

A space-themed background featuring a bright sun with a lens flare in the upper left, a large orange planet (Mars) in the lower left, and a field of stars in the dark sky. Some stars are highlighted with blue diamond shapes.

# **The European Space Exploration Programme “Aurora”**

**AGROSPACE, TERRITORY AND RESEARCH**  
**Sperlonga, 25-26 May 2006**

# Current Status

**The Aurora Exploration Programme has been approved at the ESA Council Meeting at Ministerial level in Dec 2005.**

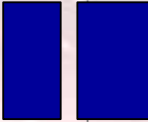
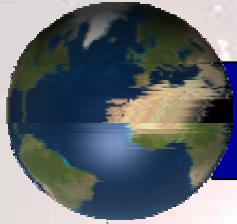
**Since the earlier Preparatory Phase in 2001, Italy established a leading role in this new programme and with about a 40% participation is today the main contributor to the Aurora Programme. Two main activities are foreseen:**

- **Core Programme, in continuation of the Aurora Preparatory Programme**
- **ExoMars, first robotic exploration mission.**

# Core Programme

- **Core Programme, in continuation of the Aurora Preparatory Programme, with the aim of preparing the future missions and technology :**
  - Define (reassess) a Road Map for the exploration of Moon and Mars
  - Define in the near term (10-15 years) a sequence of exploration and technology missions consistent with the long term exploration goal.
  - Define a Technology Development Programme, dedicated to Exploration, with major emphasis on Mars Sample Return Preparation.
- **Prepare for decision on new Exploration Missions at the next ESA Council at Ministerial level (mid 2008).**

# Aurora Programme Frame



time



**Human Mission  
Technology  
Demonstrator**



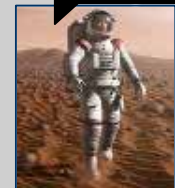
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**Human Moon Mission**

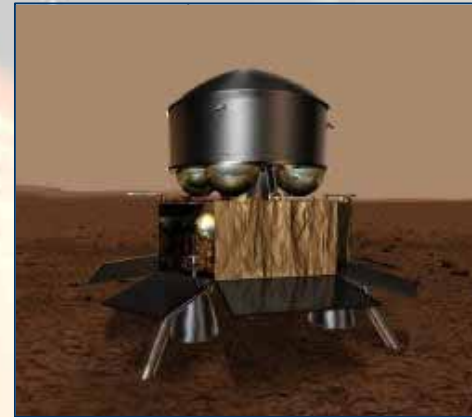


**ExoMars**

**Automatic Mars  
Missions**



**Cargo Element of first  
Human Mission**



**Mars Sample  
Return (MSR)**

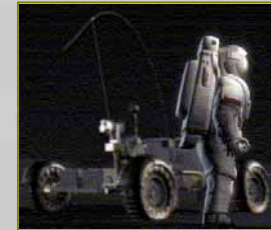
**First Human  
Mission to Mars**

# Human Moon Mission



**Moon: Next destination of international human missions beyond ISS**

**Test-bed for demonstration of innovating technologies & capabilities for sustaining human life on planetary surfaces. In such fields as:**



