FELSIC VOLCANICS ON THE MOON. B. L. Jolliff[1], R. N. Clegg-Watkins[1], M. R. Zanetti[2], S. J. Lawrence[3], J. D. Stopar[3], K. A. Shirley[4], T. D. Glotch[4], and B. T. Greenhagen[5] [1]Department of Earth & Planetary Sciences, Washington University, St. Louis, MO 63130; [2]University of Western Ontario, London, Ontario; [3]Arizona State University, Tempe, AZ 85287; [4]Stony Brook University, Stony Brook, NY; [5]Johns Hopkins University Applied Physics Laboratory, Laurel, MD (blj@wustl.edu).

Introduction: Images and data from the Lunar Reconnaissance Orbiter (LRO) have provided a significantly improved view of compositionally evolved felsic volcanics and possibly related intrusive rocks on the Moon [e.g., 1,2,3]. LRO Diviner Lunar Radiometer (Diviner) Christiansen Feature data have revealed felsic compositions [1-4] in several locations previously known as "red spots" such as the Gruithuisen Domes (GD), Mairan Domes (MD), Hansteen Alpha (HA), Lassell Massif (LM), Aristarchus crater ejecta (AE), and the Compton-Belkovich Volcanic Complex (CB). Narrow Angle Camera (NAC) images and digital terrain models (DTMs) derived from NAC geometric stereo images have been used to assess the morphometry of volcanic materials, including relatively steep slopes on volcanic constructs, summit depressions, and caldera-like collapse features [5-9].

These observations provide much needed geologic context for the fragments of compositionally evolved silicic or "felsic" materials known among the Apollo samples for many years, including granite or rhyolite and potentially related alkali-suite monzogabbro and alkali anorthosite [8,10,11]. Such fragments of rock and breccia components are known from all of the Apollo sites, but are most abundant among the Apollo 12, 14, and 15 samples [10]. In every case, these materials have been excavated by impacts and transported from unknown source regions to their sampling locations. The increased resolution of detections and characterization of sites of potential felsic volcanism, however, are leading to a better understanding of possible sites and modes of origin [e.g., 3,5,11,12].

Morphologies: The topographic and morphologic expressions of the inferred silicic volcanic complexes exhibit striking diversity. The Gruithuisen Domes are the largest of the volcanic constructs, with the δ and γ domes each over 10 km across and ~1700-1800 m high [6,13]. The Mairan Domes range in size, with the largest volcanic constructs being the "middle" and "T" domes, on order of 5-8 km base widths and at least 800 m heights, and the T dome has a distinctive summit depression [5,13]. The CB volcanic complex is a broad dome, ~25×35 km across and about half a km height, with an irregular central depression interpreted to be a collapse caldera [3,9,14].The CB complex has a range of volcanic constructs, with the "alpha" dome being the largest, with a base width of ~ 4×6.5 km, an elevation ~550 m, and a small summit depression [3,14]. The HA complex is a rough-textured triangular mound ~25 km on a side, the margins of which stand ~700 m above the surrounding mare surface.

Each of these volcanic complexes features relatively steep slopes, up to about 25°, although some of the small topographic features seen in NAC-derived DTMs at HA and CB are little more than low-relief circular bulges. Many of these small bulges also feature distinctive, dense boulder populations. These features suggest formation from relatively silicic and viscous lavas [e.g., 3,5,6,13]. The compositions indicated by remote sensing are consistent with low-FeO felsic materials [15].

Origins: Possible origins put forth for the Apollo granitic (felsic) materials include (1) extreme fractional crystallization [3], (2) partial melting of a fertile source, e.g., KREEP-rich materials by basaltic underplating [12], and (3) silicate liquid immiscibility (SLI) associated with late-stage crystallization in either scenario (1) or (2). Although SLI has been demonstrated to have occurred on a small scale [11], it is unclear whether this process could or did occur on a large scale, e.g., to produce the large domes such as GD. Late-stage SLI on a small scale, however, might be involved in the formation of small domes and bulges at HA and CB. A remaining issue is the degree and range of SiO_2 enrichment exhibited at the volcanic sites [15].

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