

Looking Towards Curiosity's Canyon Path: a 4 km Sequence of Gully, Debris Deposits, and Fan/deltas which are Bordered by a Sloping Bedform-capped Plain and Crossed by Lake Shorelines. W. E. Dietrich¹, M. C. Palucis¹, T. Parker², D. Rubin³, M. A. de Pablo⁴, D. Z. Oehler⁵, and N. T. Bridges⁶. ¹Department of Earth and Planetary Science, University of California, Berkeley, CA, bill@eps.berkeley.edu and mpalucis@berkeley.edu, ²Jet Propulsion Laboratory, Pasadena, CA, timothy.j.parker@jpl.nasa.gov, ³U.S. Geological Survey, Santa Cruz, CA, geology.dr@gmail.com, ⁴Univers. de Alcalá, Spain miguelangel.depablo@uah.es, ⁵Johnson Space Center, Houston, TX, dorothy.z.oehler@nasa.gov, ⁶Appl. Physics Lab, Laurel, MD, nathan.bridges@jhuapl.edu.

Introduction: The Curiosity Rover is headed towards layered outcrops that appear to be rich in phyllosilicates and sulphates [1] with the expectation of an eventual ascent up Mt. Sharp. One likely will take the rover up a well-defined canyon. Inspection of CTX and HiRISE imagery and topography (5 m contour intervals) reveal a rich geomorphic sequence that may be encountered during the journey.

Observations: Figure 1 shows an oblique view of Gale, possible lake shorelines based on previously observed delta forms [2] and the location of the canyon. Figure 2 is a map of the geomorphic features. The sequence is about 4 km long and begins with a gully which has cut an ~1 km long slightly sinuous path along a ~11% slope. The incised gully transitions to a boulder-rich crudely stratified deposit (Figures 3-6) that forms a relatively narrow ridge (roughly 5% slope) that spreads downslope 650 m (green outline Figure 6). The transition from gully to deposit is roughly coincident with an inferred lake level (Figure 2). The deposit in turn transitions to a wider, steep-sided deposit, which appears to spread and radiate topographically into a fan/delta-like form (red shading Figure 6). The front of this deposit corresponds to an inferred paleolake level (Figure 2). The front descends about 120 m over about 500 m to a lower distinct delta form etched with what appears to be inverted distributary channels (orange shading Figure 6). The delta slope is 10%. The lowest deposit (yellow shading Figure 6) extends another 540 m and may preserve strata deposited by large-scale bedforms. This sequence is bordered by a nearly uniformly sloping plain (about 13% slope) distinctly etched with strata deposited by well-defined regularly spaced bedforms.

Interpretations: The slope, boulder abundance and crude stratification suggest that the deposits exiting the gully were transported by debris flows. There appears to be a stacked sequence of fan/delta deposits from oldest at the lowest elevation and progressively younger towards the gully. Two of the transitions correspond to previously mapped paleolake levels. If this is a backstepping sequence it provides key evidence of a history of rising lake levels that occupied Gale Crater.

References:

- [1] Milliken R.E. et al (2010) *GRL*, 37, L04201.
[2] Dietrich W.E. et al. (2013) *LPSC XLIV*, #1844. [3]

Figures:

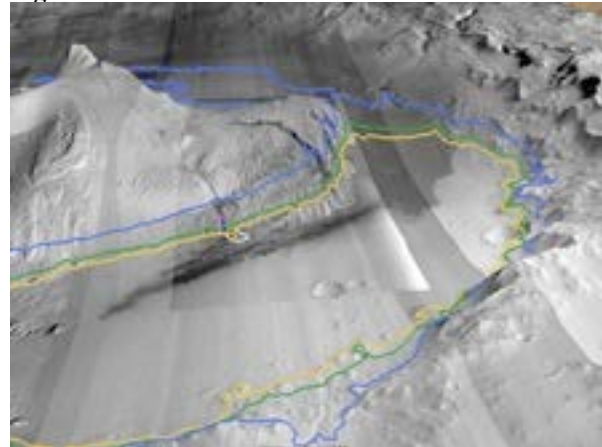


Figure 1: Yellow, green and blue lines mark the elevations that match delta forms that would be associated with paleo-lakes [2]. Multicolored lines mark fan/delta features off of Mt. Sharp shown in Fig 2.

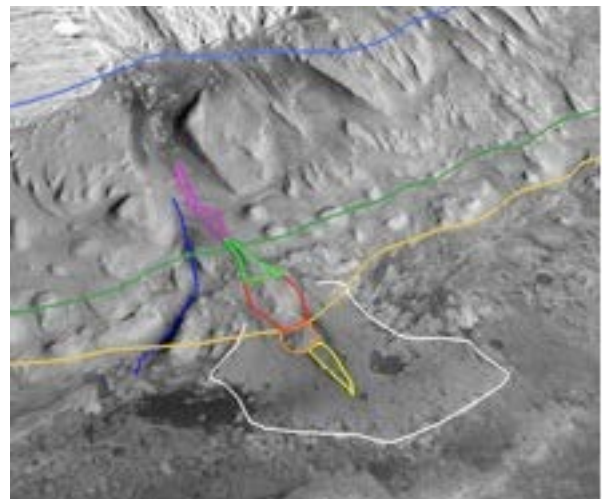


Figure 2: Geomorphic map of canyon. The yellow and green lines correspond to possible delta heights to the west shown in Fig 1.. The magenta line outlines a gully and the blue line might mark a former channel path. The green-red-orange-yellow outlines mark a succession of fan/deltas. The white line outlines a uniformly sloping surface capped by strata deposited by bedforms. Figures 1 and 2 are based on CTX data displayed by Google Earth.

