THE SEDIMENTARY STRUCTURES AND DEPOSITIONAL HISTORY OF IRESON HILL, GALE CRATER, MARS. J. M. Comellas[1], H. E. Newsom[1], G. S. Weissmann[1], L. A. Scuderi[1], Z. E. Gallegos[1], R. C. Wiens[2], J. C. Bridges[3], S. Banham[4], C. H. Seeger[5], P. J. Gasda[2]. [1]Earth and Planetary Science Dept., Institute of Meteoritics, Univ. of New Mexico, Albuquerque, NM, U.S.A. (jcomellas@unm.edu). [2]Los Alamos National Laboratory., NM. [3]Space Research Centre, University of Leicester, UK. [4]Imperial College London, UK. [5]Western Washington University, Bellingham, WA, U.S.A.

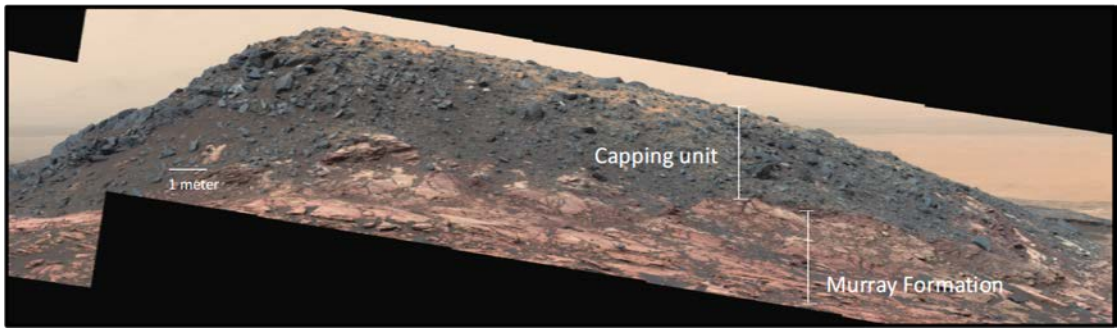

Fig 1. Mastcam Image of Ireson Hill from the East, mcam0812, Sol 1598

Introduction: Ireson Hill is located along the Mars Science Laboratory (MSL) Curiosity Rover's traverse path south of the Murray Buttes. It has a unique sedimentary structure and is isolated from other similar buttes, suggesting it may have experienced a different depositional and erosional history than the surrounding area.

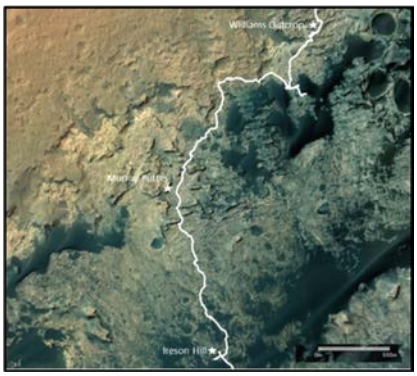

Fig 2. Curiosity Rover traverse through Gale Crater between Sols 1085 and 1609 marked with the locations of Ireson Hill, Murray Buttes and William's Outcrop.

The Curiosity Rover gathered data and images of Ireson Hill between Sols 1538 and 1610, capturing a series of images from the long distance ChemCam RMI mosaic and proximal mosaics of over 270º of the butte. Orbital HiRISE imagery and Curiosity imagery was used to determine the overall nature and physical structure of Ireson Hill providing insights into the local geologic history.

The purpose of this research is to (1) evaluate the sedimentary structures and depositional environments of the underlying Murray Formation and the blocky capping unit of Ireson Hill, (2) the nature of the contact between them and (3) the properties making Ireson resistant to erosion.

Sedimentary features observed at Ireson Hill were compared to those of other sites within the Curiosity Rover's traverse that have been previously studied and characterized. The areas of significant interest to this study are the Murray Buttes and the Williams Outcrop described by Banham et al. [1] due to their similarities and relatively close position to Ireson Hill.

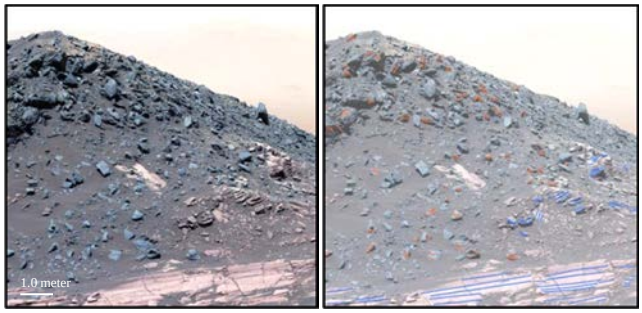

Fig 3. Mastcam images of Ireson Hill along with interpretations of the laminations, cross bedding and major bounding surfaces. Left: SE Side of Ireson hill (sol 1598, mcam08138). Right: Laminations and cross bedding of the Murray Formation shown in purple. Laminations and cross bedding of the capping unit shown in orange.

