**Chair**
Dr. John D. Rummel (COSPAR)

15:00 ***Planetary protection overview: the role of COSPAR in international missions***
Speaker: John Rummel, Chair, Panel on Planetary Protection, COSPAR, and East Carolina University, North Carolina, USA.

15:20 ***Mars lives? A planet worth protecting, either way***
Speaker: Charles Cockell, The Open University, United Kingdom.

15:50 ***The international Mars exploration program and current planetary protection measures***
Speaker: Gerhard Kminek, European Space Agency, The Netherlands.

16:20 ***Outer planet satellites as potential crucibles for life: extraterrestrial and terrestrial***
*Speaker: Kevin Hand, NASA Jet Propulsion Laboratory, California, USA.*

16:50 ***Planetary protection beyond the living world: the role of COSPAR in future exploration missions and in preserving and promoting science***
*Speaker: Pascale Ehrenfreund, Chair, Panel on Exploration, COSPAR, and George Washington University, USA.*

17:20 ***We lost Pluto? Future steps in preserving planets, satellites and small solar systems bodies***
Speaker: John Rummel, Chair, Panel on Planetary Protection.

17:40 **Discussion and summary of the symposium**

# Planetary protection overview: the role of COSPAR in international missions


**John D. Rummel**
*Chair, COSPAR Panel on Planetary Protection and*
*East Carolina University, USA*

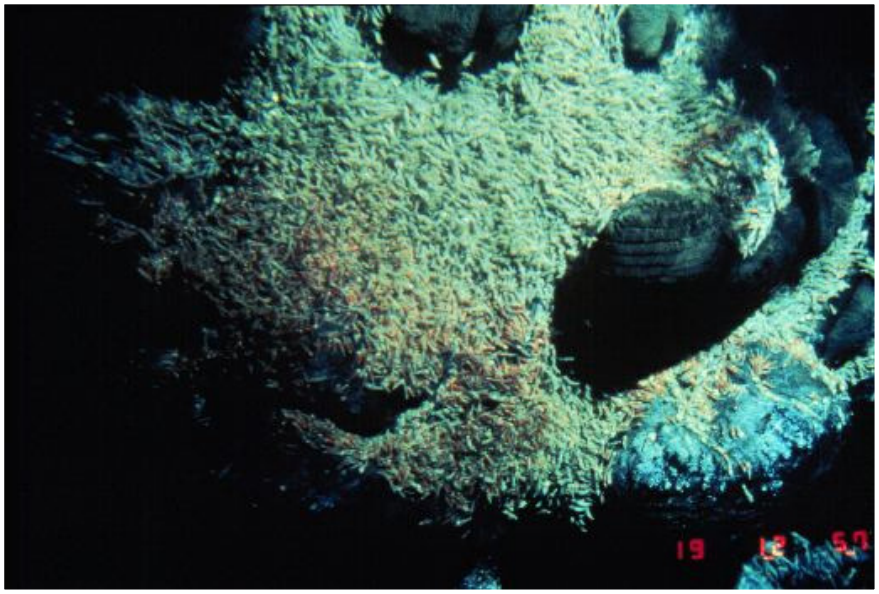
# COSPAR

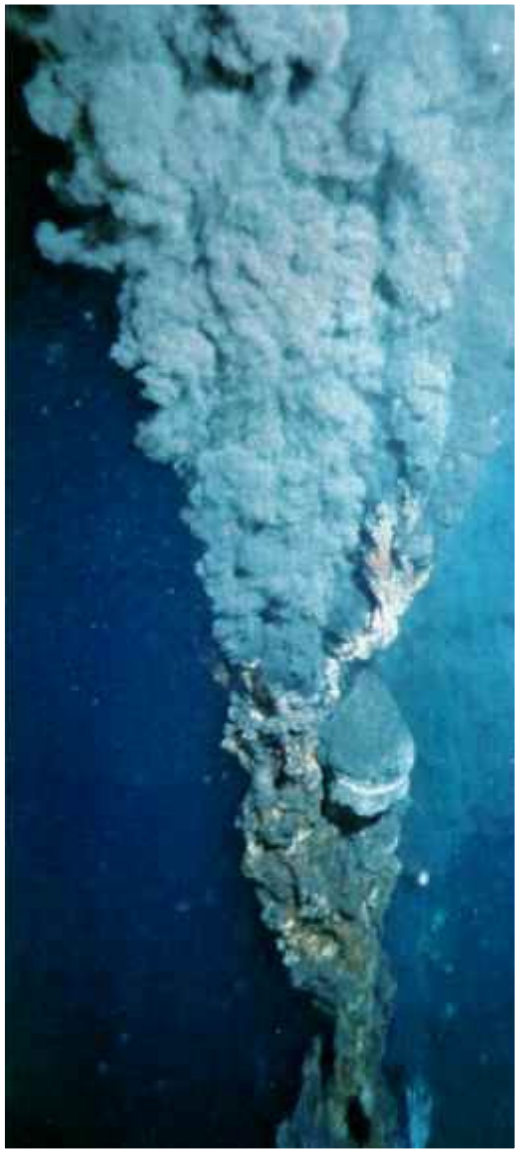
- Is responsible for organizing biennial Scientific Assemblies with strong contributions from most countries engaged in space research.
- Provides the means for rapid publication of results in its journal *Advances in Space Research,*
- Strives to promote the use of space science for the benefit of mankind and for its adoption by developing countries and new space-faring nations, in particular through a series of Capacity Building Workshops,
- Organizes, on a regional scale, scientific exchange and public outreach on specific research topics, in the framework of Colloquia and Symposia,
- Advises, as required, the UN and other intergovernmental organizations on space research matters or on the assessment of scientific issues in which space can play a role,
- Prepares scientific and technical standards related to space research, and
- Promotes, on an international level, research in space, much of which has grown into large international collaborative programs in the mainstream of scientific research.

# Life Elsewhere in the Solar System?

- Many new discoveries since US *Viking* missions (Mars, 1976)
- Earth organisms live in extreme environments previously thought impossible:
