

Planetary Protection Background & Motivation

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What planetary protection is not



It is not about asteroid defense

ightarrow Covered in the Near Earth Objects (NEO) and Space Situational Awareness (SSA) programs



Fireball exploded above Chelyabinsk city in the morning of 15 Feb. 2013

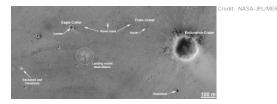
It is not about space debris

→ Covered in the Space Surveillance and Tracking (SST), space debris, and sustainability programs



It is not about cultural or natural world heritage

→ Covered by UNESCO based on a convention (for Earth) and the COSPAR Panel on Exploration (for space)



Credit: Mars Daily

It is not a green party for space





























Goals for planetary protection



Ensure that scientific investigations related to the origin distribution of life are not compromised

- → Protect our investment in space science & exploration
- Unique opportunity to learn more about the origin of life in a way that is no longer possible on Earth
- And than there is the more philosophical issue about the Drake equation

Protect the Earth from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from an interplanetary mission

- → Simple prudence protect the Earth!
- → In line with the precautionary principle of environmental protection

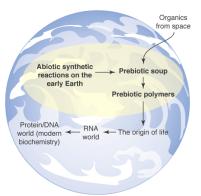
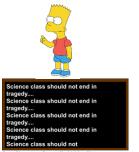


Figure credit: Bada and Lazcano, Science 296. 2002



Sense of Snow





























History of planetary protection



"...we are in the awkward situation of being able to spoil certain possibilities for scientific investigations for a considerable interval before we can constructively realize them...we urgently need to give some thought to the conservative measures needed to protect future scientific objectives on the moon and the planets..." J. Lederberg and D. B. Cowie, Science, 1958



- → Reflects the concern raised by the International Astronautical Federation (IAF), UN-COPUOS and US National Academy of Science (NAS) in this time period
- ICSU adopts a Code-of-Conduct and established the Committee on Space Research (COSPAR)
- → COSPAR established the Consultative Group on Potentially Harmful Effects of Space **Experiments**



- First spaceflight missions to use this Code-of-Conduct were the Ranger missions in 1961
- Since then, all planetary missions had to implement planetary protection measures at different degrees





























Framework for planetary protection



The legal basis and the goal for planetary protection was established in Article IX of the 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 (Outer Space Treaty)

"...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..."

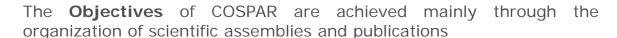




Planetary protection and COSPAR



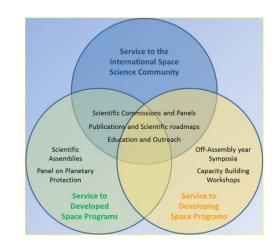
The **Purpose** of COSPAR, by its Charter from the International Council for Science (ICSU), is to promote at an international level scientific research in space, with emphasis on the exchange of results, information and opinions, and to provide a forum, open to all scientists, for the discussion of problems that may affect scientific space research





- Scientific Commissions representing each and every scientific discipline involved in space research
- Panels designed to deal with crosscutting issues that can affect particular segments of the international space research community, and often for which there is an urgent need for input































Planetary protection and COSPAR



The Panel is concerned with biological interchange in the conduct of solar system exploration, including:

- 1. Possible effects of contamination of planets other than the Earth, and of planetary satellites within the solar system by terrestrial organisms
- 2. Contamination of the Earth by materials returned from outer space carrying potential extraterrestrial organisms

The primary objectives of the Panel within COSPAR are to develop, maintain, and promulgate planetary protection knowledge, policy, and plans to prevent the harmful effects of such contamination, and through symposia, workshops, and topical meetings at COSPAR Assemblies to provide an international forum for exchange of information in this area

UN-COPUOS noted the long-standing role of COSPAR in maintaining the planetary protection policy as a reference standard for spacefaring nations and in guiding compliance with article IX of the Outer Space Treaty (UN-COPUOS General Assembly, 2017)

Through COSPAR the Panel informs the international community, e.g., the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations, as well as various other bilateral and multilateral organizations, of policy consensus in this area



























Planetary protection categories



The different planetary protection categories (I-V) reflect the level of interest and concern that contamination can compromise future investigations; the categories and associated requirements depend on the target body and mission type combinations

