

**MERIT REPORT OF A LAUREATE  
TEAM PROGRAMME**

<b>Project title:</b>	<b>Mars: another planet to approach geoscience issues</b>		
<b>Reporting period:</b>	from <b>01.05.2013</b> to <b>31.10.2013</b>	<b>Period no.</b>	<b>5</b>
<b>Agreement No.:</b>	<b>TEAM/2011-7/9</b>	from <b>01.09.2011</b> to <b>30.06.2015</b>	
<b>Laureate:</b>	<b>Daniel MEGE</b>		

**ATTENTION: the information given below should regard only the realization of the project in the reporting period indicated above.**

**1) INFORMATION CONCERNING THE PROGRESS OF THE RESEARCH** ( from 1000 to 5000 words)

*a) The progress of the research tasks*

**Research Task 1 – A Valles Marineris synthesis**

Investigating this huge area of canyons on Mars is three-fold: Critical literature review, Geographic Information System (GIS) building, and new geological interpretations. This has to be achieved by TEAM PhD student Krzysztof Dębniak, with the help of the TEAM laureate and the two TEAM postdocs.

Data preparation for the Valles Marineris Geographic Information System (GIS) has continued as planned. The datasets for the background information layers have been compiled. The main background information layer, made of mosaicked CTX orbital images of Mars, is almost completed. It includes 807 images that were downloaded, radiometrically calibrated, projected, and are being assembled in a huge photomosaic. This has taken 6 months of full-time work, instead of the 3 months initially planned (corresponding to the date of June, 2013 indicated in the laureate report for Period 4). Photomosaic completion requires a few additional weeks of computation on the dedicated server. The first data interpretation has started. A significant fraction of time has also been taken for K. Dębniak (TEAM PhD student) to review the abundant literature on Valles Marineris and the possible geological processes observed.

**Research task 2 – Diagnostic climate signatures of basalt alteration on Earth and Mars**

During this reporting period, 14 samples were selected for analysis and comparison. The samples come from three climate areas: arid hot (Ogaden, Ethiopia), arid cold (Udokan, Siberia), and wet cold (Possession Island, French Overseas Territory), all potentially representative of a Martian climatic period. Thus far, five samples were studied with AFM

(Atomic Force Microscopy), and prepared for SEM (Scanning Electron Microscopy) studies. Characteristic forms on the surface of the basalt samples were distinguished, independent and dependent on the method of sample preparation. Marta Skiścim (TEAM PhD student), who is the same researcher for this task, familiarized with the professional literature concerning the basalt sample imaging in order to prepare for further studies using SEM as a method complementary with the AFM.

### Research task 3 – Deep-seated gravitational spreading on Mars and Earth

This task is twofold: (1) Quantification of gravitational spreading of topographic ridges on Mars from orbital imagery (Mars) and study of terrestrial analogues from field work; (2) Numerical simulations of the geologic processes involved.

- **Quantification of topographic ridge spreading** – As planned, comparison between Martian and terrestrial processes continued with new field work in the Tatra Mountains (High and Low Tatras) in June 2013 aiming at producing quantitative and high-accuracy data on slope deformation using the Wide Area Differential Global Positioning System (WADGPS) technique. This technique is used for real-time evaluation of the distance between ground and aircraft upon landing, but seldom used in science field work, where reliable information on accuracy is lacking. Field work was conducted in collaboration with the State Geological Institute of Slovakia. Interpretation of WADGPS data from the two periods of field work (September 2012 and June 2013) is in progress. In the meantime, quantification of topographic ridge spreading on Mars has also progressed, with computation of additional digital elevation models from the MRO/CTX camera in the areas of interest in Valles Marineris that will be used in numerical simulations.
- **Numerical simulations** – The first numerical models have been carried out during this Period, with collaboration of Profs. Frédéric Gueydan and Jean Chéry in Montpellier. Experiments were done using different slope geometry and parameters including: angle of internal friction, Young modulus, Poisson ratio, and density.

### Research task 4 – Landslides on Mars and Earth

The first molecular dynamics models of landslide propagation have been run during Period 5. They have been compared with experimental models of landslide propagation to check their validity (see TEAM member report from T. Borykov for details). Article writing has started during Period 5. The article will present the numerical approach and a comparison with results obtained in laboratory experiments.

### Research task 5 – Evolution of periglacial landforms on Earth and Mars related to global climate changes

*This task has been defined from the field of expertise of TEAM postdoc A. Séjourné. Antoine has just been recruited on a permanent position at University Paris-Sud, France, and for this reason, starting from November 2013, he will no longer be a TEAM member. Although the TEAM group will continue collaboration with him, the continuation of this task greatly depends on the profile of the postdoc candidate that will be hired in his place.*

Period 5 was devoted to writing articles relating to A. Séjourné's two main research directions within the framework of the TEAM project: the seasonal evolution of permafrost in Yakutia in sites where geomorphological processes are thought to be similar to processes occurring in the northern mid-latitude lowlands of Mars, and mapping of a portion of the northern lowlands of Mars, called Utopia Planitia.

- **Periglacial lakes in Yakutia** – The detailed observations made in Yakutia are located around periglacial lakes. Other periglacial lakes were investigated in order to broaden the study area and examine generalization of the observations.
- **Northern Martian lowland mapping** – The surface area of the Martian lowlands is considerable, and a proposal for conducting the latter project within the framework of an international team completing geological mapping in many other sites of the Martian lowlands was submitted to the International Space Science Institute (ISSI) during Period 4. It was accepted during Period 5 and will start during Period 6.
- **European Martian Cryosphere Wroclaw** – Upon request from the participants to the *Cryosphere Wroclaw* conference held in Wrocław in January 2013, a second edition is being prepared by M. Massé, A. Séjourné, D. Mège, and A. Łosiak (a postdoc at ING PAN who collaborates with the TEAM group- see Section 7.4). Planned to be held in February 10-12, 2014, this conference will again involve invited participants only, from Poland and other European countries.

