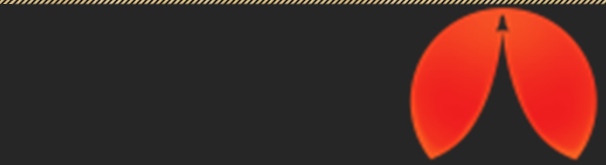
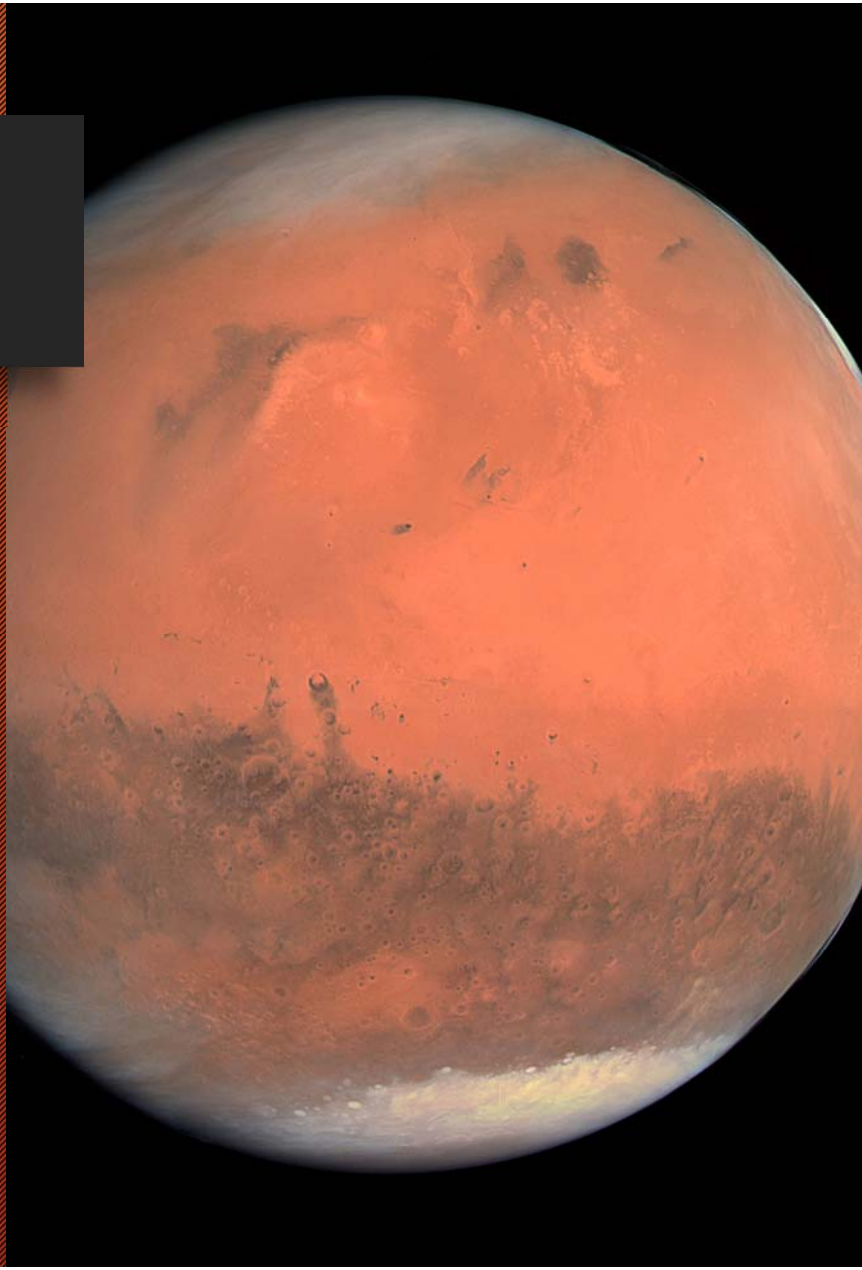


Exposing Microbes to the Martian environment

Thesis presentation

Introduction

- Why Mars?
  - Closest planet to Earth
    - Ice poles
    - Satellites orbiting
    - Rovers on the surface
- What are we looking for?



