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FLOOD ROUTING OF THE MAJA OUTFLOW ACROSS XANTHE TERRA:

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The object of this study is to trace a single flood crest through the Maja outflow system and to evaluate the effects of topography on ponding and multiple channel routing. Maja Valles provides a good model because it has a single source and a well-defined channel system. The 1500 Km long Maja Valles originates in Juventae Chasma. The outflow system stretches 1100 Km northward along the Lunae Planum--Xanthe Terra boundary, then eastward across the Xanthe Terra highlands. It descends to Chryse Planitia where it extends northeastward toward the middle of the basin.

The Lunae Planum Outflow Complex (1) includes the Maja Valles canyon section and related valleys (Vedra, Maumee, and Bahram Valles) that transect Xanthe Terra. The Maja flood traveled the first two-thirds of its distance as a semi-confined sheetflood. At the northern end, it ponded on the Lunae Planum surface until the waters rose to spill over the Xanthe Terra revetment onto the lower Chryse Planitia surface. The flow first crossed the highland terrain as sheetflood flow, but broken by irregularities in the rugged highland surface, it incised a complex series of anastomosing channels (Fig.1). Early formed channels were abandoned as hanging valleys as a few main channels captured most of the drainage (2). Flow from the trans-Xanthe channels ponded on the western edge of Chryse Planitia behind the wrinkle ridge system (3,4). As the impounded water crested the ridges, the flood continued downslope toward the center of the basin where it lost volume by infiltration and evaporation.

During much of its brief history, the Maja outflow is marked by a single flood crest. However, multiple flood crests formed as the flow across Xanthe Terra separated into multiple anastomosing channels, then recombined in the downstream reaches. Modeling the flood surge across Xanthe Terra provides insight into the erosional and depositional history of the flood in the lower portions of the channels (Fig. 2).

The distance across the highland is 75 Km along the most direct route and ranges up to 150 Km along channel routes of greatest diversion. Maumee Valles consists of 118 possible flow routes and a total of 795 Km of channel segments with approximately 400 cubic Km of channel storage. Vedra consists of 40 possible routes with 250 cubic Km of channel storage. The "South" drainage (informal name for valley headed in the crater Dixie) consists of 6 segments and 65 cubic Km of channel storage. Maja Valles (canyon section across Xanthe) was established after the other valleys, but it eventually captured the remaining drainage from Lunae Planum.

As in any flow across a rugged surface, ponding occurred in local basins. The chief impoundments, providing more than 500 cu Km of temporary storage, were in the lowland basin near the Lunae Planum--Xanthe Terra boundary, the crater Bahn, the crater Dixie, an unnamed crater at the lower end of the "South" drainage, and a lowland trough at near the mouth of Maja canyon. At these impoundments, the flood crests were delayed from 3 to 6 hours as the crater or basin filled to capacity. Then, one or more new flood crests formed as flood waters spilled through breaches in the downstream side of impeding basins.

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In the Maja canyon section, the flow onto Chryse Planitia was impeded by a highland ridge. Initially, the flow ponded in a trough on the highland side of the ridge and was diverted to the south through a 65 km relief channel. However, the flood waters eventually topped the confining ridge and cut the present gorge to allow direct drainage onto the Chryse surface.

Release of water from the lake on Lunae Planum has been modeled using weir and spillway formulas to calculate discharge as the lake drained. Within the range of reasonable limits, approximately one-half of water stored in the lake would have been drained in 1.5 to 5 days. Because the head drops during draining, discharges rates fall. From 65 to 225 days are required to drain all water from the lake.

If the Lunae Planum impoundment recieved a prolonged influx from the ultimate source region in Juventae Chasma, then the length of time for discharge into the trans-Xanthe channels is extended. Also, if only the main channels carried water after the initial release at high discharge rates, the duration of flow in the channels is prolonged. The flow through the channels lasted for many months.

Modeled times for the initial flood crest to transverse the Xanthe highland region range from 3 to 15 hours depending on flood routing and retardation within impoundments in the valley systems. Hydrographs of the flow at the termini of the chief valleys provide a graphic view of the surges as they reached the end of the valley systems. The initial flood crest was reduced to multiple surges along a prolonged flow at the terminus. Anastomosing flow was primarily responsible for reducing the initial flood crest into a prolonged flow with a series of minor ebb and flows. Ponding and release was responsible for the greatest retardations and the separation of major flood crests at the termini of the canyons.

