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Water-related processes and associated landforms in Eastern Atlantis and Northern Gorgonum Basins, Mars

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Martian water-related landforms developed in Atlantis and Gorgonum areas are related to volcanic processes in the Tharsis area via long radial fracture zones. This is the only mechanism which could bring into the Martian system sufficient amounts of water and energy to create water-related processes at the surface. The uplift of the Tharsis area formed deep crustal fractures in the Martian megaregolith such as those located inside Gorgonum and Atlantis Chaos (e.g. Sirenum Fossae) [1]. We describe here the mechanism which made possible the formation of three distinct water-related landforms, by different processes, and relate them to the regional context of northern Gorgonum basin. Tectonic movements played an important role in defining the base-level for different fluvial basins, and the general dynamics of aqueous reservoirs inside the regolith. At the first site, water accumulated beneath the Magelhaens crater rim has been released catastrophically inside the crater, forming a fan-delta in a preexisting crater lake. Later, due to tectonic movements, the outer rim collapsed toward the Atlantis Chaos, enabling the formation of fault-related stream channels. In northern Gorgonum Chaos the formation of outflow channels in the southern MEM-Vy crater first formed alluvial fans and a delta inside an unnamed pair of craters located at 169.94°W, 34.35°S, and then filled and partially eroded them, as a second outflow channel broke the neighbour's crater rim. The position of delta deposits of the main channel draining toward chaotic area, as well as other morphometric indicators, indicate that Gorgonum Chaos suffered tectonic movements related to Sirenum Fossae, which post-dated the brief fluvial activity, as was the case for those located in Atlantis Chaos. Different mechanisms of formation for the three water-related processes and

resulted landforms can be explained by the complex response of the Martian system. The history of these processes is presented, and the time of formation evaluated by crater counting and structural and geomorphic relationships [2,3].

The scattered distribution of available energy throughout Martian time made possible the catastrophic / threshold manifestation of water related processes and associated morphologies. Because water never stayed stable at the surface for medium or long periods of time [4], fluvial landforms are less developed than is common on Earth. Classic fluvial landforms, if they exist, represent only a fraction of Martian water-related landforms, the remainder being associated instead with subsurface water flow, mass movement, glacial/ periglacial and lacustrine processes and landforms. The water system acted mainly inside the Martian (mega)regolith during past and present time, and combined with gravity it created specific morphologies at the surface associated with mass movements. Periodically, it has subaerial and subaqueous components, manifested as catastrophic/ threshold releasing of liquid/ vapour water at surface and inside atmosphere, creating complex (pseudo)fluvial and lacustrine morphologies, without having the stability and the specific manifestations of the terrestrial fluvial system. References: [1] Wilson L., Head III J.W. (2002) Tharsis-radial graben systems as the surface manifestation of plume-related dike intrusion complexes: Models and implications JGR: Planets 107, no.8 p. 1-1 - 1-24, [2]A.S. McEwen (2004) New Age Mars, Lunar and Planetary Science XXXV 1756.pdf, [3] Edward B. Bierhaus *et al.*,(2005) Secondary craters on Europa and implications for cratered surfaces, Vol 437 doi:10.1038/nature04069 p. 1125-1127, [4] Baker,V.R. *et al.*(2005) Extraterrestrial hydrogeology, Hydrogeology Journal 13, no.1 (2005) p.51-68