Executive Summary

Date Prepared: August 16, 2007

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Presentation Title

Future of Lunar Sample Return: Robotics, Humans, and Robotic-Human Partnerships

Key Ideas

The intricacy of sample-return missions depends on the complexity of the geologic target. Simple sites, such as a young lava flow, can be done with a simple lander that grabs a sample, perhaps sieving to an optimum size range. More geologically complex sites require more sophisticated sampling, using human powers of observation and problem solving, field mapping and measurements, and re-visits to sites to assure that they are properly understood. Such field work can be done directly by humans or through teleoperation of robots equipped with high-definition vision systems and other tools. A key issue is deciding for which targets simple sample returns are insufficient.

Supporting Information

As described by us previously [1,2], geologic field work, including sampling for study in laboratories, can be divided into two broad categories: (1) Reconnaissance, which can be done by either automated devices or humans, and (2) field study, which requires human observational ability, intelligence, and experience. Reconnaissance provides a broad characterization of the geologic features and processes on a planetary body. It often asks specific questions, such as determining the absolute age of the youngest lava flow on the Moon, thus helping to quantify age determination based on crater counts. In contrast, field studies have more ambitious goals: to understand planetary geologic processes and units at all levels of detail. This means that field studies are long-duration and iterative, and absolutely require humans. It is risky to work in the harsh human environment and expensive to transport humans to all field sites, so a compromise is to use a robotic-human partnership through the use of telepresence in which the human geologist is transported electronically into the robotic field geologist.

(1) Spudis, P.D. and Taylor, G.J. (1992) The roles of humans and robots as field geologists on the Moon. *The Second Conference on Lunar Bases and Space Activities of the 21st Century* (W.W. Mendell, ed.), NASA Conf. Pub. 3166, 307-313.

(2) Taylor, G.J. and Spudis, P.D. (1990) A teleoperated, robotic field geologist. *Engineering, Construction, and Operations in Space II* (S.W. Johnson and J. P. Wetzel, eds.), 246-255. ASCE, New York.