LENSOID BODIES WITHIN THE MIRADOR FORMATION, GALE CRATER – GEOCHEMISTRY AND IMPLICATIONS FOR DEPOSITIONAL ENVIRONMENT AND TIMING.
C.D. O'Connell-Cooper[1 *], L.M. Thompson[1], J.G. Spray[1], R. Gellert[2], W.E. Dietrich[3], S. Gupta[4], N.I. Boyd[2], J. Berger[5], M. McCraig[2], S.J. VanBommel[6], A. Yen[7]. [1]University of New Brunswick, Fredericton, NB, Canada, (oconnell.cooper@unb.ca). [2]University of Guelph, ON, Canada. [3]University of California, Berkley, CA. [4]Imperial College London, UK. [5]Jacobs-JETSII at JSC, Houston, TX. [6]Washington University in Saint Louis, MO. [7]JPL-Caltech, Pasadena, CA.

Introduction: In early 2022, *Curiosity* investigated a series of lenticular bodies within the Mirador formation (MDf), Gale crater (Fig. 1B). These are of interest as they appeared to represent localized changes in environment, interstratified within the MDf, concentrated in the upper MDf. An in-depth study of a large (≈18 m long, ≈0.5-1 m thick) [1] well-preserved lens body ("The Prow") and a smaller body ("Panari") (elevation -3955 m) facilitated in situ analysis across the lens. A brushed surface was analyzed at "Issano", the highest lenticular body identified (elevation -3916 m) (Fig. 1). The Prow (and by inference, other lenses) exhibits markedly different chemistry to the MDf and the Mount Sharp Group (Gp). This abstract compares the lenses to the Mount Sharp Gp. This includes data up to, and including, the Avanavero (AV) drill site (elevation -3909 m) (Fig. 1A).

Depositional setting – CSf & MDf: The cross-stratified members of the MDf [*Dunnideer*, *Port Logan*, *Contigo* mbrs] are interpretated as eolian, comprising large, migrating dunes in a dry environment [1]. This represents a significant change in environmental conditions from the underlying Carolyn Shoemaker fm (CSf). The CSf (*Knockfarril Hill*, *Glasgow*, *Mercou*, *Pontours* mbrs) is interpreted as fluvio-lacustrine, predominantly mudstones with interstratified sandstones [e.g., 1-2]. The transition from fluvial-lacustrine to eolian deposition is obscured by a strong diagenetic overprint in the uppermost CSf [*Pontours* mbr] and a weaker overprint in the lowermost MDf [*Dunnideer* mbr]. In contrast to the dry dune setting of the MDf, the Prow shows evidence of deposition under aqueous conditions, interpreted as episodic interdune or transient small standing bodies of water within a predominantly dry environment [1, 3].

Chemistry – Mt Sharp Gp: Similarities between the two fluvio-lacustrine Mt Sharp formations (Murray formation (Mf); CSf) have been noted previously [4]. Although the MDf marks a change from fluvio-lacustrine to an eolian environment, APXS sees a broad similarity in elemental chemistry for the CSf and MDf. Looking at brushed (non-dusty, primary bedrock) samples only (Fig. 2), the MDf shows enrichment, relative to CSf (enrichments/depletions defined herein as "% change >10%") in P_2O_5, CaO, MnO (*x*12-14%) but a decrease in K_2O (*x*11%), Zn, Cl (*x*33-37%), and Br (*x*71%). All other elements show <10% change in mean concentrations, indicating a broad degree of similarity between formations. However, localized enrichments in diagenetic features (e.g., in Mg, Zn, Mn, P, S) are not reflected in these figures.

