JAGIELLONIAN UNIVERSITY
IN KRAKÓW

Faculty of Physics, Astronomy
and Applied Computer Science
Faculty of Geography and Geology

Second National Mars Science Seminar

16.10.2020, www.mars.uj.edu.pl

BOOK OF ABSTRACTS

Current activities of the Mars geoscience group at the Space Research Centre PAS

Prof. Daniel Mège
Space Research Centre PAS

[PRESENTATION]

The group continues studies of Valles Marineris, which offers an unique view of the geologic processes that occurred since the earliest stages of Mars evolution. Nonlinear spectral unmixing of intensely deformed bedrock in Valles Marineris has revealed with unprecendented accuracy the composition of the bedrock, and its alteration, and geological implications will be discussed. Determination of the physical properties of the Valles Marineris shallow subsurface using the SHARAD orbital radar of MRO is a long-term effort which is now going to first results. The group is also involved in the definition of new mapping standards in volcanic regions within the framework of Europlanet's (GMAP) activity, and a case study is ongoing at Arsia Mons, one of the main Tharsis shield volcanoes. A new H2020-funded, drone-mounted P-band radar project, designed for a lander mission, will be presented.

Mars Lab projects at the Jagiellonian University

Dr Joanna Kozakiewicz
Jagiellonian University

[PRESENTATION]

Mars Lab is a part of the Planetary Lab, an Interfaculty Program in Planetary Research at the Jagiellonian University. At present, Mars Lab is conducting four research projects, related to: studying aeolian processes in equatorial regions on Mars, investigating atmospheric electric activity and subsurface layers of Mars using extremely low frequency (ELF) electromagnetic waves, geomorphological mapping of Mars, and developing automatic techniques for processing, analysis, and visualization of data acquired by rovers, landers, and orbiters. We will present new results related to our Mars ELF station prototype, wind tunnel experiments, and processing and analysing of large data sets from Mars. We will also present the Strategic Program Excellence Initiative at the Jagiellonian University that can help to empower planetary research in Poland.

Development of a methodology for creating multi-resolution terrain models for Mars and classification of terrain forms using deep learning methods

Prof. Robert Olszewski
Warsaw University of Technology

[PRESENTATION]

The project will involve implementing mutually integrated research tasks. Scientific research is carried out by the team of the Warsaw University of Technology in cooperation with the Jagiellonian University. The first phase will entail developing a spatial big data analysis system using machine learning methods – a system that will enable the creation of large-scale models of the Mars relief. Development of a classification system (task 2) using deep learning, multi-source data, and models from task 1, as well as planetary measurements carried out by Mars rovers Opportunity (Mars Exploration Rover mission) will enable the automation of the process of classifying the terrain forms on Mars.

Mapping the Northern Lowlands of Mars

Dr Anna Łosiak
University of Exeter, Institute of Geological Sciences PAS

[PRESENTATION]

A project of mapping ice-related landforms was undertaken to understand the role of subsurface ice in the northern plains. This work is the first continuous regional mapping from CTX. The degradational features into the LDM (Latitude Dependent Mantle) include pits, scallops and 100 m polygons and provide supporting evidence for sub-surface ice and volatile loss between 35-70° N with the mantle between 70-78° N appearing much more intact. Results were published in a series of papers in JGR:Planets: Ramsdale et al. 2018, Séjourne et. al. 2019, Orgel et al. 2019, Ramsdale et al. 2019.

The search for ongoing surface deformations in Noctis Labyrinthus, Mars

Dr Krzysztof Gaidzik
University of Silesia

[PRESENTATION]

The growing number of findings related to current and past seismic activity on Mars calls for studies on the ongoing surface deformations and the potential impact of seismic events on landscape evolution. For that reason, we applied an optical correlation of > 100 High-Resolution Imaging Science Experiment (HiRISE) images from time span 2006-2017, focusing on several chosen areas of the Noctis Labyrinthus to search for any evidence of current surface deformation. The results show some activity produced by wind (dune movements and overburden of some areas with sand), meteorite impacts (impact crater development), and mass movement processes (landslide reactivation), etc. Even though, we found several examples of current surface deformation on Mars, it is unlikely that we have observed any coseismic displacement. This could be related to small-scale magnitudes of marsquakes, short time period of observations, not sufficient image resolution, etc.