#### **Research task 6 – Ice processes and landforms**

*This task has been led by TEAM postdoc M. Massé, who has left the TEAM group on October 30<sup>th</sup>, 2013. She is now with the Institute of Space Astrophysics, University of Paris-Sud, France. The TEAM group will continue collaboration with her, but the work that will be conducted under this task will be modified. Research on ices will evolve toward ice processes at the solar system scale, conducted by D. Mège, and perhaps to other processes, depending on the profile of the postdoc candidate that will be hired in her place.*

- **Recurring Slope Lineae (RSL)** – The study of Martian's RSL has continued with new experimental work carried out at the Institute of Planetology and Astrophysics in Grenoble, France, and the Centre for Earth, Planetary, Space and Astronomical Research, Milton Keynes, Open University, in June 2013. See details in M. Massé's TEAM member report.

- **Martian north polar cap** – The new data obtained during Period 4 about ice megadunes on the Martian north ice cap has been further analysed, and during Period 5 an article has been prepared.
- **NEW! \*\*\* KBO ices** – This new activity prepares the group to diversification of activities at the end of the TEAM project. Ices (H<sub>2</sub>O, CO<sub>2</sub>) are abundant on Mars, but understanding ice processes in general needs investigation of surfaces of more remote solar system bodies, such as the satellites of the giant planets and the Kuiper Belt Objects (KBO) beyond Neptune, where ices have other compositions (e.g., CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, CO, N<sub>2</sub>). The TEAM group PI is a collaborator to the Science Team of the New Horizons mission to Pluto and the Kuiper Belt, a mission in which LEISA, a near-infrared image spectrometer, will observe the icy surface of Pluto for the first time in July 2015. Interpretation of the LEISA data will face the issue of understanding the signature of low-temperature ices (CH<sub>4</sub>, CO, N<sub>2</sub>) and the organic matter (tholins) that form when some of these ices are damaged by stellar particles. In October 2013, D. Mège conducted experiments designed to image the near-infrared spectra of tholins in frozen methane ice and in evaporating methane ice at the Keck Laboratory, Arkansas Center for Planetary and Space Science, Fayetteville, with Dr. Vincent Chevrier and Sandeep Singh (PhD student), Keck Laboratory, and Delphine Nna Mvondo, Planetology and Geodynamics Laboratory, Nantes, France. This work is conducted through joint funding, with contributions from CNES and NASA.
- Organisation of the second European Martian Cryosphere Workshop has started – see Task 5.

*b) Summary of the results of the research tasks*

**Research Task 1 – A Valles Marineris synthesis**

- The most time-consuming "technical" aspects of the Valles Marineris GIS preparation are over. Geological observations in Valles Marineris have been made, and are now being inserted in the GIS. Two series of layers are in progress: basic (descriptive) and advanced (interpretative). The basic interpretation layers that will be generated first will include (1) the bedrock outcrops, and (2) the "Interior Layered Deposits (ILD)" outcrop and stratigraphic subdivisions, when observed. These units cover > 50% of the Valles Marineris landforms. The first advanced interpretation layers will be generated at the same time.
- These interpretations are based on the article that was submitted during period 4 (see laureate report, period 4) by Gourronc, M., Bourgeois, O., Mège, D., Pochat, S., Bultel, B., Massé, M., Le Deit, L., and Mercier, D., Valles Marineris: a relict glaciated valley landsystem along the Martian equator), which is now in press.

**Research task 2 – Diagnostic climate signatures of basalt alteration on Earth and Mars**

Some topographic surfaces were identified as olivine, one of the main basalt components. Preliminary statistics of "holes" on the basalt surfaces (size, density) were conducted. SEM analysis of the studied basalts will be done during Period 6 in order to retrieve the chemical composition of minerals, and will allow to correlate the topography identified by AFM with mineralogy. Once the minerals are identified on AFM data, their difference in alteration structures in response to their specific weathering environment can be investigated.

### Research task 3 – Deep-seated gravitational spreading on Mars and Earth

- **Quantification of topographic ridge spreading** – The field data collected so far in the Tatra Mountains indicate that the WADGPS method is accurate enough to investigate mountain slope deformation on Earth. The main focus now is on quantification of accuracy, and the parameters that influence accuracy, such as field measurement duration, walking speed, time continuity/discontinuity of measurements, weather during measurement, and local variations in elevation of the surrounding areas (hills, trees etc.). Writing of two articles has started. One focuses on methodology: the use of WADGPS for geomorphology, with application to mountain slope deformation. The second is on comparison between mountain slope deformation on Mars, using the CTX digital elevation models as the main topography control, and on Earth, based on the results of the WAGPS experiments.
- **Numerical simulations** – The preliminary studies of the deep-seated gravitational spreading (DSGS) mechanism show that the main factors in a slope stability are the slope angle and the angle of internal friction. Another significant factor is a proper shape of the initial slope. Information obtained from Valles Marineris in comparison with field examples from Tatra Mountain shows the size of DSGS features on Mars are at least one order of magnitude larger than the terrestrial equivalents; the difference of size between Martian and terrestrial DSGS features is due to topographic gradient which is one order of magnitude higher on Mars than on Earth.

### Research task 4 – Landslides on Mars and Earth

The landslide runout distance in the numerical models is similar to the distance obtained in experimental models for a number of particles of only a few thousands. This distance does not seem to be affected by particle size polydiversity – it is similar for landslides in which particles all have the same size, and for landslides involving particles of different sizes, for the considered range of particle size polydiversity. The flow properties, however, are dependent on the friction coefficients (for particle-wall and particle-particle interactions). The runout distance of the final deposits seems to depend only on the initial aspect ratio of the column, defined as the quotient of its height and its radius.

### Research task 5 – Evolution of periglacial landforms on Earth and Mars related to global climate changes

- The manuscript mentioned in the report for Period #4 was modified to include new observations at 2,700 lakes. The paper will be submitted to *Geomorphology*, with the

title “New study of retrogressive thaw slump forming thermocirques along banks of thermokarst lakes in Central Yakutia, Siberia”.

- Results from the Utopia Planitia geomorphological mapping will be presented during a workshop at ISSI held in Bern on 4-6 December 2013.

