FIRST Newsletter
October 2017, Issue 43

Geological Survey Using the D2 PHASER at the Mars Desert Research Station

By Mathieu Vander Donckt, Université Catholique de Louvain, Belgium

Introduction

The planet Mars has been the wonder of explorers and scientists for more than a century. Its similarities with Earth make it, for some, an interesting target for the study of our past and the origin of life and the solar system and, for others, the study of the future of humankind. The Mars Desert Research Station (MDRS, Figure 1) located in the Utah Desert, USA, is built to host scientists willing to confront the challenge of exploring and living on the planet Mars.

Figure 1: Aerial picture of the MDRS. Left: Musk Observatory, Top: Science Dome, Right: Greenhouse and Habitation Module.

During the month of April 2017, Crew 178 – Universite Catholiqué de Louvain (UCL) to Mars – occupied the station for two weeks. Comprising seven students in sciences and applied sciences from the University of Louvain, Belgium, this crew had several technological and scientific objectives. One of them was the study of the geology around the station using a Bruker D2 PHASER X-ray diffractometer, with the aim of assessing the feasibility of manned experiments in Martian conditions.

Operating on Mars

Living in Martian conditions implies restricted interactions with the environment. Good preparation is mandatory before exiting the habitation module. First, the selection of the sampling zone is dependent on the Extra Vehicular Activity (EVA) allocated time – usually around 3 hours a day – and whether the uneven terrain allows use of electric rovers. Once the EVA is authorized, half of the crew puts on spacesuits so they can operate outside the station, after passing through the airlock. The main obstruction to the retrieval of samples is the limited flexibility granted by the spacesuit. A manual auger was used to take samples at 10 cm into the ground, but better equipment is necessary to dig deeper. A total of 30 ground and rock samples were collected during 7 EVA at 7 different locations (Figure 2).

Geological Survey

The samples were analyzed inside the Science Dome with the D2 PHASER, the main component of this experiment. Because of its small size and

Figure 2: Map of the surroundings of the Mars Desert Research Station. Samples were taken at sites 1 to 7.

weight, the D2 PHASER could be the kind of scientific instrument sent to Mars for a manned mission. The use of this diffractometer would be a huge improvement over the CheMin system carried by the Curiosity rover on Mars. The CheMin takes up to 2 days for a single analysis.

At all 7 sites where samples were collected, we found quartz (SiO_4). In addition to quartz, we found calcite ($CaCO_3$) at sites 6 and 8 (see Figure 3). We also found a mix of quartz and calcite in some samples at site 7. In the Utah Desert, calcite is associated with deep sea deposits in an ancient geologic time. On Mars, carbonate repository could confirm the hypothesis of ancient seas covering a part of the planet.

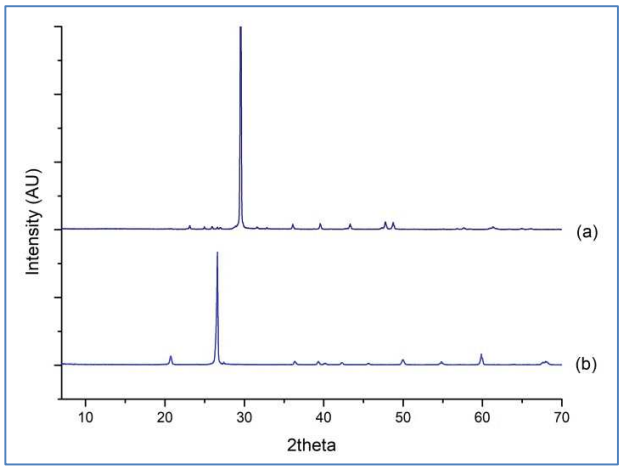

Figure 3: Diffraction pattern of (a) calcite and (b) quartz at site 6.

Discussion

The objective of this experiment was not only to describe the geologic environment at the MDRS, but also establish the potential of a manned diffractometer on the planet Mars. As expected, the D2 PHASER is perfect for geology experiments in a remote location. The internal cooling system with no need for external water supply is ideal for Martian applications. The speed of acquisition of a diffraction pattern on the D2 PHASER, in comparison to the CheMin, including sampling, could significantly increase the understanding of Martian geology. If a manned mission one day reaches Mars, it is likely

that the astronauts will bring with them a diffractometer with similar characteristics.

Acknowledgment

I would like to thank Francis De Prins of Bruker AXS, without whom this project wouldn't have existed, and Yaroslav Filinchuk from Université Catholique de Louvain (UCL) for his support. I would also like to thank the people at Bruker AXS in Karlsruhe, Germany, and in Madison, Wisconsin, USA for lending me a D2 PHASER.

Further Information

UCL to Mars website –
http://ucltomars.org/indexEN.html

UCL to Mars Facebook pages –

https://www.facebook.com/ucltomars/

https://www.facebook.com/pg/ucltomars/photos/?ref=page_internal

La mission UCL to Mars se prépare à l'Euro Space Center! website –
https://uclouvain.be/fr/decouvrir/presse/actualites/la-mission-ucl-to-mars-se-prepare-a-l-euro-space-center.html

YouTube videos –

Le projet UCL to Mars? L'occasion rêvée de mettre en pratique tous les acquis de l'université!
https://youtu.be/iiEn7Na-luI

Frank De Winne, parrain de la mission UCL to Mars
https://youtu.be/tDI3hviG5As

Bruker AXS GmbH
Karlsruhe, Germany
Tel: +49 721 50997-0
info.baxs@bruker.com
www.bruker.com