Scientific Motivations for a Lunar Return Mission

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Many exciting recent discoveries have fueled optimism for exploring our solar system. This enthusiasm has led to a wide array of innovative research and increased funding for upcoming astrobiological and planetary science missions. These opportunities have taken the emphasis of planetary science away from the Moon and directed it almost completely toward Mars. Consequently, NASA has no upcoming missions to the Moon. This exclusion will fall short of adequately paving the way for future research. Intermediate steps are needed to complement other studies in planetary geology and exobiology in the "faster, better, cheaper" paradigm.

With Lunar Prospector's confirmation of a strong hydrogen signature at both lunar poles, the next step is to send a robotic explorer into the shadowed craters of these regions to determine the chemical nature of the material binding this hydrogen. If this signature is due to the presence of water-ice deposited by comets and meteoroids, then the possibility exists that molecules of an organic nature were delivered by these planetary bodies. The confirmation of both water-ice and organics are possible via a Lunar Return Mission that would include an integrated lander and rover combination. Securing the knowledge that organics were deposited by comets would be an important insight in planetary science studies, as well as critical information for any colonization efforts. Since cometary debris would be mainly unchanged (if it survives impact) from its original deposit-protected in the eternal darkness by crater walls and overlying lunar regolith-this would be an important find. This discovery would also be a significant link in the study of life-on and beyond Earth.

Besides the possibility of water-ice, other important resources might exist on the lunar surface. For example, the Apollo astronauts brought back rocks containing ^{3}He, an isotope that could fuel the cleanest conceivable form of fusion. ^{3}He might be implanted at the poles due to an interaction of solar wind with the lunar regolith. While there is evidence for water-ice from the Clementine and Lunar Prospector missions, this is from global reconnaissance studies, and the data is inferential in nature. The presence of polar ^{3}He is also an uncertainty.

This proposal intends to send a Discovery type (a mission costing less than $299 million) robotic mission to the lunar South Pole to verify both the existence of water-ice, possible organics within the ice, and ^{3}He. This mission will include an integrated lander-rover pair to confirm the existence of these lunar resources. Determining the nature of a hydrogen source at the poles is well worth a Lunar Return Mission, and the data would be invaluable for planning future settlement initiatives. This proposal recognizes that integrative efforts with other agencies would improve chances of the Rover's exploratory success. For instance, a better surface map (than maps generated from Clementine or Prospector) would provide superior information for Rover navigation purposes. ESA's

SMART-1 mission is one example that would improve knowledge of near-surface conditions at the poles.