

# Field tests in Mojave Desert pave way for human exploration of small bodies

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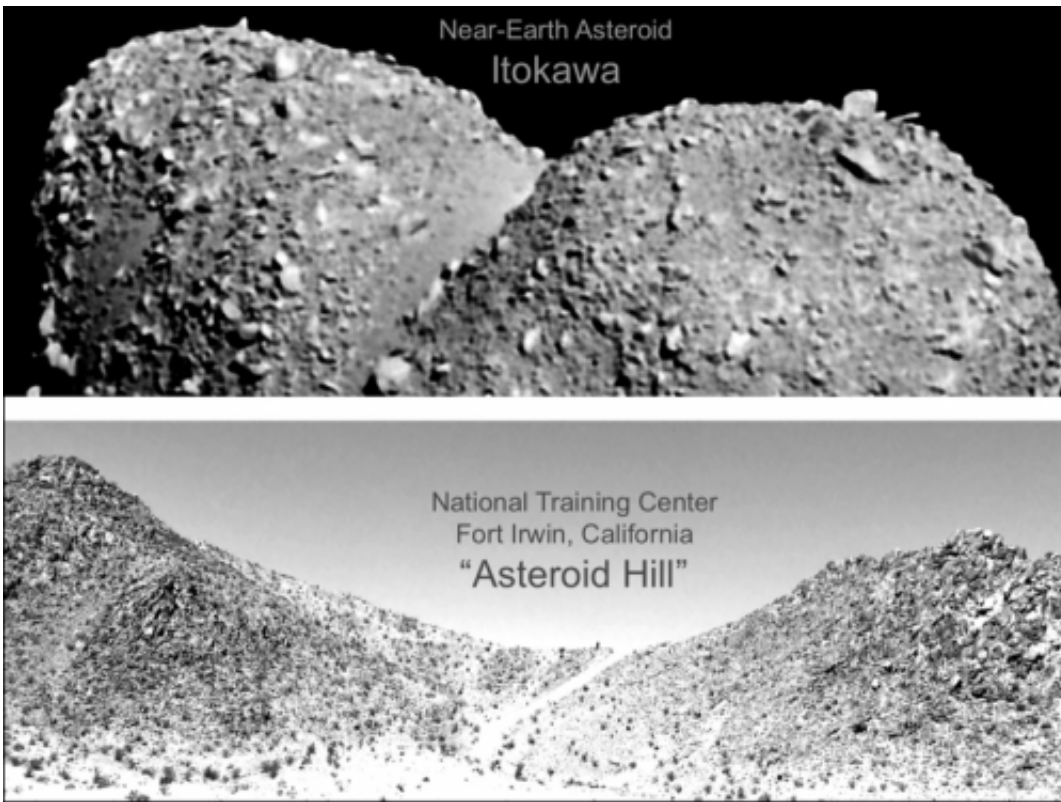


Figure 1: Top: 538 meter-long Near Earth Asteroid (25143) Itokawa imaged by Japan's Hayabusa spacecraft. The asteroid is likely a loosely consolidated rubble pile (JAXA). Bottom: Similar scaled Asteroid Hill at the National Training Center, Fort Irwin, California, the site of the April 2013 NASA Mojave Field Test. Note the blocky to gravelly surface made of granite tors and debris. (NASA).

(Phys.org) —A team of researchers from the SETI Institute, the Mars Institute, NASA Ames Research Center, and the space robotics company Honeybee Robotics, has successfully completed a first series of field tests aimed at investigating how humans will explore and work on Near-Earth Asteroids (NEAs) and eventually the two moons of Mars, Phobos and Deimos.

From 13 to 15 April 2013, field experiments were conducted at the U.S. Army's National Training Center (NTC) at Fort Irwin, California, to evaluate geotechnical methods and systems that will enable humans to be productive explorers in the low [gravity environment](#) of small rocky bodies. Sub-kilometer sized NEAs, Phobos, and Deimos are among destinations currently considered by NASA for future human missions into Deep Space.

