14 landing site (2023) Icarus 406, 115732.	Wajiha Iqbal	Uni Münster: Hiesinger, van der Bogert, Borisov	New detailed map of the Apollo 14 landing site for updating the lunar cratering chronology	✓ Pub
Characterization of high-priority landing sites for robotic exploration missions in the Apollo basin, Moon (2024) Planetary	Csilla Orgel	Uni Münster: van der Bogert, Hiesinger	1:50K geological maps for two potential landing regions in the Apollo basin, Moon	✓ Pub

Mapping project title	Project lead	GMAP contacts	Details	Status
Science Journal, 5, 29.				
Geologic evolution and map of Copernicus Crater interior (Moon) (2024) Geological Field Trips 16, 1-19.	Filippo Tusberti	UNIPD: Massironi, Pozzobon	Geological map of the Copernicus Crater	✓ Pub
Geologic history of Amundsen crater and implications for future exploration (2024) Planetary Science Journal 5, 147.	Lukas Wueller	Uni Münster: van der Bogert, Hiesinger	1:100K chronostratigraphic map of the Amundsen crater region, Moon	✓ Pub
New detailed map of lunar light plains (*revisions submitted*) Planetary Science Journal	Barbara Giuri	Uni Münster: van der Bogert, Hiesinger	1:600K map of lunar light plains, including smaller areas not previously mapped separately	⟳ Pub
Orientale basin as a roadmap for identifying dateable impact melt in lunar basins (*submitted*) Planetary Science Journal	Kirby Runyon	Uni Münster: van der Bogert, Hiesinger	Part of a project mapping lunar basins to better understand their formation and evolution	⟳ Pub ✓ Abs
Integrated spectral and compositional analysis for the lunar Tsiolkovskiy crater *(in review)*	Gloria Tognon	UNIPD: Tognon, Massironi, Pozzobon INAF-IAPS: Zambon, Giacomini, Tosi, Salari, Rinaldi, Fonte PSI: Combe	Integrate spectral-geological map of the Tsiolkovskiy Crater	⟳ Pub ✓ Abs
Geological map of the Rima Bode region,	Sascha	Uni Münster: Hiesinger,	Geological mapping of the Rima Bode	✓ Abs

Mapping project title	Project lead	GMAP contacts	Details	Status
Moon	Mikolajewski	van der Bogert	region of the Moon in preparation for a lunar mission	
Integration between geology and multispectral information for the Ingenii basin	Gloria Tognon	UNIPD: Tognon, Massironi, Pozzobon INAF-IAPS: Zambon, Giacomini, Tosi, Salari, Rinaldi, Fonte PSI: Combe	Integration between geology and multispectral information for the Ingenii basin	✓ Abs
Geological mapping of Grimaldi basin, Moon	Kirby Runyon	Uni Münster: van der Bogert, Hiesinger	Part of a project mapping lunar basins to better understand their formation and evolution	✓ Abs
Geological map of Moretus crater, Moon	Georgi Klingenberg	Uni Münster: Hiesinger, van der Bogert	Geological mapping of the Moretus crater, Moon	✓ Abs
Morphostratigraphic mapping of Valentine Domes on the Moon	Javier Suarez	JacobsUni: Suarez	Mapping of the intrusive Valentine Domes on the moon	✓ Abs
Structural Mapping of Aristarchus plateau and Marius Hills in Oceanus Procellarum (Moon)	Giacomo Melchiori	UNIPD: Riccardo Pozzobon	Structural mapping of contractional features (i.e. wrinkle ridges) in the region between the Marius Hills shield and Aristatchus plateau in Oceanus Procellarum	✓ Abs

