THE ARISTARCHUS PLATEAU AS A BASIS TO DISCUSS RESUMING LUNAR GEOLOGIC MAPPING AFTER AN OVER FOUR DECADES-LONG LULL. H. Bernhardt[1], J. D. Clark[1], and M. S. Robinson[1], [1]School of Earth and Space Exploration, Arizona State University, Tempe, USA (h.bernhardt@asu.edu).

Introduction: There have been no regional geologic map publications of the Moon since 1979 [1] (not counting sketch maps [2,3] and announced projects/abstracts [4–11]). We since gained a plethora of new lunar datasets, a greatly improved understanding of the Moon's geology, as well as new mapping techniques and technologies [12–15]. Therefore, and in light of several recent and upcoming crewed as well as robotic landings [16–18], renewed comprehensive geologic mapping for landing site characterization/selection, traverse planning, and preparing any longer-term human surface activity, is more important than ever. However, aside from renovations of older maps [19], all novel, global or regional, map-focused publications in recent years did not include full-scale poster versions of their maps (i.e., being relegated to sketch-status despite being detailed, comprehensive works) and did not fully adhere to planetary mapping guidelines in both, format as well as technique (e.g., variable point density or imprecise symbology) [20–22]. The current challenge for lunar regional map production is further complicated by the wealth of different types of new datasets, as the incorporation of "non-traditional" data (e.g., radar [23], radiometric [24], hyperspectral [15,25], gravity [26]) is crucial for a modern representation of the Moon but beyond traditional, geomorphic mapping methods. Here we offer our initial takeaways from our comprehensive geological mapping of the Aristarchus plateau, which includes many of the new challenges of lunar mapping. It can serve as a basis to discuss updated guidelines and techniques to maximize the value and usability of a new generation of regional geologic maps of the Moon.

Mapping: The Aristarchus plateau is a unique region on the Moon, hosting its highest concentration of rilles including the widest and deepest rille [27], its most extensive dark mantle deposits [28], as well as rare exposures of both, very olivine-rich and very silicate-rich materials [29–32]. As such, the plateau has been regarded as one of the most geologically complex regions on the Moon and considered as one of the most promising exploration sites apart from the lunar poles for decades [33–36]. Using a 7 m/pixel mosaic of SELENE ("Kaguya") Terrain Camera (TC) morning images, i.e., with homogeneous illumination from the east [25] as our map base, we are producing a regional geologic map (~103 km^2) centered at 50.75°E 26.11°N, encompassing the entire Aristarchus plateau and the Montes Agricola at a scale of 1:80,000. Further unit characterization and delimitation was informed by over a dozen datasets from various instruments listed in [37]. We subdivided the plateau into four quadrangles to be published as four map plates (Fig. 1).

Initial takeaways for future lunar mapping: The following items could be addressed on a map-to-map basis but establishing universal guidelines will enhance the usability of maps for the broader community (just like standardized terrestrial maps).

1. For planetary mapping, a "unit" has to be defined based on characteristics separated by geologic contacts that have a consistent definition across the entire map or, ideally, across the entire scientific community. As such, a geologic contact in the traditional sense cannot delimit a spectral or radar-backscatter domain in one location, and a geomorphic or albedo characteristic in another. A particular challenge are mare units, which are usually not delimited by contacts (e.g., flow fronts), but are defined merely as spectral domains. Defining new contact types or alternative methods of visualization (e.g., overlay textures) should be discussed.
2. Gravity, radar, spectral and other types of datasets should inform landform identification and definition, e.g., a large, degraded, arcuate scarp could be mapped as an ancient crater rim segment if gravity-data reveals an associated mascon. While the resolutions of gravity and hyperspectral datasets are usually insufficient to inform local maps (>1:10,000), they are crucial to properly identify and characterize landforms in regional and global maps.
3. As is the case for most terrestrial geologic maps, lunar regional and especially local maps should take a "field map approach", i.e., the usability for traverse planning, in-situ landscape interpretation, hazard assessment, and eventual resource/science localization should be the focus.

It is urgent that the community formulates and updates guidelines for modern lunar geologic mapping. Such findings can then be published separately and/or incorporated into existing protocols.

