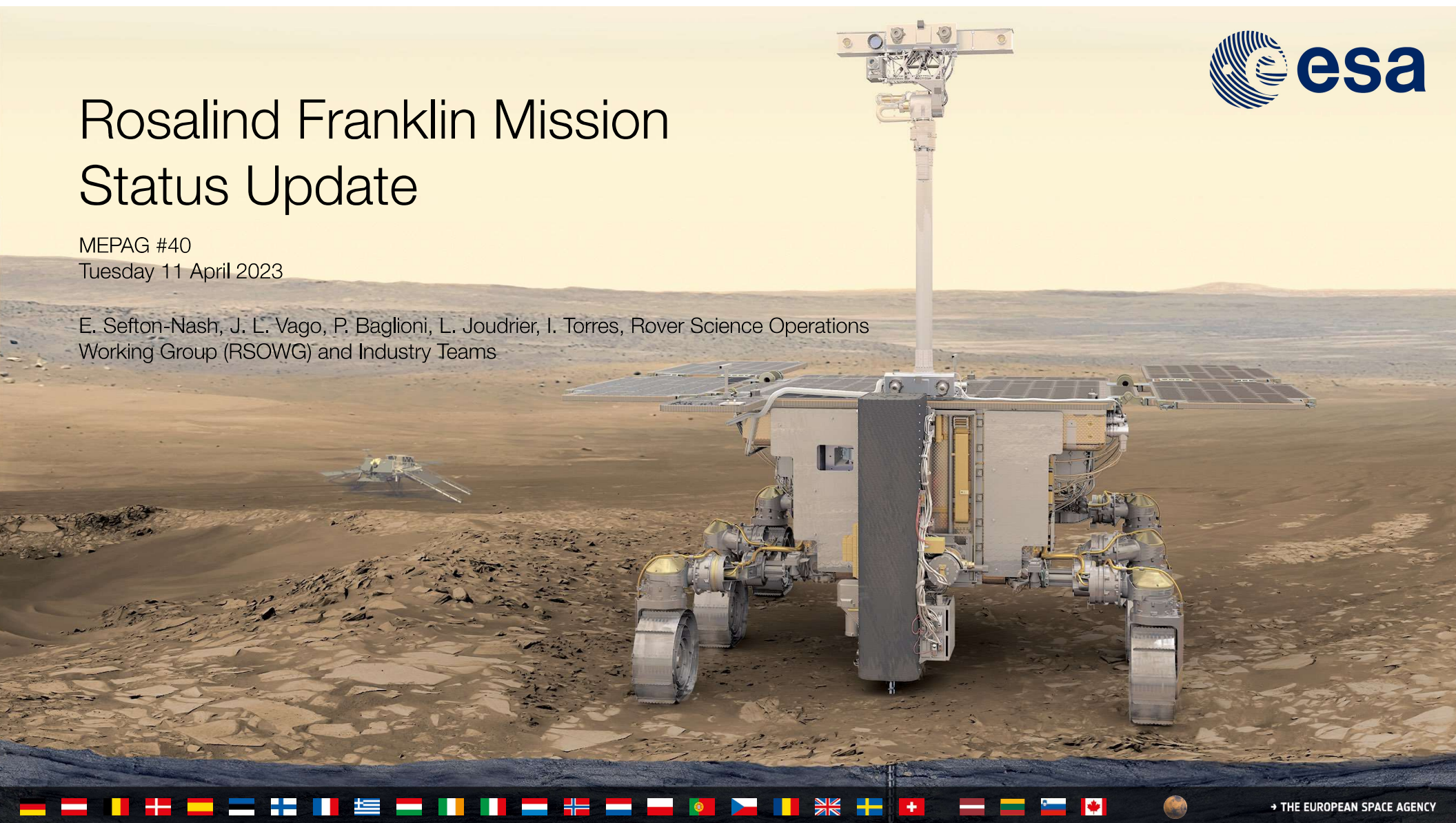


# Rosalind Franklin Mission Status Update

MEPAG #40

Tuesday 11 April 2023

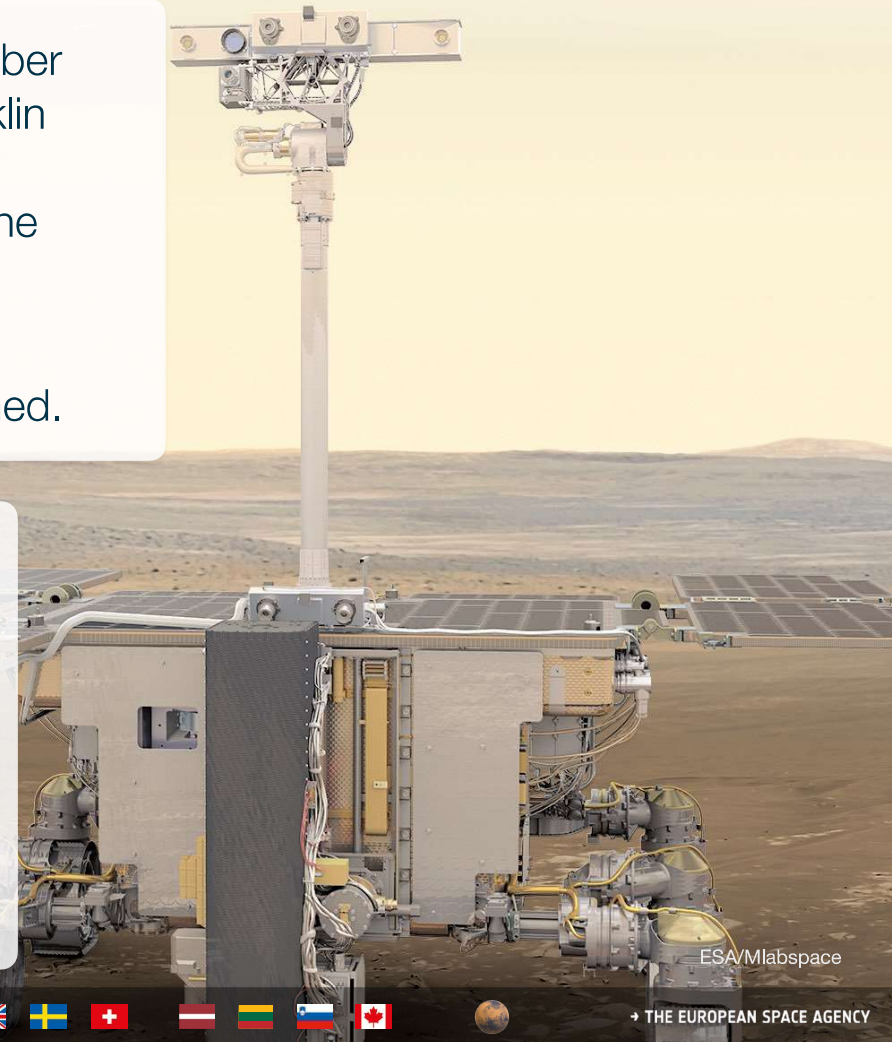
E. Sefton-Nash, J. L. Vago, P. Baglioni, L. Joudrier, I. Torres, Rover Science Operations  
Working Group (RSOWG) and Industry Teams



- At November 2022's Council at Ministerial level, ESA Member States committed to fund the new ExoMars Rosalind Franklin Mission, which will include a new European lander and partnership with NASA on key mission elements, to bring the Rosalind Franklin Rover to the surface of Mars.
- The target landing site remains Oxia Planum (18.20°N, 335.45°E), and a launch in September 2028 is now baselined.

