

RECONSTRUCTION OF THE MOST RECENT GEOMORPHOLOGICAL ACTIVITIES ON MARS BASED ON CLUSTER OF IMPACT CRATERS IN NOACHIAN HIGHLANDS

Keywords: Mars, surface; Remote Sensing; Landslides; Geomorphology

Area di ricerca: GEO/02, GEO/04

1. General presentation and state of the art

Mars is one of the planet of our solar system with active geological processes on its surface: we registered variations in aeolian depositional structures (dunes and ripples' migration and formation of new ones), seasonal changes linked to groundwater circulation and/or the cycle of freezing/melting ice (RSL, or recurrent slope lineations, gullies), and mass wasting phenomena. All these features are often found associated to impact craters, another active process on Mars and common to almost every planet and moon with a rocky surface in the solar system

This project wants to focus on unstudied craters with evidence of landslides (rock avalanches, slumps etc.) with the aim to build a catalog to highlighted potentially active processes and provide hints to reconstruct the most recent climatic setting on Mars. This work can be useful for future detailed studies regarding geological, astrobiological and climatic conditions of Martian paleoenvironments. A correlation between craters showing mass wasting activity could be interesting in terms of their (relative) ages and distribution through the highland regions, state of preservation, types of craters vs type of morphological features they develop etc. The area of Mars that I propose for this kind of project comprises Arabia Terra and Terra Sabaea, Noachian highlands that preserve very well the record of meteoric impacts through the history of the Red Planet.

2. Research Objective

- Searching for interesting impact craters with evidence of mass wasting activity in the selected regions
- Building a complete catalog with images and classification for each crater (type, size, geologic features) and landslides found in it (morphologic and morphometric features), also reporting the presence of interesting geological structures (i.e., fan-delta system, layered outcrops etc.)
- The catalog needs to be clear, precise and easy to use, developing a proper nomenclature if necessary
- Perform statistics analyses on the most common types of landslides related to impact craters and tracing correlations between craters, if possible
- A QGIS file with polygons of classified craters and/or landslides, related to the catalog and presenting the same nomenclature

3. Methodology and expected results

The first phase of the work should be oriented to find all the suitable impact craters of the selected area, using tools like Google Mars for finding the candidates and check the coverage of satellite dataset (CTX, HiRISE). During this phase, the building of the catalog should begin (an Excel file), with some general information about the location, the size, the type of crater and peculiar features inside each crater (it is mandatory to select craters with evidence of mass wasting activity). Based on these preliminary results, it's possible to decide to expand the area of interest to further martian territories. **Expected results:** total number of impact craters with evidence of landslides' occurrence and their regional distribution; reconstruction of the most recent geological evolution at regional scale based on stratigraphic approach

At this point, the catalog should have started to take form, and can be enriched with morphological information about the landslides, their type and size, their relations and coexistence with other geological features present

into the craters' floor, and relevant characteristic features (i.e., lobes, front, texture etc.). This is the phase in which we focus more on the landslides and their surroundings, go deeper in detail and looking at the high-resolution images (CTX, 5,59 m/px; HiRISE, ~1 m/px). **Expected results:** total number and type of landslides in impact craters and their regional distribution; morphologic and morphometric data; statistics analyses of the most common type of mass wasting phenomenon found in impact craters; correlation between the type of landslides and the type of geological environment inside the craters; nomenclature for the different type of mass wasting features

The last steps will be the QGIS project, a sort of graphic summary of all the findings of the previous work phases, with polygons for craters and/or for landslides equipped with an accurate table of attributes with briefly information about the kind of each selected crater and/or landslide. **Expected results:** complete the catalog; create the QGIS project and use the information in the catalog to fill it; reviewing all the results and thinking about publication (even for the QGIS distribution map alone); evaluate the possibility to also publish an illustrated kind of catalog

4. Bibliography

G. B. Crosta, P. Frattini, E. Valbuzzi, and F. V. De Blasio (2018) Introducing a New Inventory of Large Martian Landslides, AGU Publications (Earth and Space Science), [doi: https://doi.org/10.1002/2017JE005398](https://doi.org/10.1002/2017JE005398)
Kevin P. Roback, Bethany L. Ehlmann (2020) Controls on the Global Distribution of Martian Landsliding, ESS Open Archive, doi: [10.1002/essoar.10504190.1](https://doi.org/10.1002/essoar.10504190.1)

5. Description of the research in the three-year period (feasibility)

2023/2024: first work phase (finished), second phase begins

2024/2025: second work phase (finished), third phase begins

2025/2026: third phase (finished), review, conclusion of the project, further reviewing for publication