Detection and Handling of an Electric Discharge on the Moon for Dust Protection, Safe Operation, and Insitu Resource Utilization. Gunther Kletetschka[1,2,3], [1] Geophysical Institute, University of Alaska - Fairbanks, AK 99709 Fairbanks 903 N Koyukuk Drive, AK, USA (gkletetschka@alaska.edu), [2] Faculty of Science, Charles University in Prague, Albertov 6, 128 43 Praha 2, Czech Republic, [3] Institute of Geology, Czech Academy of Sciences, Rozvojová 269, Prague 6, 16500, Czech Republic

Introduction:

The discharge on the Moon may occur due to the amount of plasma that travels by the Moon surfaces from the Sun (or from the cosmic plasma sources in the galaxy). The model we are proposing for the Lunar environments is the following:

When plasma packets (electrons and protons) approach the polar regions of the Moon, they travel along with the solar radiation that creates shadows on the Lunar surfaces, airless objects. The Lunar rotation rate, latitude and crater topography control various time durations of the sun lit surfaces and surfaces that are covered with shades. Due to higher mobility of electrons, the shaded areas are populated primarily with electrons, thus are charged negatively in respect to sunlit areas that are charged positively.

When the shaded surfaces prolong their time exposure to the electrons (e.g. permanently shadowed areas), the boundary between the permanently shadows region and where the Sunlight occurs for extended amount of time, becomes a place where electric discharge takes place. For this model of electric discharge occurrence, we have a supporting evidence from the craters near the polar regions of the Moon.

There is a significant difference for sunlight disappearance and appearance near the permanently shadow craters. When the Sun rises over the crater near polar region plasma travels over the large hole of the crater while the electrons who are lighter will be diffusing into the permanently shadow craters. By the time the light transfer the crater distance, the plasma is positively charges as the electrons diffused into the PSR.

residing sunlight is next to a surface with a long-term residing shadow, the two oppositely charged surfaces get a potential for an occurrence of an electrostatic discharge. The maximum change between the sunlit and shaded surfaces is during dawn and dusk. Down/Dusk would be when the appearing charged surfaces would have the highest potential for the electric discharge.

For this situation there is supporting evidence on the Lunar poles along the rims on craters that are facing the sunset. These west-facing crater rims contain hematite deposits [1]. Our interpretation is that it is a result of electrostatic discharge melting the silicate lunar rocks and providing the oxygen to make hematite from evaporating iron [2]. The discharged areas would also leave magnetic anomalies in the electrically discharged locations [2]. Such discharge would not only allow primordial organic molecules to create amino acids (Stanley Miller experiment), but also create gigahertz frequency pulses that could be detected by the mission equipment.

We propose to use electric discharge detection when working near the south pole of the Moon. Such detector detects discharges that would be produced during the dawn/dusk time along the edges of the shadows. This phenomenon appears to be active near the polar locations, including the south pole. Ground based, and/or mobile detectors would calculate the direction and severity of the electric discharge from the location of the resulting current that would generate electromagnetic wave across many frequencies. Ground systems than use radio direction-finding techniques along with an analysis of the characteristic frequencies emitted by electric discharges.

Using two or more measurements from different locations, the location of an unknown electric discharge can be determined. Radio direction finder is widely used as a radio navigation system, especially with boats and aircraft. Ground-based systems use triangulation from multiple locations to determine distance, while mobile systems estimate distance using signal frequency and attenuation. Space-based detectors on satellites can be used to locate lightning range, bearing and intensity by direct observation.

Each system used for electric discharge detection has its own limitations [3]. These include: 1. A single ground-based electric discharge network must be able to detect a flash with at least three antennas to locate it with an acceptable margin of error. 2. Ground-based systems that use multiple locations and time-of-flight detection methods must have a central device to collect electric discharge and timing data to calculate location. 3. Each detection station should have a precision timing source that is used in the calculation.

Space-based electric discharge networks provide information often several minutes old, making it of limited use for real-time applications such as air navigation.

Charging due to solar wind plasma has another important consequence. When the Sun is rising on the

Moon, objects like craters would cast the shadows and this would initiate positive charging of the sunlit areas and negative charging the areas in shadow. However, charging process allows dust particles to repel and repulse from each other. This is why boulders on the surface of Moon are always clean with no dust on them. Dust is in between the boulders. This process has been known from reports of the Apollo mission each morning on the Moon where there was an observed increased dust occurrence [4].

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