## Science Objectives

- The mission will pursue fundamental discoveries about evidence for life by analysis of preserved organic chemistry on Mars, and the early evolution of the planet.
- RFM will be the first to sample the deep subsurface (2m) at an ancient landing site that records early Mars environments, which were more Earth-like.



Rosalind Franklin hosts 7 scientific instruments:

1. **Ma\_Miss** (IT) – An IR spectrometer, located in the Drill system: Main tool and Drill box.
2. **PanCam** (UK) – A set of panoramic and high-resolution cameras, mounted on the top of the rover deployable mast.
3. **Wisdom** (FR) – A Ground Penetrating Radar, accommodated on the rear side of the rover; antennas + electronics in the service module.
4. Close-Up Imager or **CLUPI** (CH), accommodated on the Drill box.
5. Mars Organic Molecule Analyzer or **MOMA** (DE) – A combination of Laser Desorption Mass Spectrometer from NASA GSFC and Gas Chromatographer from Max Planck- DE.
6. **MicrOmega** (FR) – A Visible and InfraRed spectrometer
7. Raman Laser Spectrometer or **RLS** (ES) – A Raman spectrometer.

Rover Analytical Laboratory Drawer (ALD)

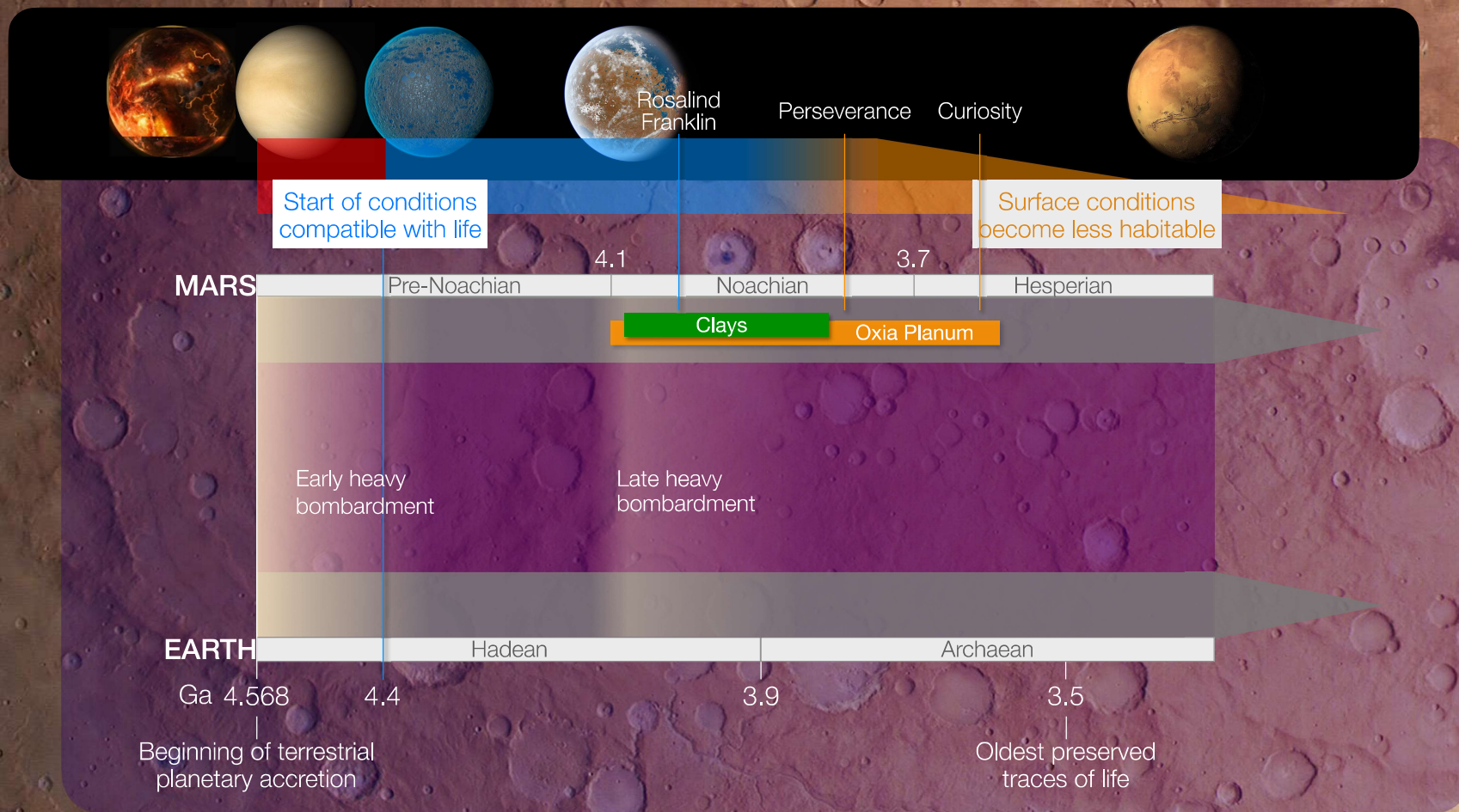
Ius Chasma canyon ESA / TGO / CaSSIS

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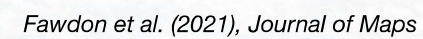


# Early Mars

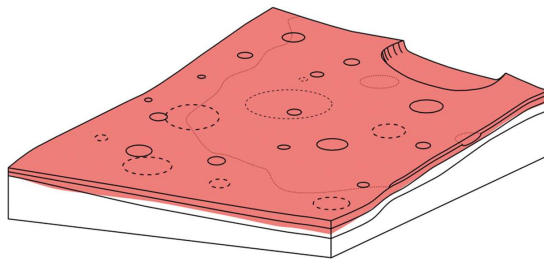
E X O M A R S



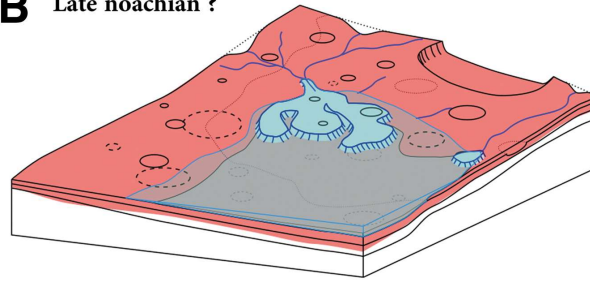
Cassini crater, ESA / MEX / HRSC



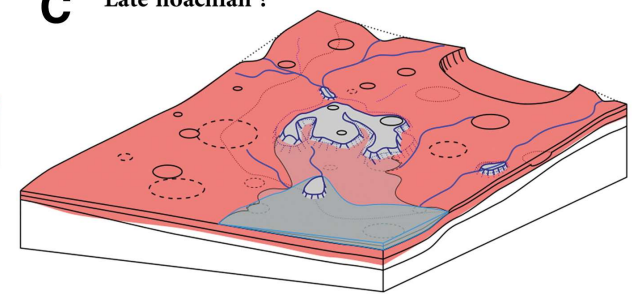
**A** Middle Noachian



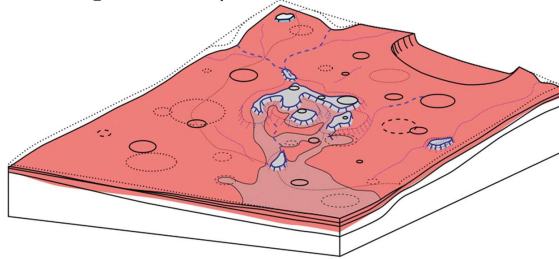
**B** Late noachian ?



