

**MECHANICAL ABRASION AS A LOW COST TECHNIQUE FOR CONTAMINATION-FREE
SAMPLE ACQUISITION FROM A CATEGORY IVA CLEAN PLATFORM** B. Dolgin¹,
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The proposed Sample Collection Architecture delivers with clean samples that are required for life detection and eventual release of the returned samples from confinement. The proposed approach does not place absolute cleanliness and sterility requirement on any part of the Lander, Assent Vehicle, Sample container, rover mobility platform, instrument sensors, and most of the caching equipment. The removal of the strict requirements in excess of the Category IVa cleanliness (Pathfinder clean) is expected to lead to significant cost savings.

The proposed architecture assumes that cross-contamination renders all surfaces in the vicinity of the rover(s) and the lander(s) contaminated. Thus, no accessible surface of accessible rocks and soil is Earth contamination free. Correspondingly, only subsurface samples (either rock or soil) can be and will be collected for eventual return to Earth.

Untampered samples can be collected from a Category IVa clean platform. Both subsurface soil and rock samples can be maintained clean if they are collected by miniature devices that are self-contained sterile on inside only. The top layer of the sample is removed in a manner that does not contaminate the collection tools. Biobarrier (e.g., aluminum foil) covering the moving parts of these devices may be used as the only self-removing bio-blanket that is required. The samples never leave the collection tools. The lids are placed on these tools inside the collection device. These single use tools with the lid and the sample inside may be brought to Earth in compliance with Planetary Protection requirements.

Untampered soil collection devices are the simplest to design though a similar device can be designed for coring. The soil collection device relies on the following approach (see Figure 1):

- Scrape the top layer of soil while covering it with a clean lid
- Collect the sample from beneath it
- Close the collection device inside the clean enclosure.

The samples collected in the prescribed manner will be exposed only to a base metal cleaned to the best level the 2002 technology allows. The cleanliness of the sample is guaranteed by design, its verification does not require biological assaying, and, if required, the verification can be performed in-situ. The enclosed sample may be analyzed in-situ or delivered to Earth for analysis.

Feasibility of the Earth contamination free regolith and rock sample collection described above has been demonstrated. Currently, the probability that a single dust particle with an Earth microorganism attached to it makes its way to the collected sample has been reduced to below 10^{-8} . Thus, in the worst-worst case scenario, if each and every microorganism permitted on a Category IVa clean spacecraft is deposited onto the immediate areas where the samples are collected and only onto those areas, the probability that a single Earth based organism will be found in the return sample is below 1%.

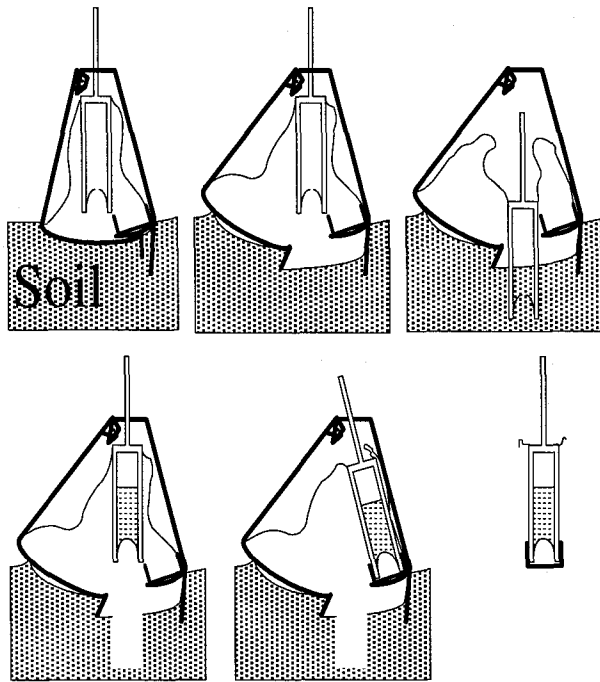


Figure 1. Sequence of steps to procure Earth-contamination free sample using a collection tool placed inside a device that is clean on the inside but