

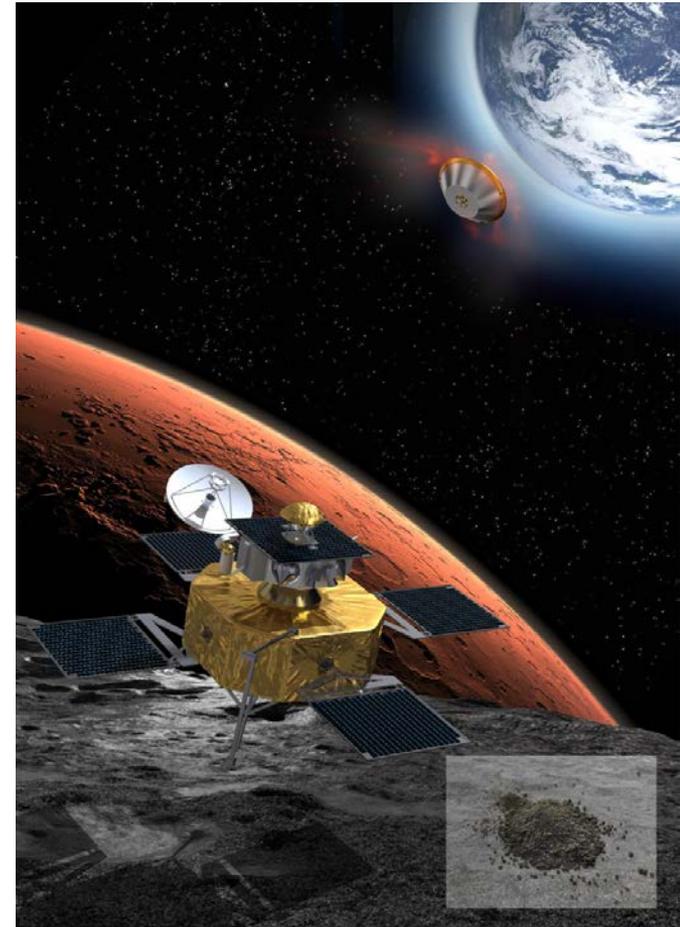
Status of Planetary Protection Approach for Phobos

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NASA Planetary Protection Subcommittee Meeting
20-21 May 2014, NASA-HQ

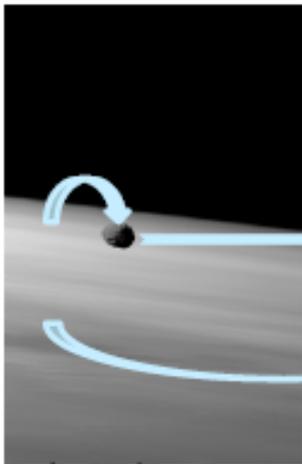
Phootprint

- Mission candidate in the frame of the Mars Robotic Exploration Preparatory (MREP) Program for launch opportunities from 2024 onwards
- Prepares critical building blocks for Mars sample return
- ESA lead mission to return samples (~100 gram) from the martian moon Phobos
- Launch planned on Ariane V from CSG with a return to Woomera Test Range, Australia
- Parallel and competitive industrial studies on-going
- Possible scenarios for cooperation with Roscosmos identified
- Implementation proposal C-MIN 2016 (tbc))

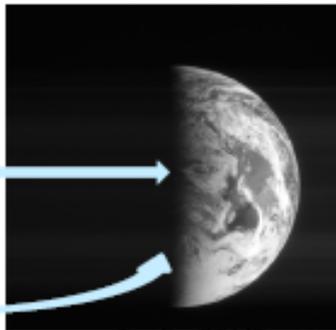


Reasons for Concern

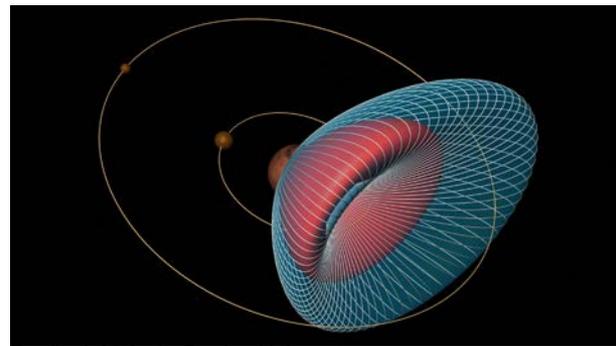
- Transfer of material from Mars to Phobos (Melosh *et al.*, 2011)
- Different models predict an abundance of martian material on Phobos in the ppm range with uncertainties that span several orders of magnitude (Chappaz *et al.*, 2012; Ramsley and Head III, 2013) and major transfers as young as 3 million years (Werner *et al.*, 2014)
- Level of biological inactivation of material transferred from Mars to Phobos due to hypervelocity impact on Phobos and exposure to the ionizing radiation and temperature environment on the surface and near sub-surface of Phobos



