GEOLOGIC SEQUENCE OF FORMATION AND EVIDENCE FOR SHEETWASH EROSION AT THE ARES VALLIS REGION, MARS. D.M. Nelson and R. Greeley. Department of Geology, Box 871404, Arizona State University, Tempe, Arizona 85287-1404

Summary: The mapping of the Ares Vallis region, Mars, has brought about the identification of 12 new geologic units, seven of which are used to refine the sequence of events which shaped the formation of this outflow channel and its surroundings. The region mapped, at 1:2M scale, spans the terrain from 30°N to 15°S, and 10° to 45°W. Also investigated was geomorphic evidence for fluvial sheetwash over the Np12 (Noachian Plateau, subdued member) geologic units within the Ares Vallis region. Three sites outside of this region, selected based on respective distance from presumed fluvial activity, were used to test whether other Np12 units were smoothed in a similar manner.

Introduction: Ares Vallis is one of five outwash flow channels which make up a complex watershed system at the eastern margin of Valles Marineris. The channel is from 25 to 100 km wide and stretches northwest for 1500 km. At the head of the channel, located in cratered highland terrain, are three chaos features, presumed to be the source region of water, named respectively (from West to East), Hydaspis, Aram, and Iani.

Geologic Units and Description of Channel Formation: The basis for mapping was the use of the 1:15M Geologic Map and geologic unit descriptions by Scott and Tanaka of the western hemisphere of Mars [1]. Some units mapped by these authors were necessarily generalized. Interpretation of Viking Orbiter images of the region mapped allowed the further subdivision of established units, notably those of Np1 and Np2, into gradations of scouring and deposition of Ares Vallis. Seven new units are used in conjunction with the others to describe the sequence of channel formation: Hch, Hrms, Hple, Hpls, NHple, (N)Hpe2, (N)Hpe1. These units have been incorporated into a new map of the region (Figure 1).

Using the Carr model [2] that chaos terrains are the headwater source for outflow channels, the sequence can be interpreted as follows. First, the fractured aquifer/ground ice zone, issued water in one or several cataclysmic floods. During the flood events, the water rushed across the high Noachian plateaus, progressing downslope towards the lowlands. This provides the basis for the formation of Np12 in this region. Successive flood events preferentially drained down topographic lows and eventually begin to scour down into these depressions. These events indicate the formation of (from oldest to youngest) the NHple units, which denote the broad flood plain specific to the Ares Vallis region, followed by Hpls and Hple, smooth and etched regions which had cut down through bedrock below the NHple unit and would form the high banks along the channel. As the channel cut down near its present level, scouring slowed, forming streamlined islands, Hrms, within the channel. Channel cutting went against a resistant layer, the Hche unit, which fluvial processes left deeply etched. Finally, the channel deposits of Hch were distributed along the broad, flat floor of this now inactive channel.

Sheetwash and the Interpretation of Np12 Units: Much of the modified Noachian Plateau material (Np12) is found to the north, or downslope, of the chaos terrains. This suggests that the terrain had been smoothed by sheetwash erosion. Evidence is found in north-south erosion trends ("islands", longitudinal grooves, etc.) parallel to the channel. Three sites, Terra Sirenum, Aonia Terra, and Noachis Terra, were selected to compare the morphologies of Np12 units of all four sites.

Np12 units consist of "interbedded lava flows and aeolian deposits that partly bury underlying rocks" [1]. Craters are usually devoid of ejecta, and valley networks have undergone both a broadening and shallowing. These units make up large sections of the Ares Vallis mapped region. There are also north-trending features which appear to have been fluvially derived. Figure 1 shows evidence of fluvial erosion, possibly by sheetwash or even standing water at Site A (Figure 1), mapped as Hpl3 (smooth plateau). The unit is smooth featured, of uniform albedo, and where there are low ridges and scarp, these appear to have been rounded by flowing water. If flowing water passed over this terrain, it was crossing northward from Aureum Chaos to Hydaspis Chaos. Also seen are generalized north-south trend of subdued ridges (example: Np12 "island" 3°N, 32°W), whereas near chaos regions they appear more arcuate, possibly indicating flow direction into or out the chaos unit (examples: southern margin of Aureum, northwest margin of Aram).

For the three selected Np12 sites, the subdued, parallel ridges and scour marks, are used as indicators for the occurrence of water. At site 1, Terra Sirenum, several broadened valley features terminate in smooth basins resembling playas or dry lake beds, suggesting accumulation of water into depressions from run-off. There is no clear indication of the parallel subdued ridges, nor are there any chaos features nearby. At Site 2, Aonia Terra, the Np12 unit is a broad, rolling to hummocky terrain, with no indication of decisive sheetwash erosion. The adjacent Hpl3 unit is featureless and smooth, where broad valleys terminate at it margins, suggesting a vast dry lake basin. This may indicate water was present, but in a low energy environment. Site 3 is 800 km to the southeast of Iani Chaos. There is no
preferred direction in the smoothing of the ridges and craters within the unit, broad valleys are common and oriented in all directions. Located here is also a basin which may have been the site for a transient lake, similar to that of site 2. There are no nearby chaos features.

To conclude, all four regions show features which indicate potential fluvial erosion. Only at the Ares Vallis site, however, does there seem to be strong evidence for sheetwash occurring, either singly or multiply, over the Npl2 units to the north of chaos terrains.

**Figure 1.** Ares Vallis and surrounding terrain, using new geologic units and those of Scott and Tanaka [1].