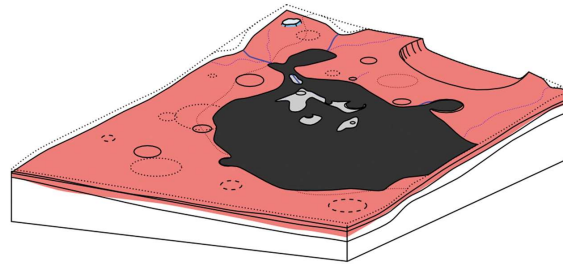
**C** Late noachian ?



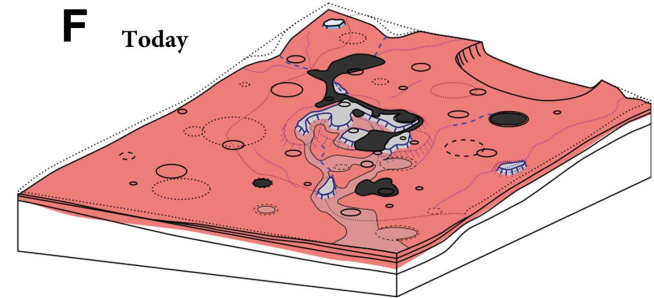
**D** Hesperian+Early Amazonian



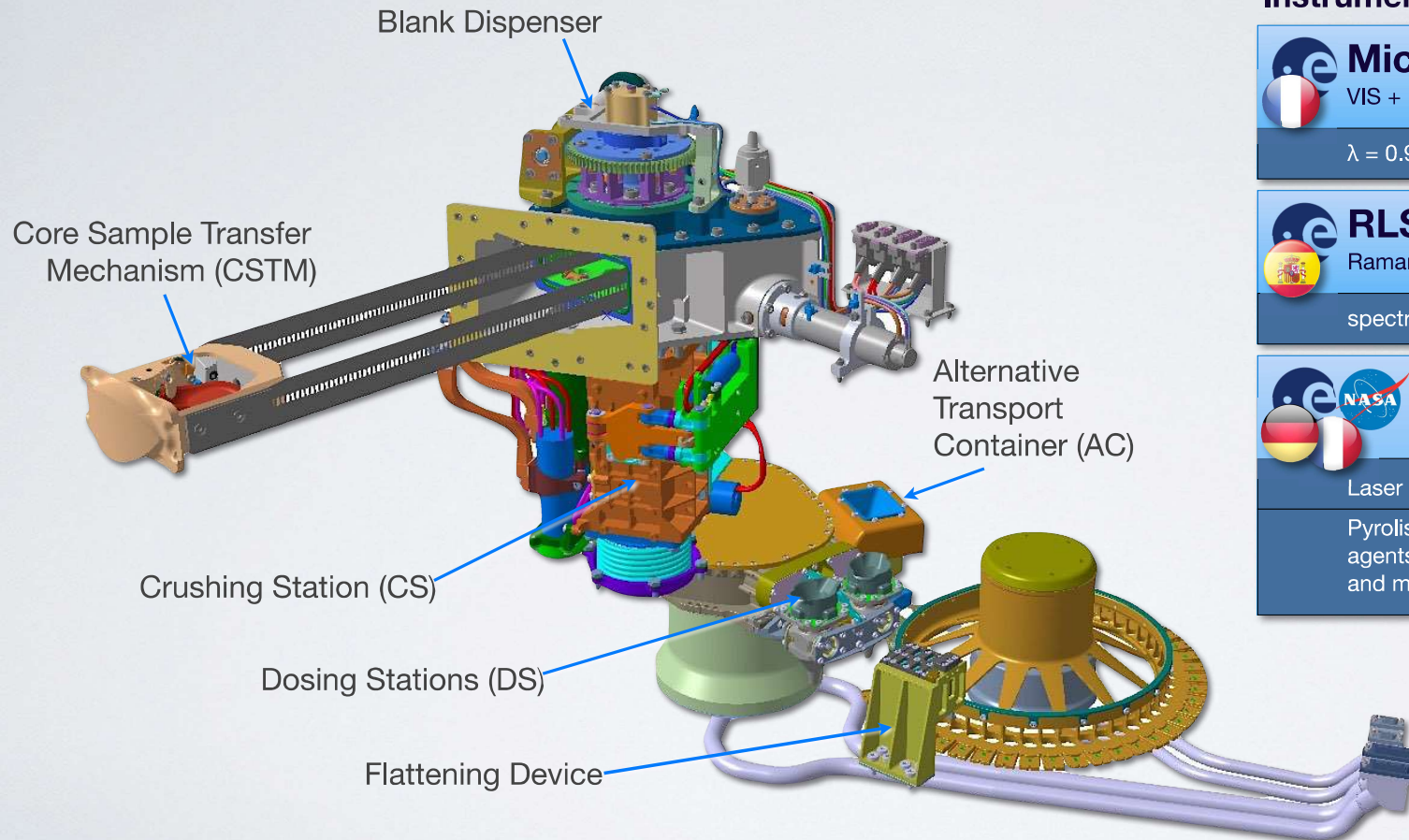
**E** Early Amazonian ?



**F** Today



Quantin-Nataf et al. (2021), Astrobiology



## Instruments for Sample Analysis



**MicrOmega**  
VIS + IR spectrometer

*Mineralogy characterisation  
of crushed sample material  
Pointing for other instruments*

$\lambda = 0.9 - 3.5 \mu\text{m}$ , 256 x 256, 20- $\mu\text{m}/\text{pixel}$ , 500 steps



**RLS**  
Raman spectrometer

*Geochemical composition  
Detection of organic pigments*

spectral shift range 200–3800  $\text{cm}^{-1}$ , resolution  $\leq 6 \text{ cm}^{-1}$

