MULTISPECTRAL ANALYSES OF MARTIAN-ANALOG SURFACES, AMBOY CRATER, MOJAVE DESERT, CALIFORNIA.

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Amboy Crater: The Amboy Crater cinder cone and lava flow field (Figure 1), located in the Mojave Desert near Amboy, California, covers ~70 km^2 between 34.48-34.57°N and 115.75-115.87°W [1]. We selected this volcanic complex for use as an analog of Martian primary, eroded, and mantled volcanic surfaces because (1) the volcanic features are partially modified by aeolian activity and, to a lesser degree, fluvial activity; (2) the emplacement and modification history is relatively straight-forward (as compared to older and longer-lived systems); (3) the climate is arid (~10 cm annual rainfall); and (4) the flow field and cinder cone are easily accessible.

Figure 1. Field photograph of Amboy Crater.

The volcanic complex was erupted onto a flat, alluvial plain ~80 ka and represents some of the youngest basaltic volcanism in southern California [2-3]. The flow morphology is primarily hummocky, vesicular pahoehoe, exhibiting surface relief of 2-5 m. Surface irregularities have been attributed to both inflation (tumuli) and deflation (collapse) processes, although lava tubes have not been identified within the flow field and only a few lava channels are evident [4-6]. Lava flows emanate from the vent at the Amboy Crater cinder cone complex. Other vents within the flow field are difficult to identify due to the irregular nature of the flow surface and the partial cover of sand, although a probable vent is located ~3 km WSW of the cinder cone and additional vents have been proposed to account for local lava drainback features [5-6]. Aeolian and fluvial sediments, where present, range in thickness from a few centimeters to >1 meter.

The Amboy Crater cinder cone is an ~75 m-high, 460 m-wide, cinder cone complex located at 34.5°N, 115.8°W, in the northeast portion of the flow field [5-6]. The construct is composed of at least four coalesced cinder cones formed during at least six eruptive periods [4]. Subsequent extrusive activity may have occurred from the same vent, but the relative timing of lava flow emplacement at that volcanic center is indeterminate.

Preliminary Data, Analysis, and Results: A broad and complementary suite of remote sensing datasets has been acquired for Amboy Crater, including ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), airborne LIDAR (light detection and ranging), MASTER (MODIS/ASTER airborne simulator), and AIRSAR (Airborne Synthetic Aperture Radar) data. Current analyses focus on ASTER and MASTER spectral data, covering visible and near infrared (VNIR), shortwave infrared (SWIR), and thermal infrared (TIR) wavelength regions. These analyses continue previous and ongoing analysis of the Amboy Crater volcanic complex that focused on (1) laboratory TIR spectral analysis of samples collected in the field and (2) stereo- and LIDAR-derived topography data that indicate that the interpretability of morphologic features depends not only on the available topographic resolution, but also the method of topographic measurement [7-8].

Preliminary analysis of ASTER and MASTER datasets covering the Amboy Crater volcanic complex in conjunction with the laboratory spectral data indicate that we are able to clearly identify the two main surface compositions: alkali basalt and sediment transported by aeolian and fluvial processes. Differences as a function of resolution have also been identified. For example, the increased spatial resolution of the MASTER data (4.5-5.8 m/pixel) relative to ASTER data (90 m/pixel) allows correlation of material distributions with volcanic structures evident in the spectral (e.g., Figure 2) and topographic datasets. Increased spectral resolution of the MASTER data (50 spectral bands 0.4-13 µm, 10 in the TIR) relative to ASTER (14 spectral bands 0.5-11.7 µm, 5 in the TIR) allows for better compositional mapping, including identifying differences in sediment composition. Additional analysis of ASTER, MASTER, and laboratory remote sensing data is required to (1) better understand the range and distribution of materials within the flow field, (2) determine how limitations of the spectral data affect interpretations of emplacement and modification processes, and (3) assess the significance for analysis of Martian datasets.

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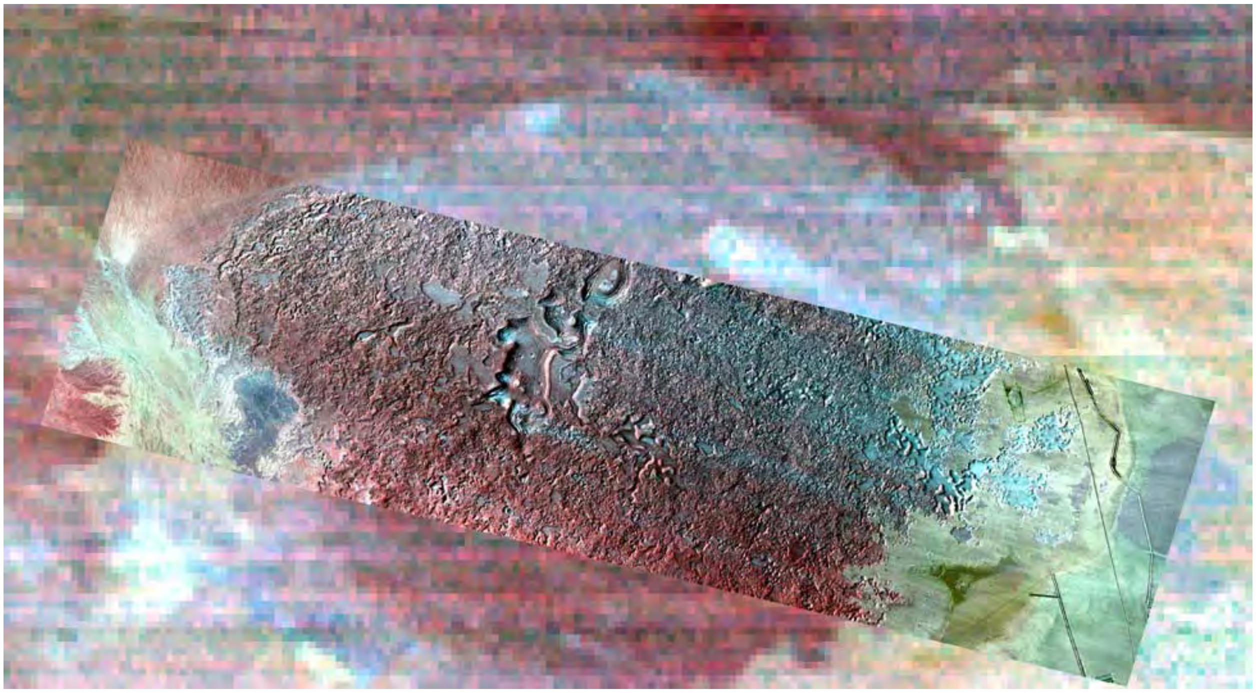

Figure 2. ASTER emissivity image (5 TIR bands, 90 m/pixel) of the Amboy Crater flow field overlaid by a higher-resolution MASTER emissivity image (10 TIR bands, ~5.8 m/pixel); note that temperature effects associated with shadowing have not been completely removed from the preliminary MASTER emissivity data presented. Both images are displayed as R=10.6 µm, G=9.1 µm, and B=8.6 µm; figure covers ~16.6×9.1 km and North is toward the top of the figure.