## Research task 6 – Ice processes and landforms

- **Recurring Slope Lineae (RSL)** – The experimental device and setup for the experiments at Open University is now operational. The experiments are scheduled for December 2013. The work done in collaboration with the Grenoble group are the topic of a research manuscript to be shortly submitted to a peer-reviewed journal.
- **Martian north polar cap** – At the end of Period 5, the manuscript on this topic is almost finished. It will demonstrate from geomorphology and near-infrared spectral criteria that like in Antarctica, the Martian megadunes display an erosion slope with glazed surface and coarse ice grain size, and an accumulation slope with sastrugi features and ice grains of fine size. The dominant agent for the formation of these dunes are katabatic winds descending from the polar highs to the polar margins. The manuscript is scheduled for submission to *Earth and Planetary Science Letters* in late November.
- **KBO ices** – The data on tholin-methane spectra obtained in October will be analysed in details during Period 6. The preliminary results are that tholins mixed with frozen methane, a situation thought to be representative of the equatorial region of Pluto at perihelion, have their spectral signature almost entirely cancelled by the strength of the methane signature. Upon methane evaporation or sublimation (toward Pluto aphelion), the tholin spectral signature reappears, though somewhat altered. These experiments are only preliminary, with some improvements in the experimental protocol planned. Nevertheless, the originality and scientific interest of the results obtained in October will probably turn to a presentation at the Lunar and Planetary Science Conference, Houston, in March 2014, as well as a peer-reviewed article.

## 2) AWARDS AND DISTINCTIONS

- Dolnośląski Bon na Innowacje na realizację usługi "Testy i kalibracja zrobotyzowanego modułu do pomiarów elektrooporowych" dla ABM Space Education Sp. z o.o., Wrocławskie Centrum Transferu Technologii, Politechnika Wrocławska, 01.08.2013 – 29.11.2013. Researcher in charge of the project in the TEAM group: Joanna Gurgurewicz
- *Martian lowlands international mapping project*, funded by the International Space Science Institute (ISSI), Bern, Switzerland, 08.2013 – 12.2014. Participation of 12 researchers in 6 countries, including Antoine Séjourné in the TEAM group.

**3) INFORMATION ON MASTER'S THESES AND OTHER SCHOLARLY DEGREES OR TITLES EARNED BY RESEARCHERS INVOLVED IN THE PROJECT as a result of the realization of the project (concerning team members who are not stipendees).**

**4) INFORMATION ABOUT PARTNERS**

*a) Description of the cooperation with foreign partners*

**1. Dawson College, Department of Geography, Montreal, Canada**

- *Researchers from foreign partner:* Richard J. Soare
- *Researchers from TEAM project:* Antoine Séjourné
- *Topic of cooperation:* Interpretation of permafrost features in northeastern Canada
- *New or established cooperation:* established
- *Type of cooperation during this reporting period:* Article writing.

**2. Ecole Normale Supérieure (rue d'Ulm), Paris, France**

- *Researchers from foreign partner:* Yves Leroy
- *Researchers from TEAM project:* Magdalena Makowska, Daniel Mège
- *Topic of cooperation:* Scientific guidance for FEM modeling and analytical modeling of gravitational spreading
- *New or established cooperation:* since TEAM Period 4
- *Type of cooperation during this reporting period:* advice to PHD student for Task 3 regarding dynamic models of gravitational processes.

**3. Institut de physique du globe de Paris, France**

- *Researchers from foreign partner:* Anne Mangeney, Mark Wieczorek, Philippe Lognonné
- *Researchers from TEAM project:* Timur Borykov, Daniel Mège
- *Topic of cooperation:* (1) co-supervision of 1 PhD student; (2) Highland Terrain Hopper project
- *New or established cooperation:* Cooperation started in 2006 with co-supervision of another PhD student by A. Mangeney and D. Mège, Antoine Lucas (currently at AIM laboratory, see item #8). With MW and PL: new cooperation (Period 4)
- *Type of cooperation during this reporting period:* Paper writing with A. Mangeney.

**4. Istituto Nazionale di Astrofisica, Bologna, Italy**

- *Researchers from foreign partner:* Roberto Orosei
- *Researchers from TEAM project:* Daniel Mège, Olga Kromuszczyńska, Joanna Gurgurewicz, Krzysztof Dębniak
- *Topic of cooperation:* (1) Interpretation of the deep structure of the Valles Marineris region on Mars from ground penetrating radars (Mars Express/MARSIS, Mars Reconnaissance Orbiter/SHARAD); (2) Highland Terrain Hopper project

- *New or established cooperation*: since TEAM Period 3
- *Type of cooperation during this reporting period*: dormant

#### **5. Joseph Fourier University, Planetology and Astrophysics Institute, Grenoble, France**

- *Researchers from foreign partner*: Bernard Schmitt, Pierre Beck
- *Researchers from TEAM project*: Marion Massé
- *Topic of cooperation*: Experimental modeling of ice stability and spectral signature on Mars
- *New or established cooperation*: since TEAM Period 3
- *Type of cooperation during this reporting period*: Experimental modeling (two-weeks stay of M. Massé in Grenoble in November 2012), article writing (submission expected during Period 6).