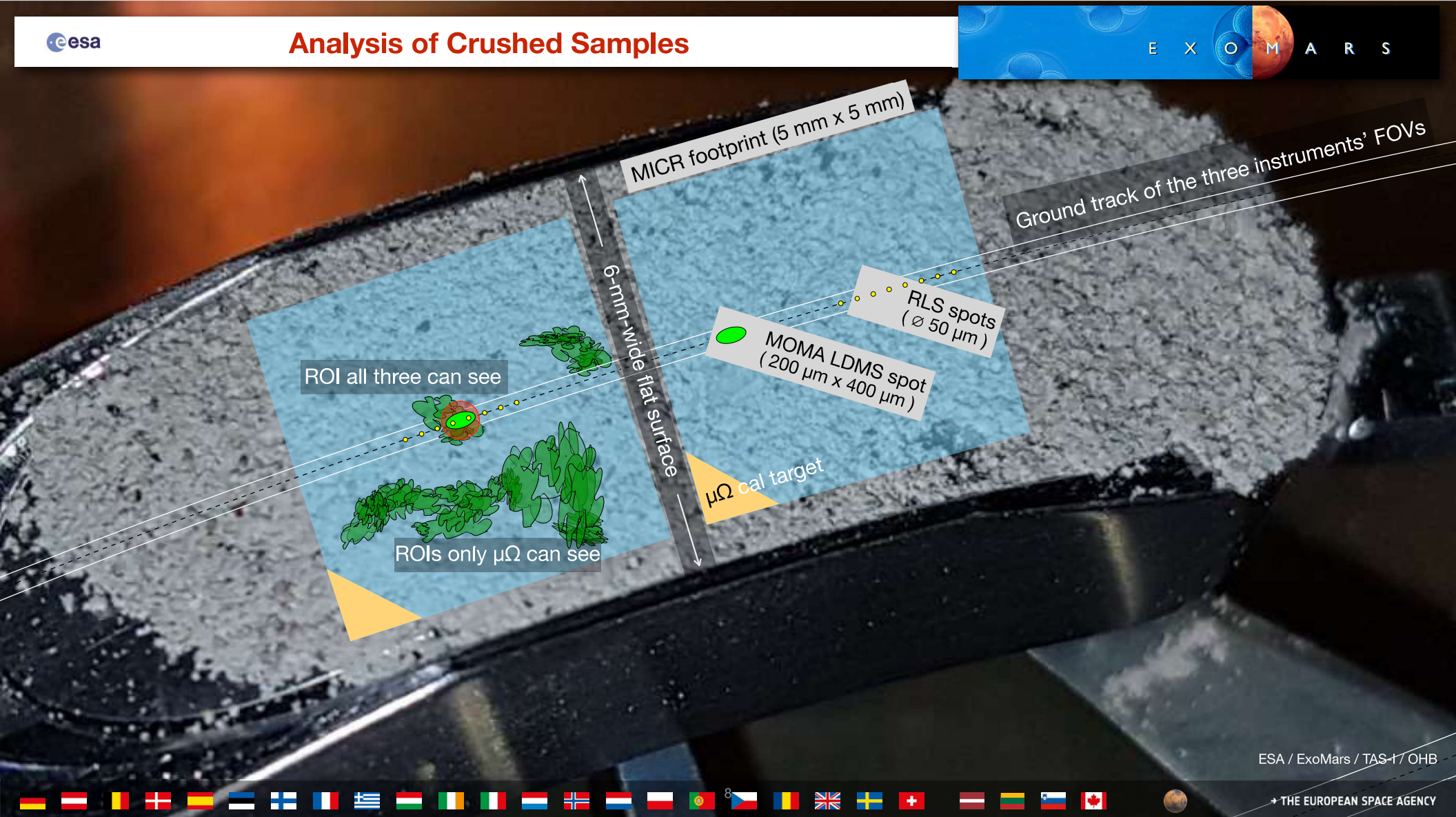


**MOMA**  
LDMS + Pyr-Der GCMS

*Broad-range, high sensitivity  
search for organic  
molecules*

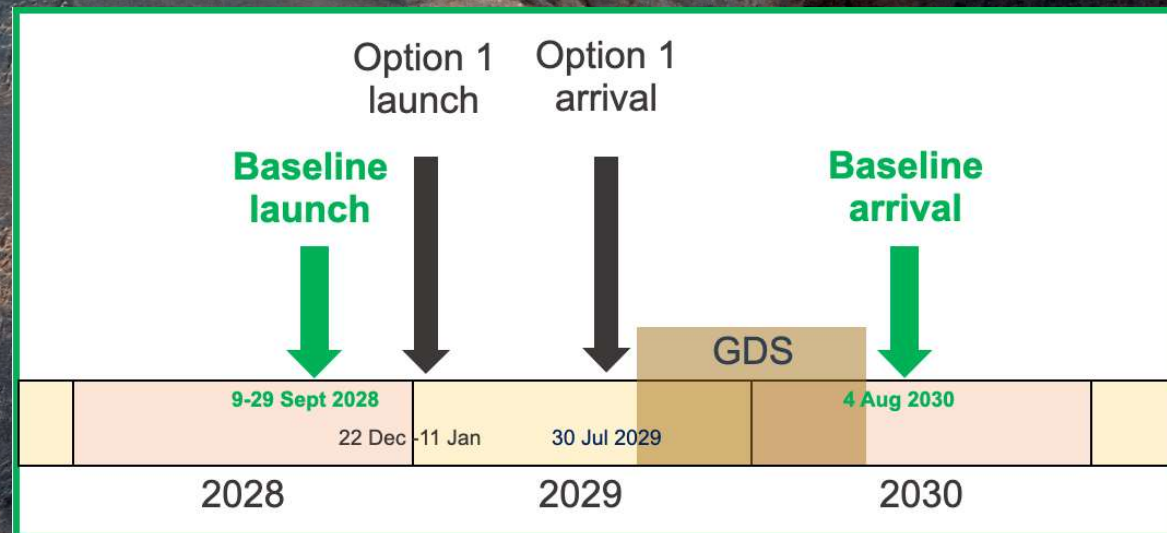
Laser desorption extraction and mass spectroscopy

Pyrolysis extraction, with or without derivatisation  
agents, coupled with chiral gas chromatography,  
and mass spectroscopy



- **Baseline trajectory (long transfer):** Launch window opens 9 September 2028, with landing on 4 August 2030. Though the transfer is ~23 months, the baseline trajectory provides a nominal surface mission of 344 sols beginning in N. Hem. Spring ( $L_s = 15$ ), enabling work over long summer sols.

- **Option 1 (short transfer):** Launch window opens 22 December 2028, with landing on 30 July 2029. Though the transfer is only ~7 months, landing occurs at  $L_s=161$ , nearing the N. Hem. autumnal equinox and start of the statistical Global Dust Storm (GDS) season.