Chemistry – The Lens: Figure 2 shows lens targets and other units ratioed to mean Mount Sharp Gp. Relative to Mt Sharp Gp, the lenses are enriched in Ni (*x*16%), Mn (38), Mg, Zn (*x*23-28%) Cl (32), Br (*x*71%) but depleted in K (*x*35%) and Cr (*x*25%). Similar enrichments (Mn, Mg, Cl, Zn, Ni, Br) and depletions (K, Cr) are identified in the lenses, relative to the Contigo mbr and MDf. Similarly, enrichments relative to sands/soils are identified in the lens for Cl, Zn, Ni (*x*56-76%) and Br (*x*97%), and depletion in Cr (*x*91%). However (in contrast to the Mt Sharp relationship), the lenses are enriched (relative to sand/soils) in K (*x*28%), but depleted in Ca, Mg (*x*15-22%).

Discussion: The lenses are interpreted as interdune pools of standing water [1]. Their markedly different chemistry to the surrounding MDf and overall Mt Sharp Gp is interpreted here as a change in primary material, rather than resulting from later alteration.

The similarity in geochemical signature throughout the Mt Sharp Gp, incorporating both fluvio-lacustrine (Mf, CSf) and eolian (MDf) environments, was noted above. In contrast, there are marked chemical differences between the eolian Stimson and MDf, both of which are interpreted as ancient dune fields. This suggests that the dune fields of the MDf were sourced from similar material to the Mt. Sharp Gp, rather than a primary basaltic source as seen in the Stimson.

Whilst Fe/Mn ratios for the Mt Sharp Gp are ≈75 (Fig. 3A), those for the lenses (≈48) are similar to modern basaltic sands/soils and the lithified dunes of the basaltic Stimson formation [5] (≈45-52). The similarity in Fe/Mn ratios between the lenses and the basaltic units (both modern and ancient) indicates a basaltic component in the lenses, not present in the MDf.

This could result from an influx of sands/soil ± dust, mixing with MDf sediments in a pool of water. Mean Mn, Fe, Mg, Ca, Na, Ti, K, and P concentrations for the lenses lie intermediate between mean MDf and mean sands/soils (e.g., Fig. 3B): this may be indicative of a mixing line between the two units.

Further work: Geochemical analysis shows that both lenses investigated by APXS (at the Prow and Issano – Fig. 1A) are very similar. Further work will look at the source of the sediment influx; the mechanism which has allowed homogeneity in composition across the Mirador lenses; how seasonal variations [e.g., 6] can be used to explain localized features such as the lenses and place them in a more global context; and timing of wet episodes in a dry environment.

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References: [1] Gupta, S. et al. (2022) EPSC2022-963. [2] Fedo, C. et al. (2022) JGR: Planets, 127(9). [3] Caravaca, G. et al., (2022) EPSC-336. [4] O'Connell-Cooper, C. et al. (2022) JGR: Pl, 127(9). [5] O'Connell-Cooper, C. et al. (2018) GRL, 45(18). [6] Kite, E. & Noblet, A. (2022) GRL, 49(24). [7] O'Connell-Cooper, C. et al. (2017) JGR: Pl. 122(12).

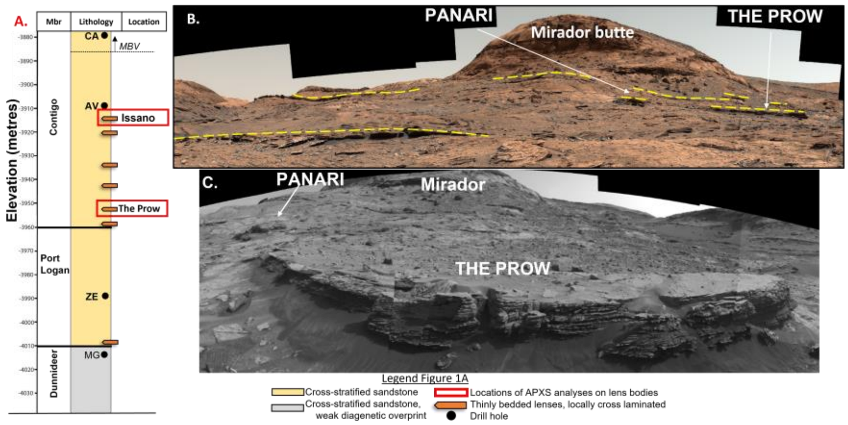

Figure 1. A. Simplified Stratigraphic column, showing only Mirador formation members (Mount Sharp Group) (after MSL Sed-Strat Working Group). **B**. Potential lens bodies in Mirador butte locale, highlighted in yellow (Mastcam: sol03347_ML_101234). **C**. Navigation camera image, showing the Prow and Panari workspaces.