  - Deep-sea hydrothermal vents (@>250 ATM; ≥121 ℃; chemosynthetic) —discovered 1977
  - Volcanic/geothermal vents in boiling water at surface
  - In rocks in hot deserts; Antarctic dry-valley sandstone
  - Mine seepage acids, with pH of < 1
  - Deep subsurface in terrestrial (>3 km) and marine (>1 km below seafloor) systems
  - High-radiation environments (survive ≥ 5 Mrad)
  - Long-term space exposure (LDEF, EURECA, EXPOSE, O/OREOS)
- Possible present-day water on Mars surface; lots of ice; abundant water in past
- Potential ocean on Europa; geysers on Enceladus; etc.

# The Search for Life –
## *"Ignorance is not Bliss"*





The discovery of abundant life at deep sea hydro-thermal vents in 1977 (7 months after the Viking missions landed on Mars) surprised *everybody!*

- It isn't that we expect to find these things out *there* –
- It's that we never expected to find them *here....*

# Historical Background

- 1956: The International Astronautical Federation (IAF) at its VIIth Congress in Rome attempted to coordinate international efforts to prevent interplanetary contamination. This led to the formation of the International Institute of Space Law.

- 1956: Initial attempts to deal with contamination and sterilization issues were also carried out by the United Nations Committee on the Peaceful uses of Outer Space (UNCOPUOS).

- 1957: The U.S. National Academy of Sciences (NAS) expressed concerns with the problems of interplanetary contamination resulting from space exploration.
  - Urges that lunar and planetary studies be carried out so as to prevent contamination.
  - Requests the International Council of Scientific Unions (ICSU) to assist in the evaluation of the possibilities of such contamination and in the development of means to prevent it.

# Historical Background (cont.)

- 1958: The ICSU established an ad hoc Committee on Contamination by Extraterrestrial Exploration (CETEX). CETEX provided preliminary findings regarding the possible contamination of the moon, Mars, and Venus and recommended the establishment of a code of conduct for space missions and research.
- 1958: ICSU accepts the CETEX recommendations, and also established the Committee on Space Research (COSPAR) to coordinate worldwide space research.
- 1958: The US NAS forms the Space Science Board (SSB), which, among other duties, was charged with addressing, and providing advice on issues of interplanetary contamination.
- 1959: The SSB reviews the CETEX report and recommends sterilization of space probes. Endorses CETEX recommendations regarding code of conduct and the formation COSPAR.

