DURATION AND RATES OF DISCHARGE THROUGH A MARTIAN OUTFLOW SYSTEM: MAJA VALLES; R. A. De Hon and E. A. Pani, Department of Geosciences, Northeast Louisiana University, Monroe, LA, 71209.

Discharge rates calculated from channel configuration provide limits for the duration of an outflow system. For a channel supplied by a well-defined, but limited, volume (a ponded source), the duration of outflow requires a sufficient length of time to discharge the volume in the source basin at the calculated flow rate. Impoundments along the flood route introduce lag times for filling and subsequent delays as breaches are cut for outlet channels. Furthermore, the flow rate from a ponded source exhibits decreasing discharge as the head in the basin drops. Thus, full channel discharge (maximum flow rate) is not maintained for the lifetime of the outflow, and the duration of the outflow is prolonged by decreasing discharge rates.

Three major impoundments occurred within the Maja Valles outflow system. Juventae Chasma is the source basin for the Maja outflow; a large impoundment occurred on the northern Lunae Planum surface (1); and an impoundment formed on the Chryse Planitia surface at the mouths of the Trans-Xanthe channels (2). Smaller, local ponding also occurred, especially within the Xanthe Terra portion of the outflow (1).

Whether Juventae Chasma represents a surface ponded source (3) or a basin formed by collapse during withdrawal of water from the subsurface (4), it can be assumed that the volume of the chasma (62,500 km³) represents a minimum volume of water available to the upper Maja Valles semi-confined channel. Channel shape is not well defined with present knowledge of surface topography, but full channel flow requires a minimum discharge rate of 20 km³/hr. Discharge rate from Juventae Chasma would decrease from the maximum as the water level in the storage area fell. The calculated lifetime for the flow from the basin is in excess of 4 months.

The flow through the upper Maja channel ponded on northern Lunae Planum with a surface area of approximately 56,000 km² and 6,000 to 30,000 km³ of storage. As the depth of water in the basin rose to crest the Xanthe Terra highland to the east (2 weeks to 2 months), it spilled across the rugged surface as sheetflood flow. As the sheetflood began to incise channels, the flow was confined to 15 outlets along the highland boundary and cut an anastomosing system of valleys that fed three major trunk valleys--Vedra Valles, Maumee Valles, and the Dixie-Northport channel. Later, the Maja Valles canyon section was cut, and it captured the remaining flow from Lunae Planum as well as later discharges from Juventae Chasma or secondary sources along upper Maja Valles.
The Trans-Xanthe channels consist of 800 km$^3$ channel storage and 1525 km of channel segments. Minimum time for crossing the Xanthe region at probable average flow velocity of 7 m/s (25 km/hr) is 3 hours, but lag produced by routing and ponding result in the initial surge through the system being spread out over as much as 16 hours. Discharge from a static Lunae Planum continued for as much as 8 months. If the Lunae Planum impoundment continued to receive input from the upper Maja Valles system, the lifetime of the lake and subsequent discharge was prolonged.

Discharge at the mouths of the trans-Xanthe channels ponded on the Chryse Planitia surface to form a lake of approximately 22,500 km$^2$ behind the Xanthe Scopulus ridge system (2). Storage volume in the impoundment was on the order of 4,000 km$^3$, which is much less than the total volume of the Lunae Planum impoundment. Ponding rose to crest the ridge system, and flow continued northeast into central Chryse Planitia. Once the ridge barrier was dissected, continuing discharge from the trans-Xanthe channels flowed unabated across the former Chryse impoundment.

The canyon section of Maja Valles was the last trans-Xanthe channel to form. Once formed it captured the remaining flow from Lunae Planum and any later discharges originating from the upper Maja Valles region. Discharge through the Maja Valles canyon across Xanthe Terra was delayed by a highland ridge on the eastern boundary with Chryse Planitia. An impoundment of approximately 4,000 km$^3$ formed on Xanthe Terra and its overflow was directed southward to skirt the blocking ridge. Once the flood rose to crest the ridge, the waters spilled directly onto Chryse Planitia and cut the gorge at the mouth of the canyon.

Thus, a single release of water from Juventae Chasma was translated into a flow regime that spanned the better part of a (terrestrial) year. Subsequent releases from Juventae or other sources along upper Maja Valles may have kept the system active for an even longer time span. At least one crater appears to have formed in the time interval between separate episodes of flow through the upper Maja system.

References: