WALLA WALLA VALLIS AND WALLULA CRATER: TWO RECENTLY DISCOVERED MARTIAN FEATURES RECORD AQUEOUS HISTORY. C. L. Dinwiddie,[1] N. M. Coleman,[2] and M. Necsoiu[1], [1]CNWRA, Southwest Research Institute, San Antonio, TX (cdinwiddie@swri.edu and mnecsoiu@swri.edu), [2]U.S. NRC (nmc@nrc.gov).

Introduction: At least three Hesperian era outflow channels sourced by the pits of Ophir Catenae [name provisionally approved by the International Astronomical Union (IAU)] occur in Ophir Planum and Aurorae Planum to the west and south of Ganges Chasma [1,2]. Here we discuss the most recently discovered outflow channel, Walla Walla Vallis (name provisionally approved by the IAU), which was unresolved until return of THEMIS images began in late 2002. These channels provide evidence that Hesperian lakes may have existed in ancestral canyons of the Valles Marineris [2].

Average planetary surface elevations decline over the approximate 750 km distance between the rims of Candor Chasma and Ganges Chasma, while the aligned Ophir Catenae pit chains are observed to extend over the same expanse (Fig. 1). The regional topographic slope between these two chasmata would have favored easterly migration of groundwater and, if the surface expression of pit chains indicates dilational faulting with the same general orientation [3], this subsurface structure would also serve to enhance groundwater flow in the same direction.

Regional Context: East of Ophir Cavus (name provisionally approved by the IAU), the oblong pit source of Allegheny Vallis, lies the pit chain that spawned the outflow channel Walla Walla Vallis (Fig. 2). Like Ophir Cavus, the source of this channel (at 2525 m above the datum) is far above the 1500 m threshold for receiving contributions from polar basal recharge [1,2] so its flow could not have derived from a globally connected aquifer [2,4]. Rather, regional recharge and a regional aquifer were needed [1,2]. The erupted floodwaters followed the natural topographic relief down into Wallula Crater (name provisionally approved by the IAU) located 2 km to the north. Wallula Crater is a subdued Noachian era feature located near 9.88˚S, 54.66˚W. It is approximately 12.2 km in diameter. The map by [5] indicates that the terrain upon which Wallula Crater and Walla Walla Vallis are superimposed consists of unit Npl_1 (cratered unit of the Plateau sequence).

Walla Walla Vallis: The water that carved Walla Walla Vallis erupted from terrain at an elevation of ~2525 m (Fig. 3). The flow probably discharged from beneath a thick cryosphere through a deep-seated dilational fault system within the Ophir Catenae complex. Collapse pits [3] formed at the source during or after the fluvial episode as surface material either dropped into subsurface cavities or was carried away with the flow of water. Walla Walla Vallis is observed to have eroded a course north-northwestward across Wallula Crater (base elevation ~2400 m). Given possible shorelines faintly visible in Fig. 2, ponded water may have accumulated in Wallula Crater until it breached or overtopped the crater's northwestern rim through a weak point or topographic low.

Beyond Wallula Crater, Walla Walla Vallis extends north-northwestward from the crater outlet and appears to terminate as a hanging valley (Fig. 2), cut-off by a later erosional channel with an ambiguous origin. We propose two possible interpretations for this additional channel (Fig. 4). First, THEMIS image V02312003 (Fig. 2) suggests that some water may have ponded in a small semicircular depression to the west of the Walla Walla Vallis outflow point on the northwest side of Wallula Crater. There appears to be a secondary outflow point originating on the western edge of this depression, leading to the inferred flowpath of Fig. 4A with the assumption that this channel also had the Walla Walla Vallis pit chain as its source. Alternatively, other THEMIS images suggest the possibility that water originating in Ophir Cavus may not have flowed only to the north, forming Allegheny Vallis, but may have flowed also to the southeast, leading to the inferred flowpath of Fig. 4B. Either way, this additional channel appears to be younger than the main (or only?) channel of Walla Walla Vallis, and THEMIS images suggest that this second channel may merge with Allegheny Vallis to the north. Thus, the Walla Walla Vallis floodwaters may have coincided with the discharge from Ophir Cavus and contributed to the total discharge through Allegheny Vallis. In-depth analysis of day/night IR THEMIS data is underway to establish superposition relations at the juncture between Allegheny Vallis and the second channel. The day/night images have dramatically different appearances, allowing the separation of albedo and thermal inertia effects. The channel relationships will be further resolved with a high-resolution digital elevation model using MOLA topographic data for this region, providing definitive answers to these provocative questions.

References: [1] Carr M.H. (2002) *JGR, 107,* doi: 10.1029/2002JE001845. [2] Coleman N.M. et al. (2003) 6th Intl. Conf. on Mars, Abstract #3071. [3] Wyrick D.Y. et al. (2003) *LPSC XXXIV,* Abstract #2025 [4] Clifford S.M. and Parker T.J. (2001) *Icarus, 154*, 40–79. [5] Witbeck N. et al. (1991) USGS Misc. Invest. Series Map I-2010.

