**MA'ADIM VALLIS PALEOCOURSES.** N. A. CABROL[1], R. LANDHEIM[2], AND E. A. GRIN[1].
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Terraces inside Ma'adim Vallis were presented in previous works as evidence of either changes in discharge rate, and/or multiple episodes of flows [1 to 7], or structural setting [8]. However, no attempt to define the different levels of the valley were made. Using the 1:500,000 scale photomosaic maps and Viking images at 69 m/pxl mean resolution, we identified ancient courses of the confined valley by reconstructing 3 major floor levels. We estimated elevation by shadow-length measurement. When interrupted along the valley course, the terrace-levels were connected by elevation and morphology comparison. Locally, we used a stereo-pair image (432S19/434S14) to identify a difference in elevation between two floor-levels. We also identified the tributary networks associated with the different valley floors. The resulting map is shown in the figures A and B.

Description of paleocourse levels: The most recent floor of Ma'adim Vallis (*level 3*) starts at the mouth of the valley, in Gusev crater, and extends upstream for 220 km where it is interrupted by a 6 km diameter impact crater. This level is associated with localized short and sub-rectilinear drainage networks with little tributary development. This level was identified as the evidence of the release of an ancient ice-covered intravalley lake [6], and is eroded on average 500m below the floor of *level 2*. The intermediate level (*level 2*) is observed all along the valley course, from upstream, at the boundary of the Hesperian ridged plains, to the two 30 km diameter impact craters at the outlet of Ma'adim level 2. It is associated with the most developed tributary system, though this hydrographic network is weak compared to the valley dimensions. The older level of confined Ma'adim Vallis (*level 1*) is observed irregularly, from 200 km of the upstream of level 2 to a 35 km diameter impact crater (-18 Lat./183.7 long.) where it is interrupted. This level is composed of terrace relics and ancient floors of perched valleys located 200m below the cratered plateau level, and it is associated with only few tributaries, almost all located within a 150 km range.

Hydrographic network reconstruction and conclusions: The first traces of the confinement of Ma'adim Vallis on the plateau is associated with the erosion of Noachian plains, $Npl_2$, but there is evidence that Ma'adim pre-existed at the plateau level prior to this period [9]. The *level 1* was located 700 m above the current course and received two major tributary valleys on its left bank originating west, in the vicinity of a strato-volcano. Neither of the *level 1* tributary systems are adjusted to subsequent levels. They are perched, implying either a cessation of the valley activity, and/or a cessation of the tributary activity. The elevation shows that Ma'adim did not yet enter Gusev crater but part of a flood plain may have been already drained by small channels and maintained a lake inside the crater over time. *The level 2* shows the development of the tributary networks all along the valley and may indicate a period of more abundant water supply, sedimentation, and terracing. The transition between *levels 2* and *3* is marked by a dramatic change in the valley dynamics, which base-level drops by 500 m. We associate this drop with the entry of Ma'adim in Gusev crater. This entry was enabled by a 30 km diameter impact crater, which breached the Gusev rampart [3]. The temporary damming of Ma'adim Vallis generated an intravalley lake [5,6], and the level 3 floor is the evidence of the release of this lake. This episode is Amazonian in age [11], implying that Ma'adim Vallis was active for about 2 billion years.

Summary: This study shows a Martian valley of long fluvial activity, existing from Noachian to Amazonian. Its former downstream flood plain may have already maintained a lake, or a series of lakes, inside Gusev through time, before the confined valley directly entered the crater. This makes Gusev an exceptional site from an exobiology perspective [6,11]. The study of the paleocourses and morphology suggests that Ma'adim Vallis is more likely to have experienced low discharge rates, the only indicators of an outflow episode being the release of the intravalley lake at the end of the Ma'adim fluvial activity. The morphologic survey does not allow to conclude definitively about the episodicity or perenniality of Ma'adim Vallis activity through time. However, the following factors suggest an episodic activity: a) the non-adjustment of level 1 with subsequent levels; b) the short, scarce, and very localized tributary networks, almost all located on the west bank of the valley which seem to favor more the hypothesis of subsurface aquifer drainage.