#### **6. Lunar and Planetary Laboratory, Arizona State University, AZ, USA**

- *Researchers from foreign partner*: Alfred McEwen
- *Researchers from TEAM project*: Marion Massé, Daniel Mège
- *Topic of cooperation*: (1) Stability and mineralogical signature of brines on Mars under present conditions; (2) scientific objectives and potential payload for the Highland Terrain Hopper project
- *New or established cooperation*: since April 2011
- *Type of cooperation during this reporting period*: Article writing

#### **7. Open University, Centre for Earth, Planetary, Space and Astronomical Research, Milton Keynes, UK**

- *Researchers from foreign partner*: Matthew Balme, Susan Conway
- *Researchers from TEAM project*: Marion Massé, Antoine Séjourné
- *Topic of cooperation*: (1) Experimental modeling of Martian brine flows in climatic chamber; (2) International Martian Lowlands Mapping Project proposed by Open University at the *Martian Cryosphere Wroshop* held in Wrocław in January 2013 (Annex 3); (3) Highland Terrain Hopper project
- *New or established cooperation*: since TEAM Period 4
- *Type of cooperation during this reporting period*: Setup of experimental protocol for brine flow experiments (M. Massé); preparation of an ISSI meeting in December 2013 about the *Martian Lowlands Mapping Project* submitted during Period 4 (A. Séjourné)

#### **8. Paris–Diderot University, AIM Laboratory (Astrophysique, Interactions, Multi-échelles), Paris, France**

- *Researchers from foreign partner*: Antoine Lucas
- *Researchers from TEAM project*: Olga Kromuszczyńska, Timur Borykov, Daniel Mège
- *Topic of cooperation*: High resolution stereo-derived digital topography of Mars
- *New or established cooperation*: since 2005



- *Type of cooperation during this reporting period:* Computation of digital elevation models of Valles Marineris for PhD work

### **9. Permafrost Institute, Yakutsk, Russia**

- *Researchers from foreign partner:* Alexander Fedorov
- *Researchers from TEAM project:* Antoine Séjourné
- *Topic of cooperation:* Characterization of periglacial features and processes in Yakutia, Siberia
- *New or established cooperation:* established for several years
- *Type of cooperation during this reporting period:* Field work collaboration and logistics in eastern Siberia (October 2012), article writing

### **10. State Geological Institute of Dionýz Štúr, Banská Bystrica, Slovakia**

- *Researchers from foreign partner:* Róbert Jelinek
- *Researchers from TEAM project:* Olga Kromuszczyńska, Magdalena Makowska, Joanna Gurgurewicz, Daniel Mège, Krzysztof Dębniak
- *Topic of cooperation:* Field collaboration for studying gravitational spreading in the lower Tatra mountains
- *New or established cooperation:* new
- *Type of cooperation during this reporting period:* Field work in June 2013

### **11. University of Arkansas, Fayetteville, AR, USA**

- *Researchers from foreign partner:* Vincent Chevrier, Sandeep Singh
- *Researchers from TEAM project:* Daniel Mège
- *Topic of cooperation:* Future interpretation of data from the New Horizons mission in 2015
- *New or established cooperation:* new
- *Type of cooperation during this reporting period:* acquisition of laboratory data

### **12. University of Montpellier, Géosciences Montpellier Lab, France**

- *Researchers from foreign partner:* Frédéric Gueydan
- *Researchers from TEAM project:* Magda Makowska, Daniel Mège
- *Topic of cooperation:* co-supervision of 1 PhD student
- *New or established cooperation:* since TEAM Period 2
- *Type of cooperation during this reporting period:* Co-advising of PhD student Magdalena Makowska.

### **13. University of Nantes, Planetology and Geodynamics Lab, France**

- *Researchers from foreign partner:* O. Bourgeois, V. Carrère, A. Gaudin, C. Herny, S. Le Mouélic, Y. Morizet, D. Nna Mvondo

- *Researchers from TEAM project:* Joanna Gurgurewicz, Marion Massé, Daniel Mège, and Marta Skiścim
- *Topic of cooperation:* (1) geology and mineralogy of Mars, as well as various issues relating to processing and interpretation of remote sensing datasets; (2) ice dynamics of polar dunes; (3) spectral signature of tholins
- *New or established cooperation:* This partnership is established for many years.
- *Type of cooperation during this reporting period:* Work on glacial postglacial geomorphology of the Valles Marineris canyons on Mars (revision of an article which is now in press); laboratory measurements of tholin spectra

#### **14. University of Paris-Sud, Orsay, France**

- *Researchers from foreign partner:* François Costard, Julien Gargani, Chiara Marmo
- *Researchers from TEAM project:* Antoine Séjourné, Marion Massé, Daniel Mège
- *Topic of cooperation:* periglacial morphology
- *New or established cooperation:* established for many years
- *Type of cooperation during this reporting period:* test of electroresistivity instrument onboard the ABM Space Education Magma White rover in a (Martian) cold room in Orsay

#### **15. University of Rennes, Physics Institute, Rennes, France**

- *Researchers from foreign partner:* Patrick Richard
- *Researchers from TEAM project:* Timur Borykov, Daniel Mège
- *Topic of cooperation:* Molecular dynamics modeling
- *Type of cooperation during this reporting period:* Development of molecular dynamics code for landslide propagation investigations within the framework of T. Borykov's PhD thesis

#### **16. University of Uppsala, Ångström Space Technology Centre, Sweden**

- *Researchers from foreign partner:* Greger Thornell
- *Researchers from TEAM project:* Daniel Mège
- *Topic of cooperation:* Miniaturized payload development for Highland Terrain Hopper
- *New or established cooperation:* since Period 4
- *Type of cooperation during this reporting period:* dormant

#### *b) Description of the cooperation with Polish partners – if applicable*

##### **1. ABM Space Education, Toruń**

- *Researchers from Polish partner:* Mateusz Józefowicz, Sebastian Meszyński
- *Researchers from TEAM project:* Joanna Gurgurewicz, Antoine Séjourné, Daniel Mège
- *Topic of cooperation:* Development and test of scientific payload onboard ABM's Martian rover; public outreach

- *New or established cooperation:* Established since TEAM Period 3
- *Type of cooperation during this reporting period:* Cold room test of electroresistivity instrument placed onboard the ABM *Magma White* rover designed for Mars exploration.

