ATROMOS: A SALMON-CLASS MARS COMPANION SURFACE MISSION

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Introduction: A low-cost mission is proposed which would place two 10kg-class science stations on the surface of Mars. The mission proposal consists of an 'enabling' probe entry system – and is comprised of a unique Entry/Descent/Landing (EDL) system based on the Tube Deployed Re-entry Vehicle (TDRV). Having minimum interface constraints to the carrier spacecraft, the TDRV is a self-orienting, low ballistic coefficient entry system which has been tested during sub-orbital test flights. The two science stations would constitute a two point network. This two point system can provide information related to climatic and geological/hydrological gradients. One of the science scenarios consists of landing a probe inside the Southern hemisphere Hellas Basin and the other on the exterior at significantly higher elevation. The investigation would help validate models which seek to explain the South Polar asymmetry (Colaprete, et al, 2005), as well as fundamental saltation phenomena critical to understanding dust lifting and the genesis of large-scale dust storms. The surface science station can also provide a platform for performing basic mineralogy and perhaps life detection. In addition, recent advances in the development of small radioisotope power sources can contribute to subsequent missions of multi-year duration. This proposal takes advantage of rapid advances in CubeSat based technologies to provide an inexpensive means of injecting new sensor technologies at higher risk sites. This architecture set can also grow into a future large-scale climatology/geophysics network mission.

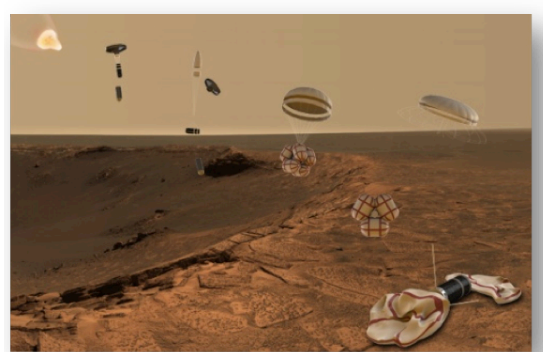

Figure 1. Atromos Entry/Descent/Landing sequence will provide an inexpensive means of delivering small science payloads to the surface of Mars.

Surface Science Mission: The specific science goals are: a) measure the total regional pressure gradient associated with the Hellas feature, b) associate the concentration of water vapor with regional climate and dynamics with the subliming southern residual water cap, c) constrain the total water flux off the subliming southern cap, d) determine the wind speed at which grain saltation occurs and dust lifting begins, e) correlate the change in radiative forcing associated with suspended dust with saltation and lifting events.

Science Canister: The science canister is landed on the surface with small-scale air-bag technology (ILC-Dover proposed design) such that impact loads are kept to a minimum. The science instrument set consists of pressure sensors, humidity sensors, opacity/saltation sensor, anemometer, accelerometer – and the potential for small sample acquisition/analysis. The avionics set is based on a unique Space Plug and Play (SPA) architecture currently being flight tested through NASA Ames. The 2W Mars-relay compatible transceiver is currently under study with a proposed flight test development.

Re-entry Technology: One of the unique features of the approach is the TDRV technology. This is characterized by a) low ballistic coefficient (<10kg/m2) and therefore reduced convective heating, b) large static margin leading to rapid self-orientation, c) ease of interface definition to the carrier spacecraft d) simplicity of internal packaging for the ejected science canister assembly. Several sub-orbital flight tests have been conducted with this shape – and it is currently a candidate for small-scale sample return from the International Space Station (ISS).

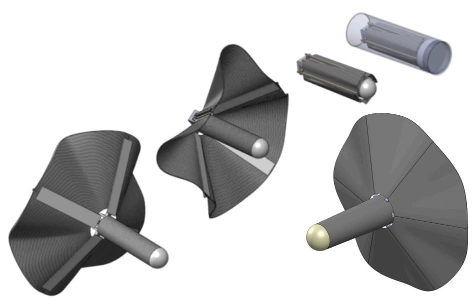

Figure 2. TDRV (Tube Deploy Re-entry Vehicle) showing how the low ballistic coefficient drag device is stored and deployed upon release.

Figure 3. TDRV Test Flight (Murbach, et al, 2009).

Scalability/Applicability: The self-stabilizing probe geometry may be scaled to larger sizes for different payload accommodation. In addition, the number of probes can be increased to encompass the Decadal Survey interest of conducting both meteorological and geo-physics based network missions. Finally, the team has been studying the simple incorporation of a small Radioisotope Power System (RPS) permitting missions of much greater duration (the science station has been designed with such an option).

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