The Martian environment

- Temperatures (Average -60oC, -125oC at the poles, +20oC at the equator)
- Soil composition (Iron and perchlorates are of interest)
- Atmosphere (95.3% CO2, 2.6% Nitrogen, 1.9% Argon, 0.17% O2, 0,0747% CO)
- No magnetic field
  - Radiation
    - •UV
    - •Gamma radiation
  - Gasses easily lost to space
- 1% of Earth's atmospheric pressure
- Low water availability
  - Tied up in ice
  - Boils at 0oC
  - Low humidity

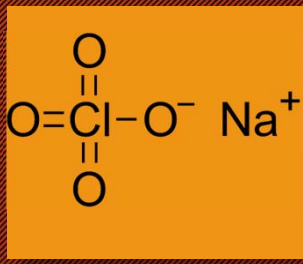
Requirements for life

- Carbon source (Organic elements: Carbon, Oxygen, Hydrogen and Nitrogen)
- Energy source
- Liquid water

Potential metabolites on Mars

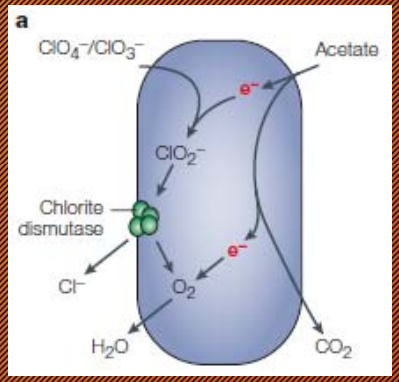
Electron donors	Electron acceptors
Fe^{2+}	Fe^{3+}
H_2	SO_2^{-4}
CO	O_2, 0,174%
Organics from meteorites	NO_3^-?
Organics from the endogenous subsurface	ClO_4^- (perchlorates)
	CO_2 (also carbon source)

Perchlorate



- Used in manufacturing rocket propellants, fireworks, flares, air bags, etc.
- Toxic to humans (affects the thyroid gland)
- Studies have shown bacterial growth in factory wastewater
- Also found in pristine soils (0,02% in the Atacama dessert)
- Made naturally in the atmosphere
- Is found on Mars (0,6%) – *We are working with 1% perchlorate*

Perchlorate reduction



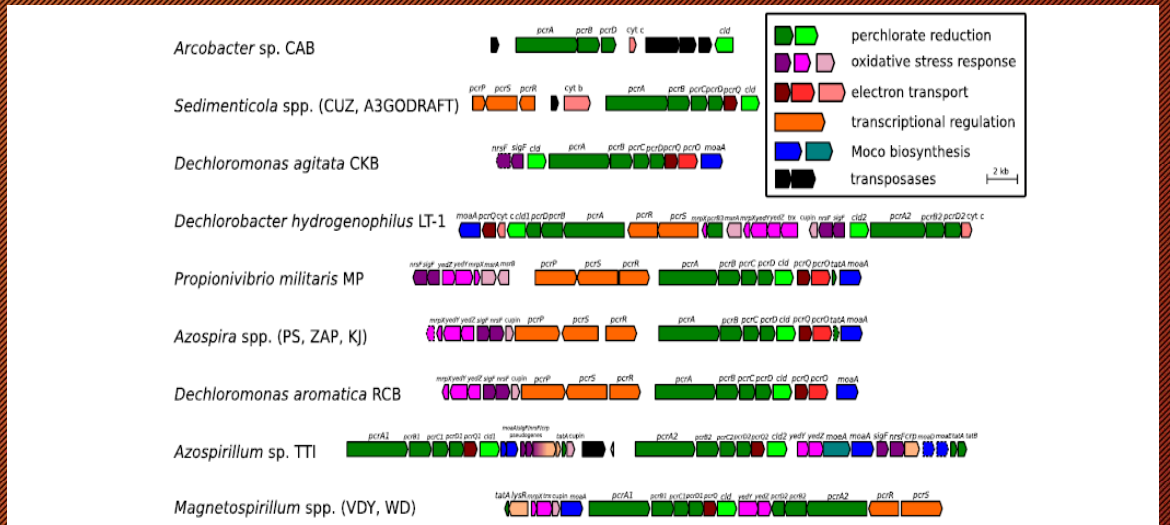
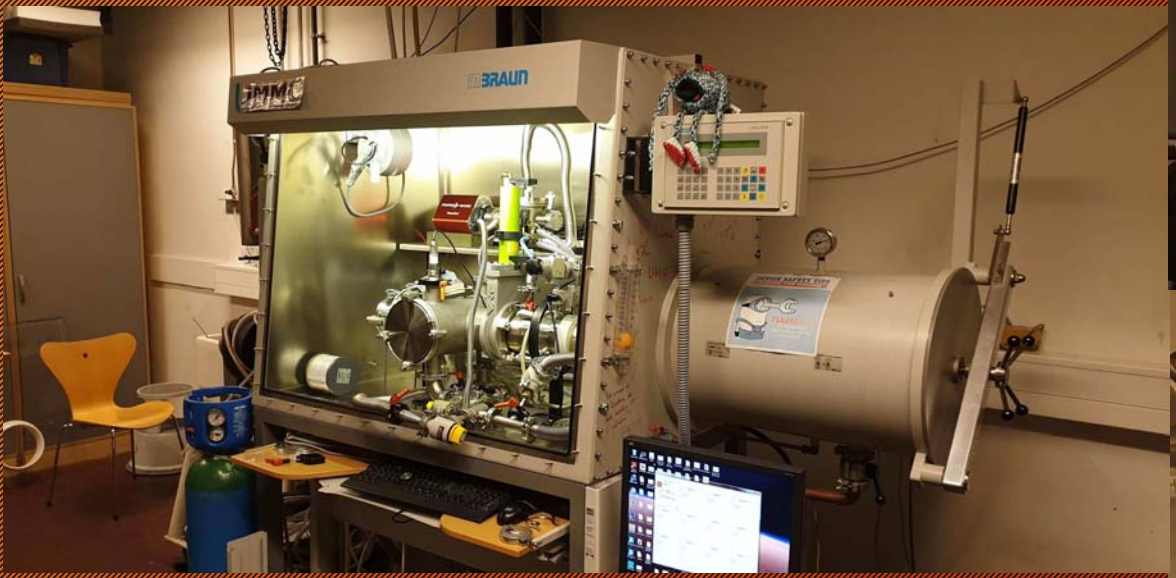