<u>Category I:</u> All types of mission to a target body which is not of direct interest for understanding the process of chemical evolution or the origin of life

<u>Category II:</u> All types of missions (gravity assist, orbiter, lander) to a target body where there is significant interest relative to the process of chemical evolution and the origin of life, but where there is only a remote¹ chance that contamination carried by a spacecraft could compromise future investigations

<u>Category III:</u> Flyby (i.e. gravity assist) and orbiter missions to a target body of chemical evolution and/or origin of life interest and for which scientific opinion provides a significant² chance of contamination which could compromise future investigations

<u>Category IV:</u> Lander (and potentially orbiter) missions to a target body of chemical evolution and/or origin of life interest and for which scientific opinion provides a significant² chance of contamination which could compromise future investigations

<u>Category V:</u> Two subcategories exist - unrestricted Earth return for solar system bodies deemed by scientific opinion to have no indigenous life forms, and restricted Earth return for all others



























¹Implies the absence of environments where terrestrial organisms could survive and replicate, or a very low likelihood of transfer to environments where terrestrial organisms could survive and replicate

²Implies the presence of environments where terrestrial organisms could survive and replicate, and some likelihood of transfer to those places by a plausible mechanism

Planetary protection categories



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

<u>Category II:</u> 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; Enceladus; others TBD

"Unrestricted Earth return": Venus, Moon; others TBD

†Additional analysis is required.



































Planetary protection and COSPAR

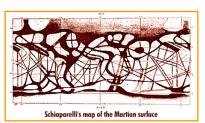


- COSPAR Planetary Protection Policy (COSPAR Bureau- and Council-endorsed version in this publication)
- New phenomena reported/new missions proposed/other external considerations
 (Peer reviewed scientific literature/request from private or public entity/recommendations from agency advisory groups)
- Possible study by a scientific organization and/or a COSPAR-sponsored workshop (May be solicited by space agencies and carried out by a National Scientific Institution or International Scientific Unions)
- Panel on Planetary Protection meeting
 (Panel business meeting at COSPAR Scientific Assemblies or dedicated COSPAR Panel Colloquium, involving representatives of the scientific community and other relevant stakeholders)
- Panel recommendation to Bureau & Council (At COSPAR Scientific Assemblies or at COSPAR Bureau meetings between Assemblies)



The prospect for life on Mars







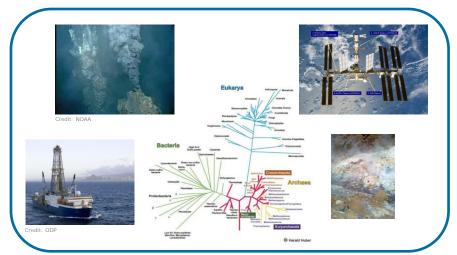


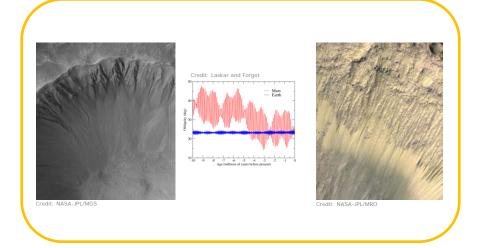


























































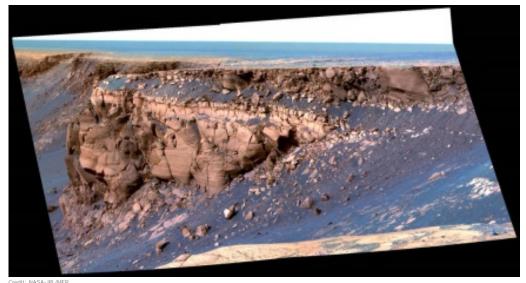


The prospect for life on Mars



"At the present, we know of no life on Mars. Despite this, there is the possibility that life might have arisen at some time in the past and might either have gone extinct or still exist somewhere on the planet today."

Bruce Jakosky, 1998



























Building a spacecraft for Mars



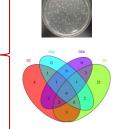




























































Things to remember



- > Planetary protection is about protecting science and the Earth
- Planetary protection regulations are based on UN Outer Space Treaty
- COSPAR maintains a planetary protection policy and associated requirements as reference for spacefaring nations
- Planetary protection categories and requirements are not cast in stone and evolve over time as new information becomes available
- > Stay tuned for the next presentation covering Earth return missions