**Surface Mobility**



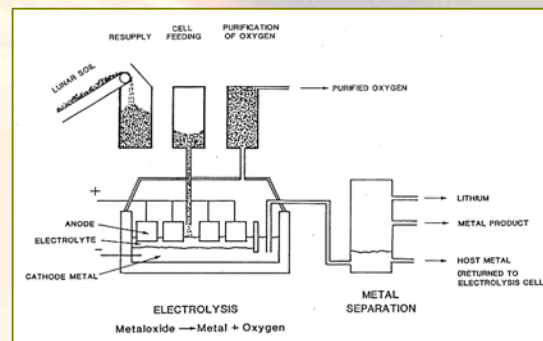
**Energy Provision & Management**



**Sustainable Life Support**



**Robotic Support**

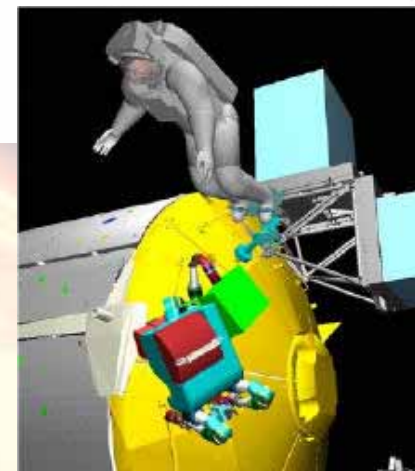
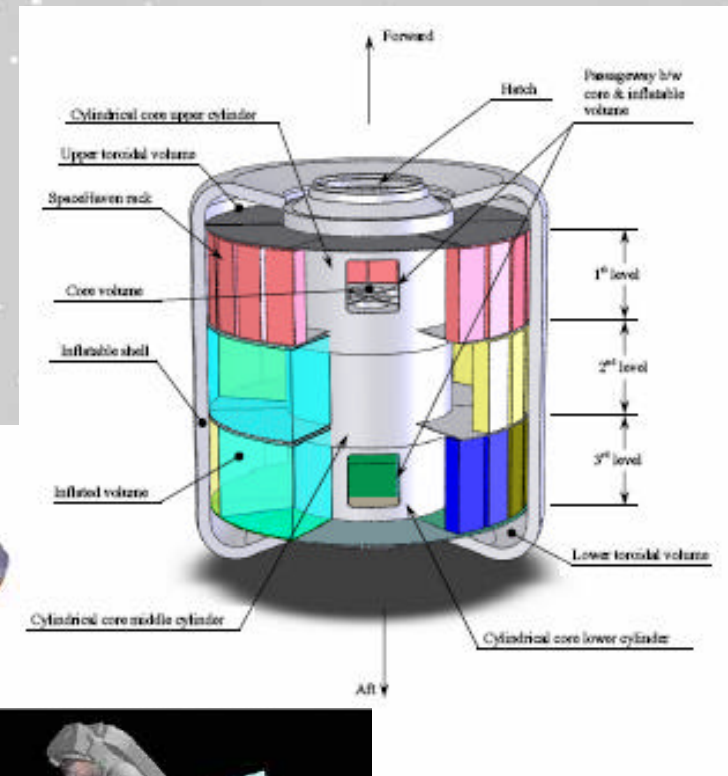


**In-Situ Resource Utilisation**

# Exploration Technologies

## *Habitation (SpaceHaven)*

- Air Regeneration (ARES)
- Hygiene
- Water/Waste Recycling
- Contamination Monitoring/Control
- Food Preparation



## *Eurobot*

# Exploration Technology

## ***HUMAN FACTORS:***

- **Radiation environment & mitigation**
- **Long-term medical survey in analogue environment (i.e. Concordia)**
- **Hardware development (sensors, etc.)**

