

## Collecting Ground Samples for Balloon-Borne Instruments

Harpoonlike sample-collection devices would be dropped, then hauled back up.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed system in a gondola containing scientific instruments suspended by a balloon over the surface of the Saturn moon Titan would quickly acquire samples of rock or ice from the ground below. Prototypes of a sample-collecting device that would be a major part of the system have been tested under cryogenic and non-cryogenic conditions on Earth. Systems like this one could also be used in non-cryogenic environments on Earth to collect samples of rock, soil, ice, mud, or other ground material from such inaccessible or hazardous locations as sites of suspected chemical spills or biological contamination.

The sample-collecting device would be a harpoonlike device that would be connected to the balloon-borne gondola by a tether long enough to reach the ground (see Figure 1). The device would be dropped from the gondola to acquire a sample, then would be reeled back up to the gondola, where the sample would be analyzed by the onboard instruments.

Each prototype of the sample-collecting device (see Figure 2) has a sharp front (lower) end, a hollow core for retaining a sample, a spring (not shown in the figure) for holding the sample in the hollow core, and a rear (upper) annular cavity for retaining liquid sample material. Aerodynamic fins at the rear help to keep the front end pointed downward. In tests, these prototype devices were dropped from various heights and used to gather samples of dry sand, moist sand, cryogenic water ice, and warmer water ice.

*This work was done by Jack Jones, Wayne Zimmerman, and Jiunn Jenq Wu of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-44444*

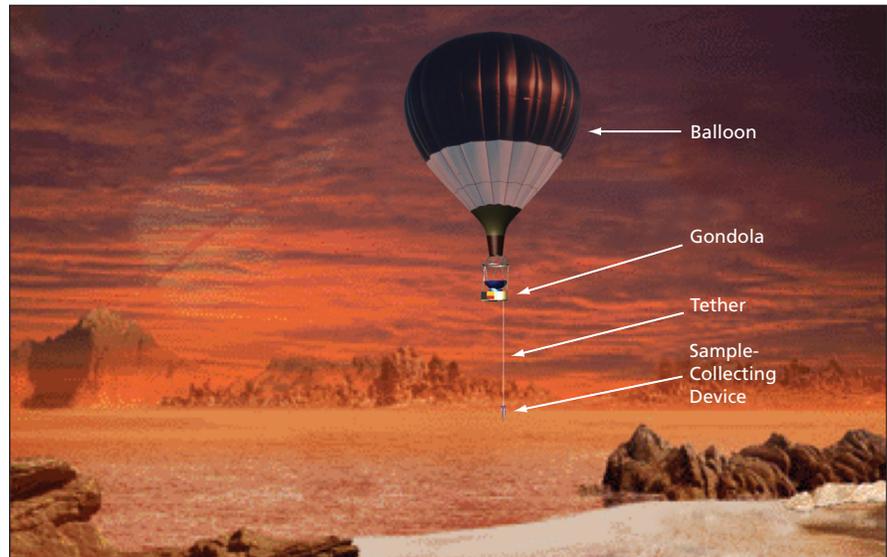


Figure 1. A **Tethered Sample-Collecting Device** would be dropped from a balloon-borne gondola to collect a sample of ground material, then reeled back up to the gondola to enable analysis of the sample.

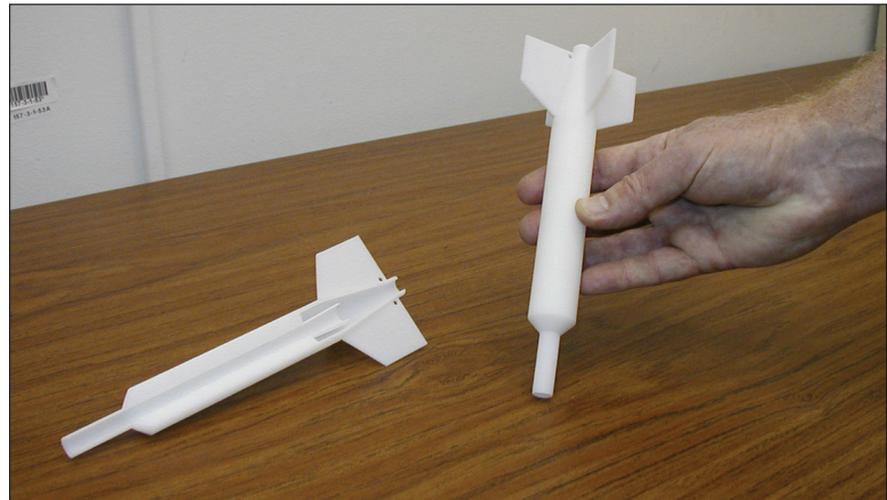


Figure 2. These **Prototype Sample-Collecting Devices** are basically harpoons with smooth, sharp front ends, rear stabilizing fins, and interior cavities for capturing and retaining samples.

## Tethered Pyrotechnic Apparatus for Acquiring a Ground Sample

A tethered projectile would be pyrotechnically driven into the ground.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed alternative design for the balloon-borne ground-sampling system described in the immediately preceding article would not rely on free fall to drive a harpoonlike sample-collecting device into the ground. Instead, the

harpoon-like sample-collecting device would be a pyrotechnically driven, tethered projectile.

The apparatus would include a tripod that would be tethered to the gondola. A gun for shooting the projectile into the

ground would be mounted at the apex of the tripod (see figure). The gun would include an electronic trigger circuit, a chamber at the breech end containing a pyrotechnic charge, and a barrel. A sabot would be placed in the