# Historical Background (cont.)

- 1961: ICSU adopts resolution 10, “Space Experiments with Undesirable Effects,” which recommends that all countries launching space experiments that could have an adverse effect on other scientific research should provide the ICSU and COSPAR with the information necessary to evaluate the potential contamination.
- 1962: COSPAR organizes a Consultative Group on Potentially Harmful Effects of Space Experiments to help conduct these evaluations.
- 1963: On the basis of extensive studies and the advice of the SSB, NASA adopts the following policy regarding the moon, Mars and Venus:

“Lunar spacecraft will reduce their microbial load to a “minimum” through the use of assembly and check out in clean rooms and the application of surface sterilants after final assembly and check out; Mars flights will have less than $10^{-4}$ probability of hitting the planet, while landers would be sterilized after complete assembly and check out, using appropriate procedures and sealed units that would not be open; Venus flights will have less than $10^{-2}$ probability of hitting the planet.”

# Historical Background (cont.)

- 1964: COSPAR adopts resolution 26.5 which establishes a quantitive framework for the development of planetary protection standards.
  This framework would last until 1982.
- 1967: UN Space Treaty entered into force.
- 1983, 1984: COSPAR issues a major revision to the policy based on Categories of protection, based on target characteristics and mission type, with an underlying probabilistic consideration for contamination.
- 1994: COSPAR issues major changes in the requirements for Mars orbiters and landers, based on this approach.
- 1999: COSPAR charters the Panel on Planetary Protection to maintain and promulgate its Planetary Protection Policy.
- 2002: COSPAR issues the Policy in a single document for future use and revision as an accessible and “living” international consensus standard under Article IX of the 1967 Space Treaty.

# International Agreement on Planetary Contamination/Protection

- Article IX of the Outer Space Treaty of 1967:

  "...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..."

  *"Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies."*
  *(entered into force, October 10, 1967)*

# Basic Planetary Protection Policy

**(Paraphrased)**

- Preserve planetary conditions for future biological and organic constituent exploration
  - *avoid forward contamination; preserve our investment in scientific exploration*
- To protect Earth and its biosphere from potential extraterrestrial sources of contamination
  - *avoid backward contamination; provide for safe solar-system exploration*

*Comply with Article IX of the Outer Space Treaty of 1967*


**Basic Planetary Protection Policy**

**(Bart Simpson)**

# COSPAR
# Planetary Protection Preamble

*Noting* that COSPAR has concerned itself with questions of biological contamination and spaceflight since its very inception, and

*noting* that Article IX of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (also known as the UN Space Treaty of 1967) states that:

> 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. (UN 1967)

*Therefore*, COSPAR maintains and promulgates this planetary protection policy for the reference of spacefaring nations, both as an international standard space exploration, and to provide accepted guidelines in this area to guide compliance with the wording of this UN Space Treaty and other relevant international agreements.

# COSPAR
# Planetary Protection Policy

*Referring* to COSPAR Resolutions 26.5 and 26.7 of 1964, the Report of the Consultative Group on Potentially Harmful Effects of Space Experiments of 1966, and the Report of the same Group of 1967, and the Report of the COSPAR/IAU Workshop of 2002,

*notes* with appreciation and interest the extensive work done by the Panel on Standards for Space probe Sterilization and its successor the Panel on Planetary Quarantine and the Panel on Planetary Protection and

*accepts* that for certain space mission/target planet combinations, controls on contamination shall be imposed in accordance with a specified range of requirements, based on the following policy statement:

The conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized. In addition, the Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from an interplanetary mission. Therefore, for certain space mission/target planet combinations, controls on contamination shall be imposed, in accordance with issuances implementing this policy.