"Human missions to Near-Earth Asteroids and to the moons of Mars present us with the exciting challenge of exploring planetary bodies with extremely [low gravity](#)" says Pascal Lee, [planetary scientist](#) at the [SETI Institute](#) and leader of the field test. "The goal of our field test was to learn how to characterize the physical properties of small body surfaces, and to test ideas that might enable humans to more productively explore these low-gravity worlds."



Figure 2: Pascal Lee (SETI Institute and Mars Institute) (left) measures the bearing capacity of gravelly soil at Asteroid Hill, National Training Center, Fort Irwin, California, using a static cone penetrometer, while Kris Zacny (Honeybee Robotics) drives an anchor into the same material to evaluate the system's design and performance. These field tests will help design surface exploration systems optimized for the exploration of Near-Earth Asteroids, Phobos, and Deimos. 14 April 2013. (First Canyon Media).

The Mojave field test included three investigations: 1) a study of whether conventional field tools commonly used to characterize the mechanical properties of soils on Earth are suitable for small bodies; 2) an evaluation of how different anchoring systems might allow robotic spacecraft and astronauts to remain bound to a low gravity body; 3) a study of how astronauts might conduct geological sampling on a small body while using anchors and tethers.

"It's important to analyze and understand how conventional civil

engineering methods and systems perform in natural settings on Earth before adapting them to the exploration of small bodies" explains Kris Zacny, Director of planetary exploration robotics at Honeybee Robotics in Pasadena, California. Honeybee Robotics is the company that developed the Rock Abrasion Tool (RAT) on NASA's Mars Exploration Rovers, Spirit and Opportunity, and the Sample Manipulation System (SMS) and Dust Removal Tool (DRT) on NASA's Mars Science Laboratory (MSL) rover, Curiosity.



Figure 3: Pascal Lee (SETI Institute and Mars Institute) (right) and Sgt Andre Pearson (U.S. Army, NTC) conduct “small body” geological sampling in simulated spacesuits while anchored and tethered on a steep boulder slope at Asteroid Hill, National Training Center, Fort Irwin, California. 15 April 2013. (NASA).

The Mojave field test was carried out on a small rocky hill at the NTC with many exposed blocks of weathered granite called tors. The site,



now named "Asteroid Hill", is reminiscent of the blocky surface of Near-Earth Asteroid (25143) Itokawa, which was explored in 2005 by Japan's Hayabusa [robotic spacecraft](#). "While neither the composition of the rocks nor the gravity at Asteroid Hill are similar to what they are on NEAs, the relevance of the site resides in the similarity in terrain texture (gravel and block abundance and sizes), topography, and scale between Asteroid Hill and Itokawa" notes Lee.

"This is an interesting analog site for planning future NASA robotic and human asteroid exploration, as it not only resembles the surface of the only sub-kilometer NEA explored by spacecraft to date, Itokawa, but it is well supported logistically by the U.S. Army's National Training Center" said Terry Fong, Director of the Intelligent Robotics Group at NASA Ames Research Center.

The Mojave field test builds on an existing partnership between NASA and the U.S. Army's National Training Center at Fort Irwin. The latter is home to NASA's Goldstone Deep Space Network (DSN) tracking station. "The National Training Center's participation in this field test with NASA represents another positive development in our Joint Interagency Intergovernmental and Multinational (JIIM) partnership. It allows NTC to showcase it's soldiers, the NTC community, and NTC's vast training resources" said Cyle Fena, Deputy G3 at the NTC.

The Mojave [Field Test](#) will be featured as part of an upcoming television documentary filmed by First Canyon Media, Inc, titled Mission Asteroid. Produced by the Canadian Broadcasting Corporation (CBC), Mission Asteroid is expected to air in North America in Fall 2013.

Provided by SETI Institute

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