

## *Summary*

ORIGIN OF PLANETARY PROTECTION

REQUIREMENTS FOR SMALL BODIES SAMPLE RETURN MISSIONS

EXPERIENCE IN EUROPE

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**UNITED NATIONS** Treaty on principles governing the activities of states in the exploration and use of outer space, including the Moon and other celestial bodies - article 9 ("**Outer Space Treaty - OST**"), 1967.

*"States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid **their harmful contamination** and also **adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter**, and where necessary, shall adopt appropriate measures for this purpose"*



**COSPAR** is observer for the UN Committee on Peaceful Uses of Outer Space (UN-COPUOS). It responds to requests from the UN to carry out specific studies and reports on space research through international teams of experts



PP recommendations



PP specifications (Space Agencies PP Standards)

## *WHAT DO WE KNOW ?*

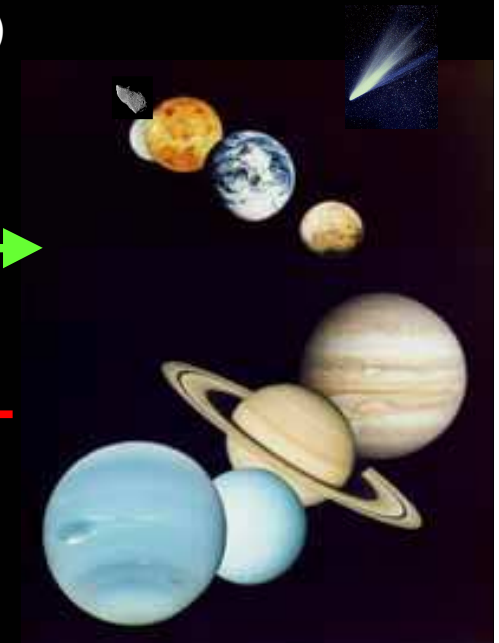
- Some terrestrial forms of life (bacterial spores) are able to survive in space and on other Solar System bodies (maybe also duplicate), depending on the local environment conditions
- Bacterial spores are able to remain viable and to wait millions of years on appropriate environment conditions to duplicate again
- Some terrestrial forms of life are able to adapt to extreme environments (extremophiles) and to duplicate ( $> 100^{\circ}\text{C}$ ,  $< -15^{\circ}\text{C}$ ,  $> 1000$  bar, PH 0, 10 Mrad, ..etc)



***Forward contamination***

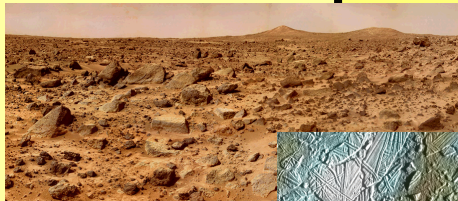
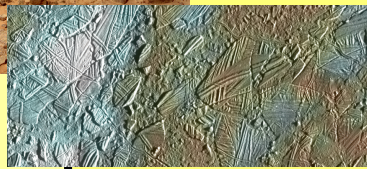



***Backward contamination***



# PLANETARY PROTECTION FOR SAMPLE RETURN MISSIONS

## MISSION CATEGORIZATION (COSPAR)

Category	1	2	3	4	5
Prevention of		Forward	contamination		Back
Biological interest	No	Significant	Significant	Significant	
Probability of contamination	Any	Remote	Significant	Significant	Unknown
Type of mission	Any	Any	Orbiter / Fly-by	Lander	Earth Return
	Mercury Venus Moon Sun Asteroids (except C)	Jupiter Saturn Uranus Neptune Pluto Comets C-asteroids	Mars Europa, ....  	Mars Europa, ....	Earth-Moon System 
Range of requirements					→ X

## *There are 2 sub-categories for cat 5 missions*

### 1 - « *Safe for Earth Return* » :

Such missions concern target bodies where the preponderance of scientific evidence indicates

the absence, presently and in the past,

- of liquid water
- energy source useful for cellular metabolism
- organic matter

and that

- they were heated  $> 160^{\circ}\text{C}$
- they received sufficient irradiation in space for sterilization,
- meteorites constituted with equivalent material have fallen on Earth.