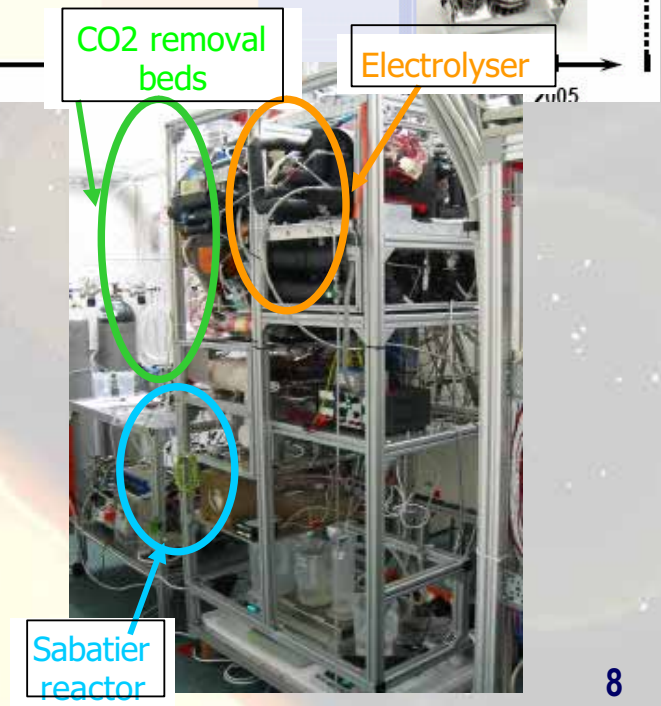
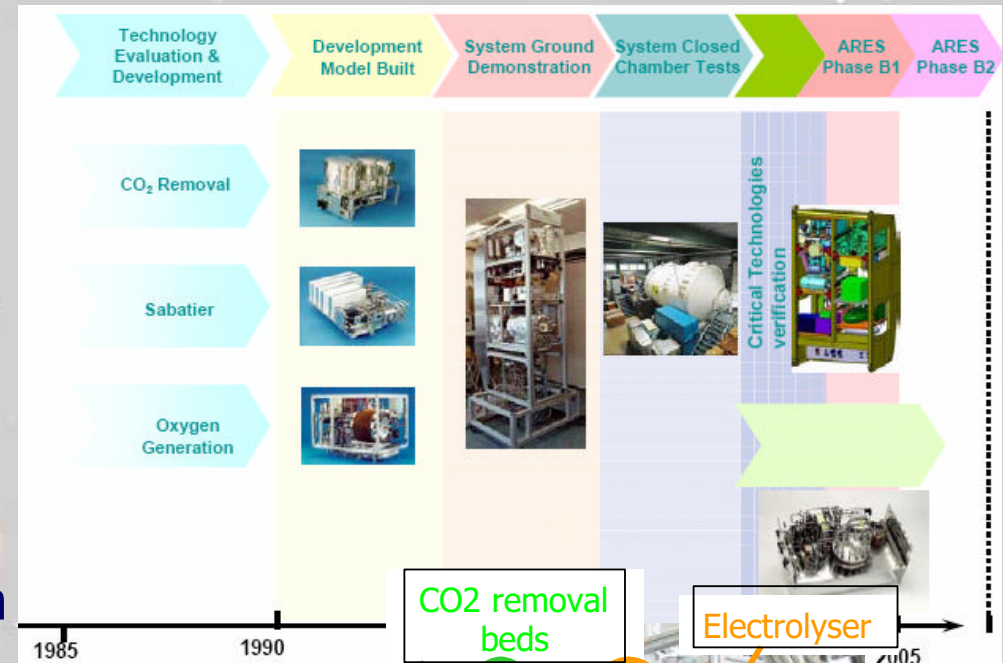


**Concordia Antarctica  
station**

# Exploration Technologies

## Air Revitalisation System

- Europe provides the ECLSS for Columbus and MPLM, no European regenerative life support system has been tested in orbit yet
- ARES is a partial closed-loop system that recycles the exhaled carbon dioxide into oxygen, based on physical-chemical processes
- ARES regenerative technology for life support will be needed for any long term exploration scenario.

