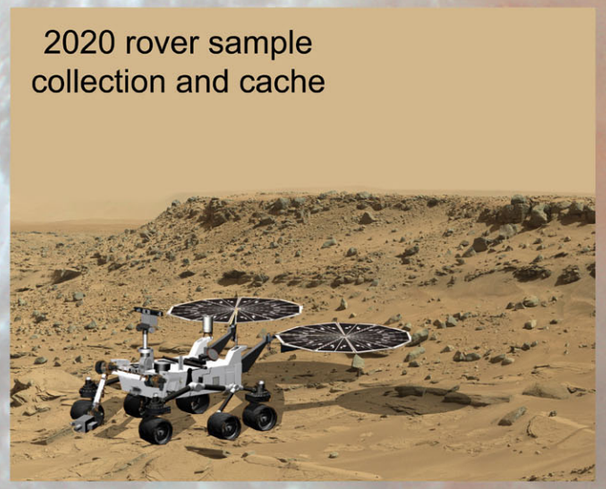


NASA or JPL images except top background: MSL MastCam mosaic by Thomas Appéré

Mars Sample Return via Robotic Collection, Phobos Cache and Human Retrieval

Philip J. Stooke

Department of Geography, and
Centre for Planetary Science and Exploration,
University of Western Ontario, London, Canada N6A 5C2
pjstooke@uwo.ca; http://publish.uwo.ca/~pjstooke.

Introduction: Mars Sample Return is the highest priority goal for deeper understanding of Mars, but its cost and complexity have repeatedly delayed its implementation. Stooke [1] proposed a program in which samples would be collected by robotic missions and delivered to Phobos over a decade or more. The first human mission to Mars, an Apollo 10-style rehearsal mission, would land on Phobos instead of Mars to collect the cached samples and return them to Earth. This poster updates the 2007 concept.

Sample Collection: The sample collection phase would be spread over about a decade and could involve missions from several space agencies. It could combine relatively simple 'ground-breaking' collection using a static lander with a sampling arm, suitable for a uniform geologic target, and sophisticated rover missions collecting samples in complex areas like Gale, Eberswalde and Nili Fossae.

Each mission would deliver its sample to Mars orbit, rendezvous with Phobos and deposit its sample on the moon's surface using the simplest possible landing system, probably a small braking rocket plus airbags. Tracking or imaging would locate the landing site, and if possible these sites would be reasonably close together.

The advantages of this scenario are that:
(1) the long, risky journey back to Earth is eliminated at this stage
(2) international cooperation in building the sample cache is possible but no single mission is in the critical path for overall mission success
(3) It is assumed that reaching Phobos is easier than a complex orbital rendezvous with a return spacecraft
(4) a delay in the subsequent human mission can be accommodated by adding more sample return missions.

Nothing precludes additional direct-to-Earth sample return missions. Deimos can substitute for Phobos as a cache if it is operationally preferred. If human Mars exploration is eventually abandoned, a flagship class robotic mission can gather the samples instead.

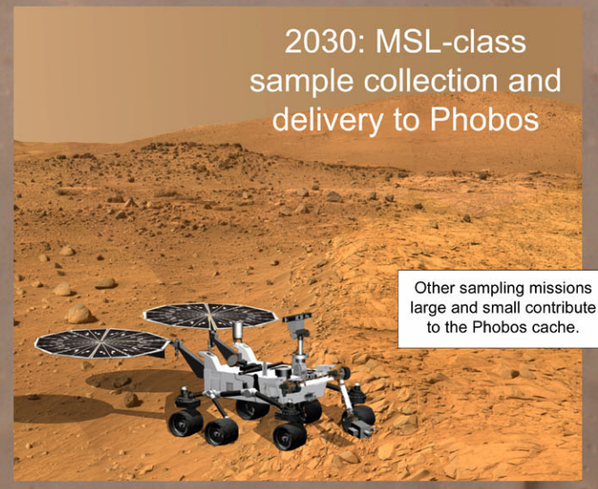
International cooperation: In its simplest form this would involve parallel Mars sample collection and caching missions. Other options include Deimos sample collection with delivery to Phobos, Mars trojan asteroid sampling with delivery to Phobos, Mars-crossing or other asteroid sampling missions with delivery to Phobos, Phobos rovers to gather samples for recovery and orbital imaging to locate samples.