Mapping project title	Project lead	GMAP contacts	Details	Status
High-res descent map Chang'e 5 landing site map	Teng Hu	CUGB: Kang (MOST)		
Mars				
Inception and Evolution of La Corona Lava Tube System (Lanzarote, Canary Islands, Spain) (2022) Journal of Geophysical Research Solid Earth, 127, e2022JB024056	Ilaria Tomasi	UNIPD: Massironi	Mapping and 3D laser scanning of an extended lava tube, as an analogue for lava tubes on the Moon or Mars	✓ Pub
Hydrothermal Alteration of Ultramafic Rocks in Landon Basin, Mars - Insights from CaSSIS, HiRISE, CRISM, and CTX (2023) Journal of Geophysical Research Planets, 128, e2022JE007223	Daniel Mège	CBK: Mège, Gurgurewicz UNIPD: Massironi, Pozzobon	Geologic map of the eastern portion of Ladon basin (Mars)	✓ Pub
DeepLandforms: A Deep Learning computer vision toolset applied to a prime use case for mapping planetary skylights (2023) Earth and Space Science, 10, e2022EA002278	Giacomo Nodjoumi	JacobsUni: Nodjoumi	Mapping planetary skylights on Mars using Deep Learning	✓ Pub
Geology of Lanzarote's Northern Region (Canary Islands, Spain) (2023) Journal of Maps 19, 2187717.	Ilaria Tomasi	UNIPD: Massironi	Geological map of the volcanic are of the northern Lanzarote region	✓ Pub
Groundwater-controlled deposition of	Ilaria Di Pietro	ASI: Di Pietro UdA:	In this project, the morphology,	✓ Pub

Mapping project title	Project lead	GMAP contacts	Details	Status
equatorial layered deposits in central Arabia Terra, Mars (2023) Journal of Geophysical Research Planets 128, e2022JE007504.		Pondrelli	stratigraphy, topography, and mineralogy of Sera and Jiji were analyzed at different resolutions in order to edit a geologic map of Sera and Jiji (Figure 2) based on a 6 m/pixel visible imagery.	
Geologic history of Deuteronilus Mensae in the Ismenius Lacus Region, Mars (2024) JGR Planets, 129, e2023JE008039.	Lukas Wueller	Uni Münster: Hiesinger, van der Bogert	The Ismenius Lacus region of Mars has a diverse geological history, and we present the first high-resolution map of Deuteronilus Cavus (36.2°N; 14.0°E, ~120 km diameter) in the fretted terrain south of the dichotomy boundary	✓ Pub
Paleoenvironmental significance of Fe/Mg phyllosilicate and sulfate deposits in Mikumi crater, northern Meridiani Planum, Mars (2024) Advances in Space Research 73, 2685-2702	Beatrice Baschetti	UNIPD and INAF-IAPS: Baschetti INAF-IAPS: Frigeri, Carli, Altieri	Morpho-stratigraphic mapping of layered phyllosilicate and sulfate rich sedimentary units within Mikumi crater	✓ Pub
Geo-stratigraphic map of the North Polar Layered Deposits close to Olympia Rupes (Mars) (2024) Geological Field Trips 16, 1-17.	Nicole Costa	UNIPD: Massironi	Stratigraphy of a restricted area close to Olympia Rupes on the Northern Polar Cap	✓ Pub

Mapping project title	Project lead	GMAP contacts	Details	Status
Glacial landforms in Mamers Valles, Mars (*in review*) Icarus	Lukas Wueller	Uni Münster: Hiesinger, van der Bogert	We examine the nature of the distinctive lobate debris apron/lineated valley fill relationships in Mamers Valles	⟳ Pub ✓ Abs
Geology of the Hypanis outlet region	Agnese Caramanico	UdA: Pondrelli	Geologic and stratigraphic studies of the Hyspanis fan-delta system	⟳ Pub ✓ Abs
Chronostratigraphic reconstruction of Eastern Tharsis volcanism	Pierre-Antoine Tesson	CBK PAN: Tesson, Mège, Gurgurewicz	Lava flow mapping at regional scale	✓ Abs
Holden crater	Monica Pondrelli	UDA: Monica Pondrelli	Geological map focused on the reconstruction of fluvial-related deposits of the Holden-Eberswalde area on Mars	✓ Abs
Geologic and structural mapping of chaotic terrains	Mauro Spagnuolo (University of Buenos Aires)	JacobsUni: Rossi	Mapping focused to reconstruct the history of selected chaos-hosted layered deposits	✓ Abs
Geological map of the Deuteronilus Mensae region	Lennard Pauw	Uni Münster: Hiesinger, van der Bogert		✓ Abs
Geology of the Tyras Vallis area	Davide Defilippis	UdA: Pondrelli	Map of the depositional environments of the Tyras Vallis paleolacustrine system using recent	