Amazonian Chronology of Arsia Mons and Southeast Tharsis

MSc Pierre-Antoine Tesson
Space Research Centre PAS

[PRESENTATION]

Arsia Mons is the southernmost shield volcano of the Tharsis Montes. Previous study found ash-deposits north of the caldera indicating episodes of explosive activity. Effusive episodes in the form of lava flows located within the caldera and in the southern lava apron, show transition away from explosive activity at 200 Ma. Here we investigate a set of fresh-looking lava flows located SE of Arsia Mons in order to constrain its late Amazonian chronology. We performed geological mapping and impact crater retention age derivation. The obtained ages range from 200 Ma to 50 Ma, with an apparent peak at 150 Ma. These ages corelates with the ones found within the caldera. Morphology of lava flows indicate magma of mafic composition. Our results confirm that after effusive volcanism resumed, activity at Arsia Mons was not restricted to the caldera or the main flanks. Future work will focus on studying the relationship between these lava flows, the ash deposits and older underlying lava fields.

JAGIELLONIAN UNIVERSITY IN KRAKÓW

Second National Mars Science Seminar

Morphology and factors controlling formation of aeolian ripple marks on the Earth and Mars

Magdalena Baranowska
Adam Mickiewicz University

[POSTER]

Mars and Earth are characterised by different physical conditions on their surface: e.g. the atmosphere is less dense, gravity is less than Earth's. This has an impact on the morphology and dynamics of aeolian ripple marks. As a result, on Mars there are some features that are absent on Earth: large ripples in fine sand, which can reach a length of up to 5 m. Martian large ripples in fine sand are diverse morphologically, oriented transversely and longitudinally to the direction of the wind, they may have asymmetrical and symmetrical cross-sections, sinuous or straight crests. Granule ripples occur on both planets, but on Mars some of them are active and non-active. Earth's aeolian ripples form transversely to the wind direction, have an asymmetrical cross-section and straight ridges. Aeolian ripple marks are diverse also in components of ripples: e.g. on Earth mainly of quartz grains (rarely of "mafic" grains, on Mars of crushed basalt, olivine and plagioclase grains.

JAGIELLONIAN UNIVERSITY IN KRAKÓW

Second National Mars Science Seminar

Aeolian forms in Meridiani Planum along the traverse of the Opportunity rover

Dr Joanna Kozakiewicz
Jagiellonian University

[POSTER]

Aeolian forms dominate in Meridiani Planum. Orientation and morphology of these landforms are crucial to understand aeolian transport in the area. Studying aeolian landforms requires employing in situ data, as orbital images are not sufficient to determine small features at the planetary surface. Landforms observed by the Opportunity rover are fine- and coarse-grained ripples, sand shadows, dunes, sand sheets, wind streaks, and ventifacts. The orientation and superpositions of these forms indicate that they were shaped and reshaped by different winds. Coarse-grained ripples, which cover almost entire area of Meridiani Planum, indicate changes in wind force and wind regimes over time, and formation of unstable accumulation and deflation zones.

JAGIELLONIAN UNIVERSITY IN KRAKÓW

Second National Mars Science Seminar

Spatial analysis and cartographic visualization of latitude-dependent mantle thickness in the area of impact craters of Utopia Planitia

Piotr Król
University of Warsaw

[POSTER]

The latitude-dependent mantle is a thick layer covering the surface of Mars in both hemispheres between 30 and 60 latitudes, thought to be composed of water ice and dust, formed by means of airfall deposition and surface accumulation. It contains frozen water, which is a crucial factor in learning more about Mars. This project focuses on developing a possible method of estimating and visualizing the thickness of LDM. The method bases on a correlation between impact crater diameter and depth, which allows comparing pairs of craters of similar diameters across Utopia Planitia. Data used in this study comes from MOLA (Mars Orbiter Laser Altimeter) and CTX (The Context Camera), and it is processed using JMars software. Once the database is completed, it will be used in ArcMap to create and visualize a map of estimated LDM thickness. The presentation is based on the ongoing master's project at the Faculty of Geography and Regional Studies, University of Warsaw.

