The ExoFit Rover field trial - simulating ExoMars Rover operations

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Abstract

The ExoMars 2020 *Rosalind Franklin* Rover has scientific objectives to search for signs of past and present life on Mars, and to study the water/geochemical environment as a function of depth in the shallow subsurface. The mission will launch in summer 2020, together with the Kazachok surface platform, and includes a comprehensive instrument suite and a drill that can penetrate to ~ 2 m beneath the surface (Vago et al., 2017, *Astrobiology 17-6/7*, 471-510). The mission will land in an area of Mars known as Oxia Planum that contains sedimentary rocks with high clay-mineral content (Quantin-Nataf et al., LPSC 2018, Abstr. # 2562).
To prepare for ExoMars surface operations, an ExoMars-Like Field Trial (ExoFiT) using an instrumented ExoMars-like Rover has been performed. The aim of the trial was to understand how the ExoMars Rover and its instrument payload would be used to meet the ExoMars Rover science goals, when operated by a realistic science team. Also, to provide 'lessons-learned' to improve and inform operations planning for the real mission.

The first part of the trial occurred in the Tabernas desert, Spain, in 2018. The field area contained a sedimentary sequence of sedimentary rocks and hosts a variety of geomorphological and mineralogical features typical of clay-rich desert surfaces. The second part of the trial was performed in the Atacama desert, Chile, in 2019. This site has a very Mars-like environment, consisting of a dry desert pavement made of gravel and boulders, interspersed with finer-grained, coarse sand patches.

The ExoFiT Rover and lander platform were supplied and operated by AIRBUS and have similar capabilities and dimensions to the ExoMars Rover hardware. The ExoFiT Rover included emulators for the ExoMars' PanCam (colour stereo panoramic camera), CLUPI (close-up camera), WISDOM (ground-penetrating RADAR), ISEM (infrared reflectance spectrometer), RLS (Raman spectrometer), and drill instruments.

In both trials, the rover was controlled from a Rover Control Centre (RCC) in the UK. The RCC team included members of several ExoMars instrument teams, planetary scientists, engineers, and ESA observers. In all cases, the RCC was kept "blind" and had to control the Rover as if it were on Mars, using only Mars-like orbital remote sensing assets, and data returned to the RCC from the Rover itself. Realistic rover operations constraints (e.g., daily operating time and data budget) and tactical planning uplink/downlink time constraints were used. The astrobiological "mission success" science goal for ExoFiT was to return a drill core sample from a fine-grained sedimentary material laid down in water, or

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that had undergone deposition of minerals from groundwater, and so had once been both a habitable environment and one in which biosignatures could have been preserved.

Here, we present a description of the ExoFiT trials including tactical and strategic planning, pre-mission orbital mapping, and analysis of science return. We assess whether we were able to meet the ExoFit astrobiological science goal, and summarise key lessons learned for the real ExoMars Rover mission.