## **2. Astronika, Warsaw**

- *Researchers from Polish partner:* Jerzy Grygorczuk, Łukasz Wiśniewski
- *Researchers from TEAM project:* Joanna Gurgurewicz, Daniel Mège
- *Topic of cooperation:* Scientific background, scientific support, and lab and field testing for the Highland Terrain Hopper project submitted to European Space Agency (ESA), in which Astronika is Prime Contractor and ING PAN a subcontractor.
- *New or established cooperation:* since Period 4
- *Type of cooperation during this reporting period:* dormant (waiting for ESA's funding decision for the project submitted at the end of Period 4), then brainstorming (how to bypass the veto of Poland that prevents ESA from funding the project after successful review – see Section 7.1)

## **3. Polish Academy of Sciences, Space Research Centre, Warsaw**

- *Researchers from Polish partner:* Jerzy Grygorczuk, Łukasz Wiśniewski, Hans Rickman, Karol Seweryn, Marek Banaszkiewicz, and others
- *Researchers from TEAM project:* all the TEAM group members
- *Topic of cooperation:* (1) similar to Astronika (SRC PAS is another Highland Terrain Hopper Project subcontractant); (2) environment conditions on early Mars
- *New or established cooperation:* established (2010)
- *Type of cooperation during this reporting period:* similar to Astronika

## **4. University of Wrocław, Faculty of Earth Sciences and Environmental Management, Institute of Geography and Regional Development**

- *Researchers from Polish partner:* Piotr Migoń
- *Researchers from TEAM project:* most TEAM members
- *Topic of cooperation:* geomorphological processes and landforms on Earth and Mars
- *New or established cooperation:* started in TEAM Period 1
- *Type of cooperation during this reporting period:* scientific exchanges, implication of PhD students from the University of Wrocław in Martian geomorphology

## **5. University of Wrocław, Faculty of Earth Sciences and Environmental Management, Institute of Geological Sciences**

- *Researchers from Polish partner:* Joanna Kostylew, Wojciech Bartz
- *Researchers from TEAM project:* Joanna Gurgurewicz, Marta Skiścim, Daniel Mège
- *Topic of cooperation:* (1) Lower Silesia Festival of Science; (2) Petrographic and chemical analysis of rock samples
- *New or established cooperation:* established for several years

- *Type of cooperation during this reporting period:* preparation of XVI Lower Silesia Science Festival (2013) (W. Bartz)

## 6. University of Wrocław, Faculty of Physics and Astronomy, Institute of Experimental Physics

- *Researchers from Polish partner:* Leszek Jurczyszyn, Leszek Markowski
- *Researchers from TEAM project:* Marta Skiścim, Joanna Gurgurewicz, Daniel Mège
- *Topic of cooperation:* nanoscale characterization of surfaces, specifically altered basalt
- *New or established cooperation:* started in Period 1
- *Type of cooperation during this reporting period:* Daily cooperation through PhD student M. Skiścim, who is doing another PhD in this institute

## 7. Wrocław University of Technology, Wrocław Centre for Networking and Supercomputing (WCSS)

- *Researchers from TEAM project:* Timur Borykov
- *Topic of cooperation:* Access to supercomputing facility for granular modeling of landslides and debris flows.
- *Type of cooperation during this reporting period:* dormant during Period 5.

5) IS THE PROJECT COMPATIBLE WITH THE HORIZONTAL POLICIES SPECIFIED IN ARTICLES 16 AND 17 OF COUNCIL REGULATION (EC) NO. 1038/2006 (I.E. THE POLICY OF EQUAL OPPORTUNITIES AND ENVIRONMENTAL PROTECTION, AND WHETHER THE PROJECT IS CARRIED OUT IN COMPLIANCE WITH THE PRINCIPLE OF SUSTAINABLE DEVELOPMENT)?

YES NO 

*If Community policies are not being followed, please provide an explanation as to what irregularities there have been and what remedial action has been planned and undertaken.*

6) IS THE PROJECT BEING REALIZED ACCORDING TO THE SCHEDULE ATTACHED TO THE CONTRACT ?

YES NO 

*If the answer is NO, please provide an explanation :*

Yes – but: although only weakly threatening for the achievement of the TEAM project tasks, fractions of the work are constantly delayed by centralisation at ING PAN in Warsaw. For instance, the absence of a network engineer locally results in various malfunctions relating to e.g. software network license and digital library access since the beginning of the project.

Centralisation in the Warsaw branch of the TEAM-purchased software has resulted in removal of some students' work and legal software purchased by TEAM collaborating institutions on their workstations during auditing in September 2013. The absence of an accountant that would be based in Wrocław daily delays the TEAM group activities, as well as makes life difficult for the accounting administration and results in many errors in financial reports that could be easily avoided if the financial matters could be dealt with locally.

## 7) ADDITIONAL INFORMATION

*Other important information relevant to the project*

### 7.1. TEAM Group activities for space exploration

Following the entrance of Poland in ESA in November 2012, two projects have started.

- **Galago: the Highland Terrain Hopper project.** This highly innovative, internationally supported project of robot prototype development for investigation of low-gravity planetary bodies, was submitted to the European Space Agency (ESA) in April 2013 (see laureate report #4). Eligible for funding by ESA after project review, the project was then censored by the Polish ministry of economy in September 2013, leading to official postponement of ESA's final decision. Other funding opportunities are being investigated.
- **Magma White:** A project aiming at testing an electroresistivity instrument designed to identify shallow discontinuities on Mars was submitted during Period 4, and funded and conducted during Period 5. Laboratory tests in Martian temperature and pressure conditions were conducted at the Martian cold room at University of Paris-Sud, Orsay, France, by researchers from the TEAM group (J. Gurgurewicz, A. Séjourné).

### 7.2. Organisation of conferences

- **Organisation of the next European Martian Cryosphere Wroczshop**

*(see Progress of research task, Task 5)*

- **Organisation of ESA's next MPSE meeting**

Following the impulse of the first MPSE meeting (Mars – Connecting Planetary Scientists in Europe) held in Budapest in June 2012, the second MPSE meeting will be organised by the TEAM group and co-organized by the Space Research Centre (CBK PAN) in Warsaw in June 3-6, 2014. This meeting will include long morning invited review lectures on Mars-related topics by leading scientists in their fields, and short afternoon presentations by researchers from eastern and western Europe on Martian scientific issues. The meeting is sponsored by the European Space Agency, and request for co-sponsoring has been sent to Geoplanet, a

consortium of Polish Academy of Sciences laboratories in the field of Earth and Space science. During Period 5 the first steps in MPSE organisation have been undertaken.