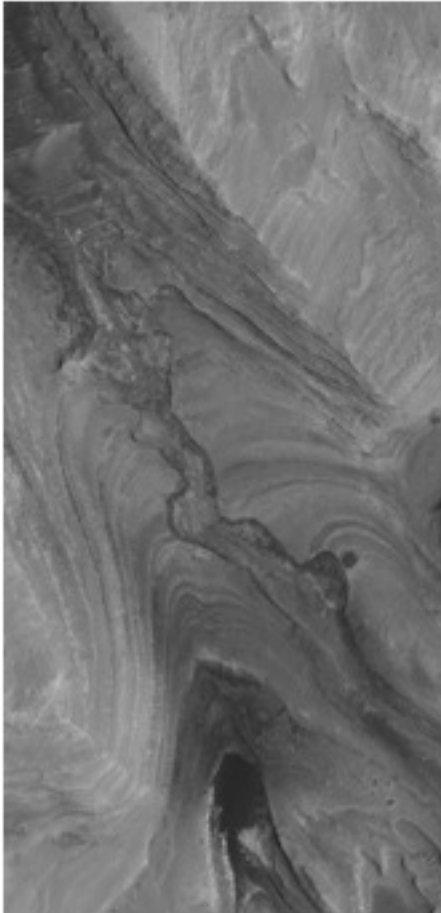


Figure 3: A close-up of the feeder gully (HiRISE ESP_019988_1750_RED)

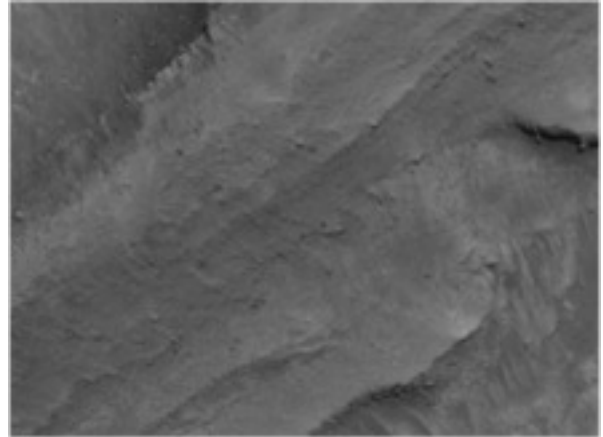


Figure 4: HiRISE ESP_019988_1750_RED showing boulder deposit at the downstream end of the gully that leads to the first of the four possible fan/deltas.

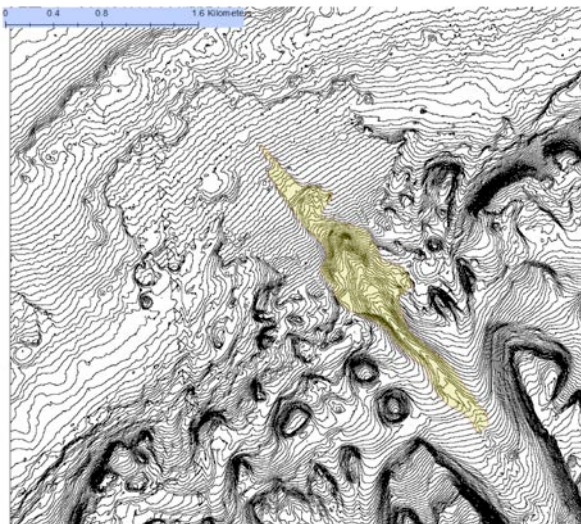


Figure 5: 5 m contour interval map of canyon and distal deposits (sequence of fan/deltas shown in Figure 6 highlighted in yellow here). North is towards top of map. Derived from HiRISE imagery.

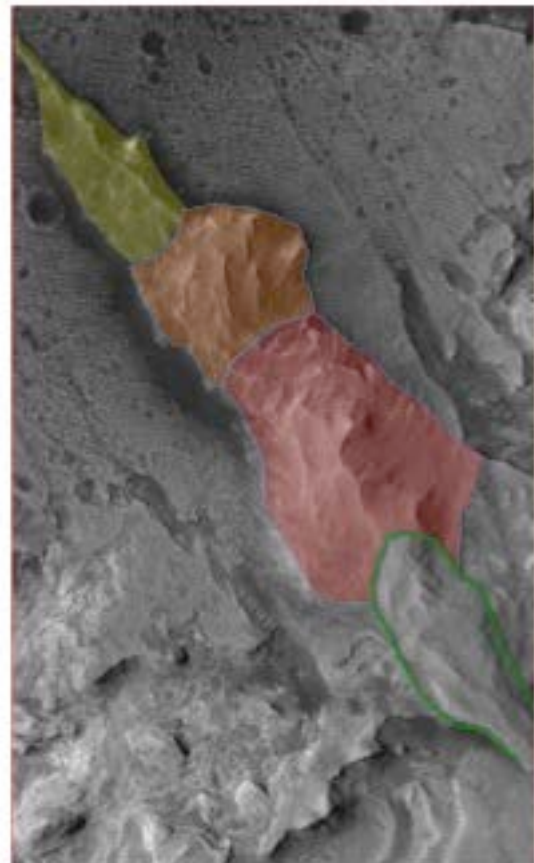


Figure 6: Four distinct depositional phases that may record fan/delta deposits, color-coded from apparently oldest (yellow) to youngest (outlined in green). Sharp curving ridges may record distributary channels.