Relating Small-Scale Texture of Basaltic Lava Flows To Thermal Inertia. L. N. Schwartz[1], B. Halverson[1], and A. G. Whittington[1] [1]The University of Texas at San Antonio, San Antonio, TX (lauren.schwartz@my.utsa.edu)

Introduction: Remote mapping of planetary surfaces provides invaluable data about surface processes but even with the advanced instruments that have been sent there, we are not able to discern small scale texture necessary to differentiate a pahoehoe from an a'a' flow. Thermal inertia measures a material's resistance to temperature change over time. It is defined as $I = \sqrt{(k\ c\ \rho)}$, with k as the thermal conductivity, c as the thermal capacity, and ρ as the density [1]. It can be estimated from thermal remote imagery using the apparent thermal inertia, defined as $ATI = (1- \alpha) / \Delta T$, with ΔT as the temperature difference over some time, and α as the albedo [1]. We seek to understand how variations in the thermal inertia of three young basaltic lava flows relate to variations in their small-scale texture. This will be facilitated by collecting thermal images in the field with a Forward-Looking Infra-Red (FLIR) camera, analyzing samples in the lab, and examining satellite remote sensing data.

Figure 1: Map of flow locations in New Mexico [2]

The lava flows being studied are Carrizozo, Aden Crater (Potrillo Field), Paxton Springs, and McCartys (Zuni-Bandera Field), located in central and southern New Mexico. We collected ten samples from the lava flows, four pahoehoe from Carrizozo, three `a`a from Paxton Springs, and three pahoehoe from Aden Crater. Thermal images were collected for all three lava flows at 30 sec or 1 min intervals over the course of 30 to 180 minutes during sunrise and sunset. Wind speeds were measured during image collection with an anemometer.

Samples will be characterized by measuring the density by pycnometry, the heat capacity by differential scanning calorimetry (DSC), the thermal diffusivity by Light Flash Analysis (LFA), and their geochemistry using X-ray Fluorescence (XRF). One-inch blocks were cut from the samples for heating in the lab furnace and monitoring their cooling with the FLIR camera which, can then be compared to observe the effects of sample mass, vesicularity, crystallinity, and surface area have on the cooling rate. ENVI was used to create daytime and nighttime temperature images along with albedo images for each of the flows to be used to calculate apparent thermal inertia.

Figure 2: Image of screen of FLIR camera during test

The preliminary lab and remote sensing results suggest that lower density/higher porosity samples correlate to lower apparent thermal inertia values and vice versa. Therefore, apparent thermal inertia appears to provide an estimate for porosity but not necessarily to differentiate pahoehoe flows from aa flows.

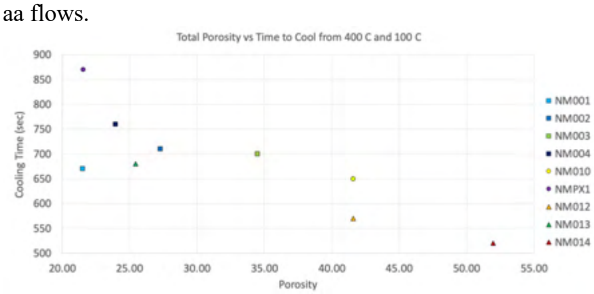

Figure 4: Total porosity of the nine samples plotted against the time for the cubes to cool from 400 C to 100 C.

References:

[1] Simurda, C., Ramsey, M., and Scheidt, S., 2020, Assessing Lava Flow Subpixel Surface Roughness and Particle Size Distribution for Improved Thermal Inertia Interpretations: Remote sensing (Basel, Switzerland), v. 12, no. 18, p. 2914.

[2] Renault, J., 1970, Major element variations in the Potrillo, Carizozo, and McCartys basalt fields: New Mexico: New Mexico Bureau of Mining and Mineral Resources Circular, v. v. 113, p. 1-22.