EVIDENCE THAT A PALEOLAKE OVERFLOWED THE RIM OF JUVENTAE CHASMA, MARS. Neil Coleman[1] and Vic Baker[2], [1]U.S. Nuclear Regulatory Commission (MS T2E26, Washington, DC 20555; nmcoleman@comcast.net), [2]The University of Arizona (Hydrology and Water Resources, Tucson, Arizona 85721-0011; baker@hwr.arizona.edu).

Introduction: Here we report evidence that a paleolake filled Juventae Chasma until it overtopped and eroded its rim, carving the outflow channels of Maja Valles. These channels begin at the equator near the northern rim of Juventae Chasma (Fig. 1). Northward the main channel divides into multiple channels and traverses 1300 km of highland terrain. The Maja flooding probably occurred during mid- to late-Hesperian time because the flows eroded both Noachian-aged surfaces and Lunae ridged plains material of lower Hesperian age [1]. At the highland margin the channels converge into a single valley that descends through a gorge onto the plains of Chryse Planitia at 17.88˚N, 53.80˚W. There the channel divides, with the main channel continuing northeast and another trending north where it crosscuts Maumee Vallis, which also was formed by highland runoff. Distinct Maja channels can be traced more than 360 km from the highland rim out into Chryse. The deepest channel floor has a base elevation of –3650 m at 20.798˚N, 48.309˚W. This channel ends abruptly at a north-south ridge that forms the western margin of a field of polygonally fractured ground centered at 21.10˚N, 47.44˚W. Viking I landed near the same ridge.

Discussion: The presence of a former lake in Juventae Chasma has been suspected because Maja Valles begins at its northern end and because of the layered interior deposits in Juventae [2]. THEMIS images and laser altimeter (MOLA) data (Figs. 2 & 3) now reveal erosional features on the northern rim of this canyon that we interpret as flood scoured. A spillover channel >100 m deep is eroded across the top of the plateau (see MOLA profile in Fig. 3), the margins of which indicate an elevation of approximately 1180 m for the initial overflow flooding from Juventae. This chasma is not connected to a long chain of canyons that could have provided multiple episodes of floodwaters. However, there are large areas of collapsed terrain located south and west of Juventae that may have formed in response to large-scale groundwater migration northward from a possible paleolake in ancestral Candor Chasma.

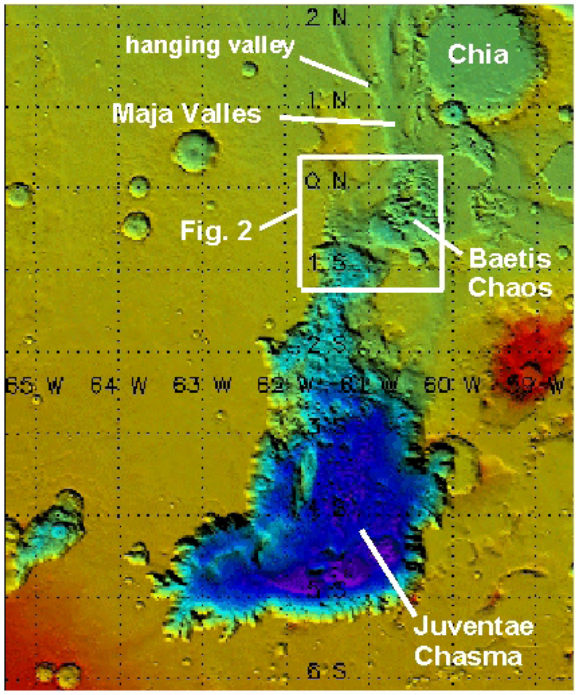


Fig. 1. Location map of Juventae Chasma, Maja Valles, and Baetis Chaos.

The spillover channel and the northern margin of Juventae are truncated by Baetis Chaos (Fig. 2), which is 60 km wide W to E. Genesis of this chaos may have been triggered by deep fluvial incision during the spillover flooding from Juventae, initiating groundwater outflows that added to the discharge (cf. [3]). An inner channel (Fig. 2) leads directly into the lowest point on the chaos floor, which has an elevation of –638 m. The inner channel reveals that a final spillover of greatly reduced discharge rate occurred at an elevation of ~0 m. Subtracting this elevation from the initial spillover elevation indicates that a lake water column ~1180 m deep was drained by the flooding. Discharge could have continued from Baetis Chaos after the spillover ceased.

