FIELD STUDIES OF TERRESTRIAL ANALOGS FOR MARE-STYLE VOLCANISM AND APPLICATIONS OF LIDAR FOR LUNAR SURFACE EXPLORATION. W.B. Garry[1], S.S. Hughes[2], S.E. Kobs Nawotniak[2], A. Sehlke[3], J.L. Heldmann[3], [3]D.S.S. Lim[3], [1]NASA Goddard Space Flight Center, Code 698, Greenbelt, MD 20771, [2]Idaho State University, Pocatello, ID, [3]NASA Ames Research Center, Moffett Field, CA.

Introduction: The lunar maria are composed of a variety of volcanic flow morphologies and edifices [1]. Field studies of terrestrial volcanic features have been important to piecing together the styles of eruption that created the lunar mare during the Apollo program [2]. High-resolution (centimeter to meter-scale) visible imagery and topography data from Lunar Reconnaissance Orbiter (LRO) allow for more direct comparisons with terrestrial field data at comparable scales and resolutions [3]. Here, we discuss terrestrial analogs that provide insight into mare eruption styles.

Lava Flows: Flow lobe margins in the lunar mare are scarce [4,5]. The ~400 to 1000 km-long flows mapped in Mare Imbrium have the longest, most well-defined flow lobes on the Moon [6]. Their morphology and overlap are strikingly similar to ‘a‘ā-style flows at Askja volcano (Iceland); morphologic indicators suggest the flows in Mare Imbrium could be lunar versions ‘a‘ā-style emplacement [7].

Lava Tubes: Several open pits [8,9] discovered in the lunar maria are potential entrances to lunar lava tubes or lava caves. In addition, the stratigraphic sequences of the local mare materials are exposed in the pit walls. Skylights and openings above terrestrial lava tubes have several similarities to the lunar pits. Indian Tunnel lava tube (Craters of the Moon, ID) [10] and Lava River Cave (Flagstaff, AZ, USA) [11] have entrances similar to the open-pits and bowl-shaped pits observed on the Moon. Investigations of lava tubes provide insight to the types of flow features, structures, and hazards that could be observed in relatively pristine conditions within any lunar tubes or caves.

Lunar Plains-Style Volcanism: A series of cones (Osiris, Isis) and irregular shaped mounds aligned along Rima Reiko [12,13] and additional vent and lava-pond structures (Abetti) in southeastern Mare Serenitatis resemble a sequence of volcanic features along the Inferno chasm rift, in the southeastern Snake River Plain (Idaho, USA) [14]. The alignment of the cones, domes, and a 3-km long channel, plus a lava pond and sinuous rilles in the area resemble the patchwork-style of plains-style volcanism [15].

Irregular Mare Patches (IMPs): Ina is one of the most enigmatic features on the Moon [16,17] and could represent geologically recent volcanism (<100 Ma) [18]. Inflated plateaus at the McCartys lava flow (New Mexico, USA) [19] have similar morphology with higher-elevation, broad mounds and a lower-elevation hummocky unit [20]. Alternatively, a drained lava lake or caldera, similar to events at Kīlauea Iki (Hawai‘i) are possible processes that may have formed these strange morphologic features [21,22].

Rilles: Sinuous rilles are long, channels that formed during mare eruptions. The Apollo 15 crew explored Hadley rille and collected basaltic samples from the edge of the rille. Terrestrial analogs for rilles could be a cross between studies of lava channels (Inferno Chasm) and collapsed lava tube structures (Bandera volcano, NM) [23] with additional debate on the role of thermal and mechanical erosion.

Surface Exploration with Lidar: Laser-ranging instruments (lidar) have multiple uses for surveying the terrain during surface exploration missions. A mountable or portable lidar instrument can effectively increase the situational awareness and decrease decision making risk through detailed surveys of the local terrain (craters, boulders) and geologic features in the distance (pit or rille wall), plus changes in local slope and identification of hazards. Data visualizations, including terrain models and virtual reality (VR) environments can also be derived [24]. Additional surface operation use-cases for lidar include tracking position and movement by the crews and mobile assets and as a navigation-aid in shadowed regions.

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