### 7.3. Public Outreach

- **XVI Lower Silesian Science Festival 2013**

Like in 2012, under the leadership of J. Gurgurewicz, the TEAM group actively participated to the science festival. The main differences with the 2012 edition are the following: (1) In 2012, the *Chomik* penetrator, an instrument onboard the Phobos-Grunt spacecraft built at CBK PAN, had been presented to the public. In 2013, the *Kret* instrument for penetrating the lunar regolith, also built at CBK PAN, was presented; (2) the Magma White rover, built by ABM Space Education, included a new instrument built by the University of Innsbruck designed to detect chlorophyll; (3) the 3D Mars image exhibition was complemented with a 3D Moon image exhibition. Details are below:

Zespół geologów planetarnych WROONA z Instytutu Nauk Geologicznych PAN, przy współudziale inżynierów z Centrum Badań Kosmicznych PAN oraz zespołu z firmy ABM Space Education, przygotował w ramach XVI Dolnośląskiego Festiwalu Nauki dwudniowy cykl wykładów i pokazów z elementami happeningu oraz wystawę, przybliżającą uczestnikom nie tylko Marsa, ale również naszego ziemskiego satelitę – Księżyc. Imprezy odbyły się w dniach 20–21 września w ramach „Weekendu z geologią”.

Wykład „Księżyc – pierwszy krok w kierunku Marsa” (1) rozpoczął się krótkim quizem. Pytania dotyczyły Księżyca i jego budowy, Marsa i jego cech charakterystycznych, ciekawostek z misji kosmicznych, było także do rozpoznania kilka zdjęć z Ziemi, Księżyca i Marsa. Podczas quizu publiczność była bardzo ożywiona, chętnie i z zapałem odpowiadano na pytania.

Po quizie rozpoczęła się księżycowa część wykładu. Prezentowano historię obserwacji naszego satelity, opowiedziano o jego powstaniu, przedstawiono podstawowe fakty dotyczące Księżyca (jego odległość od Ziemi, wielkość, masę, itp.). Następnie zaprezentowana została historia eksploracji ziemskiego satelity, wyścig w podboju Księżyca między USA i ZSSR w czasie zimnej wojny, a także późniejsze misje. Przedstawiono plany na przyszłe wyprawy księżycowe, zakładające m. in. budowę bazy na Księżycu. Podczas tej części wykładu uczestnicy mogli zobaczyć kilka filmów (o powstaniu Księżyca, przygotowania do misji Apollo 10, fragment filmu fabularnego "Apollo 13" prezentujący moment awarii na statku kosmicznym), na które reagowano bardzo żywiołowo i oglądano z dużym zainteresowaniem.

Marsjańska część wykładu rozpoczęła się historią obserwacji Czerwonej Planety, po której pojawiła się animacja lotu na Marsa, wzbudzająca duże zainteresowanie. Następnie uczestnicy mogli dowiedzieć się o wielkości, masie, objętości, gęstości Marsa, a także innych jego cechach w porównaniu z cechami naszej planety. Słuchacze byli następnie przekonywani o tym, że mimo wielu różnic między Marsem i Ziemią, na obu planetach działają podobne procesy, tworząc analogiczne formy terenu (wydmy, osuwiska, wulkany, kaniony, itd.). Następnym etapem była opowieść o historii eksploracji Marsa – od prezentacji pierwszych misji marsjańskich po przedstawienie obecnie działających misji. Uczestnicy dowiedzieli się także jakie rodzaje danych misje marsjańskie dostarczały i dostarczają. Część marsjańska zakończyła się przedstawieniem misji na Marsa zaplanowanych na najbliższą przyszłość.

Wykład zwieńczony został podaniem poprawnych odpowiedzi na pytania z quizu (te zawarte były w książkowej i marsjańskiej części prezentacji, więc uczestnicy chętnie i z entuzjazmem wykrzykiwali prawidłowe odpowiedzi) oraz rozdaniem nagród (globusy Księżyca i Marsa do samodzielnego złożenia), co oczywiście spotkało się z największą euforią i wybuchami radości. Dodatkowo każdy uczestnik wykładu otrzymał "pocztówkę z Marsa", co zostało przez słuchaczy uznane za wyjątkową pamiątkę z wykładu. Łącznie w wykładach wzięło udział ponad 100 osób. W piątek były to głównie grupy zorganizowane ze szkół, w sobotę najwięcej było rodzin z dziećmi.

Uzupełnieniem wykładu był pokaz urządzeń przygotowany przy współudziale inżynierów z Centrum Badań Kosmicznych PAN oraz zespołu z firmy ABM Space Education. Centrum Badań Kosmicznych przygotowało pokaz dotyczący instrumentu KRET. Na stanowisku znajdował się model testowy najnowszego projektu penetratora geologicznego dedykowanego do pracy na Księżycu. Urządzenie jest zdolne zagłębić się pod powierzchnię srebrnego globu do 5 metrów. KRET został zaprezentowany w analogu regolitu księżycowego, w którym był testowany. Analog regolitu księżycowego to materiał opracowany przez Akademię Górniczo-Hutniczą w Krakowie, który pod względem mechanicznym odpowiada temu, co znajduje się na powierzchni Księżyca. Na stoisku prezentowano filmy ilustrujące pracę urządzenia. Stoisko obejrzało około 300 osób. Zwiedzający pytali najczęściej o cel budowy instrumentu, który ma wbijać się pod powierzchnię księżyca, jak również o zasadę działania urządzenia.