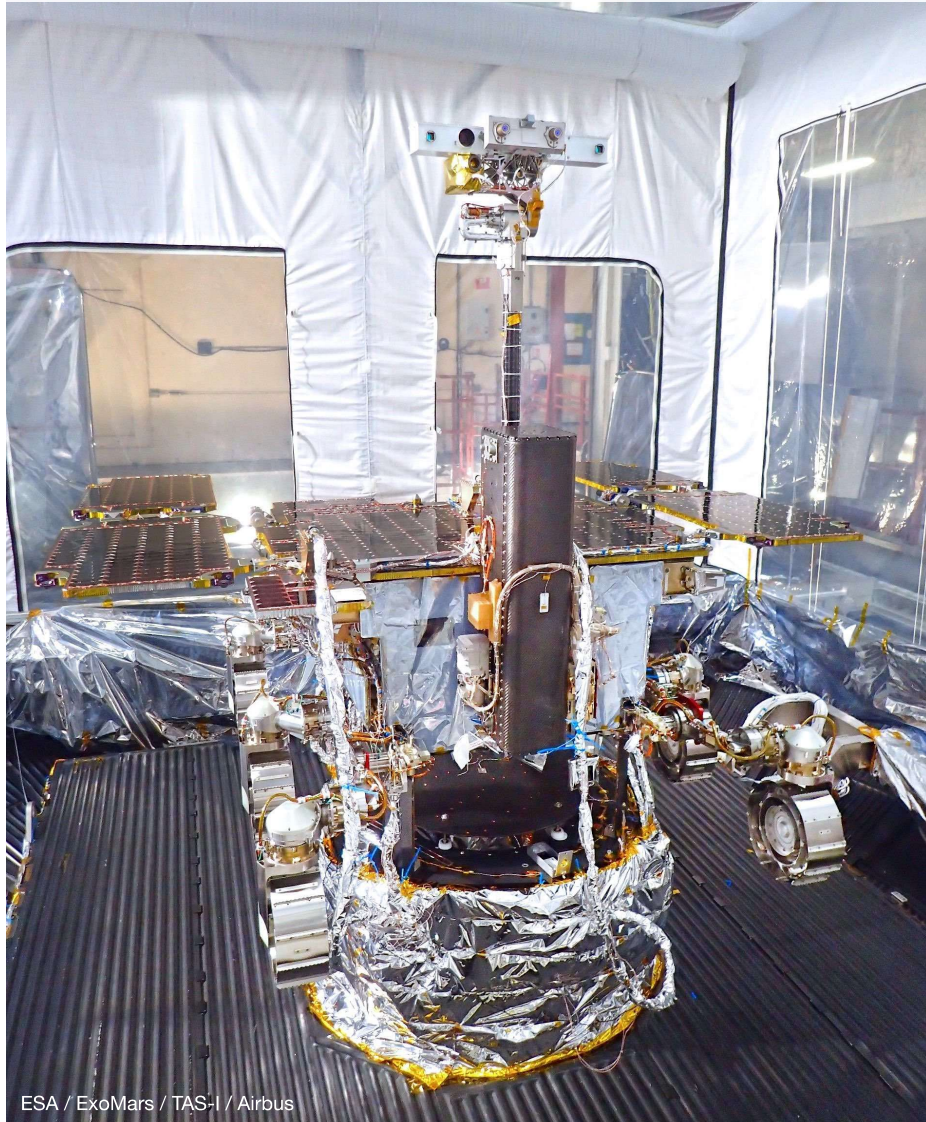
- **Both options continue to be studied.** Certain design improvements would increase resilience of Rosalind Franklin to dust events, and increase the feasibility of Option 1.

- RFM will include the already built Carrier Module (CM) and Rover, and a new ESA-built Entry Descent Landing Module (EDLM), integrating:
  - ➔ ESA built flight hardware (Parachutes, Radar doppler altimeter, OBC, etc..)
  - ➔ NASA contributions replacing lost elements (which were provided by Roscosmos for ExoMars 2022):
    - Launcher - selected through competition;
    - Radioisotope Heating Units for the Rover;
    - Braking engines and throttling valves.
- The implementation of an European EDLM will recover one of the principal original goals of the ExoMars program: for Europe to autonomously land a substantial scientific and technological payload on Mars.



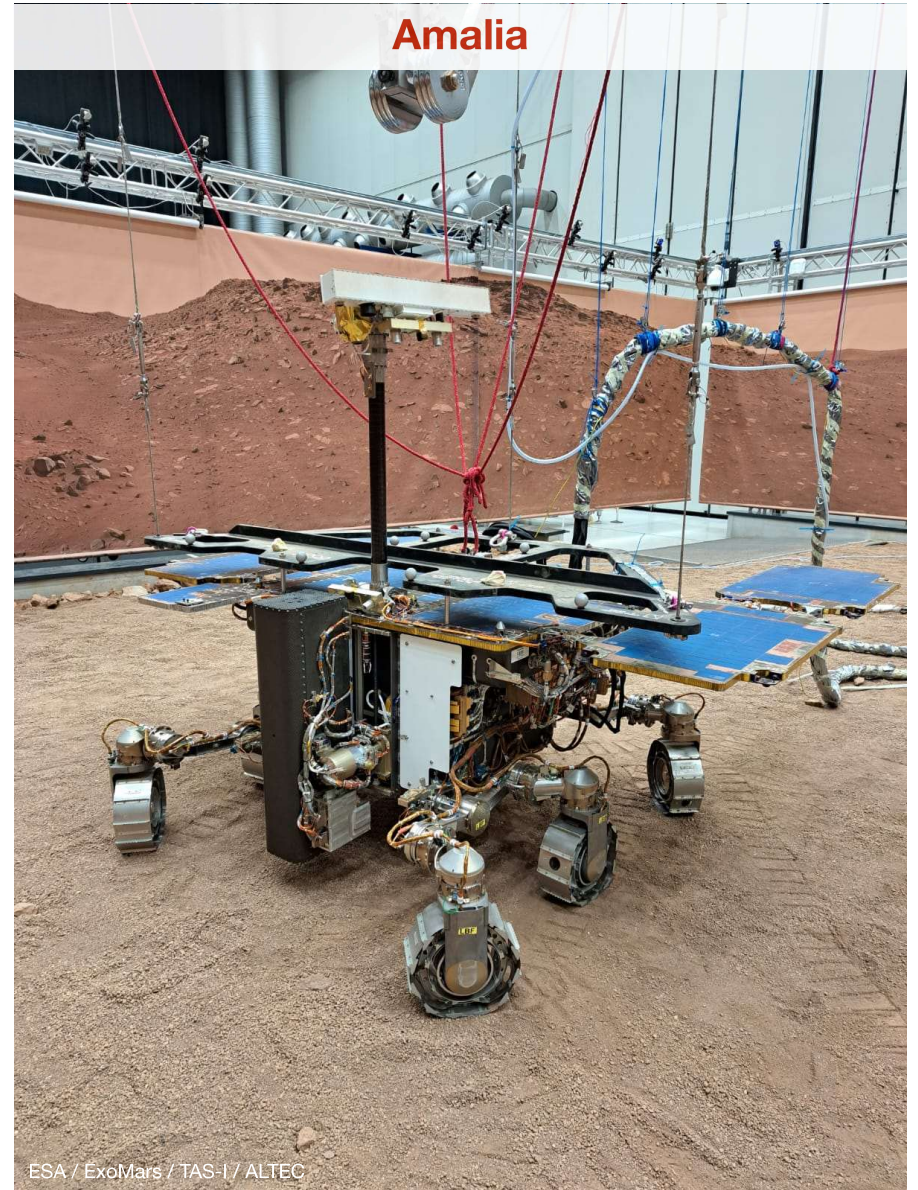
- ‘Maintenance and Schedule Protection’ activities are underway, with regard to the Rover and Pasteur Payload Instruments.
- Certain essential repair/refurbishment/upgrade activities for science instruments have been agreed with Payload Teams, and need to be confirmed by the Lead Funding Agencies. These essential activities will be carried out in the coming 2 years in order to ensure the payload readiness for re-integration in the Rover in June 2025, as required by the 2028 launch schedule.
- The possibility to replace the lost Russian-led infrared spectrometer (ISEM) with an IR spectrometer from Europe, in order to maintain the scientific capability of the mission as it was initially conceived, is currently under evaluation.