*No requirements if at least  
one condition among these  
6 is met*



Otherwise

### 2 - « *Restricted Earth Return* »

*PP requirements*

## *Requirements for the Prevention of Backward Contamination*

- ➔ **Sample hermetic containment (redundant fail safe system)** Hermeticity shall be demonstrated in flight before Earth re-entry maneuvers
- ➔ **Contact chain shall be broken** (no uncontained H/W that contacted the target body shall be returned to Earth) as long as sterilization is not applicable (proven method is required)
- ➔ **Safe Earth landing and recovery (system reliability)**
- ➔ **Sample quarantine with**
  - Life detection
  - Biohazard testing
- ➔ **High security laboratories** (BSL4 / P4 facility) for the analysis of samples





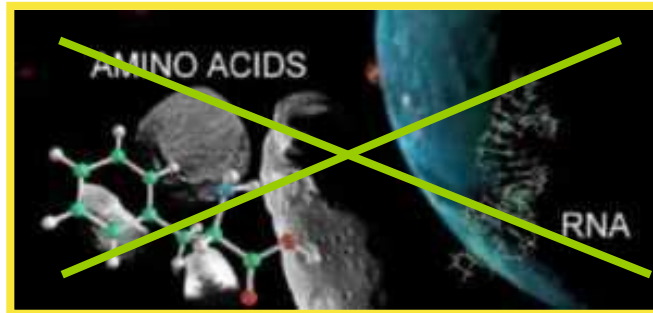
## *Preservation of Sample Properties*

- ➔ Avoidance of “**false positive**” results : discovering, on extraterrestrial samples, life or traces of life, biohazard from terrestrial origin, leading to confusion.
- ➔ On systems in contact with samples: sample collection systems, drills, experiments, containers, ..., it requires

***Sterilization***  
(active life)



***Organic cleanliness*** (organic compounds / molecules related to active life: RNA, DNA, amino acids, proteins, PAH, ..etc.



- ➔ Cleanliness may also be required if in-situ science includes the search for life or traces of life

## *Take benefits of past and present experience*

- ➔ **ESA + National Agencies representatives + Scientists:** Involvement in the COSPAR PP Panel activities, ECSS working groups (standard PP procedures), PPWG for Aurora.
- ➔ **Biological / Organic cleanliness:** *Mars 96, Beagle2, MSR - Premier, Exomars, a lot of studies and tests (biological mainly).*

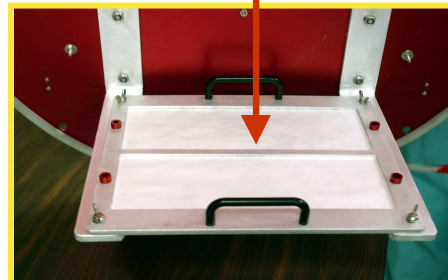
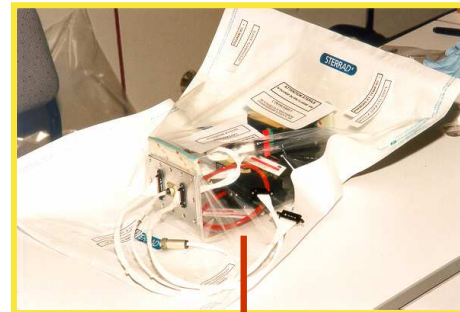
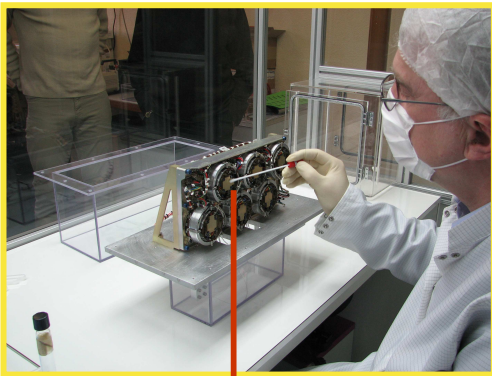


Photo sources: Open University, CNES



## *Take benefits of past and present experience*

- ➔ **Sample containment / contact chain breaking :**  
*Studies performed for AURORA MSR mission (ESA).*
- ➔ **Sample quarantine / ET samples analysis protocol:**  
*NASA, A draft test protocol for detecting possible biohazards in Martian samples returned to Earth. NASA CP/2002-211842 - October 2002 (Results of workshops organized by NASA and CNES in the frame of MSR - PREMIER missions).  
Will be updated*
- ➔ **High security laboratories (BSL4 / P4 facility)**  
*Feasibility Study for a European Mars Sample Receiving Facility, Study funded by ESA, 2004*

**Thank you**

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