A LONG-DISTANCE TRAVERSE OF SURFACE TEXTURE MEASUREMENTS WITH ENDURANCE IMAGERS: UNDERSTANDING LUNAR VOLCANISM AT NEW DETAIL.

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Introduction: Studying textural variations across a long-distance traverse spanning farside mare basalts, pyroclastics, and other volcanic deposits would provide important new insights into eruption dynamics and the formation of volcanic constructs on the Moon. Here we discuss such important science that could be achieved along the Endurance traverse with the *TriCam Stereo Imagers* and *Hand Lens Imager*.

Texture Measurements with Endurance Imagers: The Endurance rover has two imaging systems that would enable high-spatial resolution textural measurements of the lunar surface.

TriCam Stereo Imagers. A pair of color stereo imaging cameras mounted on the mast would enable images with pixel scales of 1 mm to 1 cm at 4-m to 45-m ranges, respectively [1]. The nominal Endurance Traverse phase accounts for stereo image acquisition every ten minutes while driving (every ~37 meters). Thus, TriCam images would provide near-continuous coverage along the rover traverse for measurements of surface texture, morphometry, and rock abundance/type.

Hand Lens Imager (HLI). The arm-mounted HLI would enable microscopic-scale imaging of the lunar surface, with 2-cm to “infinite” focal range (15-μm pixel scale at 23-mm range) [1]. The nominal Endurance Traverse phase accounts for HLI imaging every 2 km during planned “Interval Stops.”

Volcanic Science Addressed by Long-Distance Traverse Measurements: *TriCam Stereo Imagers.* Stereo images would be used to study the texture of the surface – irregularities as well as the predominant pattern of surface roughness. Texture measurements can be used to assess regolith protolith, differentiate individual lava flows, classify lava types, reconstruct local stratigraphies and emplacement sequences, characterize post-emplacement surface modification processes, and estimate of surface age [e.g., 2–7]. Additionally, the surface texture of basaltic lava flows varies with flow distance from source vents and can be used to understand changes in lava viscosity, temperature, and emplacement conditions [e.g., 8–11].

Hand Lens Imager (HLI). HLI images would provide essential context for understanding the texture, fragmentation, and particle-size distribution of surface materials on the scales of 1–10 μm. At this petrologic scale, texture describes the components of the rock (e.g., crystals, glass bead forms, and vesicles) and the spatial relationships between them. Petrologic texture can yield unique information about the genetic relationships between solids, liquids, and gases in rock-forming and rock-altering processes.

Lava surface texture and morphological measurements can help constrain regolith protolith, lava crystallinity, rheology, emplacement flow dynamics, and cooling histories [e.g., 2, 3, 8–14]. Measurements of lacunarity (voids in fractal fill space) can shed light on eruptive volatile content, residence time of migrating volatiles, flow cooling histories, and near-surface volume available for micro-cold trapping of volatiles [e.g., 11, 15–17].

Ties to Orbital Data: Surface texture depends on the baseline of interest and spatial resolution over which texture is measured. Thus, high-resolution, long-distance stereo images acquired by Endurance would provide important new insight into lunar surface characteristics, complimentary to existing orbital-scale roughness measurements [e.g., 4, 15].

Solar System-Scale Relevance: Understanding the generation and emplacement of magma on the Moon has wide-reaching applicability to other Solar System bodies, including the terrestrial planets [18], mapping to Decadal Priority Science Q5: *Solid body interiors and surfaces*. Additionally, roughness measurements at various length scales directly support Artemis Science Plan objectives, including “understanding planetary processes” and “understanding volatile cycles” [19], underscoring more synergies with the Artemis program and the importance of Endurance-A implementation.

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