Mapping project title	Project lead	GMAP contacts	Details	Status
			datasets.	
The geologic map of Zhurong landing site	Teng Hu	CUGB: Kang (MOST)	Map for the Chinese mission site	
Geologic mapping and interpretation of a Fractured-Floor Crater in Ladon Basin - Mars	Diandra Cardinali	UNIPD: Massironi		
Mapping of Martian geoforms as an input to construct an analogue enviroment in Colombia	Javier Suarez	JacobsUni: Suarez	A necessary prior step to the construction of a rock garden in an analogue station in Colombia	
Geological map of an unnamed crater in Arabia Terra (Mars)	Alessandra Piscopo	UDA: Pondrelli	Map of the light-tone layered deposits of the crater and the nearby intercrater plains in Arabia Terra	
Mineral composition of Gale Crater and geological context	Fatima-Ezzahra Jadid	INAF: Baschetti, Carli		
Mars Double Impact Crater Lithostructural Virtual and 3-D Model Evaluation	Wayne Barnett	UNIPD: Massironi UNIPD: Pozzobon JacobsUni: Rossi	Virtual reality mapping of the double impact crater on Mars, and 3D modelling of the lithostratigraphy	
Mercury				
A 1:600K Geological Map of the Sibelius Crater, Mercury (2023) Geological Society, London, Special	Marc Canale	INAF: Penasa	A geological map of spectral and geomorphological features of the Sibelius Crater on	✓ Pub

Mapping project title	Project lead	GMAP contacts	Details	Status
Publications, 541(1), SP541-2022.			Mercury using MESSENGER MDIS imagery	
Geologic mapping of the H-9 Eminescu quadrangle, Mercury	Gloria Tognon	UNIPD: Tognon, Massironi, El Yazidi INAF-IAPS: Galluzzi, Giacomini	Geologic map of the equatorial H-9 Eminescu quadrangle on Mercury	✓ Abs

Examples of mapping projects (See also Rossi et al. 2020; 2022c) are included below:

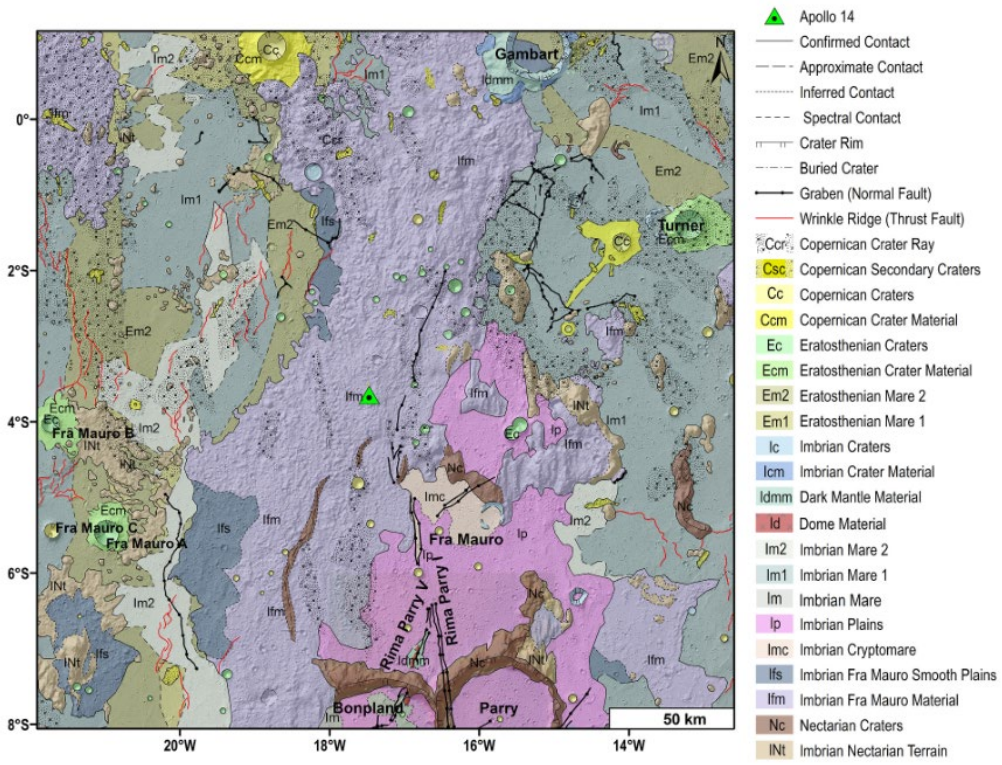

Figure 1: Map output from the community mapping project on the Apollo 14 landing site (Iqbal et al., 2023).

Beyond the lifetime of Europlanet 2024 RI, datasets produced within community mapping projects will be discoverable via the GMAP portal and shared on FAIR

repositories of choice, primarily Zenodo (in which a GMAP community[2] exists and will be progressively populated), see e.g. Canale et al. (2023a,b).