Firma ABM Space Education zaprezentowała robota MAGMA WHITE – analog łazika marsjańskiego wykorzystywany do symulowanych misji kosmicznych, który w lutym b. r. wziął udział w symulowanej misji na Saharze w Maroku. Zainstalowano tam na nim laserowy detektor chlorofilu L.I.F.E. rozwijany przez Uniwersytet w Innsbrucku. W ramach programu Ministerstwa Nauki Szkolnictwa Wyższego i Austriackiego Ministerstwa Nauki wspierającego współpracę naukowców z obu krajów L.I.F.E. jest obecnie udoskonalany i przystosowany do stałej współpracy z łazikiem. Przyrząd został zaprezentowany na łaziku podczas dwóch dni Festiwalu i wzbudził duże zainteresowanie. Ponadto łazik stanowi platformę dla rozwijanego wspólnie z grupą WROONA przyrządu do elektrooporowych badań gruntu, o którym także konstruktorzy opowiadali licznej młodej i dorosłej publiczności.

Krótki wykład i pokaz generowania kraterów impaktowych, przedstawiony czterokrotnie w ramach happeningu „Rakietą na Księżyc i dalej” (2) cieszył się dużym zainteresowaniem. Łącznie obejrzało go około 70 osób, w przedziale wiekowym od 4 lat po osoby dorosłe. Wykład o rodzajach kraterów uderzeniowych, sposobie ich powstawania oraz przykładach z Układu Słonecznego był świetną logiczną kontynuacją wcześniejszej prezentacji o Księżycu i Marsie. Mnóstwo emocji budził pokaz powstawania kraterów przy użyciu kamieni o różnej wielkości (mających imitować wpływ prędkości i wielkości na średnicę krateru) oraz petard (ukazujących oddziaływanie eksplozji). Dzieci chętnie brały udział w tworzeniu kamieniami kraterów w wielowarstwowym, kolorowym piasku. Największe emocje towarzyszyły eksplozjom, dzięki którym widzowie mogli zaobserwować powstawanie kraterów miseczkowych o idealnych kształtach.

W ramach happeningu uczestnicy mieli również niepowtarzalną okazję przygotować i „odpalić” swój własny model rakiety. Pomimo, iż paliwem raketowym był ocet oraz soda oczyszczona, rakiety cieszyły się dużą popularnością nie tylko wśród najmłodszych uczestników, ale również młodzieży szkolnej. W czasie trwania imprezy z inicjatywy starszych uczestników został również zorganizowany konkurs na raketę, która poleciał najwyżej. Zużyto prawie 10 butelek octu i kilka

opakowań sody oczyszczonej oraz niezliczoną ilość kartonowych skrzydeł – „stateczników” i plastikowych butelek – „kadłubów”. Uczestnicy byli zdania, że z całą pewnością należy w przyszłym roku powtórzyć ten eksperyment, poszerzając jego zasięg o kolejne 10 butelek octu.

Każdy z odwiedzających wystawę „Spacer po Księżycu w drodze na Marsa” (3) na początek został wyposażony w specjalne okulary oraz mapy Księżyca i Marsa z zaznaczonymi na nich trasami. Na trasach tych umieszczono lokalizacje miejsc, z których pochodziły prezentowane na wystawie zdjęcia; każde zdjęcie opatrzone było numerem, także zwiedzający mógł w każdej chwili sprawdzić na mapie, w którym miejscu na Księżycu czy Marsie się znajduje. Zwiedzanie rozpoczynało się „spacerem po Księżycu” (część wystawy umieszczona na parterze), a później można było „udać się na Marsa” (ciąg dalszy wystawy na piętrze „Rotundy”, ul. Cybulskiego 32). Przed rozpoczęciem spaceru można było podziwiać trójwymiarową półkulę Księżyca oraz pierwsze zdjęcie Ziemi wykonane z odległości Księżyca w 1966 roku. Trasa księżycowa prowadziła od miejsc lądowań misji programu Apollo do tych badanych ostatnio zdalnie przez orbiter. Ta część wystawy obejmowała łącznie 10 zdjęć, w tym 4 anaglify. Wyprawa marsjańska rozpoczynała się w ogromnym basenie impaktowym Hellas, a kolejne kroki pozwalały na odwiedzenie wielu ciekawych zakątków Czerwonej Planety. W części marsjańskiej zaprezentowano łącznie 22 zdjęcia, z czego aż 15 w 3D. Ekspozycja wzbudzała duże zainteresowanie, a trójwymiarowe obrazy szczególnie pobudzały wyobraźnię. Tematyka pytań zadawanych przez zwiedzających była bardzo zróżnicowana – od szczegółów misji księżycowych do marsjańskich procesów geologicznych. W ciągu dwóch dni wystawę odwiedziło łącznie ponad 300 osób. Znaczną część zwiedzających stanowiły grupy zorganizowane i dorośli z dziećmi, którzy wcześniej uczestniczyli w wykładzie i pokazach/happeningu. Były też osoby, które uczestniczyły w imprezach przygotowanych przez zespół WROONA w ubiegłym roku.

(1) <http://www.festiwal.wroc.pl/2013/index.php?c=events&do=detail&id=9427>

(2) <http://www.festiwal.wroc.pl/2013/index.php?c=events&year=2013&do=detail&id=9428>

(3) <http://www.festiwal.wroc.pl/2013/index.php?c=events&do=detail&id=9429>

Pozostałe adresy:

<http://www.festiwal.wroc.pl/2013/index.php?c=article&id=1070>

<http://www.festiwal.wroc.pl/english/?c=article&id=173>

#### 7.4. Additional manpower at ING PAN

The TEAM group intends to develop planetary sciences in Poland beyond the end of the project in 2015. Since October 1<sup>st</sup>, 2013, the Wrocław Branch of ING PAN has a new NCN/FUGA 2 postdoc, Anna Łosiak. She will develop her own research project on Mars and meteorites during 2 years. Anna will closely collaborate with the TEAM group.

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**I, the undersigned, hereby confirm that the information contained in the merit, periodic report (both electronic and paper version) are true. I am aware of the legal consequences of giving untrue information in a legally significant situation, as stated in article 271 of the Penal Code.**

**Appendixes to the merit report in the electronic version:**

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- Project realization indexes (on-line data base),
- Scientific Achievements of the Laureate and Stipendees (on-line data base),
- List of conferences and scientific exchanges,
- merit reports of the Stipendees.

**Appendixes to the merit report in the hard copy:**

- documents confirming the execution of payments of pension and retirement insurance premiums (for PhD students) – only in paper form.