Disclaimer: An employee of the U.S. NRC made contributions to this study on his own time apart from regular duties. NRC has neither approved nor disapproved the technical content of this abstract.

Figure 1. Context image for the Ophir Catenae region that lies between Candor Chasma to the west and Ganges Chasma to the east. MOLA topographic imagery for the Coprates MC-18 Quadrangle. Map Credit: USGS Astrogeology Research Program (http://planetarynames.wr.usgs.gov/mgrid_mola.html).

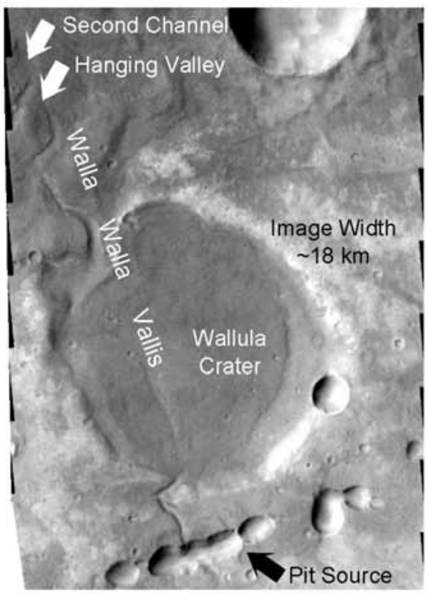

Figure 2. Walla Walla Vallis was sourced by a pit chain located at the bottom of the image (THEMIS image V02312003). The floodwaters that erupted to carve Walla Walla Vallis entered Wallula Crater and eroded a north-northwest trending channel. Image credit: NASA/JPL/Arizona State University (http://themis-data.asu.edu/).

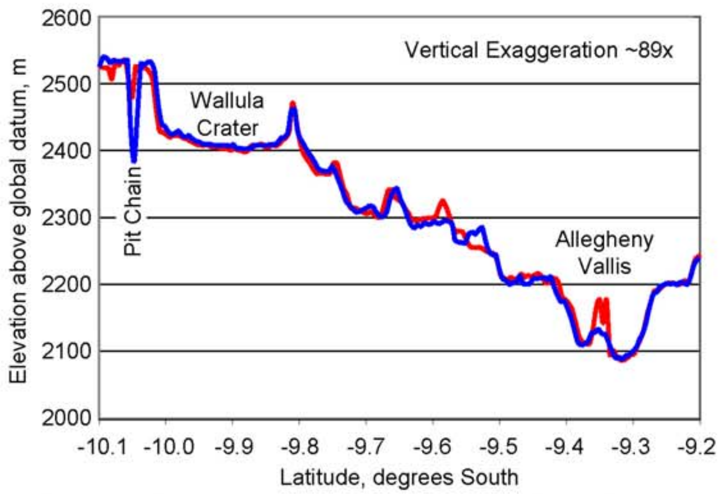

Figure 3. MOLA topographic profiles from Pass 1793 (red) and ap10452l (blue) crossing the pit source area for Walla Walla Vallis, Wallula Crater, and Allegheny Vallis. Data for MOLA Pass 1793 and ap10452l are available at http://wufs.wustl.edu/missions/mgs/mola/.

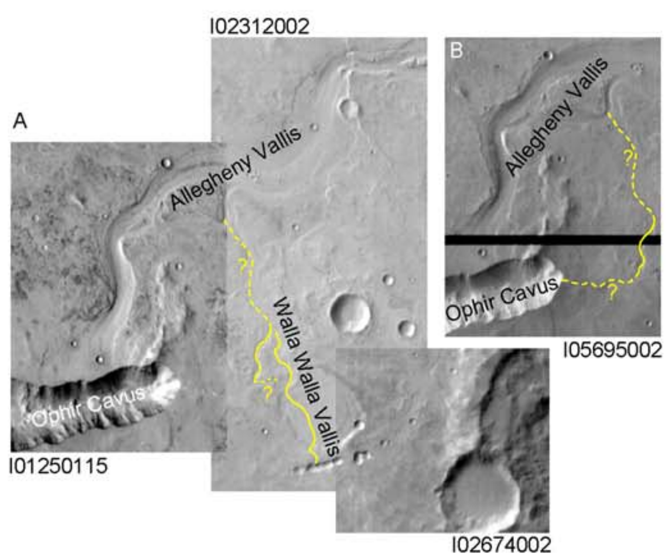

Figure 4. Two possible interpretations for channel between Wallula Crater and Allegheny Vallis: Incised channel is sourced by (A) the pit chain south of Wallula Crater and resulting ponded waters within the crater or (B) waters originating from the southeastern edge of Ophir Cavus. Either way, this channel may merge with Allegheny Vallis to the north. Credit for images (widths ~32 km) due to NASA/JPL/Arizona State University (http://themis-data.asu.edu/).