MOON MINERALOGY MAPPER (M3): SCIENCE AND EXPLORATION OPPORTUNITIES.

Carle M. Pieters[1] and the M3 Team, [1]Department of Geological Sciences, Brown University, Providence, RI 02912 (Carle_Pieters@brown.edu).

The Moon Mineralogy Mapper (M3, or "m-cube") is a state-of-the-art imaging spectrometer that will characterize and map the mineral composition of the Moon. M3 will be flown on Chandrayaan-1, the Indian Space Research Organization (ISRO) mission that is scheduled for launch in late 2007. The Moon is a cornerstone to understanding early solar system processes, and M3 high-resolution compositional maps will dramatically improve our understanding of the early evolution of a differentiated planetary body and provide a high-resolution assessment of lunar resources.

M3 is one of several foreign instruments chosen by ISRO to be flown on Chandrayaan-1 to complement the already strong ISRO payload package. After a detailed NASA peer-review process, M3 was selected for funding through NASA's Discovery Program as a Mission of Opportunity. M3 is under the overall oversight of PI Carle Pieters at Brown University. It is being built by a highly talented and committed JPL team led by Tom Glavich as Project Manager and Rob Green as Instrument Scientist. Each member of the M3 Science Team is uniquely experienced and has a specific responsibility for data calibration, analysis and/or interpretation. The rest of the Science Team includes: J. Boardman, B. Buratti, R. Clark, JW. Head, T. McCord, J. Mustard, C. Runyon, M. Staid, J. Sunshine, LA Taylor, and S. Tompkins.

The primary *science* goal of M3 is to characterize and map lunar surface mineralogy in the context of lunar geologic evolution. This translates into several sub-topics relating to understanding the highland crust, basaltic volcanism, and potential volatiles. The primary *exploration* goal is to assess and map lunar mineral resources at high spatial resolution to support planning for future, targeted missions. These goals translate directly into requirements for accurate measurement of diagnostic absorption features of rocks and minerals, with sufficient spectral resolution for deconvolution and sufficient spatial resolution for context. These requirements are met by M3's design: visible to near-infrared imaging spectrometer with high signal to noise, and excellent spatial and spectral uniformity.

M3 spectral requirements are for a 0.7 to 3.0 µm range (optional to 0.43 µm is the baseline). Measurement are obtained for 640 cross track spatial elements and 261 spectral elements. This translates to 70 m/pixel spatial resolution and 10 nm spectral resolution (continuous) from a nominal 100 km polar orbit for Chandrayaan-1. Spectra of lunar soils and minerals sampled to the full resolution of M3 are shown in Figure 1. The M3 FOV is 40 km in order to allow contiguous orbit-to-orbit measurements at the equator that will minimize lighting condition variations.

Over the two-year mission lifetime, there are four periods of optimal lighting conditions for spectroscopic measurements (two 2-month periods/year). One period will be devoted to global assessment at reduced resolution (320 spatial elements, 87 spectral) and the other three will be devoted to obtaining full resolution data for prioritized targets (10-50% of the surface). The nominal mission relies on India's new Bangalore DSN facility for data downlink. This implies that data for only 6 of 12 orbits/day will be transmitted when the Moon is in sight of Bangalore DSN. The nominal measurement timeline and data collection sequence for M3 is shown in Figure 2.

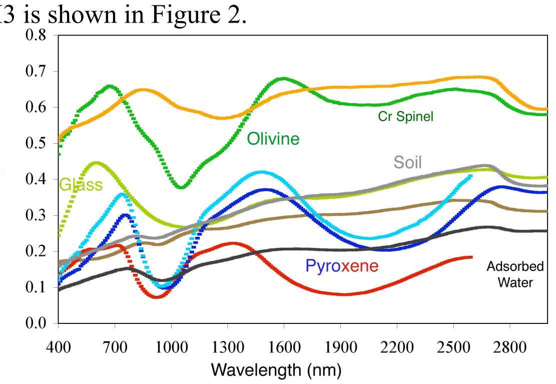

Figure 1. Example reflectance spectra of lunar minerals and soils sampled to M3 full resolution. [The weak feature near 2900 nm is due to trace amounts of terrestrial water remaining on the samples in a purged environment.]

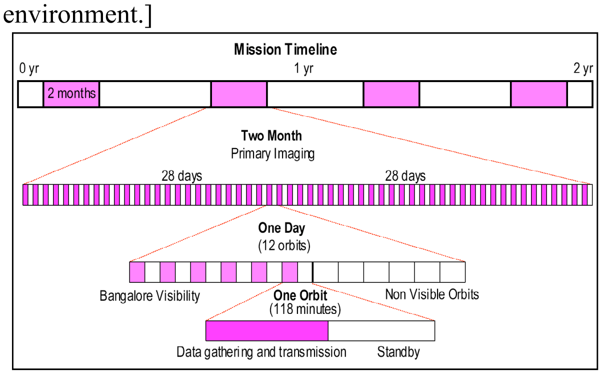

Figure 2. M3 data acquisition periods during a nominal Chandrayaan-1 mission timeline.

Mission Status: M3 has had a Preliminary Design Review (PDR) and is scheduled for Critical Design Review (CDR) in early 2006. International agreements are proceeding in parallel with instrument design and implementation.