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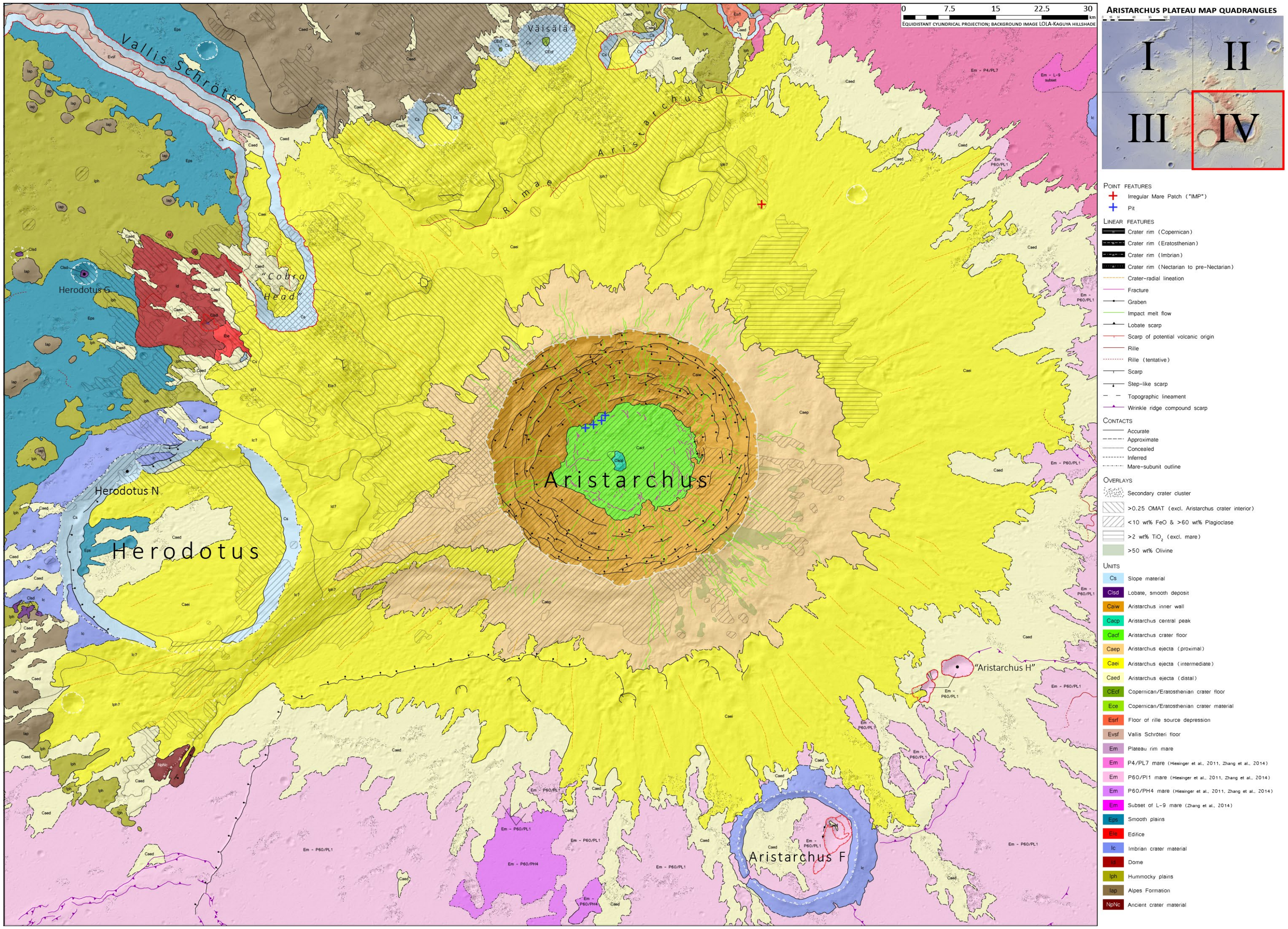

Figure 1: Preliminary geologic map of quadrangle IV of our ongoing Aristarchus plateau mapping project (mapping scale 1:80,000); equidistant cylindrical projection; background is a hillshade based on the merged LOLA-Kaguya LDEM. See [37] for further data and methodology description. Morphologically as well as spectrally, we deem this to be one of the most complex regions on the Moon and, therefore, a testbed providing a basis to discuss a new generation of regional geologic maps and associated techniques and standards for the Moon.