# COSPAR
# Planetary Protection Mission Constraints

- Depend on the nature of the mission and on the target planet
- Assignment of categories for each specific mission/body is to be determined by the “best multidisciplinary scientific advice”
  - COSPAR will provide it in case such advice is not available to a nation
- Examples of specific measures include:
  - Controls on spacecraft operating procedures
  - Spacecraft organic inventory and restrictions
  - Reduction of spacecraft microbial contamination
  - Restrictions on the handling of returned samples
  - Documentation of spacecraft trajectories and spacecraft material archiving


***Any successful policy must take into account the realities of space exploration....***

# COSPAR Policy: Planetary Protection Mission Categories

| PLANET PRIORITIES | MISSION TYPE | MISSION CATEGORY |
|---|---|---|
| Not of direct interest for understanding the process of chemical evolution. No protection of such planets is warranted (no requirements). | Any | I |
| Of significant interest relative to the process of chemical evolution and the origin of life, but only a remote chance that contamination by spacecraft could compromise future investigations. | Any | II |
| Of significant interest relative to the process of chemical evolution and the origin of life and for which scientific opinion provides a significant chance of contamination which could compromise future investigations. | Flyby, Orbiter | III |
| | Lander, Probe | IV |
| Any Solar System Body | Earth-Return | V |

*"restricted" or "unrestricted"*

*Proposed:*

## Category-Specific Listing of Target Body/Mission Types

Category I: Flyby, Orbiter, Lander: Undifferentiated, metamorphosed asteroids; others TBD

Category II: Flyby, Orbiter, Lander: Venus; Moon (with organic inventory); Comets; Carbonaceous Chondrite Asteroids; Jupiter; Saturn; Uranus; Neptune; Ganymede*; Titan*; Triton*; Pluto/Charon*; Ceres; Kuiper-Belt Objects > 1/2 the size of Pluto*; Kuiper-Belt Objects < 1/2 the size of Pluto; others TBD

Category III: Flyby, Orbiters: Mars; Europa; Enceladus; others TBD

Category IV: Lander Missions: Mars; Europa; Enceladus; others TBD

Category V: Any Earth-return mission.
"Restricted Earth return": Mars; Europa; others TBD;
"Unrestricted Earth return": Venus, Moon; others TBD.

*The mission-specific assignment of these bodies to Category II must be supported by an analysis of the "remote" potential for contamination of the liquid-water environments that may exist beneath their surfaces (a probability of introducing 1 viable terrestrial organism of $<1 \times 10^{-4}$), addressing both the existence of such environments and the prospects of accessing them.

# COSPAR
# Planetary Protection Reports

## COSPAR

*Recommends* that, in order to meet this objective, members provide information to COSPAR within a reasonable time not to exceed six months after launch about the procedures and computations used for each flight and again within one year after the end of a solar-system exploration mission about the areas of the target(s) which may have been subject to contamination. COSPAR will maintain a repository of these reports, make them available to the public, and annually deliver a record of these reports to the Secretary General of the United Nations. For multinational missions, it is suggested that the lead partner should take the lead in submitting these reports.

**Reports should include, but not limited to, the following information;**

1. **The estimated biological burden at launch, the methods used to obtain the estimate (e.g., assay techniques applied to spacecraft or a proxy), and the statistical uncertainty in the estimate.**
2. **The probable composition (identification) of the biological burden for Category IV missions, and for Category V "restricted Earth return" missions.**
3. **Methods used to control the biological burden decontaminate and/or sterilize the space flight hardware.**
4. **The organic inventory of all impacting or landed spacecraft or spacecraft-components, for quantities exceeding 1 kg.**
5. **Intended minimum distance from the surface of the target body for launched components, for those vehicles not intended to land on the body.**
6. **Approximate orbital parameters, expected or realized, for any vehicle which is intended to be placed in orbit around a solar system body.**
7. **For the end-of-mission, the disposition of the spacecraft and all of its major components either in space or for landed components by position (or estimated position) on a planetary surface.**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Advances in Space Research xxx (2010) xxx–xxx

ADVANCES IN SPACE RESEARCH (a COSPAR publication)

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# Report of the COSPAR mars special regions colloquium

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# "Workshop on Planetary Protection for Outer Planet Satellites"