**Rosalind Franklin**



ESA / ExoMars / TAS-I / Airbus

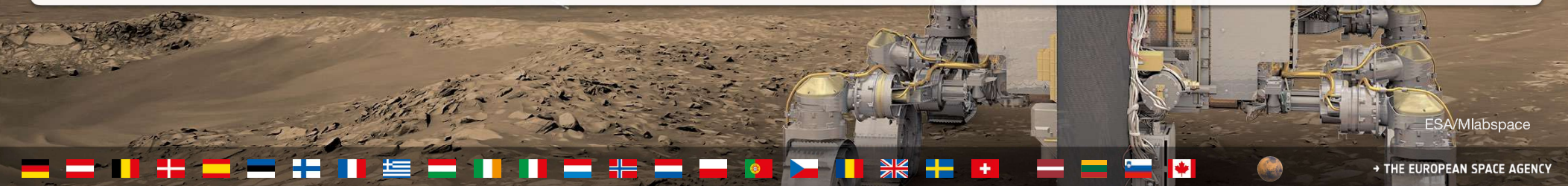
**Amalia**



ESA / ExoMars / TAS-I / ALTEC



- Pasteur Payload Instrument teams, having achieved a high level of readiness for launch and operations in 2022, have made plans together with ESA and industry to ensure the science instruments will maintain their performance for a later launch.
- The Rover Science Operations Working Group (RSOWG) continue preparatory mission science work.
- Two sub-groups of RSOWG: 'Micro' and 'Macro' address science topics at those spatial scales.
- The industry operations team at the Rover Operations Control Centre (ROCC) at ALTEC (Turin) successfully completed a programme of operations tests, to demonstrate operations readiness. The work of ROCC personnel now focusses on exercising and refining operations systems and processes.



ESA/Mlabspace

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ExoMars Science Working Team Meeting 2022



Rover Operations Control Centre (ROCC), Turin, IT



Deep sampling (1.7m) with the Amalia ground test rover model

[https://www.esa.int/Science\\_Exploration/Human\\_and\\_Robotic\\_Exploration/ExoMars\\_rover\\_testing\\_moves\\_ahead\\_and\\_deep\\_down](https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/ExoMars_rover_testing_moves_ahead_and_deep_down)

## A Knowledge Base for Sample Analysis

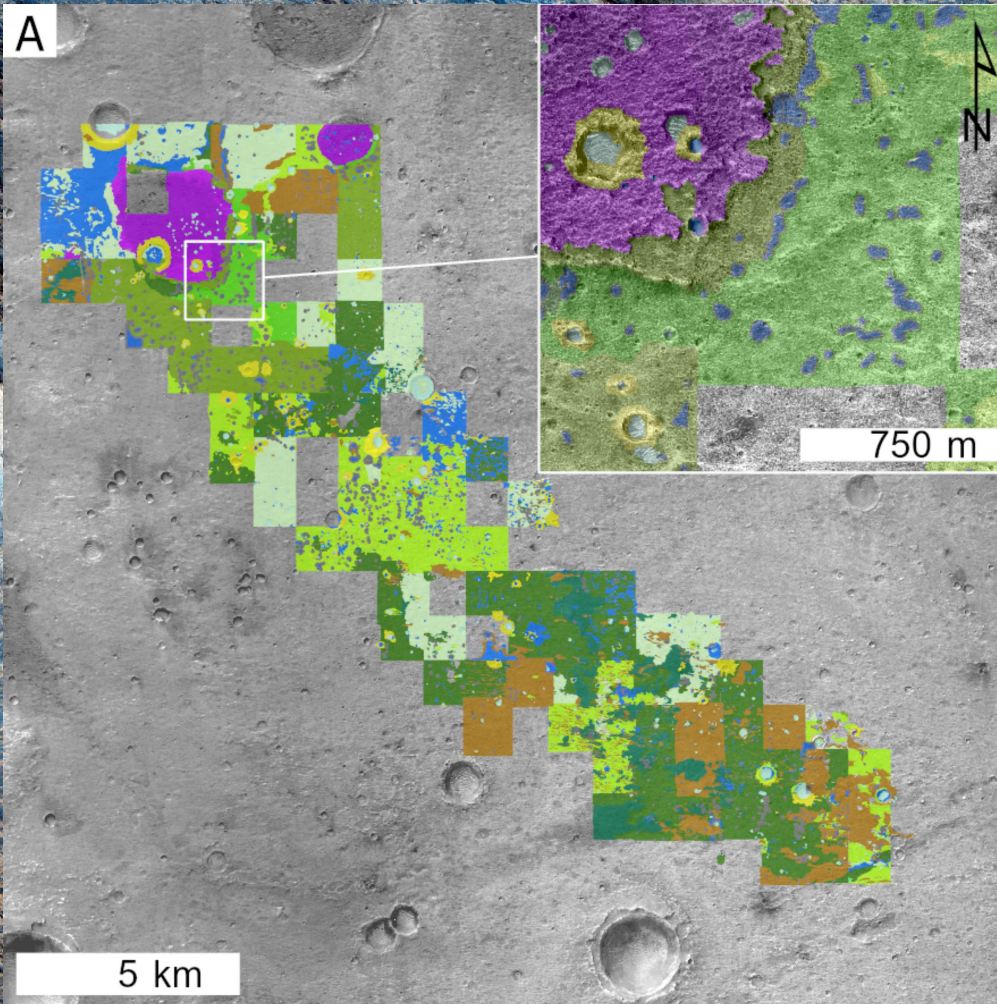
- RSOWG-Micro ran a process in 2021 to select a suite of Mission Reference Samples to be characterised by ground models of the rover's instruments, to build a knowledge base of combined analyses before operations.
- Mission reference samples are:
  - ➔ As representative as possible of those we expect to extract at Oxia Planum.
  - ➔ Provide scientific signatures (geological, chemical, biological) that allow the instrument teams to well-exercise analytical techniques.
  - ➔ Able to have the ExoMars Biosignature Score applied to them (Vago et al., 2017, Astrobiology).
- 6 samples were selected from 36 proposals for detailed coordinated analysis amongst instrument team laboratories.
- **Status:** Sample preparation, distribution and analysis is underway by several laboratory teams.

Lost Hammer Spring, Canadian Arctic, Niederberger et al. (2010).