Thus, flood routing through multiple channels and retardation in local impoundments are responsible for breakup of the initial flood crest and the formation of multiple flood crests. Recombined flow near the mouths of these canyons results in an extended flow regime and multiple flood surges. As a result of ponding along the flood course, depositional sites are localized and renewed erosion downstream (from ponded sites) results in sediment source areas not greatly removed from depositional sites. Some sites, especially at the mouths of the trans-Xanthe canyons, experienced a complex history of deposition and erosion in response to the ebb and flow of multiple flood crests imposed by flood routing and multiple ponding. The flow history after the intial flood surge is measured in months rather than hours or days.

References:

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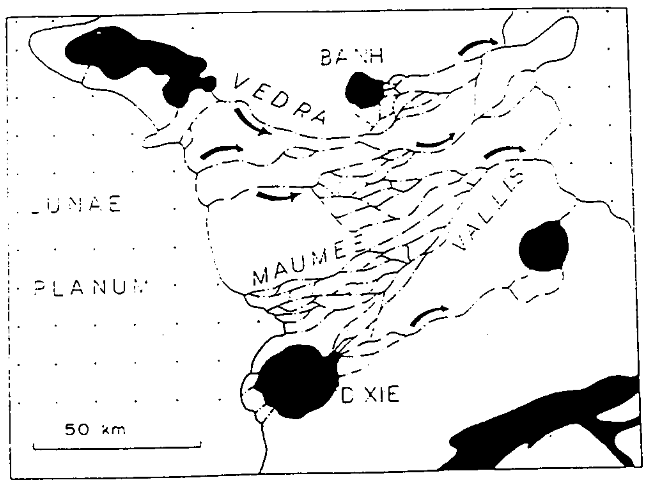

FIGURE 1. Subparallel and anastomosing channels across Xanthe Terra.

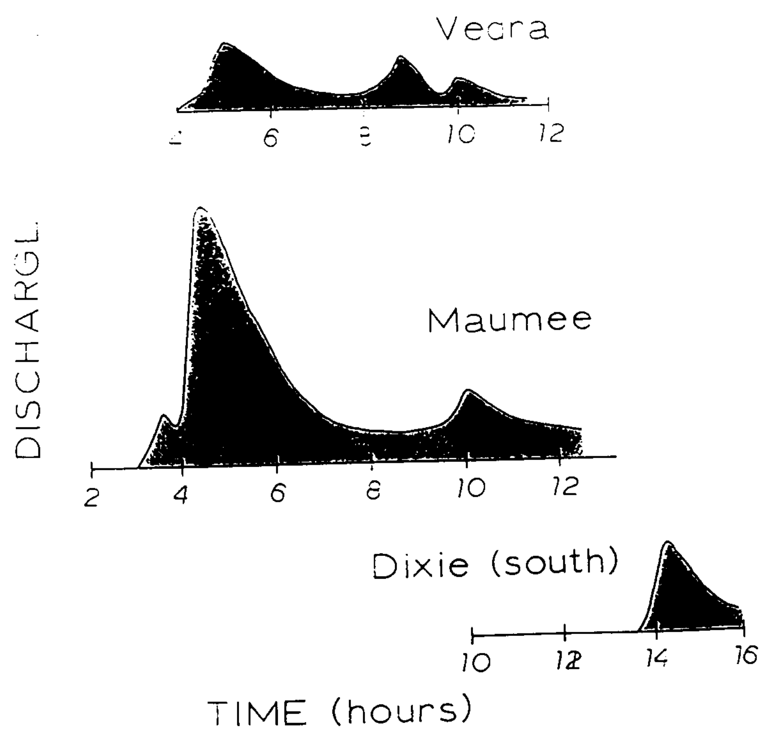

FIGURE 2. Model hydrographs for discharge at the mouths of the trans-Xanthe valleys. From a single flood surge at the head of the valleys, multiple channel routing and intra-valley basin storage produces multiple flood crests at the mouths.