GEOLOGIC ANALYSIS OF ARECIBO RADAR IMAGES OF MARS; R. E. Arvidson\(^1\), J. Harmon\(^2\), B. Campbell\(^3\), and E. A. Guinness\(^4\), \(^1\)Dept. of Earth and Planetary Sciences, Washington University, St. Louis, MO 63130, \(^2\)Areceibo Observatory, Puerto Rico, \(^3\)Smithsonian Institution.

Five equatorial to mid-latitude regions of Mars were covered by the Arecibo S-band (12.6 cm) system and reduced to specific cross section images that show backscatter in same-sense and oppositely polarized circular polarization [1]. The purpose of this paper is to summarize analyses of surface properties inferred from the data, Viking Orbiter images, and comparisons to data acquired over lava flows in Hawaii and the Lunar Crater Volcanic Field, Nevada with the AIRSAR system. Detailed descriptions of the work will be presented in subsequent papers by Harmon et al., in preparation. A prime result of the analyses is that two very young units display very high same-sense backscatter, with values comparable to rough, young a'a flows on Earth. They are: (a) the plains member of the Olympus Mons Formation (Aop [2]) that girdles Olympus Mons in N, E, and S directions from the shield; and (b) the young channeled and plains volcanism terrain located in Elysium and Amazonis Planitiae (Achu [3]; Cerberus Plains [4]). We suggest that these surfaces developed after weathering was unable to destroy roughness associated with flows and channels; i.e., volcanism, channeling, and the efficacy of weathering were all related.

Fig. 1 shows the northern portion of the Tharsis region as same-sense backscatter data and a mosaic of Viking images. The mean incidence angle varies from approximately 20 degrees in the lower middle to 50 degrees at the top corners of the figure. The high backscatter terrain surrounding Olympus Mons is mapped as the youngest plains member of the Olympus Mons Formation (Aop) [2]. The Aop unit consists of youngest Amazonian System rocks, i.e. youngest materials mapped on Mars. The Olympus Mons shield also has high backscatter. The bulk of the remaining terrains exhibit a range in cross sections, but without spatial coherency. Viking images (not shown) demonstrate that the Aop unit exhibits numerous well-preserved flow fronts as compared to surrounding older units. Specific cross sections average approximately -8 dB for these two units, values that are much higher than the scenes in general. Further, the values are comparable to data extracted from AIRSAR coverage over the Blackrock Flow, Lunar Crater Volcanic Field. The Blackrock Flow is only about 38 k.a. in age [5] and is an a'a flow with an rms height of 30 cm measured over 10 m intervals [6]. The straightforward explanation for the patterns evident in the Mars data is that the youngest unit has retained the properties associated with emplacement, i.e., the terrain has not yet been weathered to produce more subdued surfaces.

Fig. 2 shows the backscatter and Viking image data for a portion of the Elysium and Amazonis Planitiae areas. Mean incidence angles for the radar image range from approximately 10 degrees at the bottom middle to 60 degrees at the top corners of the image. The main feature evident in the radar data is the high backscatter feature mapped as young channeled terrain (Achu [3], corresponding to youngest Amazonian System rocks) and as Cerberus Plains by [4]. This highly backscattering region corresponds to a suite of young channels and flows. The backscatter strength is only a few dB lower than the scatter from the young Olympus Mons Aop unit. The most likely interpretations are that the Achu unit represents one of the last surface modification episodes, and that weathering has not yet had a chance to remove the roughness produced as a consequence of the fluvial and/or volcanic processes that produced this distinctive system.

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Figure 1. Left side shows same sense circular radar specific cross sections for the northern Tharsis region, including Olympus Mons and surrounding areas. On the right is a Viking VIS image mosaic of the same area. Region covers approximately 110° to 155°W, 5° to 35°N.

Figure 2. Same as Figure 1, but for Elysium and Amazonis Planitiae. Achu unit corresponds to the NE-SW trending high backscatter area connected to the E-W trending terrain with high values. Plains and channels are evident in the Viking mosaic for this region [3]. Region covers approximately 170° to 215°W, -3°S to 25°N.