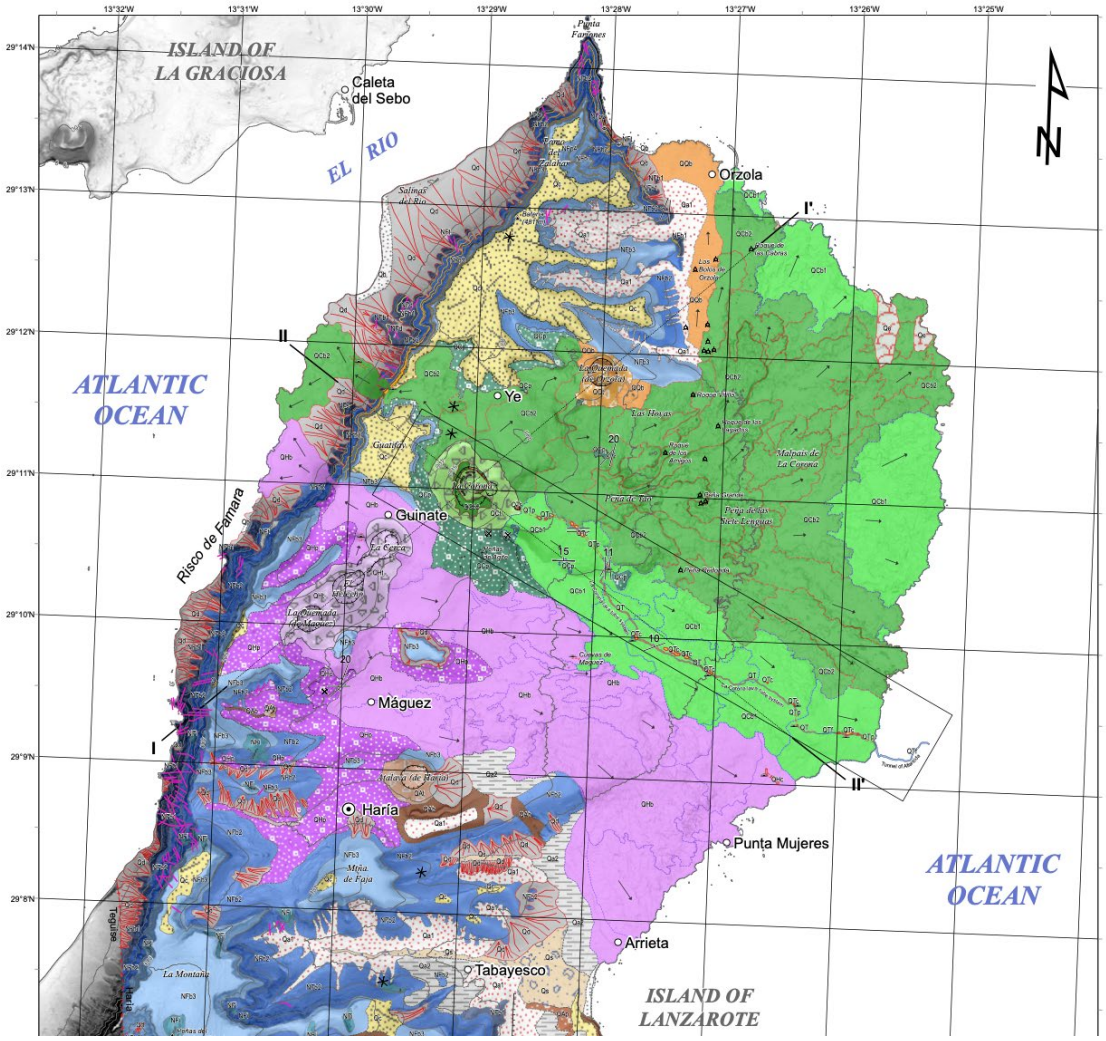

Figure 2: Excerpt of the geological map of the northern Lanzarote island (see Tomasi et al., 2023, GMAP wiki).

Some projects involved participants in the 2021 edition of the GMAP Winter School (Marc Canale, Open University, Canale et al., 2023a,b). Also, several mapping projects from our Chinese partner, MOST, are present (projects from Z. Kang, CUGB).

- **Relevant community mapping project publications**
  - Baschetti, B., Frigeri, A., Altieri, F., Tullo, A., Sgavetti, M., "Paleoenvironmental significance of Fe/Mg phyllosilicate and sulfate deposits in Mikumi crater, northern Meridiani Planum, Mars", Advances in Space Research, 2024, doi: https://doi.org/10.1016/j.asr.2023.12.060