Prototype of the station for the observations of the ELF electromagnetic waves on the surface of Mars

Prof. Andrzej Kułak
AGH University of Science and Technology

[POSTER]

The station is an autonomous ELF electromagnetic receiving system built in the micro-power technology, operating in the frequency range from 30 mHz to 450 Hz. Station will be placed on the surface of Mars. The project developed with a new magnetic antenna technology. Developed antennas are characterized by a low weight of 0.6 kg and a very low noise level of 0.1 pT / sqrt (Hz) at 10 Hz. The station is powered by the solar batteries that ensure the continuous recording, data processing by the on-board computer and transmitting of the analysis results to the orbital retransmitter.

Acknowledgments: the research project no. NCN-2015/19/B/ST9/01710 financed by the National Science Center

JAGIELLONIAN UNIVERSITY IN KRAKÓW

Second National Mars Science Seminar

Geomorphological mapping of Meridiani Planum along the Opportunity rover traverse

MSc Mateusz Sobucki
Jagiellonian University

[POSTER]

We present first results of geomorphological mapping of Meridiani Planum. The study area covers terrain around the Opportunity rover traverse. In our novel method, we use HiRISE images, Digital Terrain Model, as well as the images acquired by the Opportunity rover cameras. Employing the data, we performed visual detection and interpretation of landforms, such as: wind streaks, ripples, dunes, sand shadows, sand sheets, ventifacts, deflation pavements, grabens, and craters of different size and age. We present an exemplary geomorphological map with proposed symbology based partially on symbology used in terrestrial mapping. The obtained results will be used for mapping of other regions, without surface image coverage, and as training data for automatic landform recognition using machine learning.

JAGIELLONIAN UNIVERSITY IN KRAKÓW

Second National Mars Science Seminar

What life could have been like on Mars

Adam Tużnik
Jagiellonian University

[POSTER]

Mars is the fourth planet of the Solar System. Today, there are many interesting speculations as to whether life could have existed on this planet once, for example simple living organisms, such as bacteria. Recently, on the second planet of the Solar System - Venus, a chemical compound was discovered that may be responsible for simple forms of anaerobic bacteria. This is definitely a new breakthrough in astrobiology. Were there ever favorable conditions for life on Mars? Will we ever live there? Certainly, intriguing questions. In 2018, during the ERC competition in Starachowice, I had the great pleasure to talk in detail about Mars with Dr. Robert Zubrin, and a year later in Kielce with the deputy head of NASA - Steve Jurczyk. These meetings gave me a lot of new knowledge as well as experiences that I can share with. I realized that the discovery of life in space has never been so close, especially now in the times we live in.

Isidis Planitia: its regional and local characteristics

Dr Natalia Zalewska
Space Research Centre PAS

[POSTER]

We consider the surface structures and geological history of Isidis Planitia on Mars. It is a plain located inside a large impact basin of ~1500 km in diameter. Its age is ~3.8 Ga ago. Geologic history of Isidis Planitia (or at least some of its parts) is quite complicated and many details remain unclear. We believe that better analysis of surface structures (especially chains of cones) and large deep structures (e.g. mascon) will allow a better understanding of the processes responsible for present structures of Isidis. Our analysis of chains of cones indicates that they can be grouped in larger systems. In this way Isidis Planitia has been divided into several characteristic regions. We are examining the system of cones on Isidis Planitia. Many of these chains forms have a characteristic furrow through the center, suggesting that fissure volcanism along circumferential dikes was common in the Isidis area.