THERMAL REMOTE SENSING ANALYSIS OF MARTIAN-ANALOG VOLCANIC SURFACES, AMBOY CRATER, MOJAVE DESERT, CALIFORNIA.

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Motivation and Approach: Understanding volcanic terranes is an important goal of planetary geology, because (1) volcanism both affects and reflects the chemical and thermal evolution of planetary bodies, and (2) may be critical for creating environments in which life could develop. In order to better understand remote sensing signatures associated with relatively small-scale volcanic features, we are analyzing a suite of field, airborne, and spaceborne remote sensing datasets and comparing them with field observations. The study site is a Mars analog, selected because modification of the volcanic features has occurred due to aeolian and, to a lesser degree, fluvial activity; the emplacement and modification history is relatively straight-forward compared to older and longer-lived systems; the climate is arid (~10 cm annual rainfall); and the flow field and cinder cone are easily accessible. This work builds on previous analysis of topographic and spectral signatures associated with the same study site.

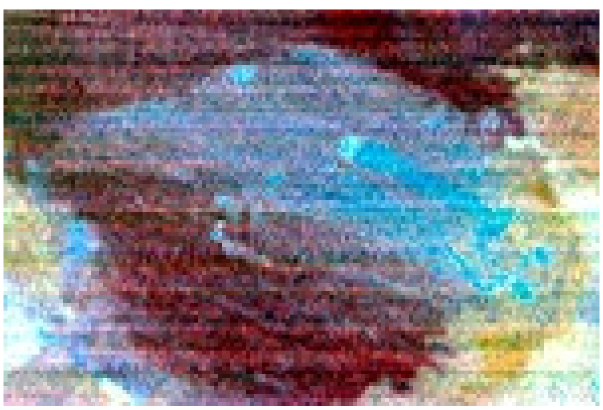

Figure 1. False-color ASTER thermal infrared image showing the Amboy Crater cinder cone and lava flow field; north is to the top of the image.

Field study site: The selected volcanic terrestrial analog is the Amboy Crater cinder cone and lava flow field, located in the Mojave Desert near Amboy, California (Figure 1). Relatively recent basaltic volcanism produced a flow field that covers ~70 km^2 between 34.48-34.57°N and 115.75-115.87°W [e.g., 1]. The flow morphology is primarily hummocky, vesicular pahoehoe, exhibiting surface relief of 2-5 m. Flow surfaces are commonly mantled by sand of variable thickness, and basaltic lag deposits are present throughout much of the flow field [2-5].

Current research focus: A field experiment was conducted in April 2007 to better understand surface characteristics within the flow field. High-precision, high-spatial resolution thermographic data were collected at 6-30 second intervals over ~36 hours using a FLIR camera (Figure 2). During that time, spaceborne thermal infrared data were collected by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on board the Terra spacecraft. This data includes two acquisitions: one during the day and one during the night. The FLIR and ASTER data allow for comparison of surface thermal characteristics at high temporal and spatial resolution but limited spatial extent with lower temporal and spatial resolution but greater spatial extent.

Preliminary results: Preliminary analysis of the thermal data indicates that differences in thermophysical characteristics may be used to distinguish different surface types exposed within the flow field. Significantly, the rate at which different materials heat and cool as a function of the diurnal cycle (i.e., the apparent thermal inertia [6-7]) may be related to the size and composition of materials, and produces independent and different results than mapping the distribution of surface materials based on their topographic or spectral signatures. The initial analysis is limited by jitter in the FLIR data that was introduced during acquisition due to high, gusting winds. Correction of the camera jitter will allow for more quantitative comparison of the field and spaceborne remote sensing datasets.

References: [1] Glazner, A.F., Farmer, G.L., Hughes, W.T., Wooden, J.L., and Pickthorn, W., 1991. J. Geophys. Res. 96, 13,673-13,691. [2] Parker, R.B., 1963. California Division of Mines and Geology, Special Report 76, 21 pp. [3] Greeley, R. and Iversen, J.D., 1978. In Greeley, R., Womer, M.B., Papson, R.P., and Spudis, P.D. (eds). Aeolian Features of Southern California: A Comparative Planetary Geology Guidebook, NASA, Washington, DC, 23-52. [4] Wood, C.A. and Kienle, J. (eds), 1990. Volcanoes of North America. Cambridge, England: Cambridge University Press, 354 pp. [5] Byrnes, J.M., Finnegan, D.C., Anderson, S.W., and Ramsey, M.S., 2006. In Lunar and Planetary Science XXXVII, Abstract #1205, Lunar and Planetary Institute, Houston (CD-ROM). [6] Price, J.C., 1977. J. Geophys. Res. 82, 2582-2590. [7] Kahle, A.B., 1987. Geophysics 52, 858-874.

Figure 2. Amboy Crater surface materials. Left image is a photograph of sand, basaltic lag, and basaltic rocks making up the area imaged by the FLIR camera. Right image is a false-color FLIR temperature image of surface. Apparent thermal inertia (i.e., variations in surface temperature as a function of the diurnal cycle) [6-7] can be used to distinguish the three classes of materials illustrated.