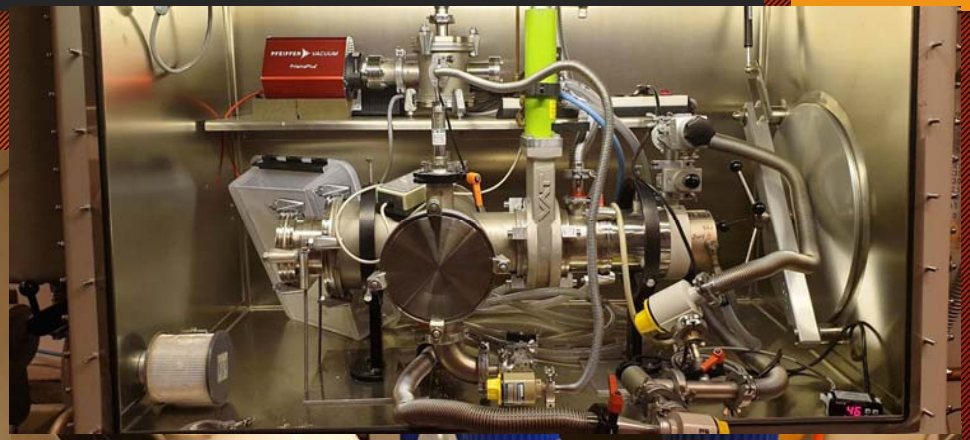
Fig. 4 The PRI core from the 13 DPRB genomes. Genes are colored according to functional groups and labeled with gene names, rather than locus tags. Locus tags can be found in Table S2

Experimental setup

- Soil samples from a “similar” Mars environment
- Growing and isolating bacteria
- Testing bacteria to Mars like environmental circumstances
  - Presence of perchlorates, anoxic environment, low humidity, low pressure, UV radiation, and temperature (4oC)
- Martian soil analogue
  - Added 1% perchlorate

The Mars Chamber





Slower growth rates when exposed to perchlorates

Increased OD at 4oC, dropping OD when 1% perchlorate is added

- The presence of perchlorates does not have a big effect *on bacteria*
- Some of the isolates can grow under anaerobic conditions
- Humidity ~17%, and ~0.04 atmospheric pressure
- UV radiation: 20 seconds? No problem
- Temperature 4oC. Enter dormant state. Regrow when reintroduced to 23oC

Binary results

- Growth or no growth
- 1. Mars chamber experiment – Low humidity, anaerobic
- 2. Mars chamber experiment – Low humidity, anaerobic (N2), low pressure (0.01 bar – 0.04 bar), lockdown

Thank You!