NASA SBIR 2007 Phase I Solicitation

S5.04 Surface and Subsurface Robotic Exploration

Lead Center: JPL

Participating Center(s): ARC, GSFC

Technologies are needed to enable access to surface and subsurface sampling sites of scientific interest on Mars. Mobility technology is needed to enable access to difficult-to-reach sites such as access through steep terrain. Many scientifically valuable sites are accessible only via terrain that is too steep for state-of-the-art planetary rovers to traverse. Sites include crater walls, canyons, and gullies. Tethered systems, non-wheeled systems, and marsupial systems are examples of mobility technologies that are of interest. Tether technology could enable new approaches for deployment, retrieval and mobility. Innovative marsupial systems could allow a pair of vehicles with different mobility characteristics to collaborate to enable access to challenging terrain. It is envisioned that a 500-800 kg primary vehicle could provide long traverse to the vicinity of a challenging site and then deploy a smaller 20-50 kg vehicle with steep mobility access capability for access to the site.

Technologies to enable subsurface access and sampling in multiple holes at least 1 - 3 meters deep through rock, regolith or ice compositions are also sought. Subsurface access solutions to be integrated onto 500-800 kg stationary landers and mobile platforms are of interest. Consideration should be given for potential failure scenarios, such as platform slip and borehole misalignment for integrated systems, and the challenges of dry drilling into mixed media including icy mixtures of rock and regolith. Systems should ensure minimal contamination of samples from Earth-source contaminants and cross-contamination from samples at different depths.

Innovative low-mass, low-power, and modular systems and subsystems are of particular interest. Technical feasibility should be demonstrated during Phase 1 and a full capability unit of at least TRL level 4-6 should be delivered in Phase 2. Specific areas of interest include the following:

- Tether play-out and retrieval systems including tension and length sensing;

- Low-mass tether cables with power and communication;
• Steep terrain adherence for vertical and horizontal mobility;
• Modular actuators with 1000:1 scale gear ratios;
• Electro-mechanical couplers to enable change out of instruments on an arm end-effector;
• Drill, core, and boring systems for subsurface sampling at 1 to 3 meters.