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Investigation of Martian surface and interior structure by penetrator probe

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We propose a mission to investigate the Martian surface environment and internal structure by multiple instrumented penetrator probes. The Mars penetrator has two parts, a slender forebody and finned afterbody, connected by an umbilical cable. At the impact, the forebody penetrates into the surface material, whereas the afterbody remains on the surface with a flared terra-brake. As for scientific instruments, a slightly broadband seismometer, thermal conductivity sensor, gamma-ray sensor, and water-detection sensor are housed in the forebody together with most of the electronics parts and a battery package for power supply. A meteorological sensor package and a radio source for geodetic experiment are installed in the separated afterbody. For the purpose of a long-lived geophysical observation, solar panel arrays might be stuck on the facets of flared structure. In addition, the atmospheric density, pressure and temperature will be derived using entry and descent data, and then, an accelerometer profile will be used to determine the impact velocity, depth of penetration and the mechanical properties of surface layers at impact site. The four identical penetrators will land within 100 to 300 km of each other on the Elysium region or Tharsis province; the former is assumed to be most recently active in volcanism, the latter is located in a vast fault zone. Both the two candidate sites have not yet been landed by soft-landers. Primary goal is to demonstrate the penetrator technology that will enable future science missions and, in particular, geophysical network observations. Secondary goal is to determine the seismicity of Martian interior as well as meteoroid impact flux. Third, a continuous monitoring of surface environment(atmospheric temperature, pressure and magnetic field) is essential for the analysis of seismic data and for the advanced design of future geophysical instrument package. After separation of penetrators, the orbital spacecraft will fly over daily and communicate with each penetrator probe for data-relay and measurement of libration parameters of Mars. And also, An impact monitoring camera onboard the spacecraft would detect a number of impact craters and landslides occurred during the mission operation and we could make good use of imaging data in 1˜10 meter scale as known locations of Mars quake foci in order to investigate the crust/upper mantle structure.

Keywords: Mars, Surface enviroment, Internal structure, penetrator