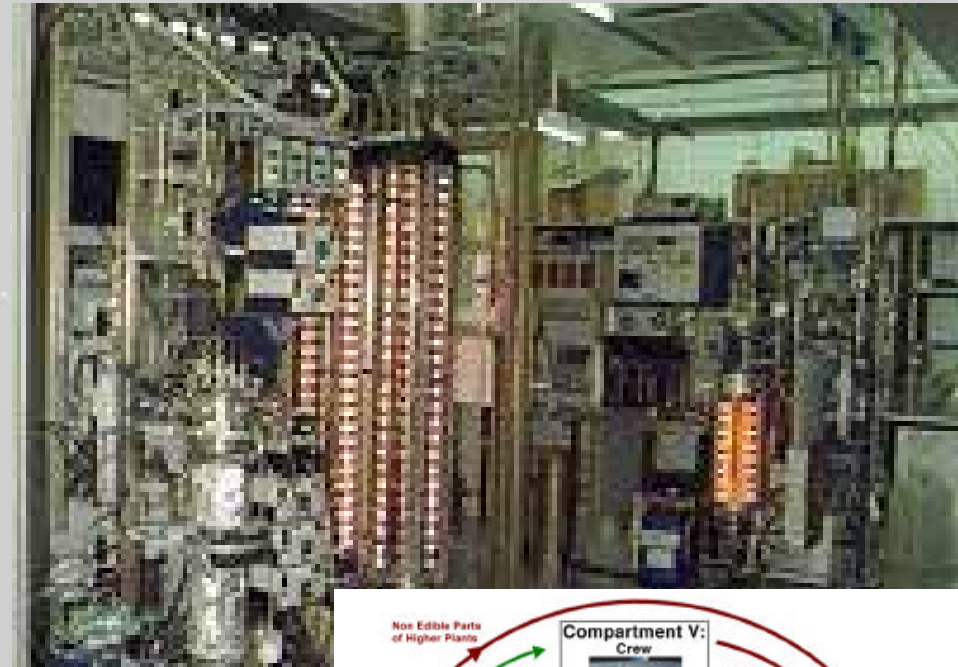


# Exploration Technology

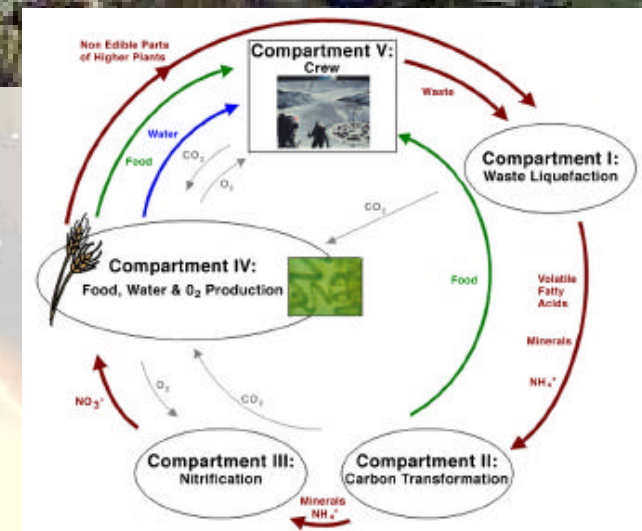
## LIFE SUPPORT SYSTEMS:

Technology development for:

- closed-loop regenerative life support systems (ARES),
- space exploration self-sufficient ecosystem (MELISSA), including large breadboard development