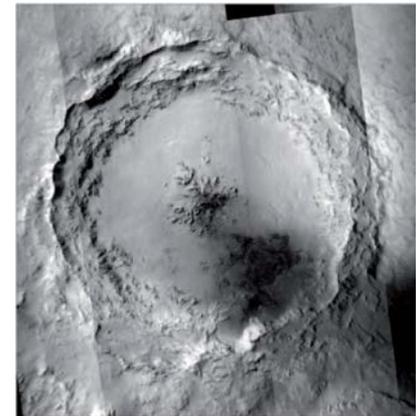
Credit: ESA/Mars Express



Credit: ESA/Rosetta



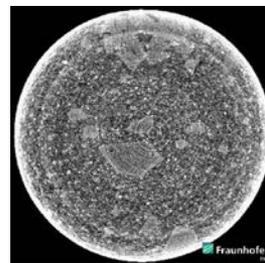
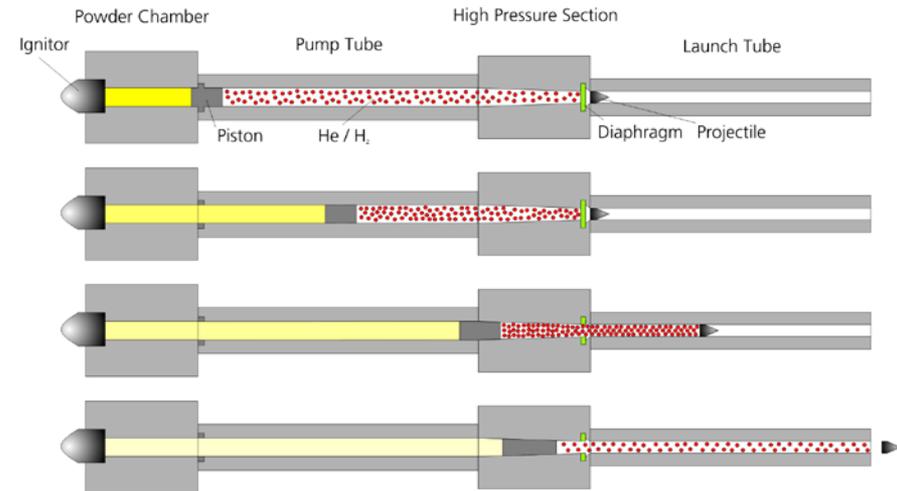
Credit: J. Melosh, Purdue Univ.



Credit: Werner *et al.*, 2014, NASA MRO CTX

Feasibility Tests

- Goal of the tests was to demonstrate feasibility to manufacture basaltic projectiles, accelerate them to 5 km/sec, and recover them from a low-density target
- Feasibility was demonstrated
- Tests were performed by the Fraunhofer Institute, Ernst Mach Institute, Freiburg, Germany



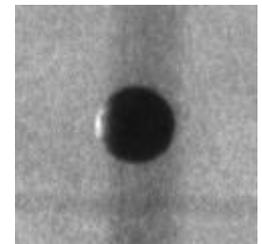
Glass spheres



Quartz powder



Basalt powder



→ **ESA Planetary Protection Working Group (PPWG) meeting/topical workshop**

- Goal: Identify additional information required to confirm unrestricted Earth return categorisation
- Extensive list of test and modelling parameters and conditions were identified
- Output used for Statement of Work

→ **Phase 1 (7 month):**

- Review and consolidate the requirements to be verified by tests and analyses
- Demonstrate through tests and analyses the feasibility of the tests and modelling necessary
- Produce a test plan

→ **Phase 2 (7 month):**

- Perform the inactivation tests using separately heat, ionizing radiation and hypervelocity impact
- Perform the radiation transport modelling for the surface and immediate sub-surface of Phobos
- Perform the temperature modelling for the surface and immediate sub-surface of Phobos
- Perform the material and impact modelling supporting and extending the hypervelocity impact tests
- Produce a synthesis of the tests and modelling results and evaluate the level of assurance that no unsterilized martian material naturally transferred to Phobos is accessible to a sample return

- Invitation to Tender (ITT) issued: July 2013
- During the Tender Evaluation Board (TEB) issues have been identified that did not allow to place a contract and made it necessary to re-issue the ITT
- Planned new TEB: mid June 2014
- Planned negotiation/kick-off: July 2014
- Planned completion of Phase 1: February 2015 (followed by a review prior to start Phase 2)
- Planned completion of Phase 2: October 2015
- Planned review of results: end 2015