The flexibility offered by ion propulsion and use of Lagrange Points makes sample transfer even from main belt asteroids feasible today where it may not have been in the past. A range of cooperative missions are available, all valuable if successful, but none critical to overall success if they fail.

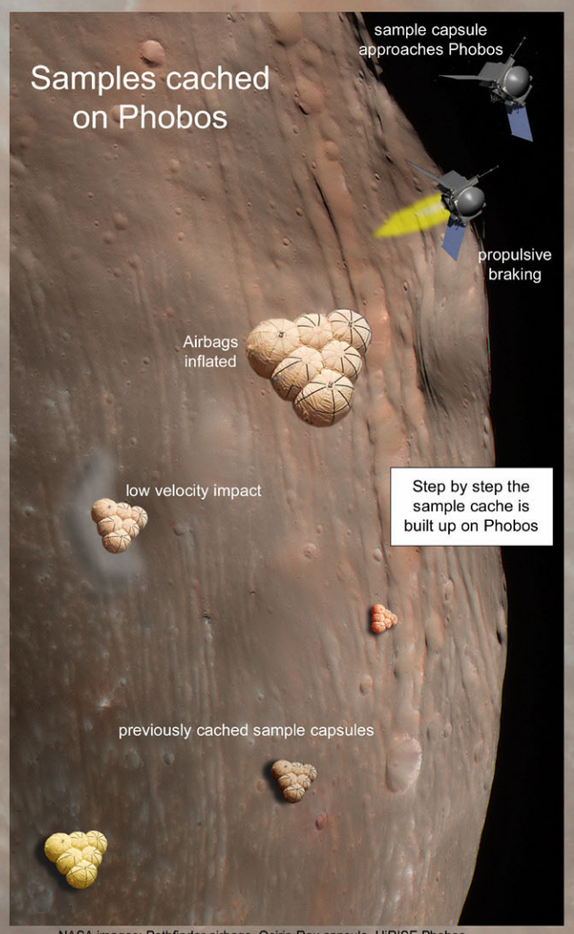
Human mission: A human Mars mission will involve great expense and high risk. A test flight similar to Apollo 10 or a suggested initial Golden Spike landing mission (orbiting the Moon with a crew while testing the lander in automated mode) would be very desirable but hard to justify if its science return is minimal.

The first human crew would land on Phobos, not Mars. Apart from sampling Phobos, itself a major scientific goal, it would collect all the waiting Mars samples and return them to Earth. There they would be distributed to the appropriate space agencies.

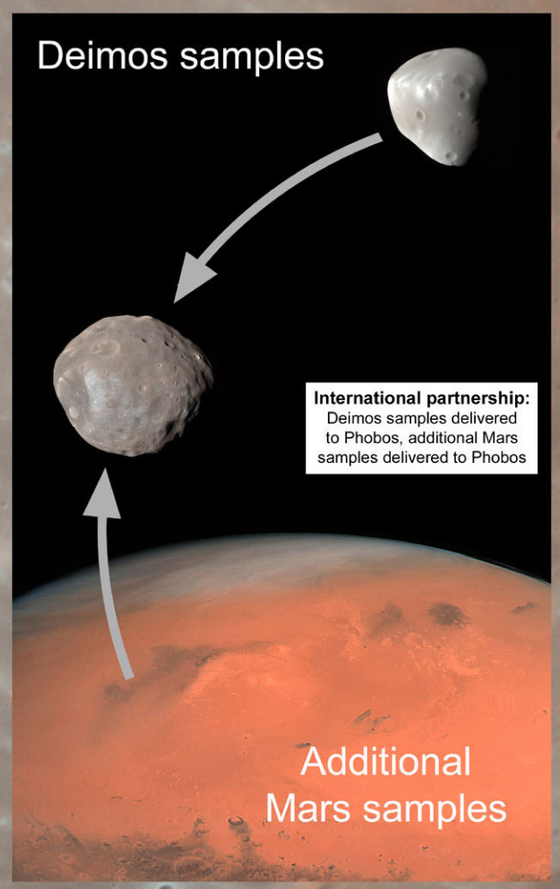
Reference: [1] Stooke, P. J. (2007). First International Conference on the Exploration of Phobos and Deimos, 5-7 November 2007, NASA Ames Research Center, Mountain View, CA. Abstract no. 7001.



