A SUGGESTED GEOLOGICAL DEVELOPMENT FOR ARES VALLIS, MARS; C.A. Robinson[1], G. Neukum[1], H. Hoffmann[1], A.Marchenko[2], A.T. Basilevsky[2] and G.G. Ori[3] [1]DLR, Institute of Planetary Exploration, Rudower Chaussee 5, D-12489 Berlin, Germany; [2]Vernadsky Institute, Kosygin St. 19, 117975 Moscow, Russia; [3]Department of Science, Università d'Annunzio, I-65127 Pescara, Italy.

Ares Vallis emerges close to the equator at 18 ° W and is the easternmost channel of a complex affecting the southern rim of the Chryse Basin. At its mouth are rich arrays of sculptured landforms and remnants of the plateau in which the channel was incised [1]. Our crater count and sedimentological studies of the channel indicate that until 3.5Ga ago it may have formed by glacially-related processes, with some fluvial activity, and that at more northerly locations, localized volcanic resurfacing followed until 1.6 Ga ago.

Crater counting was carried out using high-quality hard copies of Viking Orbiter images (on the German side) and digital images (on the Russian side), for frame numbers: 4a44, at 19.4°N 32.9°W (which covers the supposed Mars 1996 Pathfinder ellipse center), 745a01, at 9.5°N 23.3°W, 745a39, at 5.6°N 18.8°W, 4a19-23, 36, 40, at 18°N 35°W, 4a49-50, at 20°N 31°W, 632a25 at 27.8°N, 29.8°W and 632a28 at 26.9°N 28.9°W. The standard crater-production curve compiled by Neukum and Ivanov [2] was used to determine the relative age of the selected area. This crater-production curve was derived by inspecting bodies on the Moon, Mars, Venus, Mercury and the asteroids Gaspra and Ida. Curves for all these bodies show striking similarities in their production crater-size distribution, confirming the shape of the standard crater-size distribution curve (this essentially coincides with [3] where the production distribution was measured on Mars directly). In this curve steepening of the production crater size distribution at sizes ≤ 1 km is considered to be due to the characteristics of the primary impactor production size distribution and not to an admixture of objects from secondary cratering processes. Hence, secondary craters were excluded from the study. Attention was also paid when counting subtle, small craters. An observation limit of 6 pixels was taken to define the smallest countable crater, to try to ensure that small impact craters were not measured with too large a diameter (owing to the difficulty in defining the edges of crater rims) and also to try to reduce errors arising from personal bias in interpreting whether or not faint features are impact craters. Results from the independent German and Russian crater-counting studies are compatible. From south to north the ages retained in the following image frames (and their geological subunits, if applicable) are: 745a39: 3.60 Ga; 745a01: 3.52Ga; 4a19-23, 36 and 40: 3.47Ga for tear-drop shaped islands and 2.21Ga for the channel floor; 4a44: 1.7Ga; 4a49-54: 3.76 Ga for tear-drop shaped islands and 2.98 Ga for the surrounding floor; 632a28: 3.86Ga; and 632a25: 1.66Ga. These results indicate that Ares Vallis has been formed by different events occurring at different times, with the major period of channel formation lasting until 3.5Ga ago. The older ages obtained are observed most extensively upstream, where features that may resemble glacial moraines are also observed, such as the linear ridges at 2.63°N, 17.58°W. Downstream these ridges assume the form of fluvial bars, observed as braid bars if depositional or teardrop-shaped bars when erosional; these downstream features record the older ages as well. The crater count results also show later

resurfacing events, mainly restricted to more northerly locations, occurring between 2.21 and 1.66 Ga ago. These areas show no glacial- or fluvial-type features, implying resurfacing was probably volcanic (this we hope to clarify by examining the signatures of colour images that exist for these regions). Crater count results from these northern parts (20-25°N, 28-33°W) provide a clear example of the two-phase style of activity described. Here the age of the old channel floor is only preserved in the tear-drop shaped islands, whereas the surrounding channel material gives a younger age (Fig. 1). This pattern is very similar to that observed at Kasei Vallis [4].

In summary, we suggest that until 3.5Ga ago Ares Vallis may have been formed by glacially-related processes, with some fluvial activity (as for [5]), and that at more northerly locations, localised volcanic resurfacing followed until 1.6 Ga ago.

References: [1] Carr, M.H. (1981) *Surface of Mars,* 139-148. [2] Neukum, G., and B.A. Ivanov (1994) *Hazards due to comets and asteroids,* 359-416. [3] Neukum, G. (1983) *Habilitation thesis, Univ. of Munich.* [4] Neukum, G., and K. Hiller (1981) *J. Geophys. Res. 86, No. B4,* 3097-3121. [5] Kargel et al. (1995) *J. Geophys. Res. 100, No. E3,* 5351-5368.

Fig. 1. Cumulative crater-size frequency curves for Ares Vallis (20-25°N, 30-32°W). The left curve (showing the younger age) was generated from an area of channel-floor material, and the right curve was generated from an area including tear-drop shaped islands as well as channel-floor material.