SEVERAL SEARCHES FOR SHORT-TERM CHANGES IN THE LUNAR SURFACE. Arlin Crotts[1] for the AEOLUS Consortium[2], [1]Department of Astronomy, Columbia University, 550 W. 120th St., New York, NY 10027, arlin@astro.columbia.edu; [2]Atmosphere seen from Earth, Orbit and the LUnar Surface.

Introduction: Several phenomena have been traced to the transient production of volatiles at or near the lunar surface, and these may or may not be related. The undertsnding of some or all of these phenomena may prove crucial to future lunar exploration. Herein we describe several investigations that are underway or recently completed to search for such changes, using novel techniques, We plan to present results from all or some of these at the meeting.

Volatiles in the form of hydration (water and/or hydroxyl) were detected in the outer layer of lunar regolith by several spacecraft recently. [1,2,3] Speculation as to the origin of this signal includes the reaction of solar wind protons with regolithic oxygen. Other forms of lunar hydration are found intrinsic to several types of lunar materials. [4,5,6] A third source consists of significant masses of ice rertained in permanently shadowed regions near the lunar poles, probably of cometary/meteoritic origin. [7,8] Several prior reports of hydrated lunar material can be found. [9,10,11]

Before the recent hydration results, lunar volatiles were also detected in transient ^{222}Rn outgassing events, seen with alpha-particle spectrometers on *Apollo 15* and *Lunar Prospector*. [12,13,14] Episodic outgassing is also indicated for the major lunar atmospheric mass constituent ^{40}Ar. [15] Recently, this ^{222}Rn activity has been shown to correlate at high significance with lunar optical transient activity. [16,17] This correspondence can plausibly be understood in terms of gas from the lunar interior accumulating at the base of the regolith at a rate so fast as to release explosively rather than percolate slowly to the surface. [18] Curiously, the predicted spatial scale and timescale of such explosive outgassing events correspond closely to those typically reported for lunar optical surface transients.

Is there any relation to the endogenous hydration detected in lunar materials and endogenous volatile outgassing form the lunar surface? Might these or other mechanisms change features on the lunar surface on short timescales? We suggest several investigations into these and related questions [18] and have made progress on several of these. Some of these might also reveal the effects of other lunar processes, such as impacts and mass wasting.

Permanent Changes over Four Decades: The comparable imaging resolutions of the Lunar Reconnaissance Orbiter (LRO) Camera narrow angle channel and high-resolution modes on *Lunar Orbiter III* and *V* (LO) more than 40 years ago allows one to survey large areas (~ 10^5 km^2) for changes over a few meters. We will soon complete a systematic comparison of LROC-NAC data with LO images that have been optimally processed to eliminate cosmetic defects. [19]

Transient Changes on Minute Timescales: The typical duration of reported lunar optical transients, as well as the dynamical timescale of explosive outgassing through the regolith, is of order several to tens of minutes. [18] We are conducting an automated search using robotic imaging telescopes for changes anywhere on the entire lunar Near Side on timescales of 1 min or more. [20] These robotic telescopes have already produced about 200,000 nearside images and some plausible candidates for optical transients.

Rapid Changes in Lunar Surface Hydration: We show that hydration 2.9 μm-band absorption can be used even within ground-based data (from InfraRed Telescope Facility/SpeX) to measure OH or H_2O absorption strength over large lunar areas. [21] We are completing a program sensitive to changes in this signal over a lunation, and as a function of latitude.

We will also detail several smaller studies. For instance, we are also probing changes in surface age-sensitive bands e.g. 0.9 μm, revealing of recent changes and activity perhaps inaccessible to LROC.

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