Methods: The images and measurement data included in this Ireson Hill research were sourced from the Jet Propulsion Laboratory (JPL) public website, MSL Curiosity Analyst's Notebook, MSL's Web GIS

and JPL's OnSight 3D virtual reality tool. Malin Space Science Systems website provides access to complete Mastcam mosaics of Ireson Hill. Digital Elevation Models (DEMs) taken by HiRISE were sourced from University of Arizona's HiRISE website for the creation of interactive maps and representations of the study area with ArcGIS.

Laminations, cross bedding and major bounding surfaces were outlined in Adobe Illustrator on individual Mastcam images to create a visual representation of the nature of the rock (Fig 3).

Results: Ireson Hill is a relatively isolated feature. It stands about 1000 m south of the Murray Buttes and its base is 60 m above the Murray Buttes in elevation. The contact between the Murray Formation and the overlying capping unit appears to dip 10 degrees to the north when observed from the east (Fig 1) and 5 degrees to the southwest when observed from the southeast.

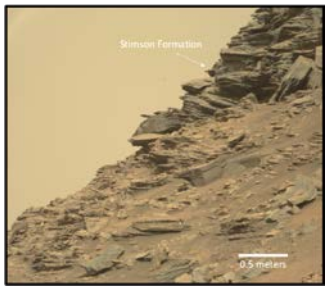

Fig 4: Mastcam image of a Murray Butte showing the Stimson Formation from Sol 1450.

Discussion: Based upon comparisons of Mastcam imagery of the Murray Buttes, the capping unit of Ireson Hill has very similar sedimentary structures to the Stimson Formation that makes up the Murray Buttes (Fig 4). Although the capping unit of Ireson Hill is broken into blocks ranging in size from approximately 0.01 m to 1.3 m, similar cross bedding and lamination thicknesses were observed (Fig 5). Structurally, however, the Murray Buttes do not share most of the same features as Ireson Hill. The pedestal of Murray Formation that the capping unit sits upon is not present in any of the Murray Buttes. This pedestal was measured to be 1.5 m in height on average around the hill. While the blocks of Stimson formation on the Murray Buttes are in situ and easily distinguished, the exposed surface of the capping unit of Ireson Hill mainly consists of shattered and disrupted material, so we could not consistently determine the lamination and dip angles of the original deposition.

The chemical compositions of float rocks from the capping unit of Ireson Hill were investigated. As discussed by Bowden et al., the float rock Perry, thought to come from the hill, resembles the Stimson Formation visually and compositionally [3]. However, the float rock, Pogy, has an unusual crystalline texture and composition that does not resemble Stimson formation [3].

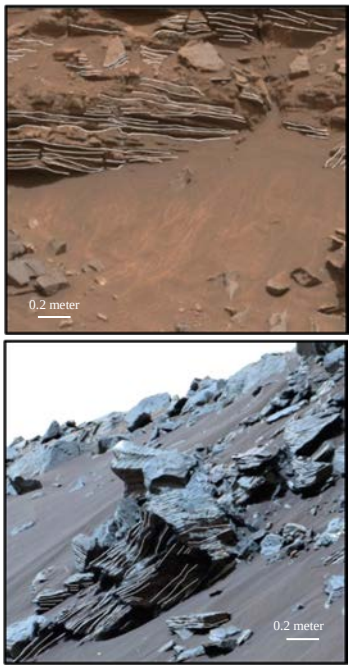

Fig 5: Comparison of a Mastcam image of a Murray Butte showing the Stimson Formation from Sol 1455 (top) and a Mastcam of the capping unit of Ireson Hill from Sol 1600 (bottom). Laminations and cross bedding shown in white.

Conclusion: Ireson Hill is an isolated butte that has resisted erosion. Its capping unit primarily consists of eolian Stimson Formation that also caps the Murray Buttes. The contact between the two units represents a long unconformity, possibly millions of years long, and a change in climate and environment.

The contact between the units of Ireson Hill dips about 10 degrees to the North towards the Murray Buttes, and closely aligns with the base of the Stimson Formation at the Murray Buttes. This, as well as its similar sedimentary structure, is an indication of the Stimson Formation being present on Ireson Hill.

The disrupted blocks and Murray pedestal are indications that Ireson Hill experienced a different erosional history than the Murray Buttes. The fact that Ireson Hill is much smaller also supports this conclusion. It is possible that Ireson Hill is the remnant of a landscape similar to the current Murray Buttes. The chemistry of exotic float materials identified by Bowden et al. [3] at the base of Ireson Hill may possibly be associated with the resistance of Ireson Hill to erosion.

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References: [1] Banham et al. (2018) Sedimentology, v. 65: 993-1042. [2] Wiens et al. (2019) in preparation. [3] D. L. Bowden, J. C. Bridges, et al. LPSC this meeting.