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Unanswered questions in lunar science

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Following the end of the very successful Apollo program in 1972, there have been a grand total of three spacecraft that have been placed into orbit about the Moon. Two of these, Clementine (1994) and SMART-1 (2005), were in essence technological demonstrations, whereas Lunar Prospector (1998) was the sole that was dedicated to scientific purposes. While such a dearth of missions to the nearest celestial object of the Earth has given many the impression that there remains little to be discovered about this rocky object, a survey of recent scientific articles about the Moon demonstrates that even the most basic questions have not yet been adequately resolved. For instance, the size and composition of the lunar core are only weakly constrained, the reason as to why the majority of the mare basalts erupted on the visible side of the Moon is hotly debated, and the quantity and economic potential of hydrogen deposits in the polar regions are largely unknown.

In stark contrast to the past three decades, a sizable flotilla of spacecraft is slated for launch to Moon in the next few years. These include the Japanese SELENE mission, the US Lunar Reconnaissance Orbiter, the Indian Chandrayaan-1, the Chinese Chang'e-1, and a commercial mission named Trailblazer. The reorganization of NASA towards a manned return to the Moon and Mars, and the apparent race for prestige among the developed nations to compete in such an endeavor, will certainly yield several missions on top of these in the decade to come.

The purpose of this talk will be to put into perspective what has been learned about the Moon by more than thirty years of detailed scientific analyses, and those questions that remain unresolved. Emphasis will be placed on describing those questions that are addressable by the orbiting SMART-1 mission and instrumentation that is slated for launch in the next few years. While much can be made from orbital investigations, the case will be made that the next renaissance in lunar science will require the emplacement of long-lived geophysical packages on the lunar surface, and the return of

samples from a few key localities.