[2] https://zenodo.org/communities/gmap/?page=1&size=20

- Canale, M., Wright, J., & Rothery, D. A. (2023). A hybrid geological map of Sibelius crater on Mercury, and its associated ejecta and impact melt deposits. *Geological Society, London, Special Publications*, *541*(1), SP541-2022. https://doi.org/10.1144/SP541-2022-296
- Costa, N., Massironi, M., Penasa, L., Ferrari, S., Pozzobon, R., & Nava, J. (2024). Geological map of the Nord Rupes (North Polar Cap, Mars). *Geological Field Trips*, *16*(1.4), 1–17. https://doi.org/10.3301/GFT.2024.04
- Frueh T., Hiesinger H., van der Bogert C. H., Clark J. D., Watters T. R., Schmedemann N. (2023) Timing and origin of compressional tectonism in Mare Tranquillitatis. JGR Planets 128, e2022JE007533, https://doi.org/10.1029/2022JE007533
- Hu T.; Yang Z.; Li M.; van der Bogert C. H.; Xu X.; Hiesinger H. (2023) Possible sites for a Chinese International Lunar Research Station in the lunar south polar region. Planetary and Space Science 227, 105623, https://doi.org/10.1016/j.pss.2022.105623
- Hu, T. , Kang, Z. , Massironi, M., Hiesinger H., van der Bogert C. H., Gamba P., Brunetti M. T., and Melis, M. T. (2020). Geological evolution of the sinus iridum basin. Planetary and Space Science, 194, 105134. https://doi.org/10.1016/j.pss.2020.105134
- Iqbal W., Hiesinger H., Borisov D., van der Bogert C. H., Head J. W. (2023) Geological mapping and chronology of the lunar landing sites: Apollo 14. Icarus, 406, 115732. https://doi.org/10.1016/j.icarus.2023.115732
- Mège, D., Gurgurewicz, J., Massironi, M., Pozzobon, R., Tognon, G., Pajola, M., Tornabene, L. L., Lucchetti, A., Baschetti, B., Davis, J. M., Hauber, E., de Toffoli, B., Douté, S., Keszthelyi, L., Marinangeli, L., Perry, J., Pommerol, A., Pompilio, L., Rossi, A. P., … Thomas, N. (2023). Hydrothermal Alteration of Ultramafic Rocks in Ladon Basin, Mars—Insights From CaSSIS, HiRISE, CRISM, and CTX. *Journal of Geophysical Research: Planets*, *128*(1). https://doi.org/10.1029/2022JE007223
- Nodjoumi, G., Pozzobon, R., Sauro, F., & Rossi, A. P. (2023). DeepLandforms: A Deep Learning Computer Vision Toolset Applied to a Prime Use Case for Mapping Planetary Skylights. *Earth and Space Science*, *10*(1), 2–31. https://doi.org/10.1029/2022EA002278
- Orgel C., I. Torres, S. Besse, C. H. van der Bogert, R. Bahia, R. Prissang, M. A. Ivanov, H. Hiesinger, G. Michael, J. H. Pasckert, and S. H. G. Walter (2024) Characterization of high-priority landing sites for robotic exploration missions in the Apollo basin, Moon. Planetary Science Journal, 5, 29, 10.3847/PSJ/ad1108.
- Pietro, I. D., Schmidt, G., Tangari, A. C., Salese, F., Silvestro, S., Fairén, A. G., et al. (2023). Groundwater-Controlled Deposition of Equatorial Layered Deposits in Central Arabia Terra, Mars. *Journal of Geophysical Research: Planets*, *128*(3). https://doi.org/10.1029/2022je007504

- Qian Y., L. Xiao, Q. Wang, J. W. Head, R. Yang, Y. Kang, C. H. van der Bogert, H. Hiesinger, X. Lai, G. Wang, Y. Pang, N. Zhang, Y. Yuan, Q. He, J. Huang, J. Zhao, J. Wang, and S. Zhao (2021) EPSL 561, 116855. https://www.sciencedirect.com/science/article/pii/S0012821X20306464
- Tognon, Gloria, Riccardo Pozzobon, Matteo Massironi, and Sabrina Ferrari. 2021. "Geologic Mapping and Age Determinations of Tsiolkovskiy Crater" Remote Sensing 13, no. 18: 3619. https://doi.org/10.3390/rs13183619
- Tomasi, I., Massironi, M., Meyzen, C. M., Pozzobon, R., Sauro, F., Penasa, L., Santagata, T., Tonello, M., Gomez, G. D. S., & Martinez-Frìas, J. (2022). Inception and evolution of La Corona lava tube system (Lanzarote, Canary Islands, Spain). *Journal of Geophysical Research: Solid Earth*. https://doi.org/10.1029/2022JB024056
- Tomasi, I., Tonello, M., Massironi, M., Tesson, P. A., Sauro, F., Meyzen, C. M., … Mederos, E. M. (2023). Geology of Lanzarote's northern region (Canary Island, Spain). *Journal of Maps*, *19*(1). https://doi.org/10.1080/17445647.2023.2187717
- Tusberti, F., Massironi, M., Pozzobon, R., & Penasa, L. (2024). Geologic evolution and map of Copernicus Crater interior (Moon). *Geological Field Trips*, *16*(1.1), 1–19. https://doi.org/10.3301/GFT.2024.01
- Wueller et al. (2024) Geologic History of Deuteronilus Cavus in the Ismenius Lacus Region, Mars. JGR Planets, 129, e2023JE008039, https://doi.org/10.1029/2023JE008039.
- Wueller L., Iqbal W., Frueh T., van der Bogert C. H., Hiesinger H. (2024) Geologic history of Amundsen crater and implications for future exploration. Planetary Science Journal, 5, 147, https://iopscience.iop.org/article/10.3847/PSJ/ad2c04

- **Outlook and post-Europlanet 2024 RI perspective**

Currently, more than 42 GMAP community mapping projects have been started or embedded. Among these, 33 have published abstracts and 22 have also been published in peer-reviewed international journals or are currently under review. All of these records and datasets are visible to, and reusable by, the planetary geologic community.