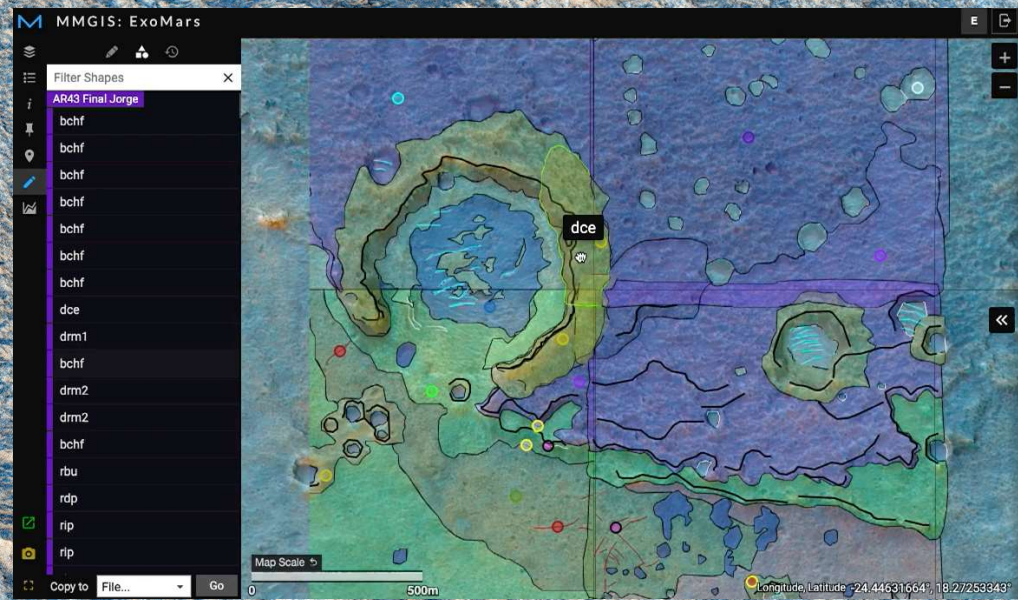
Josephdal Cherts, Barberton (ZA), Frances Westall.

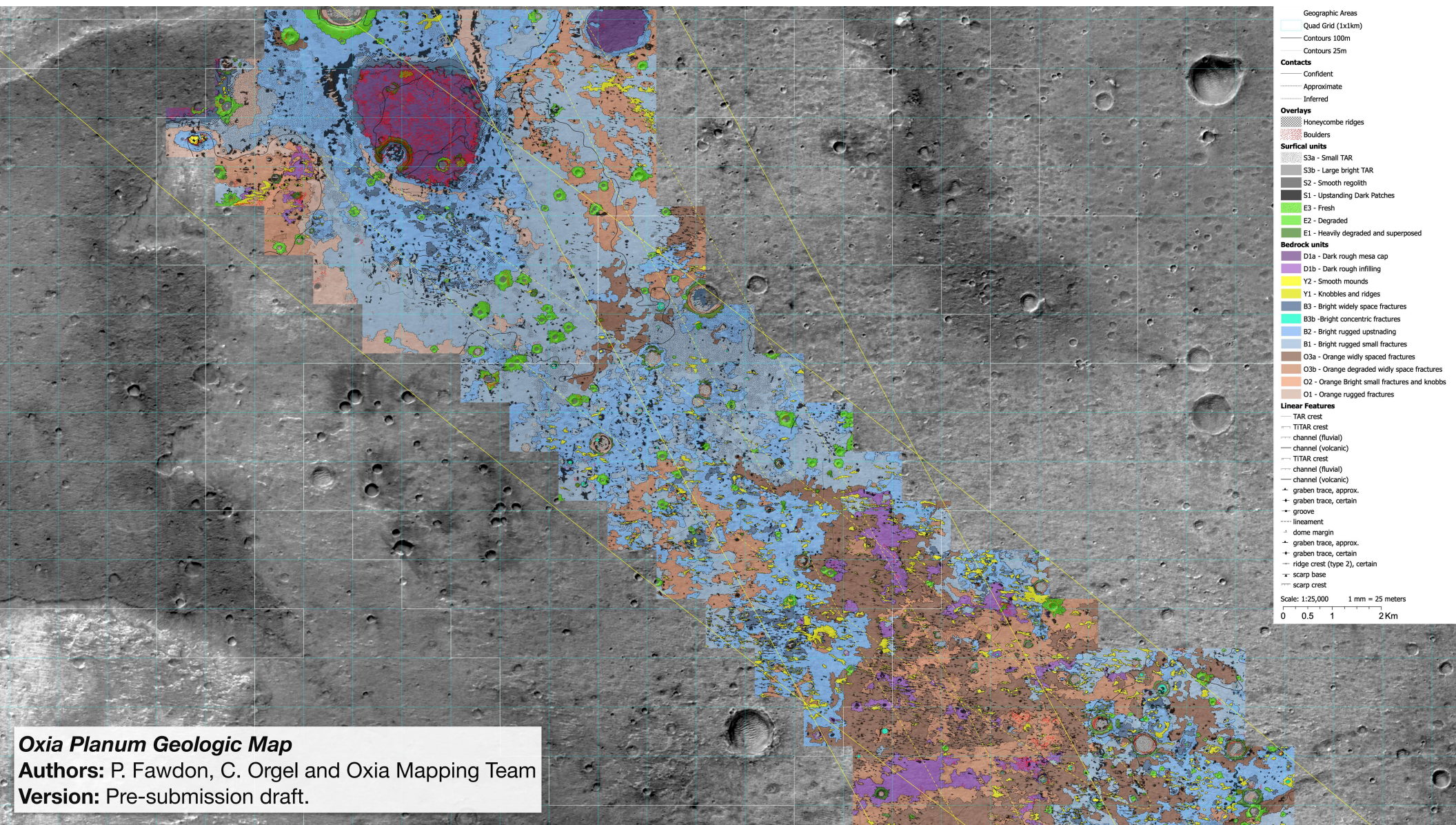
Hydrothermally altered crust, Iceland, Tamara Carley.





- In 2020, the RSOWG Macro group performed a group-mapping project of the landing ellipse.
- 89 volunteers followed a training and familiarisation programme. Digitisation work was divided to cover the large area in fine detail.
- Throughout 2021 and into 2022, raw data was 'reconciled' by mapping leads, to be made coherent across quad boundaries.
- Current status: Readying map and report for publication.





The **Strategic Science Plan, SSP**, is a tool that we will use to flow mission questions into individual commands sent to the rover. The SSP guides day to day operations planning, and adapts to new findings.

## 1. MISSION QUESTIONS

Consolidated from current understanding of Mars and Oxia Planum, driven by mission objectives.

### Examples

*How did the clay-rich rocks form?*  
*Was there an ocean at Oxia?*  
*Was there life?*

## 2. MISSION HYPOTHESES

A collection of testable hypotheses derived from questions.

