Non-destructive Testing on “Mars” Terrestrial Analog Sites

Overview

- Scientist-astronaut, Ana Pires of INESC Technology and Science - Associate Laboratory conducted some groundbreaking geotechnical studies at the Mars Desert Research Station in Utah
- The Schmidt Hammer and Equotip hardness tester were used to gather data about the rock characterization and hardness.
- Despite challenging conditions, it was possible to gather a significant amount of valuable data.

Ana Pires was the first Portuguese woman Scientist-astronaut to finish with success the Program supported by the NASA Flight Opportunities. She is also a researcher at INESC TEC's Centre for Robotics and Autonomous Systems. When it comes to pushing limits, Ana has been using Screening Eagle’s Proceq equipment for over 20 years and takes things to a whole new level with her research. From the ground-breaking missions here on earth, in marine environments, to the all-women microgravity mission to perform research in “space”, Ana really proves that there are no limits…

Challenge

Human and robotic planetary exploration has increased interest recently, focusing on identifying potential habitats for future human missions, engineering, science, construction, and operations in challenging environment. Around the world there are several terrestrial analog sites, which means areas that are very similar to the geological and geomorphological environment on Mars or the moon. Hence, they become best locations to conduct experiments and test technologies, presenting these areas of Earth crucial for research to support future deep space missions.

This two-week research mission took place in the Mars Desert Research Station (Utah, USA) operated and managed by the Mars Society, where the crew members were completely isolated as part of a simulation.

Aside from their research challenges, the crew members also had to live, cook and eat as astronauts would on Mars. The team had to manage both normal life chores and their scientific tasks, plus the repairs and cleaning of all their equipment in extremely dusty conditions and harsh environment.

This also meant cooking dehydrated food and taking special measures to save water and energy inside the habitat. General life for the two weeks took place within the isolated research station like a simulated Martian habitat. When a crew member needed to go outside, they had to wear a space suit (mockup) which can be very heavy and challenging to maneuver in extreme hot conditions. This fact was mitigated by wearing specialist smart textiles clothing to absorb sweat,which was developed by a woman from Portugal with a background in materials engineering.

Ana Pires and her colleague conducting extravehicular activities.

Every day, the crew also have to deliver reports to their mission support. That is the outside team (on Earth) who gives them advice of the upcoming climate, permission to do research activities, and help if there is any problem.

Whilst these kinds of missions are a great opportunity to test the rock characterization and hardness of materials similar to those found on Mars, it is also a great sociological experiment. With different personalities and habits in these environments, it highlights how important human relations will be when we are taking deep space missions in the future.

If engineering and construction on Mars is ever to happen, it is crucial to first need to understand the soils, rocks, the subsurface and the rock characterization. Thanks to terrestrial analogue sites like this one and non-destructive technologies, it is possible to start collecting data from similar materials here on earth.

Solution

To find out the geological and geotechnical characterization of the mass rocks and geomaterials hardness, Ana used the Schmidt hammer and Equotip hardness tester.

The Schmidt hammer uses rebound technology to accurately test the widest range of strength classes for concrete and rock materials.

The Equotip hardness tester is mainly used to evaluate metal, however it is also a convenient tool to test the Unconfined Compressive Strength (UCS) of rock.

Together they make a great combination to assess the rock characterization and hardness in detail, comparing results from both data sets.

Although not designed to be used while wearing a space suit and gloves, the Equotip and Schmidt hammer are both extremely portable and durable, making them the perfect choice for such challenges.

Results

In just two weeks, with only two humans and two devices, in extremely harsh conditions, they gathered a total of 950 measurements in four survey scanlines (with a total length of 80 meters) and 19 stations!

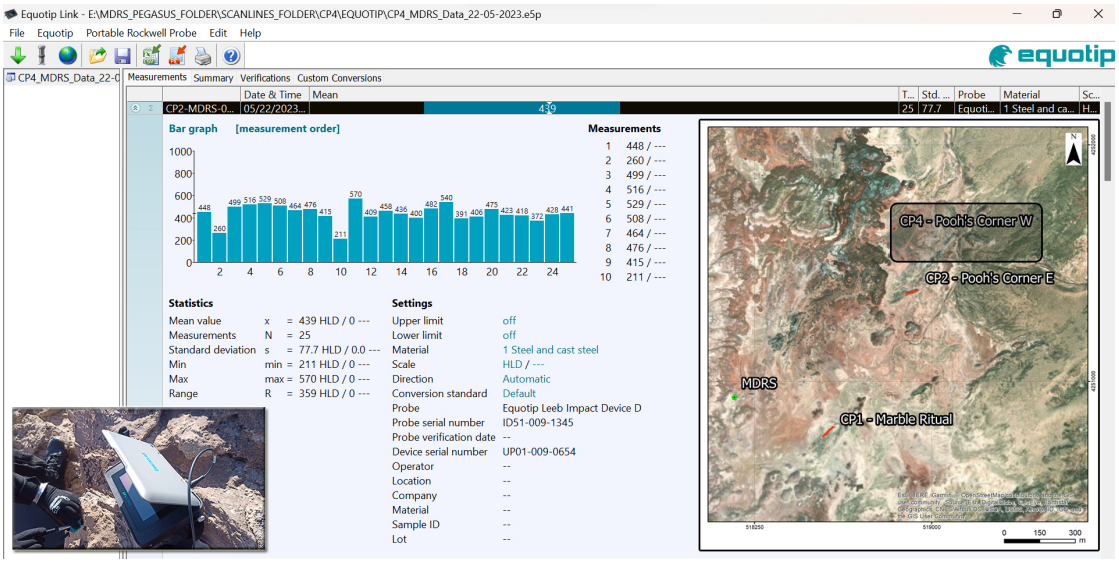

Fig.1: Example of some of the outputs acquired by the Equotip rock hardness in one of the stations (25 measurements in each station) of the scanline #4, located in Pooh's Corner (West side), Hanksville (Utah desert, USA).

For Ana, it wasn't just about the results themselves, it was also to learn if these types of nondestructive technologies could even survive these types of severe conditions – some of the most challenging on earth. Our planet Earth continues to be the best scientific and technological testbed that we could have. According to Ana, Earth is preparing us to go to other planets, as the interplanetary species that we are. Like the sunrises of each "Sol", that Ana had the chance to watch in the "Martian" habitat, the future is bright towards to the Moon, Mars and beyond.

The results showed that not only is it possible to use nondestructive technologies such as the trusted Equotip 550 and Rock Schmidt or Silver Schmidt hammer in the harshest environments, but it's possible to collect a vast amount of quality data.

For those of us that don't plan on visiting Mars anytime soon, at least you can be sure which hardness testers and rebound hammers are the pro-choice for testing in the most extreme conditions with dust, dirt and harsh environments.

Check out our Inspection Space for more real case studies and application notes using Equotip Portable Hardness Testers and Schmidt Hammers.