USING TERRESTRIAL VOLCANIC FIELDS AS AN ANALOG FOR THE GEOPHYSICAL CHARACTERIZATION OF POTENTIAL LUNAR RESOURCES E. Bell[1], N. Schmerr[1], J. Bleacher[2], K. Young[2], R. Porter[3], P. Whelley[4], W. Brent Garry[2], S. Kruse[5], S. Esmaeili[5], S. Jazayeri[5], J. Richardson[4], J. West[6], D. Pettit[7]S. Rees[3]. [1]University of Maryland, Department of Geology, 8000 Regents Dr., College Park, MD 20742 ebell1@umd.edu, nschmerr@umd.edu; [2]NASA Goddard Spaceflight, Center 8800 Greenbelt Rd, Greenbelt, MD 20771; [3]Northern Arizona University, School of Earth Sciences and Environmental Sustainability, PO Box 4099, Flagstaff, AZ 86011; [4]University of Maryland, Astronomy Department, 8000 Regents Dr., College Park, MD 20742; [5]University of South Florida, School of Geosciences, Tampa, FL 33620; [6]Arizona State University, School of Earth and Space Exploration, PO Box 871404, Tempe, AZ 85287, [7]NASA Johnson Space Center, 2101 East NASA Parkway, Houston, TX 77058.

Introduction: Terrestrial volcanic fields are excellent analogs for the geologic conditions that will be encountered on the Moon. Field sites such as the San Francisco Volcanic Field (SFVF), AZ and Lava Beds National Monument (LBNM), CA, can be used for the refinement of field techniques and data analysis methods for application to the future resource prospecting that will enable lunar habitation. Potential lunar resources may encompass processable materials such as volatiles and minerals, along with geologic structures such as lava tubes that can be found in terrestrial volcanic fields. The detailed geophysical characterization of these locations can be difficult though due to the small spatial variations in the characteristics of the near subsurface and potential difficulty with traversing through the regions. These issues can compound the uncertainties of the non-unique nature of geophysical analysis. Characterization of both the geologic near surface, as well as location accessibility will be key to successfully executing resource exploration missions on the lunar surface.

Study Region: Our field sites include both the SFVF, as well as the LBNM. The SFVF study site is a 50 km^2 area that is centered on the SP Crater cinder cone, and is part of the San Francisco Mountain stratovolcano complex. It is characterized by numerous cinder cone volcanoes, lava flows, rilles, and faults. [1] LBNM, encompasses a multitude of lava tubes, lava flows, and cinder cone volcanos associated with the Medicine Lake shield volcano. The lava tubes range in length from a few meters to nearly 7 km, with diameters up to 20 meters. [2, 3]

Approach and Analysis: For the SFVF we are addressing two primary scientific problems. The first of these is the distinguishing of multiple overlapping lava flows in the upper 40 meters of the surface. The second is to attempt to correlate the alignment of cinder cone vents to local faults and possible magmatic propagation along these faults. For these problems, active seismic techniques were employed. Shorter, 115 meter long, geophone lines were used to obtain data for lava flow analysis, while longer, 1 km long, nodal seismometer lines were used to collect data on the deeper structure to search for faults and magma propagation. In addition, a swath of magnetic data was collected around each of the 1 km nodal lines in an attempt to search for magnetic anomalies that may indicate a magmatic intrusion [4, 5]. 2-D seismic Bayesian inversion analysis has resulted in discerning several layers and possible faults. In addition, the seismic data will be used to create probabilistic power spectrum plots of the background seismicity.

At the LBNM we have collected ground level magnetic data, as part of the TubeX project [6], to use magnetics to characterize the geomorphology and location of lava tubes. At this point the magnetic anomalies results appear promising for locating intact tubes found along large diameter tube complexes. Additionally, GPS located LiDAR data of the tube structure has enabled forward modeling to produce the expected ground magnetic signature of a large diameter lava tube for comparison to field data. [7] The next step is to extrapolated these results for identifying magnetic signatures of other lava tube complexes such as those possibly found on the Moon. However due to the non-unique nature of magnetic inversion analysis, confirmation of an intact lava tube will likely require coupling with other geophysical techniques such as ground penetrating radar, gravimetry, or seismic sounding [6].

Conclusion: We have collected both seismic and magnetic data sets to address various geologic problems. The data collected in these field studies can be used for the characterization of the material properties of the subsurface layers, as well as to envelope the geophysical conditions such as the probabilistic power spectrum of the seismicity and the magnetic variability. Additionally, seismic source requirements can be determined along with data resolution for both seismic and magnetic studies. All of these will need to be accounted for in the collection of data on similar features on the Moon. Therefore, using the data from these studies to characterize the geophysical and surface conditions will aid in the ability to successfully execute a lunar surface geophysical study.

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