## 15 - 17 April 2009 Vienna, Austria

**John D. Rummel**
***Chair, Panel on Planetary Protection***
**Pascale Ehrenfreund, Nicolas Peter**
***Editors***

# "Workshop on Planetary Protection for Titan and Ganymede"

## Caltech, Pasadena

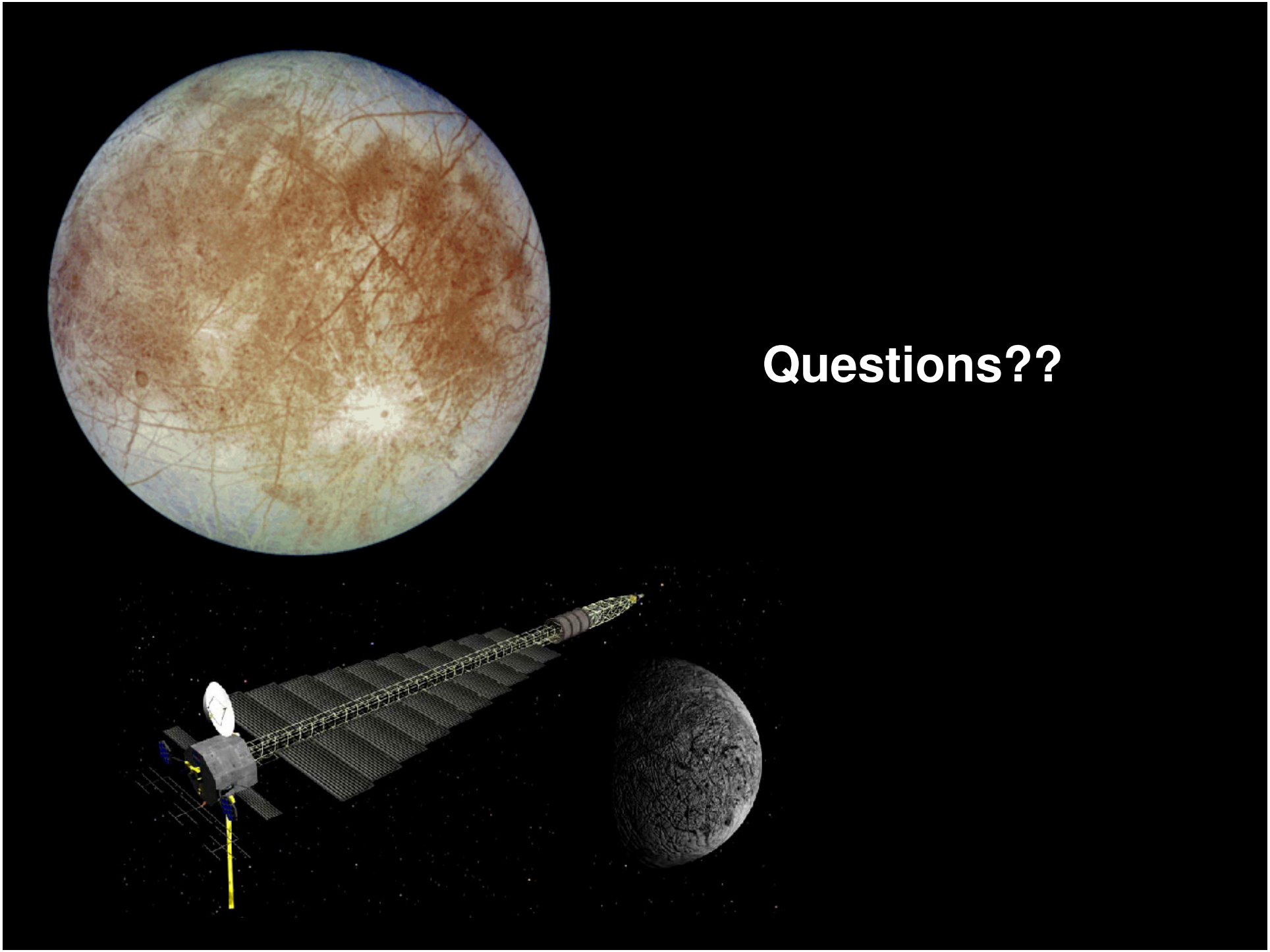
*John Rummel*
*François Raulin*
*Pascale Ehrenfreund*

**9-10 December 2009**


QuickTime™ and a
decompressor
are needed to see this picture.

# COSPAR
# Panel on Planetary Exploration

- The objective of the COSPAR Panel on Exploration (PEX) is to provide independent scientific advice
  - To support the development of exploration programs and
  - To safeguard the potential scientific assets of solar system objects
- PEX and the Panel on Planetary Protection have complementary roles within COSPAR, and work together in the area of protection planets for scientific purposes.


Questions??

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