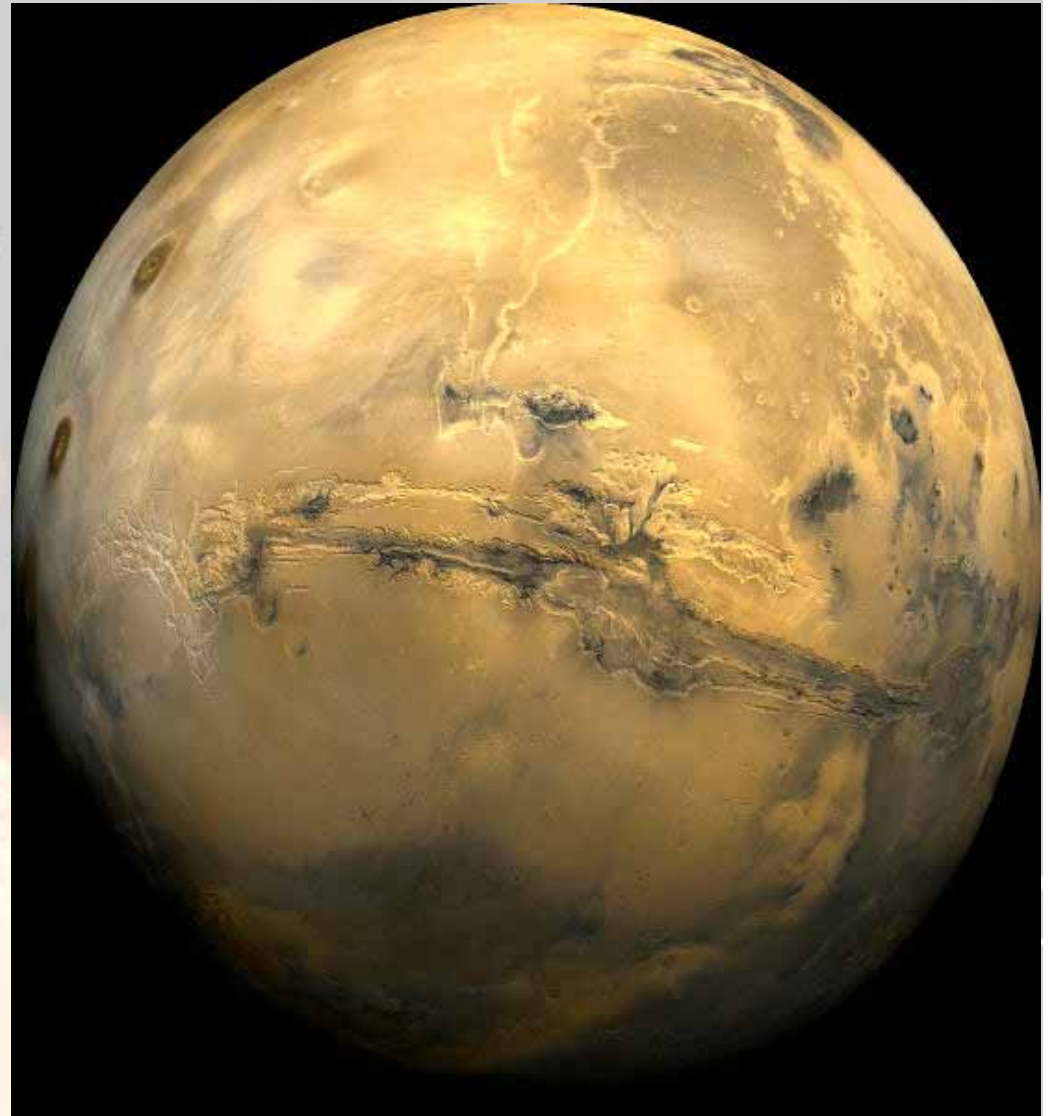


MELISSA  
Pilot-plant

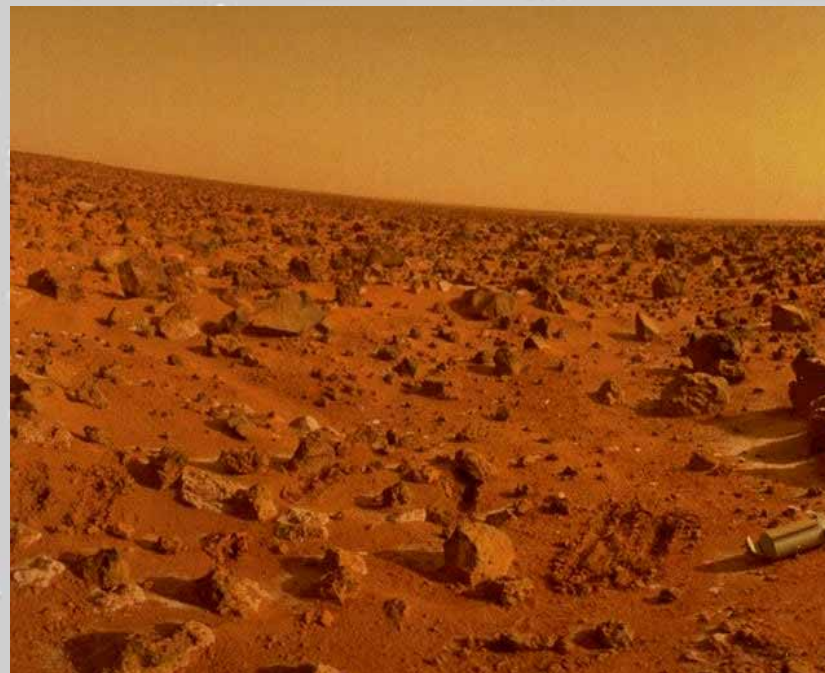
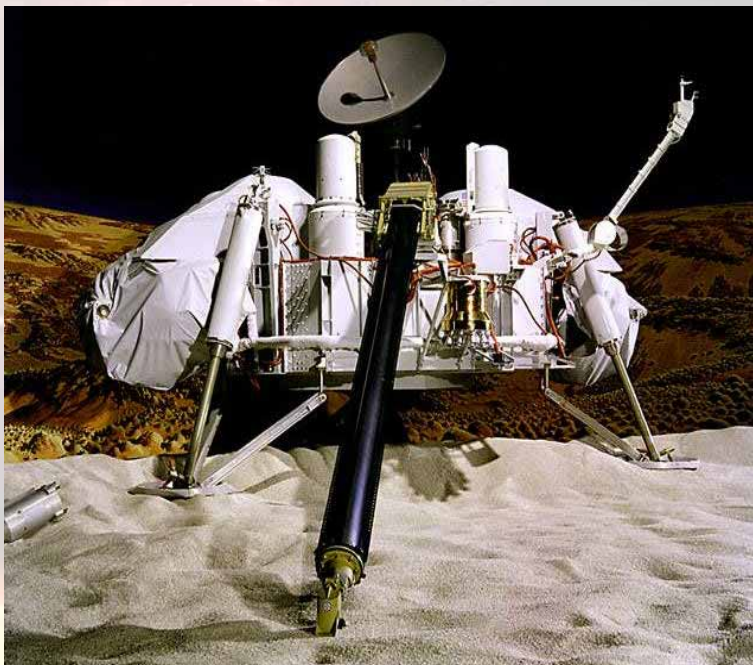


# Why Life on Mars

- Early in the history of Mars, liquid water was present on its surface;
- Some of the processes considered important for the origin of life on Earth may have also been present on early Mars;
- Asteroid and comet impacts may have been less severe on Mars, favouring the survival of life;
- Establishing if there ever was life on Mars is fundamental for planning future human missions.



## Vikings 1 & 2 (1976)



The Viking GC/MS did not detect organics above part per billion (ppb) level. However, the detection limit for amino acids was in the tens of ppm range. At ppm level, amino acids from  $\sim 10^7$  cells per gram of Martian soil would not have been detected.

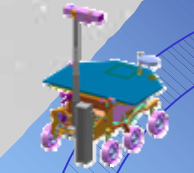
**Viking did not rule out the possibility of life on Mars, past or present.**

