

**ORIGIN OF GROOVED FEATURES IN THE HESPERIAN/
NOACHIAN CRATERED TERRAIN, MEMNONIA QUADRANGLE (MC-16),
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Geologic maps have been completed for the Memnonia region of Mars (MC-16) showing a variety of geologic units [e.g., 1,2]. The oldest mappable unit includes cratered materials of Hesperian/Noachian age with a variety of geologic features. One of the most interesting features located in these materials are parallel grooves which occur in clustered sets of about a dozen or more. Individual grooves are typically 1 to 10 km apart, are >5-km-long, and are commonly aligned west-northwest oblique to Memnonia Fossae (e.g., Viking orbiter photograph 637A82). Previous work has suggested that these features are ejecta materials from unknown or perhaps traceable impacts [e.g., 1], while others have suggested that these features represent ancient valley networks [3]. Other possibilities include mass-wasting features similar to those observed by Sharp [4] on the steep slopes of Valles Marineris, or yardangs eroded by strong regional winds as discussed by Ward [5].

In support of martian channel studies, the Mars Observer Mission and other future Mars projects and missions, geologic maps at 1:500,000 scale are being produced based on Mars Transverse Mercator projection photomosaics (MTM's) for much of the Mangala Valles area/Memnonia quadrangle [6,7,8]. The purpose of this work was to determine the origin of the parallel grooved features; important for completing these geologic mapping projects and in increasing present understanding of the geologic processes that have occurred throughout martian history.

In order to determine the spatial distribution and orientation, a map of parallel grooved features in the Memnonia quadrangle was produced based on Viking orbiter photographs. Approximately 100 locations were identified and by observing slight variations in the morphology of these features, the following categories were made:

- Type (1) features frequently begin as parallel but converge downslope to form a dendritic pattern. They also occur as anastomosing troughs between topographic obstructions which may or may not converge (e.g., Viking orbiter photograph 639A11).
- Type (2) features occur on topographic highs such as crater rim crests or isolated ridges. These features appear to be dependent on slope and are aligned downslope (i.e., they appear radial to the interior of a crater rim crest; e.g., Viking orbiter photograph 597A75).
- Type (3) features occur across topographic highs such as crater rim crests or isolated ridges. These have no relationship to slope. In moderate resolution (~200m/pixel) photographs they appear linear, however, high resolution photographs or enlarged moderate resolution photographs show that these features consist of linearly arranged hills and valleys similar to the "Imbrium Sculpture" observed on the moon (e.g., Viking orbiter photograph 637A84. Compare with Lunar orbiter photograph IV-090-H2).

The Type 1 grooved features closely fit the morphologic description by Pieri [9] for "parallel valley systems" or other valley network systems. "Parallel valley systems" are ancient valley networks arranged in a narrow direction which coalesce up-network. Pieri [9] suggested that these features originated from ground water sapping which occurred along a unidirectional flat slope, was controlled by structure, or was areally restricted through a headward source area. Similarly, Type 2 grooved features are also parallel to the slope direction suggesting a relationship. They differ from the Type 1 features in that they rarely appear to coalesce and they do not terminate in an amphitheater shape. Although their occurrence is infrequent, these features are usually located on crater rim crests of a variety of sizes and ages and are concentric to the crater floor. On moderate resolution images they are linearly discontinuous, and higher resolution images show that they are steep-crested. In general, they closely resemble the U-shaped avalanche chutes associated with steep scarps such as the walls of Valles Marineris [4,10], however, debris aprons are not found at

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the base of the Type 2 grooves. The U-shaped avalanche chutes may have been induced from the sublimation or melting of ground-ice [e.g., 11]. Because most crater rim heights are shallow when compared to the ~3-km deep Valles Marineris system, large debris aprons may not be possible for Type 2 features.

The most frequently recognized are Type 3 features. Using high resolution or enlarged moderate resolution photographs, these features show the same linearly arranged hills and braided texture as "Imbrium Sculpture" indicating possible emplacement through impact processes. Assuming the Type 3 features do represent radial structures associated with basin ejecta emplacement, an attempt was made to determine a likely or possible source basin or crater. By plotting 20 typical Type 3 features on a Wulff Net, several positions on the planet were seen to be possible locations (Fig. 1). The most abundant intersection/convergence of trends is centered at -55.0° , 45.0° , or the approximate center of Argyre. This 600 km diameter basin is the youngest of the large impact basins on Mars (early to mid-Noachian; [12]), yet it is ~4000 km from the Memnonia quadrangle. An important possibility exists if Type 3 features do represent ejecta: Argyre ejecta may represent a major datum for subdividing the Noachian similar to the Fra Mauro (Imbrium Basin) ejecta on the Moon. Other source craters are possible, however, and the most probable scenario explaining the orientation of the Type 3 features is that they represent multiple impact events that have occurred throughout martian history.

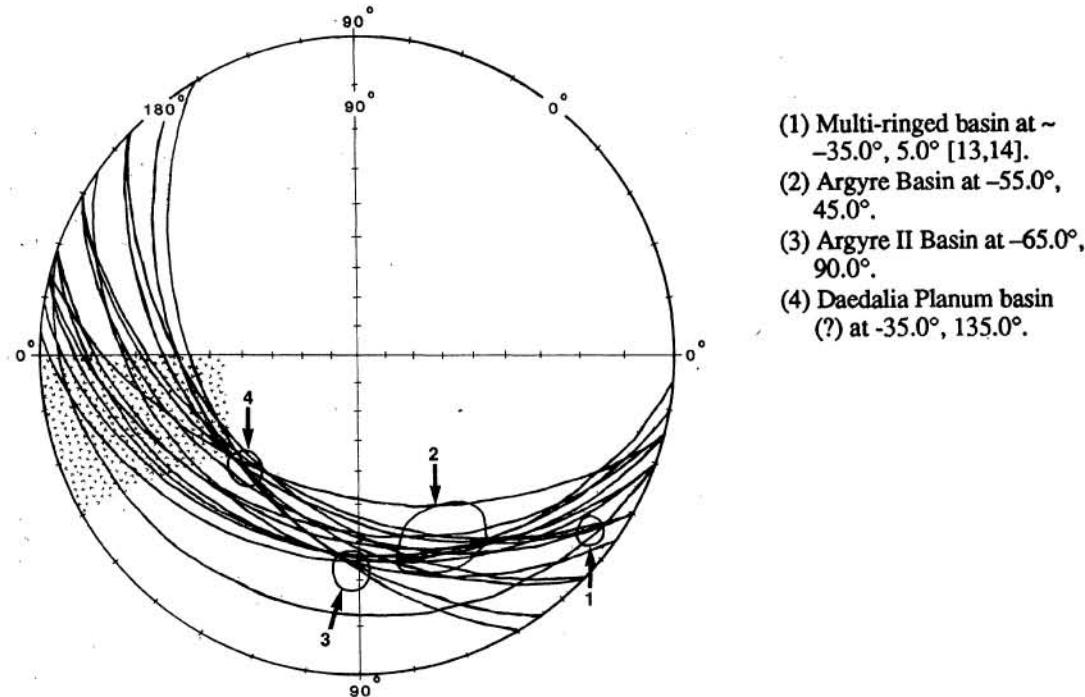


Fig. 1. Wulff net (stereo net) projection of Mars centered at 90.0° longitude. Lines show trends of 20 Type 3 features projected across the planet. Intersection/convergence of lines indicate areas of possible origin. Stippled area is the Memnonia quadrangle (MC-16).

References

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