THE GEDIZ VALLIS SYSTEM IN GALE CRATER ON MARS: HIRISE VIEWS OF THE INVERTED CHANNEL.

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Introduction: Gale is a 154 km diameter crater that formed near the dichotomy boundary (5.3°S, 137.7°E) around or after the time of the Noachian-Hesperian transition [e.g., 1, 2]. The rim of Gale is locally dissected by valleys, several of which terminate in alluvial fans or deltaic deposits on the interior crater walls or floor [e.g., 2-6]. Several canyons, most notably Gediz and Sakarya Valles, incise into the present-day form of Aeolis Mons (Mt. Sharp) in the middle of Gale crater [e.g., 7, 8]. As part of the Mars Science Laboratory extended mission, *Curiosity* is soon to explore Gediz Vallis and associated deposits.

Overview of the Gediz Vallis System (GVS) (Fig. 1): Gediz Vallis is a degraded valley on the north slope of Mt. Sharp that is ~800 m-wide, ~75 meters deep [8] and ~10 km long [7]. A ridge on the floor of Gediz Vallis is interpreted to be a fluvial and (or) debris flow channel deposit that now stands in positive relief due to subsequent differential wind erosion that is inferred to have removed finer grained material at its margins. The ~100 m-wide, ~2.1 km long inverted channel deposit on the floor of Gediz Vallis is confined by channel banks in the upper reaches of the valley [8]. The height of the inverted channel relative to the surrounding terrain varies from ~5 to ~70 meters [8]. At the distal end of the inverted channel, the landform transitions into the broader Gediz Vallis ridge that crosses the Greenheugh pediment.

The significance of the GVS. Analysis of sedimentary outcrops by *Curiosity* confirmed the presence of long-lived fluvial and lacustrine environments within Gale [9]. As *Curiosity* climbs Mt. Sharp, the rover is acquiring detailed views of the inverted channel within Gediz Vallis [10] that may have been associated with a larger fan deposit [e.g., 2, 8, 11-13]. The planned Mt. Sharp ascent route (MSAR) will provide the first opportunity to study a large, relict channel deposit that likely provides a late-stage record of the geologic history of Gale. This is possibly related to the timing of late fluvial activity on the upper Peace Vallis fan [e.g., 5] and may correlate to a widespread episode(s) of late alluvial fan formation on a global scale [14]. The nature of these Gediz Vallis deposits and their relationship to other landforms will provide insight into the late-stage climate and habitability of the planet. We give an overview of the Gediz Vallis system and HiRISE views of localities that will help address our key questions and working hypotheses.

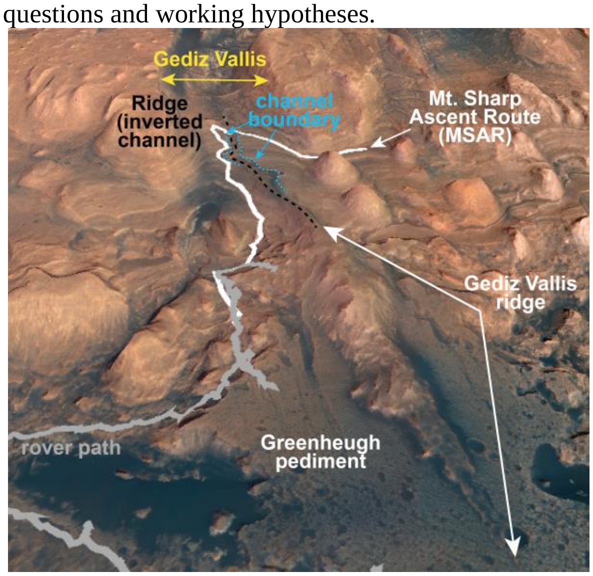

Fig. 1. HiRISE imagery draped over topography (2X vertical exaggeration) showing the context of the GVS that originates along the northern slope of Mt. Sharp. Perspective view looking toward the south.

Questions and Hypotheses Related to the GVS: *Curiosity's* payload will be used to determine the nature, origin, and evolution of the GVS. In particular, the inverted channel likely provides evidence for late-stage aqueous processes within Gale crater that is accessible by the rover, permitting the opportunity to investigate significant environmental changes preserved in the geologic record.

Key Questions to Guide Exploration. What process(es) were involved in the formation and modification of the GVS and what was the role, amount, and duration of water? What was the associated climate and depositional environment, and how did that evolve over time?

Working Hypotheses. (1) The inverted channel deposit is a valley floor deposit in which the active channel at times of deposition was narrower than the valley floor of the modern day Gediz Vallis. (2) Sediment in the inverted channel was derived from wind driven canyon wall retreat and landslides in the source basin. (3) Downstream sediment transport occurred by debris flow, streamflow, and (or) sheetflood processes. (4) Variations in channel form (e.g., apparent downcutting and vertical offsets along the axis of the ridge surface) relate to changes in depositional style and (or) environment over time. (5) Transient lakes may have influenced the baselevel of the deposit [6]. (6) Sediment infilling the exit channel occurred during final phase of sediment transport. (7) The GVS represents an example of a late-stage habitable environment in Gale.

