BAHRAM VALLIS, MARS: A BRIEF HISTORY OF A LONG TERM DISCHARGE. R. A. De Hon and P. A. Washington, Department of Geosciences, Northeast Louisiana University, Monroe, LA 71209 <gedehon@alpha.nlu.edu>.

Summary: Bahram Vallis is a 350 km long, sapping channel on northeast Lunae Planum. The catastrophic outflow that cut Maja Valles ponded on Lunae Planum before spilling across Xanthe Terra to Chryse Planitia. Infiltration from the paleolake charged the subjacent aquifer. After drainage of the lake, long term ground water seepage from the aquifer carved Bahram Vallis. Current estimates indicate that 3.5×10^{12} m^3 of water could have infiltrated into the surface aquifer and that the valley may have been actively cut over a period of 5,000 to 50,000 terrestrial years.

Introduction: Bahram Vallis is a 350 km long, sinuous channel that winds across northeastern Lunae Planum and Xanthe Terra to discharge onto northwestern Chryse Planitia. The geology of the region is mapped and discussed by several investigators [1, 2, 3, 4, 5, and 6]. Because the valley is in a region of the much longer and more prominent Maja Valles, Bahram Vallis has not received extended attention. This study investigates the valley's role in draining the lake formed on Lunae Planum during catastrophic discharge of Maja Valles, subsequent dewatering of the Lunae Planum surface aquifer, and headward erosion of the valley.

Physiography: Lunae Planum is an elevated plateau projecting northward from the high plateau associated with Vallis Marineris [7]. Lunae Planum is bound on the west and north by Kasei Vallis and on the east by Xanthe Terra and Chryse Planitia. The plateau slopes from 9000 m, at the north rim of Vallis Marineris, northward for about 1550 km, to an elevation of approximately 2000 m. The east side of the plateau is buttressed against the slightly higher, cratered terrain of Xanthe Terra which drops to an elevation of approximately 1000 m eastward to the lower surface of Chryse Planitia.

Maja Valles begins in the box canyon of Juvenate Chasma and cuts a 150 km-wide, 650 km-long swath northward along the eastern boundary of Hesperian-age ridged plains material which caps Luna Planum and Noachian-age materials of Xanthe Terra. Discharge from Juventae Chasma ponded on northeast Lunae Planum and then spilled 75 to 100 km eastward across Xanthe Terra, cutting a number of anastomosing, relief channels--lower Bahram Vallis, Maumee Valles, Vedra Valles, and lower Maja Valles.

Bahram Vallis is composed of two distinct segments, an upper, sinuous reach on Lunae Planum and a lower, less sinuous reach across Xanthe Terra. In contrast to the other trans-Xanthe channels, Bahram Vallis begins 110 km from the eastern edge of Lunae Planum and wanders in a broad, sweeping curve, 350 km to the western edge of Xanthe Terra, and thence to Chryse Planitia. The valley is superposed across the rim and floor of the 45 km-diameter crater, Waspam. Once into the more rugged terrain of Xanthe Terra, the valley loses its sinuosity and develops an anastomosing pattern much like the other trans-Xanthe channels.

The head of the valley is mantled by ejecta from the Amazonian crater Pompeii. The valley begins with a northward course; curves to a southeastward course; then curves back northward as it transects the rim of the crater Waspam near the junction of Lunae Planum and Xanthe Terra. The sinuous reach is characterized by alcoves that tend to concentrate along the northern side of the valley. The valley tends to parallel the northern contact of ridged plains material and older cratered terrains. From Waspam, the valley turns northeast, loses the alcoved aspect, and splits into multiple segments across Xanthe Terra.

Hydrology and origin of valley: While the Maja Valles outflow impounded on Lunae Planum, a large, short-lived lake reached approximately 5.25×10^4 km^2 in area and less than one km in depth. For the short time the lake existed, water infiltrated into subjacent ridged plains materials. Storage of water in the aquifer was limited by the infiltration rate, the length of time that water was stored on the surface, the thickness and extent of the surficial aquifer, and the porosity and permeability of the aquifer. Preliminary modeling suggests that a minimum of 3.5 x 10^{12} m^3 of water could have been stored in the aquifer. The average thickness of ridged plains material in the region of the paleolake is 400 m [8].

Discharge from the aquifer by seepage was responsible for carving the sinuous, alcoved, reach of upper Bahram Vallis. From the contact between ridged plains materials of Lunae Planum and cratered plateau materials of Xanthe Terra, the valley was extended headward across Lunae Planum by caving, as ground water seepage undermined ridged plains materials.

Flow through the aquifer to the scarp face discharged into an actively retreating channel head. A small overland flow component along the basin thalweg from topographic highs, upstream from the scarp face, is required to provide the source for recharge needed to sustain headward erosion. Flow through the developing channel must have been sufficient to move materials from the valley head to the mouth of the valley and to the plains beyond.

Assuming a porosity of 0.33, hydraulic conductivity of 3 m/d, and 200 m thick section of saturated material, preliminary modeling of the ground water flow and headward retreat of Bahram Vallis suggest that the valley required a minimum of 1.75 x 10^6 days (4.8 x 10^3 terrestrial years) to reach its present stage of development. This model furnishes 2.1 x 10^{10} m^3 of water discharging at the valley head to remove approximately 3.8 x 10^9 m^3 of rock debris.

Discussion: Bahram Vallis consists of two chief segments--an alcoved valley on Lunae Planum and a multichanneled segment traversing Xanthe Terra. The trans-Xanthe channels were cut by overland flow following spillover from the paleolake on Lunae Planum. The valley segment on Lunae Planum is modeled as headward erosion by ground water sapping and undercutting of ridged plains materials. With this model, free-flowing water is supplied to the developing channel for a minimum of 5000 terrestrial years. In order to account for the broad, sinuous curves of Bahram Vallis, this model incorporates a pre-existing thalweg (or ground water ridge) on the floor of the Lunae Planum paleolake basin to control the location of the channel.

References:

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