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**Date: November 1st, 2013**

Laureate Signature.....  


Institution Stamp.....



## LIST OF CONFERENCES AND SCIENTIFIC EXCHANGES

## TEAM PROGRAMME

### LIST OF CONFERENCES AND SCIENTIFIC EXCHANGE ACTIVITIES

Attachment to merit report

<b>Project title:</b>	Mars: another planet to approach geoscience issues		
<b>Reporting period</b>	from 01.05.2012 to 31.10.2013	<b>Period no.:</b> 5	
<b>Agreement no.:</b>	TEAM.2011-7.9	holding from 01.09.2011 to 30.06.2015	
<b>LAUREAT:</b>	Daniel MEGE		

**ATTENTION: the information given below should regard only the realization of the project in the reporting period indicated above.**

## 1. CONFERENCES

### 1.1 Participation of persons involved in the realisation of the Project in national and international conferences:

NO.	NAME AND SURNAME	CONFERENCE TITLE	COUNTRY, CITY	DURATION OF STAY (DATES)		TITLE OF THE PRESENTATION	TYPE OF PRESENTATION (ORAL . POSTER)
				FROM	TO		
1.	Krzysztof DĘBNIAK	V Ogólnopolskie Sympozjum, Sopotkie Forum Młodych pt. "Dokąd zmierza świat"	Poland, Sopot	18.05.2013	18.05.2013	Valles Marineris – miejsce pełne odpowiedzi	oral
	Krzysztof DĘBNIAK	IAG International Conference on Geomorphology	France, Paris	27.08.2013	31.08.2013	A Valles Marineris synthesis	poster
	Antoine SEJOURNE	International Conference on Geomorphology Workshop	Paris, France	27.08.2013	31.08.2013	Important melting of ice-wedges and formation of thermocirques on slopes of thermokarst lakes in Central Yakutia (Siberia)	oral
	Daniel MEGE	European Planetary Science Congress	UK, London	08.09.2013	14.08.2013	Scientific exploration of low-gravity planetary bodies using the Highland Terrain Hopper.	poster

## 2. SCIENTIFIC EXCHANGE – other than conferences

### 2.1. Official international trips:

*Exchanges in italic were partly made during Period 4 and partly during Period 5.*

NO.	NAME AND SURNAME	SCIENTIFIC UNIT	COUNTRY, CITY	DURATION OF STAY		AIM OF THE STAY
				FROM	TO	
1.	<i>Marion MASSE</i>	<i>Univ. Nantes, Univ. Joseph Fourier, Open Univ</i>	<i>France, Nantes, Paris; UK, Milton Keynes</i>	<i>28.04.2013</i>	<i>13.05.2013</i>	<i>Writing scientific paper (Univ Nantes+ Univ Joseph Fourier) and laboratory experiments (Open Univ)</i>
2.	<i>Timur BORYKOV</i>	<i>Institut de Physique du Globe de Paris</i>	<i>Paris, France</i>	<i>16.04.2013</i>	<i>02.05.2013</i>	<i>Improving and testing discrete element techniques and relevant programming sources, writing a paper</i>
3.	<i>Daniel MEGE</i>	<i>Planetology and Geodynamics Lab, Univ. Nantes</i>	<i>France Nantes</i>	<i>18.04.2013</i>	<i>12.05.2013</i>	<i>Work on three science articles with collaborators abroad</i>
4.	Joanna GURGUREWICZ	IDES, Univ. Paris-Sud	Orsay, France	20.10.2013	27.10.2013	Laboratory test of electroresistivity instrument onboard prototype Martian rover in cold room
5.	Magdalena MAKOWSKA	Geosciences Montpellier, Université Montpellier 2	Montpellier, France	16.06.2013	28.06.2013	Modelling of deep-seated gravitational slope deformation using 2D finite element code ADELI
6.	Marion MASSE	Planetology and Geodynamics Lab, Univ. Nantes	France, Nantes	29.04.2013	14.05.2013	Collaboration with C. Herny, Writing of a scientific paper
7.	Marion MASSE	Institut of Planetology	France,	13.05.2013	23.05.2013	Writing of a scientific paper about laboratory experiments

		and Astrophysics, Joseph Fourier University	Grenoble			
8.	Marion MASSE	Planetary Science and Comparative Planetology, Lab, Open University	UK, Milton Keynes	24.05.2013	14.05.2013	Laboratory experiments
9.	Marion MASSE	Geology Laboratory, Univ of Lyon	France, Lyon	22.07.2013	28.07.2013	Realisation of Digital Elevation Models of Mars
10.	Daniel MEGE	Planetology and Geodynamics Lab, Univ. Nantes	France, Nantes	30.09.2013	02.10.2013	Scientific collaboration with various researchers
11.	Daniel MEGE	Arkansas Center for Planetary and Space Science	USA, Fayetteville, AR	03.10.2013	25.10.2013	Acquisition of laboratory near-infrared spectra of tholin-ices mixtures for interpretation of New Horizons spacecraft data in 2015
12.	Daniel MEGE	Planetology and Geodynamics Lab, Univ. Nantes	France	26.10.2013	31.10.2013	Scientific collaboration with various researchers
13.	Antoine SEJOURNE	IDES, Univ Paris-Sud	Orsay, France	20.10.2013	27.10.2013	Laboratory test of electroresistivity instrument onboard prototype Martian rover in cold room

2.2. *Official domestic trips:*

NO.	NAME AND SURNAME	SCIENTIFIC UNIT	COUNTRY, CITY	DURATION OF STAY		AIM OF THE STAY
				FROM	TO	

2.3. *Guests invited in connection with the realization of the Project (national and . or foreign):*

NO.	NAME AND SURNAME	SCIENTIFIC UNIT	COUNTRY, CITY	DURATION OF STAY		AIM OF THE VISIT
				FROM	TO	
1.	Dirk Schulze-Makush	Technische Universität Berlin	Germany, Berlin	22.09.2013	24.09.2013	Lecture: Search for life in the solar system: targets and missions