FORMATION OF MANGALA VALLES, MARS, THROUGH CATASTROPHIC DRAINAGE OF A LARGE SURFACE LAKE. T. J. Parker and D. S. Gorsline, University of Southern California, Dept. of Geological Sciences, Los Angeles, CA 90089-0741.

Mangala Vallis is a large outflow channel (about 850km long) in the eastern Memnonia region of Mars. The channel heads within a graben in Memnonia Fossae at 18.5°S lat., 149.5° lon. The heavily cratered terrain in this region exhibits a prominent set of large-scale ridges trending north to northeast that are cross-cut by younger east-northeast graben (Memnonia Fossae). Mangala Vallis is separated from Arsia Mons-derived volcanic plains by one of these ridges. The bifurcated lower reaches of Mangala begin where the channel crosses the remnant of another, less prominent northeast trending ridge at 9.5°S lat., 151.5° lon. (1). South of this ridge the channel is much broader and shallower, and cuts into a smooth plains unit which Scott and Tanaka (2) labeled Hchp, or channel floodplain materials.

We believe this plains unit and part of the Hpl3 unit to the south (2) are comprised of sediments deposited in a temporary lake which formed upstream from the northeast trending ridge at 9.5°S lat., 151.5° lon., for two reasons. (I) Headward erosion escarpments within the Hchp unit (from about 10°S to about 16.5°S lat. on the east side of Mangala) are reminiscent of knick point or cataract development in a rapidly drained lake. Current scours upstream from craters at 10.5°S lat., 151° lon. and at 15°S lat., 148.5° lon., and others also suggest flow of water over the Hchp surface, rather than derived from the subsurface at the edge of the unit. (II) Spillways from the Hchp unit north across the heavily cratered terrain appear to have developed in at least two places prior to breaching of the ridge. These spillover channels can be seen in high resolution images on the 1:500,000 photomosaics at 9.5°S lat., 149.5° lon., and at 8°S lat., 148° lon. (3). The first of these can be identified in several places where it flowed northward until it debouches into a 50km crater at 6°S latitude, 149.5° lon. A narrow channel then flows out of this crater to the north where it empties into eastern Tinia Valles and finally into the northern plains. The second spillover channel also drained northward, eventually reaching Hermus Vallis and possibly Dubis Vallis and then the northern plains. The theatre-headed valleys at the lowland/upland boundary escarpment in the vicinity of Mangala Valles might indicate headward knickpoint migration of overland runoff channels rather than subsurface groundwater sapping channels.

In our proposed flood scenario, then, the "true" source of the Mangala flood is the obstructing ridge at 9.5°S lat., 151.5° lon., which acted as a natural earthen dam that failed catastrophically. This explains why the most intense scouring and bifurcation of the system occur in this vicinity and downstream, where the flood's erosive capability was greatest. To the south (headward direction), this scouring became progressively less intense as the lake drained. The "apparent" source of the channel (the graben in Memnonia Fossae), therefore, represents the point at which the lake level had dropped such that scouring of the bed, and subsequently the flood, ceased.

Where did the lake come from? The Hchp and Hpl3 units extend from 9.5°S to almost 40°S lat in Scott and Tanaka's map (2). We have identified a narrow sinuous channel, over 500km long and up to 1km wide, that appears to have originated in the vicinity of the terminus of Arsia Mons-derived volcanics to the east. This channel starts near 35°S lat., 141° lon., flowed initially southwestward for about 300km, then turned north within the Hpl3 unit, eventually fading at about 34°S lat., 147° lon (5). It becomes visible again at 31°S lat., 149.5° lon., and "flows" an additional 50km or so northward. The plains between these two reaches comprise an area of approximately 40,000km^2, and may consist, in part, of lake sediments. A third reach can just be detected at 38.5°S lat., 150.5° lon., flowing north approximately 100km to 27°S lat., 152° lon., where it finally fades into the plains (6). The total length of this channel appears to be greater than 1500km. We would place the southern limit of the proposed lake at or near this latitude. The area of this lake would have been on the order of 60,000km^2. Assuming an average depth of 10m yields a total volume of 600km^3, a rather "modest" volume for a martian flood channel. Given this type of flood, essentially a dam failure, it is likely that it took on the order of weeks or less to carve Mangala Valles.

This scenario is attractive in that it does not require unusual regolith porosities to enable the extremely rapid removal of groundwater from the vicinity of the Memnonia Fossae graben to produce a catastrophic flood. Nor does it require multiple events to produce the observed channels. However, it may require an epoch of relatively warm temperatures to maintain flow in the small source channel to the south without its freezing solid. A surface ice layer, both over the channel and the lake, cannot be ruled out and would reduce the surface temperatures required.

REFERENCES: (1) USGS Map I-1652, 1985. (2) Scott, D. H., and Tanaka, K. L., USGS Map I-1802-A, 1986. (3) USGS Map I-1696, 1985. (4) USGS Map I-1664, 1985. (5) USGS Map I-1555, 1983. (6) USGS Map I-1187, 1979.