# ExoMars Mission

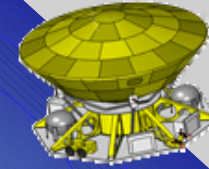


Launch: 2011

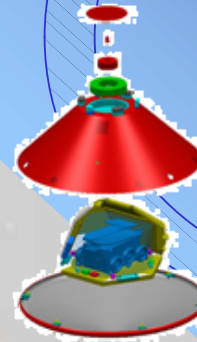
Rover with Pasteur Payload



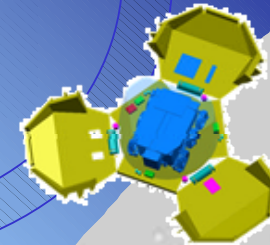
Carrier



Entry, Descent and Landing System



Descent module



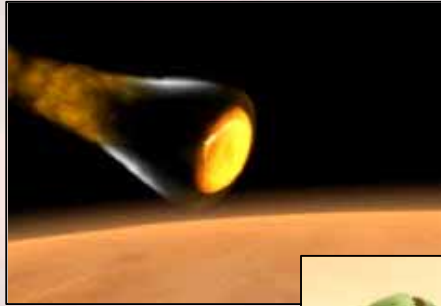
## Main objectives in technology

- Safe entry, descent and landing of a large size payload
- Mobility on Mars surface (Rover) and access to sub-surface (Drill)
- Progressing Planetary Protection

## Main objectives in science

- Search for traces of past or present life on Mars
- Determination of Mars' geochemistry and water distribution
- Improving knowledge on Martian environment and geophysics
- Identifying surface hazards for future manned missions

# Entry, Descent and Landing



## Entry

Energy dissipation via aerodynamic drag;  
Velocity Range: start ~5.4 km/s end ~430 m/s.



## Parachute Descent

Energy dissipation via aerodynamic drag;  
Velocity Range: start ~430 m/s end ~85 m/s.



## Retrorockets

Energy dissipation via propulsive impulse;  
Velocity Range: start ~85 m/s end ~10-15 m/s.



## Landing

Landing with airbags  
Velocity Range: start ~10–15 m/s end 0 m/s.



**...on the Surface**



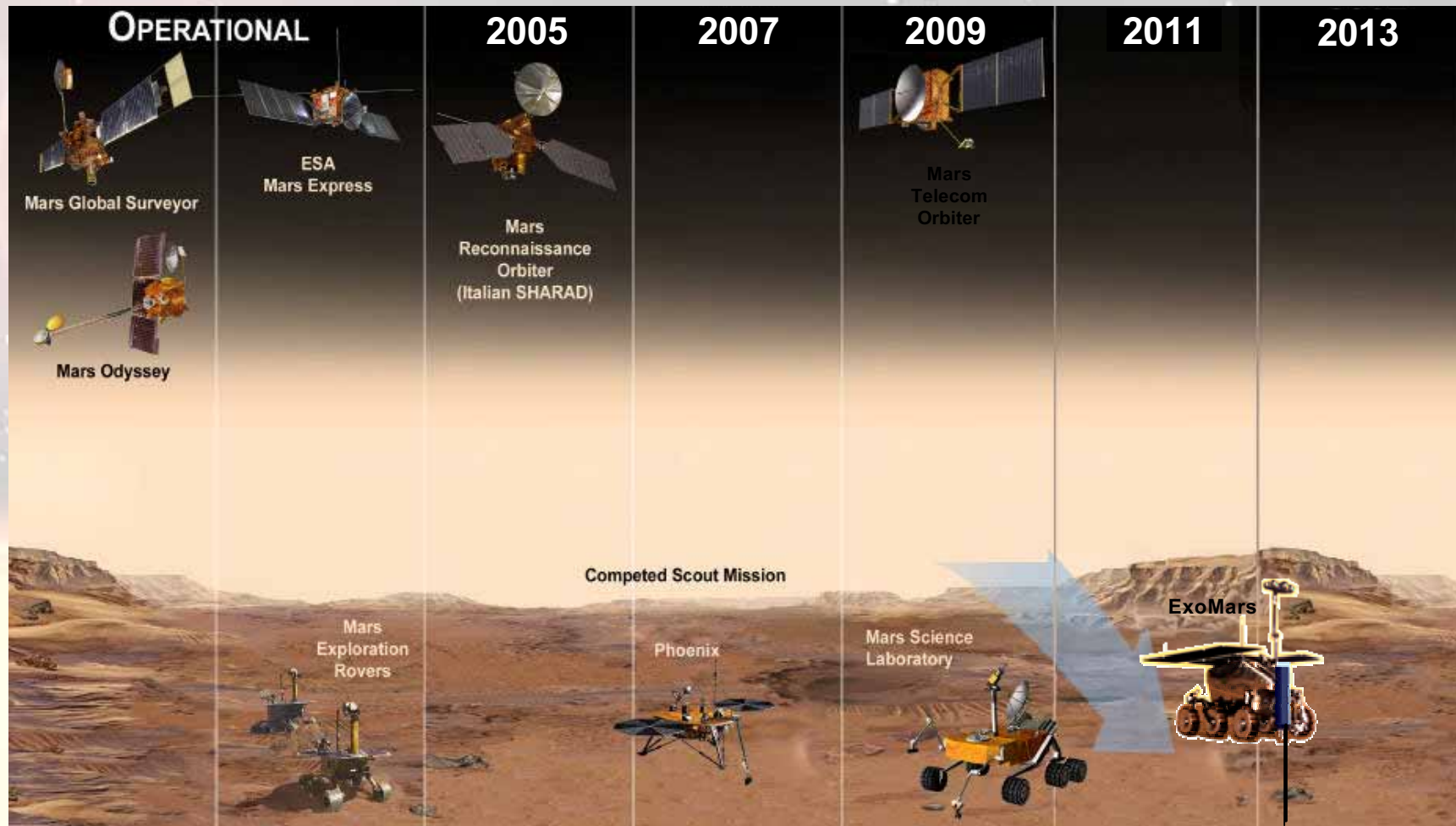
**...guided from the Rover Control Centre (Torino).**



**Alcatel Alenia Space- Italy is the ExoMars Prime Contractor.**

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# The international context



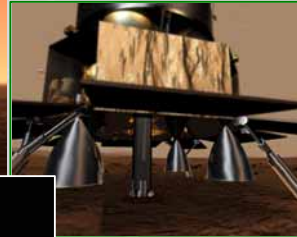
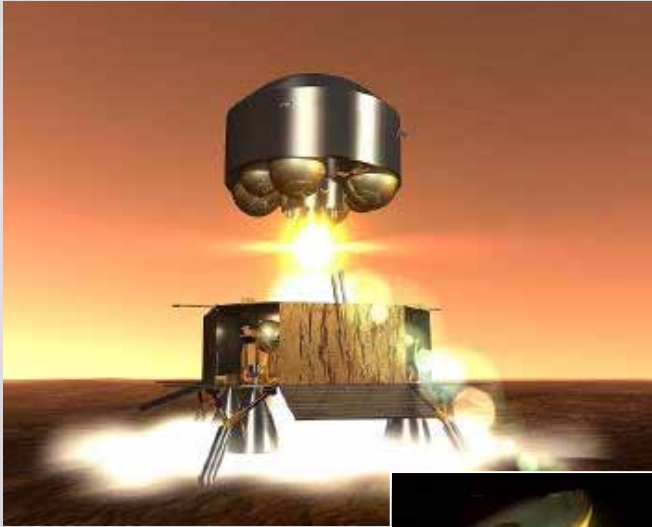
➤ **MSL: powerful geology rover; large 2-D mobility.**

➤ **ExoMars: next-generation instruments; 3-D mobility.**

# Mars Sample Return - MSR

First robotic mission including all elements representative of a human mission to Mars :

- Earth/Mars transfer stage
- Mars Orbiter
- Descent module
- Ascent module
- Earth re-entry vehicle.



## Main objectives in technology

- Large mass soft landing
- Ascent from Mars
- Sample collecting device
- Planetary protection

## Main objectives in science:

- Search for traces of past or present life on Mars on the basis of a Martian soil/rock sample from deep under the surface
- Improve knowledge about environment and geophysics of Mars