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ExoMars: Mars analogue rocks in the European lithotheque at Orleans

Nicolas Bost (1,2), Frances Westall (1), Claire Ramboz (2), Frédéric Foucher (1), Derek Pullan (3), Iris Fleischer (4), Goestar Klingelhöfer (4), Michel Viso (5), Jorge Vago (6), and Tanja Zegers (7)

(1) Centre de Biophysique Moléculaire, CNRS, Rue Charles Sadron, 45071 ORLEANS cedex 2, France (nicolas.bost@cnrs-orleans.fr), (2) Institut des Sciences de la Terre d'Orleans, CNRS, 1A Rue de la Ferollerie, 45071 ORLEANS cedex 2, France, (3) Space Research Center, University Leicester, University Road, Leicester LE1 7RH, UK , (4) Inst. Anorganische und Analytische Chemie, Joh. Gutenberg-Universität Mainz, Germany, (5) Centre National d'Etudes Spatiale, 2 place Maurice Quentin, 75001 Paris, France, (6) ESA, Noordwijk,Netherlands, (7) Faculty of Geosciences, Utrecht University, Postbus 80.021, 3508 TA Utrecht

In the new double rover scenario for the 2018 NASA-ESA mission to Mars, the science objectives of European rover, ExoMars, are to search for traces of past or present life and to document the water/geochemical environment as a function of depth in the shallow subsurface. The instruments on ExoMars rover therefore include a variety of cameras and a close up imager for observation, Raman and IR spectroscopes as well as an XRD for mineralogy, and GCMS and LDMS for chemical characterisation of the organics. A drill will provide subsurface access to (hopefully) preserved organics. The American rover, Max-C, seeks to determine the habitability of the surface of Mars with the aim of selecting and caching rocks potentially containing traces of life for the future Mars Sample Return mission. Its instrumentation suite for observation and mineralogical/organic/elemental mapping is arm-based. The instruments on both rovers will provide good complementary information that is will be essential for interpreting the ExoMars laboratory analyses.

Optimization of the science return of the various instrument suites requires testing the flight instrumentation with the same suite of Mars-analogue rocks. A library of such is being prepared by the Observatoire de l'Univers de la region Centre (OSUC) at Orléans. The rock library is being coupled to a database of the textural, compositional and geotechnical properties of the rocks. Both rocks and database will be available to the space science community involved in in situ missions, including those on other planetary bodies (with a wider range of analogue materials).

We have characterised a preliminary range of Mars analogue materials using standard laboratory techniques. The samples chosen cover a range of lithologies found on Mars: a variety of basalts (plus cumulates), Early-Mid Archaean shallow-water volcanic sands (Barberton, South Africa; the Pilbara, Australia), and an Early Archaean banded iron formation (Pilbara). The basalts include an ultramafic basalt from Svalbard (Norway) containing dunite xenoliths (cumulate); an altered basalt from Tenerife (Spain), a primitive basalt from Stromboli (Italy), a komatiite, and silicified altered basalts from Barberton.

Apart from their compositional relevance, many of the rocks were formed at a time period equivalent to the Noachian of Mars, and some of them contain fossil (and sometimes recent) biosignatures. These samples have been analyzed by visual observation, optical and electron microscopy, Raman, IR and Mössbauer spectrometry (plus Raman mapping), XRD, cathodoluminescence and microprobe.