HiRISE Views of the Inverted Channel: The proposed MSAR takes *Curiosity* along and near the eastern flank of the inverted channel (**Fig. 2a**). The distal end of the inverted channel, where it connects with the broader Gediz Vallis ridge, is an important locality to assess the stratigraphy and internal features that can aid our understanding of the geologic history and relative importance of various processes (e.g., fluvial, lacustrine, aeolian) involved in the evolution of the GVS (**Fig. 2b**). Variations in the topographic expression and morphology of the present-day inverted channel may be related to erosion, and (or) may indicate distinct depositional units and (or) changes in the style of deposition. For example, apparent increases in downstream downcutting (**Fig. 2c**) may indicate a change in discharge or depositional environment (e.g., change in paleolake levels as suggested by [6]).

Future Measurements and Observations: The nature of the contacts within the Gediz Vallis channel (as well as contacts with the underlying and surrounding units), layering, stratification, cross stratification, sorting, grading, imbrication, grain size, degree of induration, variations along strike and down dip, evidence for channels, textures, rounding or angularity of clasts, and chemistry and mineralogy of matrices and clasts, will be assessed using *Curiosity's* payload. Taken together, these observations and measurements can inform the role of aqueous (or other) processes and style and timing of deposition (e.g., Are deposits clast supported? Does the channel deposit indicate there were one or multiple distinct depositional events?).

References: [1] Le Deit et al. (2013). JGR, doi.org/10.1002/2012je004322 [2] Thomson et al. (2011). Icarus, doi.org/10.1016/j.icarus.2011.05.002 [3] Anderson and Bell (2010). Mars 5, doi:10.1555/mars.2010.0004 [4] Grant et al. (2014). GRL, doi.org/10.1002/2013GL058909 [5] Grant and Wilson (2019). GRL, doi.org/10.1029/2019GL083444 [6] Palucis et al. (2016). JGR, doi:10.1002/2015JE004905 [7] Hughes et al. (2022). JGR, doi.org/10.1029/2021JE006848 [8] Bryk et al. (2019), LPSC #2263. [9] Grotzinger et al. (2015), Science, doi:10.1126/science.aac7575. [10] Davis et al. (2023). LPSC [11] Malin and Edgett, (2000). Science, 290, 1927-1937. [12] Thomson et al. (2008). LPSC #1391. [13] Fraeman et al. (2016). JGR, doi.org/10.1002/2016JE005095 [14] Wilson et al. (2021), GRL, doi.org/10.1029/2020GL091653

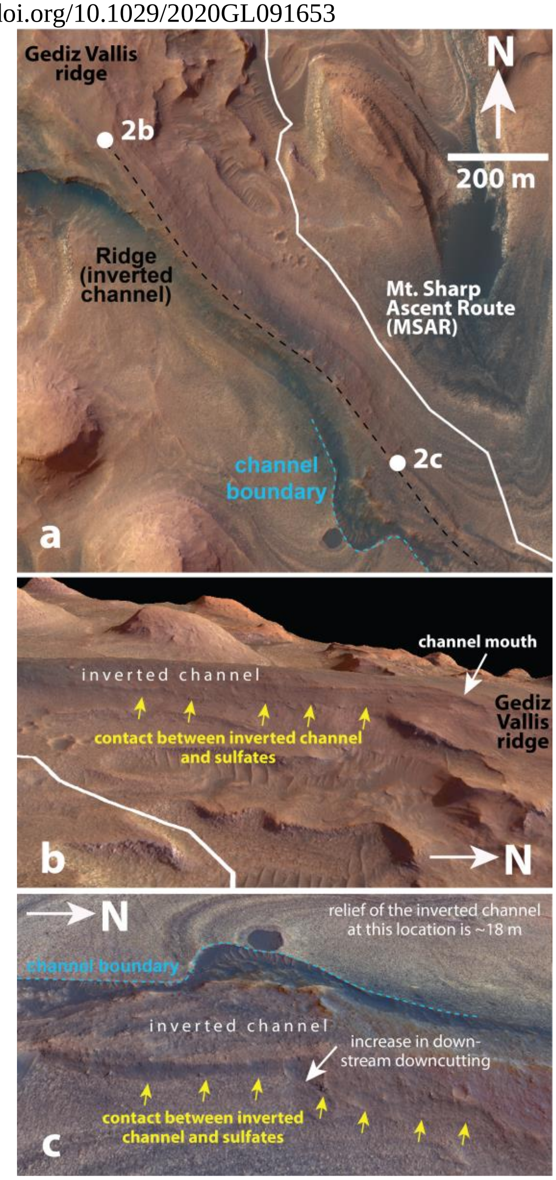

Fig. 2. **a**) The MSAR permits examination of the eastern margin of the inverted channel. **b**) The stratigraphic relationship between mouth of the coarsely layered inverted channel and the GV ridge is an important locality to understand the evolution of the GVS. The contact between the apparent base of the inverted channel and underlying layered sulfates is visible in several locations. **c**) Channel downcutting may indicate changes in discharge or environmental conditions.