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Project RED: A challenging student project on space sciences and planetary geology

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Project RED started in 2019 at the Department of Sciences and Methods for Engineering of the University of Modena and Reggio Emilia (Italy) as a team of BSc, MSc and PhD students passionate about robotics, aerospace and planetary sciences. Since 2021, the team has included students from the Department of Chemical and Geological Sciences. The objective of Project RED is to design and build a prototype of a rover for extraterrestrial exploration with which to compete in the European Rover Challenge (ERC), an annual international competition based on real ESA and NASA missions. The competition consists in a short traversal of an autonomous rover on the "Mars Yard" (i.e., the ERC competition area simulating a real Martian region) aiming at executing a science-driven exploration based on a coherent geological and geomorphological interpretation of the "landing site" surface. Project RED has participated in the 2021 edition of ERC and is now preparing for 2022 edition of ERC.

To cope with the ERC tasks, the Project RED team comprises divisions of engineering and geology students who carried out different activities, such as the building of the rover and the geological analyses of the Martian surface. In particular, the main activities of the geology students ("Science Division") aim at reconstructing the geological setting of a surface portion of the planet with particular attention to the analysis of a landing site where a hypothetical rover will be directed. The analysis foresees the characterization of the Martian surface from a geological, geomorphological, chemical and mineralogical viewpoint, recognizing and interpreting the origin of landforms and their chronostratigraphy.

The study area selected for the 2021 edition of ERC was northern Elysium (135-155E, 22-35N), situated in the eastern hemisphere of Mars. The Science Division reviewed existing literature, thematic maps and high-resolution satellite images. All data were analyzed in a Geographic Information System (GIS) environment. Landforms were identified through CTX images and HiRISE images and mapped in a georeferenced system (Mars2000 Equidistant Cylindrical clon0), leading to the production of extracts of geomorphological sketch maps. The results highlighted that the Elysium region has been affected by different geological processes, such as tectonic, fluvial, mass-wasting and volcanic ones associated with channel formation, faulting and volcano/ground-ice modifications. The main geological features found in the study area are: (i) fractures, (ii) narrow linear depressions, (iii) lobate scarps, (iv) rimcrests and (v) impact craters.

These analyses were performed in order to determine and trace the most suitable and safest path to be followed by the rover during the ERC competition avoiding potential obstacles.