- **Other References in the text**

Canale, M., Wright, J., & Rothery, D. A. (2023a). A hybrid geological map of Sibelius crater on Mercury, and its associated ejecta and impact melt deposits. Geological Society, London, Special Publications, 541(1), SP541-2022. https://doi.org/10.1144/SP541-2022-296

Canale, Marc, Jack Wright, and David Rothery (2023b) map dataset for “A hybrid geological map of Sibelius crater on Mercury, and its associated ejecta and impact melt deposits.” February. https://doi.org/10.21954/ou.rd.21964925.v2.

Mikolajewski et al. (2022a) LPSC 53, #1961, https://www.hou.usra.edu/meetings/lpsc2022/pdf/1961.pdf

Mikolajewski et al. (2022b) Annual Meeting of Planetary Geologic Mappers, #7021, https://www.hou.usra.edu/meetings/pgm2022/pdf/7021.pdf

Nass et al., (2020) D9.1 GMAP Standard Definition Document, Europlanet H2020 RI deliverable, available online at: https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Nass et al., (2023) D9.4 GMAP Standard Definition Document, Europlanet H2020 RI deliverable. update 1, available online at: https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Qian, Y., Xiao, L., Head, J. W., van der Bogert, C. H., Hiesinger, H., & Wilson, L. (2021). Young lunar mare basalts in the Chang'e-5 sample return region, northern Oceanus Procellarum. Earth and Planetary Science Letters, 555, 116702.

Raugh, A. C., Arviset, C., Jackman, C. M, Kerner, H., Lapenta, G., Marmo, C., Melis, M. T., Williams, D. A. (2020) VA 1st year External Board Review, Europlanet Deliverable D1.5. Available online at https://www.europlanet-society.org/europlanet-2024-ri/europlanet-2024-ri-deliverables/

Raugh, A. C., et al. (2022) VA 2nd year External Board Review, Europlanet Deliverable D1.8. Available online at https://www.europlanet-society.org/europlanet-2024-ri/europlanet-2024-ri-deliverables/

Rossi, A. P., Penasa, L., Pozzobon, R., Massironi, M., Brandt, C., and the GMAP partners (2021) D9.2 JRA Report Year 1, Europlanet H2020 RI deliverable, available online at: https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Rossi, A. P., Penasa, L., Pozzobon, R., Massironi, M., Brandt, C., and the GMAP partners (2022a) D9.6 JRA Report Year 2, Europlanet H2020 RI deliverable, available online at: https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Rossi, A.P., Pozzobon, R., Penasa, L. Massironi, M.., et al. (2022b) D8.4, GMAP VA Report Year 2, Europlanet H2020 RI deliverable, available online at https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Rossi et al., (2022c) D8.5 GMAP Community mapping report 1, Europlanet H2020 RI deliverable, available online at: https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Rossi et al. (2023) D8.10 GMAP VA 3rd year report, Europlanet H2020 RI deliverable, available online at: https://wiki.europlanet-gmap.eu/bin/view/Main/Deliverables/

Suarez Valencia, J. E. and Pio Rossi, A.: Geomorphologic mapping of the Valentine Domes in the Moon, intrusive domes, and their mineral resource potential, Europlanet Science Congress 2022, Granada, Spain, 18–23 Sep 2022, EPSC2022-923, https://doi.org/10.5194/epsc2022-923, 2022.

Tesson, P.-A., Mège, D., Lagain, A., Gurgurewicz, J., 2020. Late Amazonian lateral lava flows coeval with caldera eruptions at Arsia Mons. EPSC Abstracts, 14, EPSC2020-710