### Examples

*Clay minerals formed from volcanic ashfall onto water.*  
*Oxia was sub-aqueous for > 1 Ma*  
*There was life that left molecular evidence.*



Main Control Room, Rover Operations Control Centre (ROCC), ALTEC, Turin

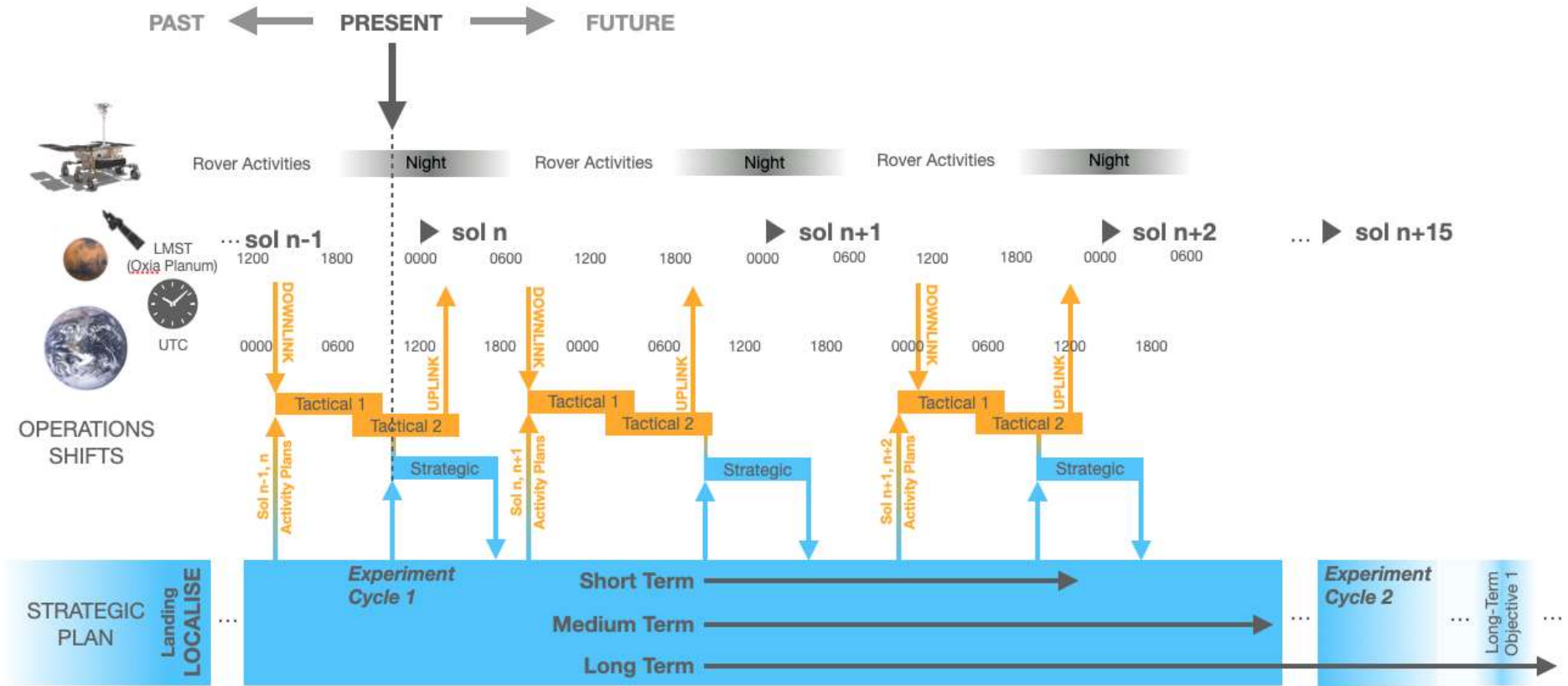
## 3. MISSION "CAMPAIGNS" (INVESTIGATIONS)

Groups of observations/analyses of specific targets, by Rover instruments, that could **test** hypotheses.

## 4. ACTIVITY PLANS

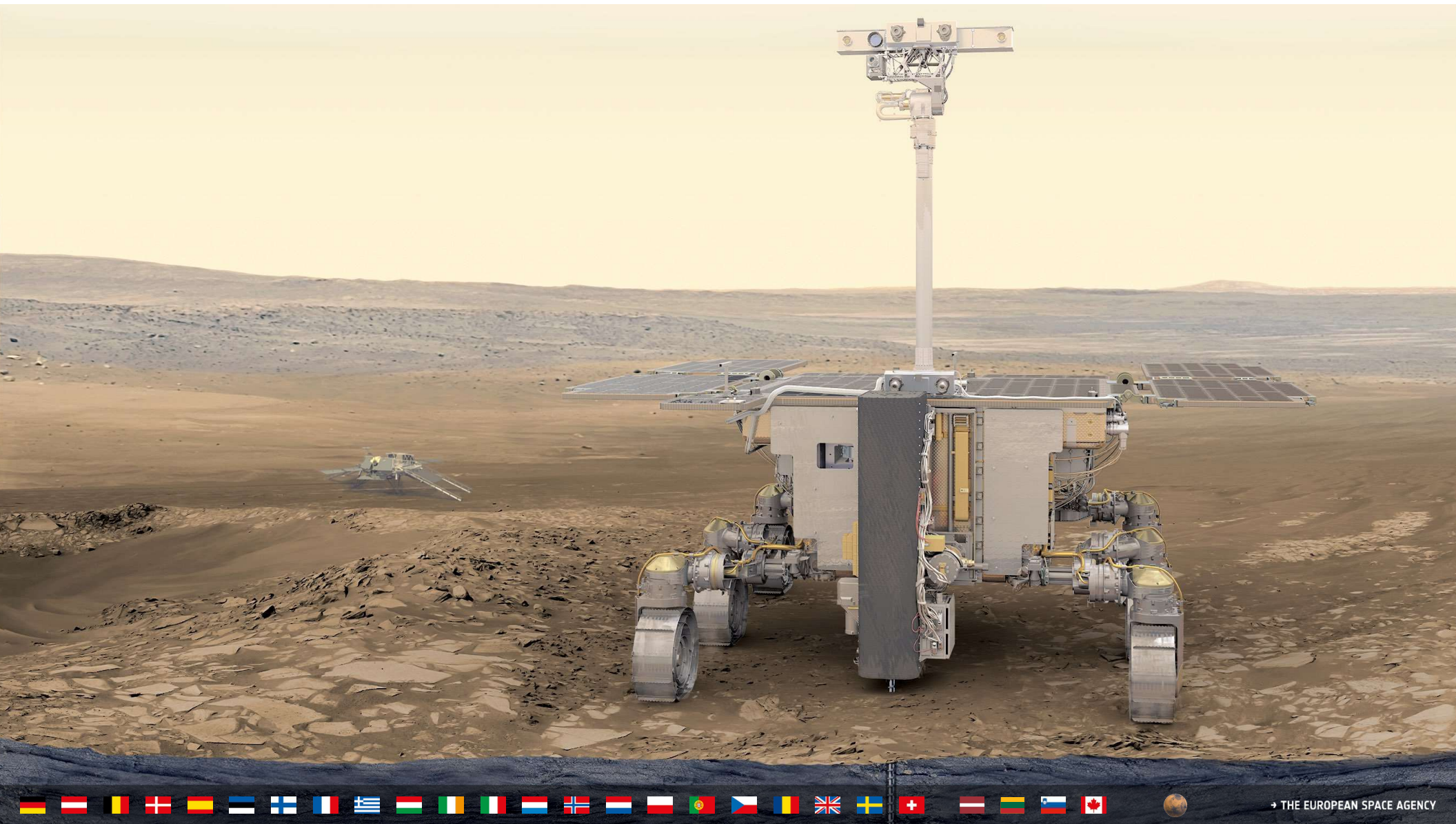
Pre-prepared command sequences, and potential targets, to perform the Campaigns.

# Strategic Science Plan in Rover Operations



Oxia Planum, NASA / MRO / HiRISE





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