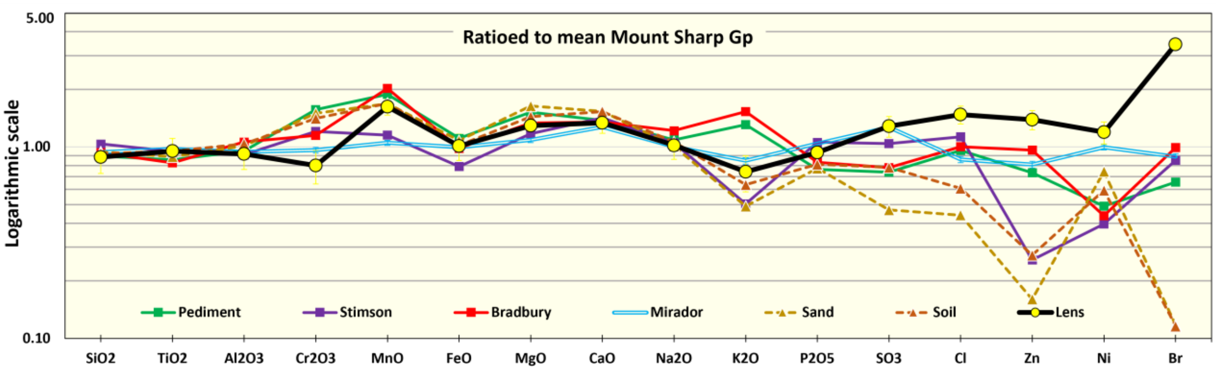

Figure 2. Ratio plot (log scale). All groups ratioed to mean Mount Sharp bedrock (excluding veins, nodules and other outliers). Sands/soil in dashed lines. Lens highlighted in black; standard error shown.

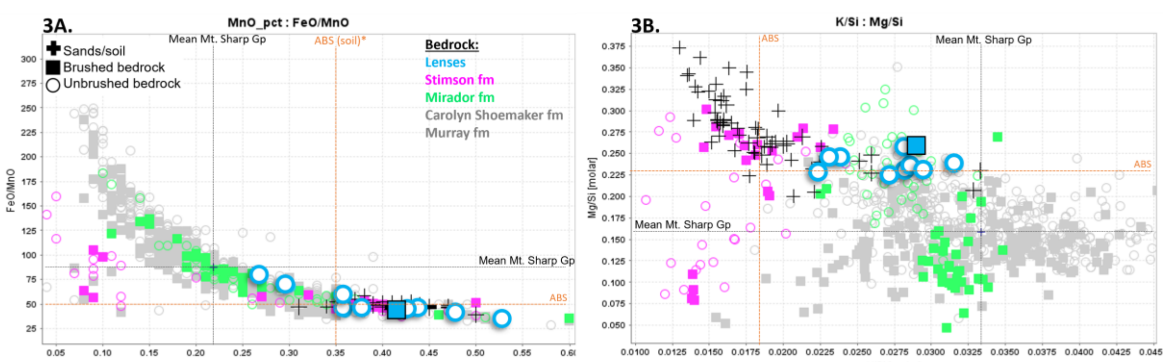

Figure 3. A. MnO (wt.%) versus FeO/MnO. **B.** K/Si (molar) versus Mg/Si (molar). ABS=Average basaltic soil [7]. Lens targets = 9 unbrushed targets (*The Prow+Panari*), 1 brushed target (*Issano*).