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References: [1] Schneeberger, D.M. (1989), *LPSC* 20, 964-965; [2] Goldspiel. J.M., and S.W. Squyres (1992), *Icarus 89*, 392-410; [3] Cabrol *et al.* 1993, *LPSC 24*, 241-242; [4] Landheim *et al.* (1994), *LPSC 25*, 769-770; [5] Cabrol *et al*. (1994), *LPSC 25*, 215-214; [6] Cabrol *et al*. 1996, *Icarus 123*, 269-283; [7] Kuzmin *et al.*, (in progress); [8] Brackenridge, G.R. (1990), *J.G.R 95*, 17,289-17,308; [9] Landheim *et al.* (to be submitted); [10] Cabrol *et al.* (to be submitted); [11] Grin and Cabrol (submitted to Icarus).

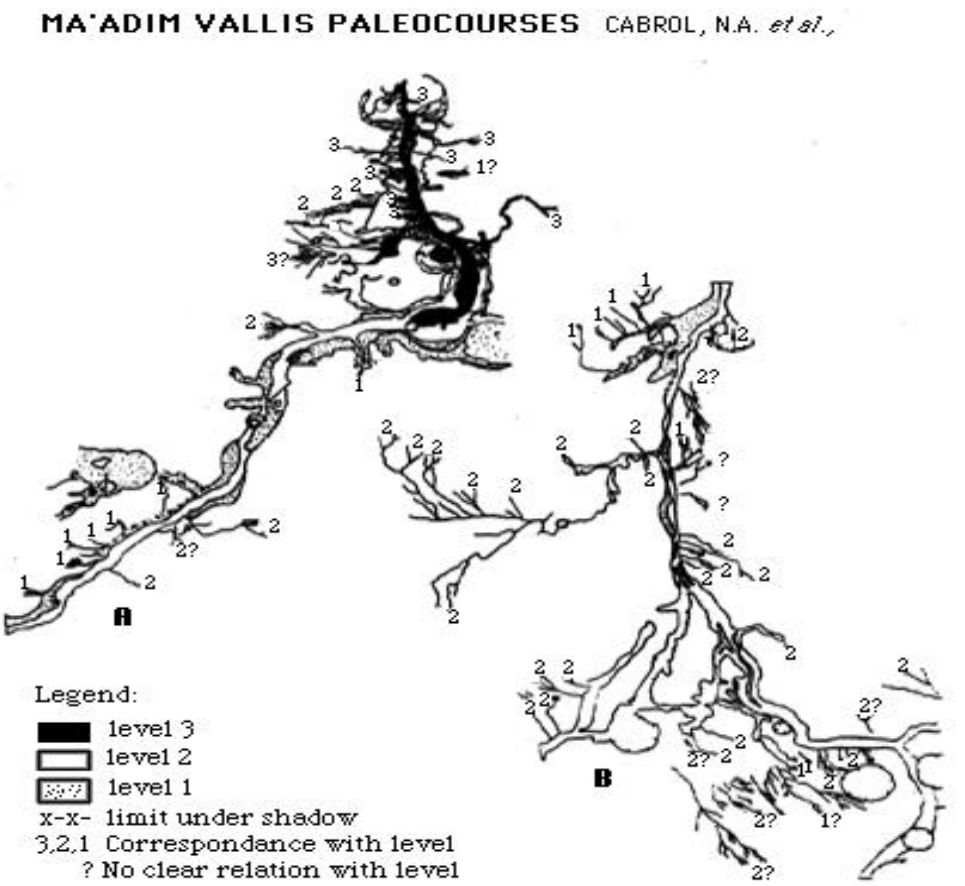


**Figure**: A: Downstream segment of Ma'adim vallis (-15.°Lat/184° long. to -21.5° Lat./182°long). B: Upstream segment (-21.5° Lat./182°long to -28.5° lat/182.5° long)