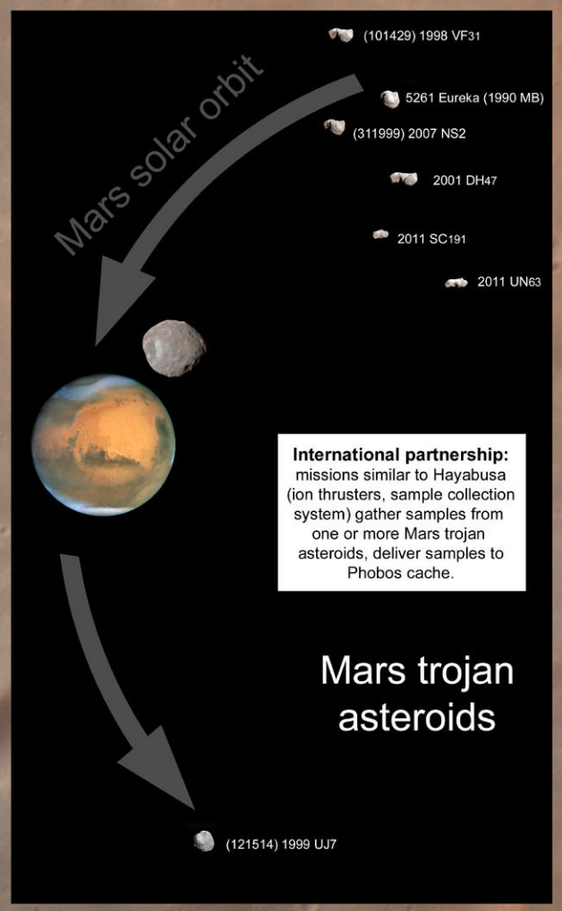
NASA and JPL images except top panorama: Spirit Pancam mosaic



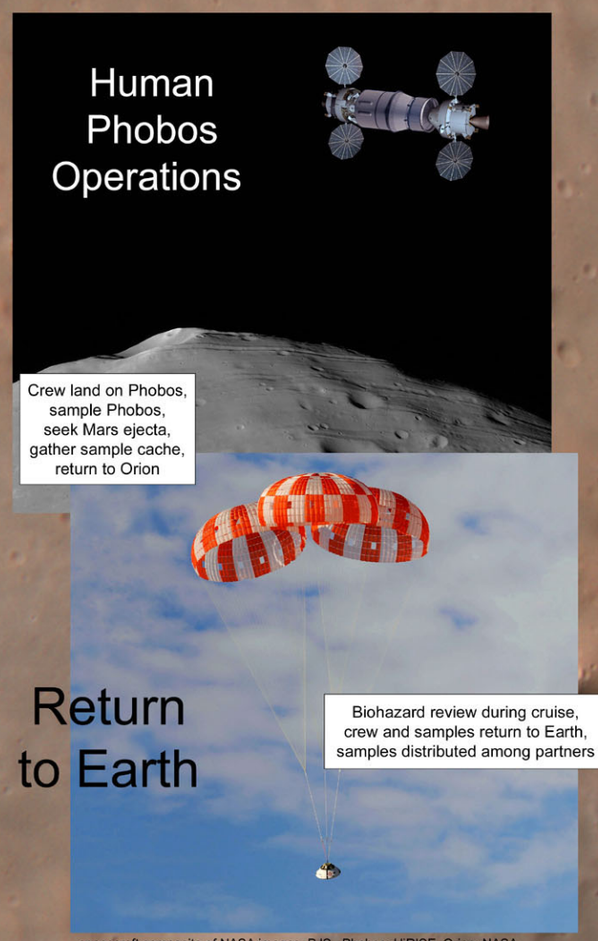
NASA images: Pathfinder airbags, Osiris-Rex capsule, HiRISE Phobos



Phobos and Deimos: HiRISE, Mars: Rosetta image
(OSIRIS Team MPS/UPD/LAM/IAA/RSSD/INTA/UPM/DASP/IDA)



Mars: HST, Phobos: HiRISE, Galileo images of 243 Ida stand in for trojans



spacecraft composite of NASA images: PJS, Phobos: HiRISE, Orion: NASA