Exploring the mineralogy of the Moon with M3

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From the initial era or lunar exploration, we have learned that many processes active on the early Moon are common to most terrestrial planets, including the record of early and late impact bombardment. Since most major geologic activity ceased on the Moon ∼3 Gy ago, the Moon's surface provides a record of the earliest era of terrestrial planet evolution. The type and composition of minerals that comprise a planetary surface are a direct result of the initial composition and subsequent thermal and physical processing. Lunar mineralogy seen today is thus a direct record of the early evolution of the lunar crust and subsequent geologic processes. Specifically, the distribution and concentration of specific minerals is closely tied to magma ocean products, lenses of intruded or remelted plutons, basaltic volcanism and fire-fountaining, and any process (e.g. cratering) that might redistribute or transform primary and secondary lunar crustal materials.

The Moon Mineralogy Mapper (M3, or "m-cube") is a state-of-the-art imaging spectrometer that will fly on Chandrayaan-1, the Indian Space Research Organization (ISRO) mission to be launched late 2007 to early 2008. M3 is one of several foreign instruments chosen by ISRO to be flown on Chandrayaan-1 to complement the strong ISRO payload package. M3 was selected through a peer-review process as part of NASA's Discovery Program. It is under the oversight of PI Carlé Pieters at Brown University and is being built by an experienced team at the Jet Propulsion Laboratory. Data analysis and calibration are carried out by a highly qualified and knowledgeable Science Team. To characterize diagnostic properties of lunar minerals, M3 acquires high spectral resolution reflectance data from 700 to 3000 nm (optional to 430 nm). M3 operates as a pushbroom spectrometer with a slit oriented orthogonal to the S/C orbital motion. Measurements are obtained simultaneously for 640 cross track spatial elements and 261 spectral elements. This translates to 70 m/pixel spatial resolution from a nominal 100 km polar orbit for Chandrayaan-1.

The primary *science* goal of M3 is to characterize and map lunar surface mineralogy in the context of its geologic evolution as outlined above. This translates into several sub-topics that focus on exploring the mineral character of the highland crust, characterizing the diversity basaltic volcanism, and identifying potential volatile concentrations near the poles. The primary *exploration* goal is to assess and map lunar mineral resources at high spatial resolution to support planning for future, targeted missions.