Most of the margin of Baetis Chaos stands at elevations of about 1000 m, indicating a maximum chaos depth of 1600 m. The 15-km-wide channel of Maja Valles emerges from the northern end of Baetis Chaos (Fig. 1). Just west of Chia Crater the channel splits into two valleys

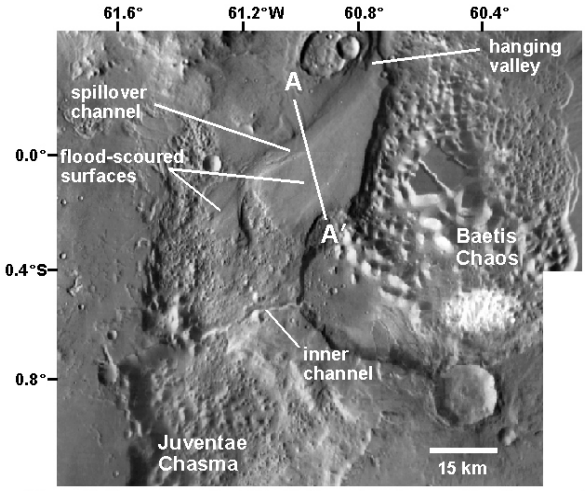
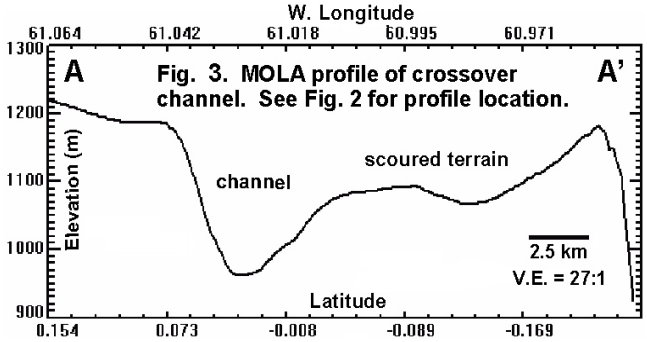


Figure 2. Source area for Maja Valles. Flood-scoured surfaces mark minimum elevations for the initial overflows (i.e., 1180 m). THEMIS Daytime IR Mosaic (Christensen et al. http://themis-data.asu.edu/).

that continue northward for hundreds of km. The western channel is a hanging valley (Fig. 1) where it diverges from the main channel, which is >200 m deeper. The greater depth of the main channel indicates that it incised more quickly and eventually captured all of the flow, causing flooding to cease in the western channel. Chia Crater was inundated by the Maja flooding, as indicated by notches eroded in its western rim.

Chapman et al. [2] examined Juventae Chasma, its interior layered deposits, and Maja Valles. They concluded that if the layered deposits represent sub-ice volcanoes, then at least two periods of flooding and deposition occurred. *Chapman et al.* [2] observed depositional bars with mega-ripples (MOC image M15-00976) on the floor of the western channel of Maja Valles, demonstrating that catastrophic floods carved the Maja channels because mega-ripples are not produced by other surface processes such as debris flows or glacial erosion. Since the western channel is a hanging valley, these mega-ripples were likely formed by the earliest overland flows. Chapman et al. [2] used MOLA data to construct a topographic profile across Maja Valles in the area southwest of Chia Crater where overland flooding was relatively narrow and the channels are well defined. Using floodwater depths of 440 and 589 m they estimated maximum discharges of 2×10^8 to 4×10^8 m^3/s. They also concluded that discharges up to 10^6 m^3/s may be more realistic given that bank-full floods rarely fill valleys [cf. 4].

Our interpretation of a former lake in Juventae Chasma is consistent with geochemical evidence for past aqueous activity in the Valles Marineris canyons. *Gendrin et al.* [5] present several interpretations for the origin of abundant sulfates in the canyons and associated chaotic terrain, including alteration of mafic minerals by acidic precipitation, evaporation of standing water bodies, or by the seepage of hydrothermal brines. *Catling et al.* [6] considered an evaporite origin for the light-toned layered deposits in Juventae to be inconsistent with evidence that the deposits were being exhumed from beneath chaotic terrain. They dismissed a volcanic origin based on the abundance of gypsum as inferred from spectroscopy data from the Mars Express OMEGA instrument.



Conclusions: Regardless of the origin of the light-toned layered deposits, consistent with [2] we find clear evidence that a lake, probably ice-covered, existed in ancestral Juventae Chasma and that the water eventually overflowed and eroded the northern canyon wall, triggering the formation of Baetis Chaos and carving Maja Valles. The present-day floor of Juventae Chasma has a low point at −4400 m. Given the initial overflow elevation of 1180 m, if any part of the ancestral canyon was as deep as it is now, a former lake with a depth >5 km would have been present.

References: [1] Tanaka, K. (1997), *JGR*, 102, 4131-4150. [2] Chapman, M., Gudmundsson, M., Russell, A., and Hare, T. (2003), *JGR*, 108, doi:10.1029.2002JE002009. [3] Coleman, N. (2005), *JGR*, 110, doi:10.1029/2005JE002419. [4] Wilson, L., Ghatan, G. J., Head, J. W., and Mitchell, K. L. (2004), *JGR*, 109, doi:10.1029/2004JE002281. [5] Gendrin, A., et al. (2005), *Science*, 307, 1587-1591. [6] Catling, D. C., et al. (2006), *Icarus*, 181, 26-51.