Mineralogic Stratigraphy and Depositional Environment in Miyamoto Crater, Mars

J. B. Adler and J. F. Bell III
Arizona State University School of Earth and Space Exploration
(jacob.b.adler@asu.edu)

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1. Introduction

- Spectral signatures of phyllosilicate and hydrated sulfate minerals identified from CRISM data in Miyamoto Crater and NE Margaritifer Terra
- Region contains a former top 6 MSL candidate landing site (West rim deposits [1]) and a Mars 2020 proposed landing site (East Margaritifer chloride[2]) and has been studied by [3,4,5]
- Deposits were map projected and displayed in RGB color images
- Preliminary cross section made to analyze stratigraphy
- Some deposits not stratobound, which indicates complex precipitation history not necessarily consistent with simple global Martian climate models, e.g. [6]

2. Methods

- CRISM [7] Full-Resolution Targeted (FRT) and survey mode sequences with high phyllosilicate signatures identified
- FRT images processed and atmospherically corrected for CO_2 absorptions in ENVI with CRISM Analysis Tools software [8]
- CRISM parameters BD2100 (monohydrated minerals) and D2300 (phyllosilicates) map projected [9]
- Reflectance spectra examined to confirm characteristic Mars I/F
- Parameter maps of phyllosilicates and hydrated sulfates combined into RGB composite images to show geographic relationships between materials (Fig. 4), MOLA [10] topographic profiles created
- 3D deposit overlays created in ArcScene with CTX [11] imagery over an HRSC [12] mosaic DTM

3. Previous Work

- A plausible geologic history of Miyamoto Crater could consist of 4 stages:
  1. Impact structures shaped the early Martian crust
  2. Fluvial episode eroded major channels, formed deposits in west rim
  3. Meridiani Planum materials were buried
  4. Exhumation and erosion formed inverted channel deposits, revealed basal phyllosilicate-bearing deposits [1] (Fig. 1)
- Contemporaneous deposition of phyllosilicates and sulfates observed in Australia [13] (Fig. 2)

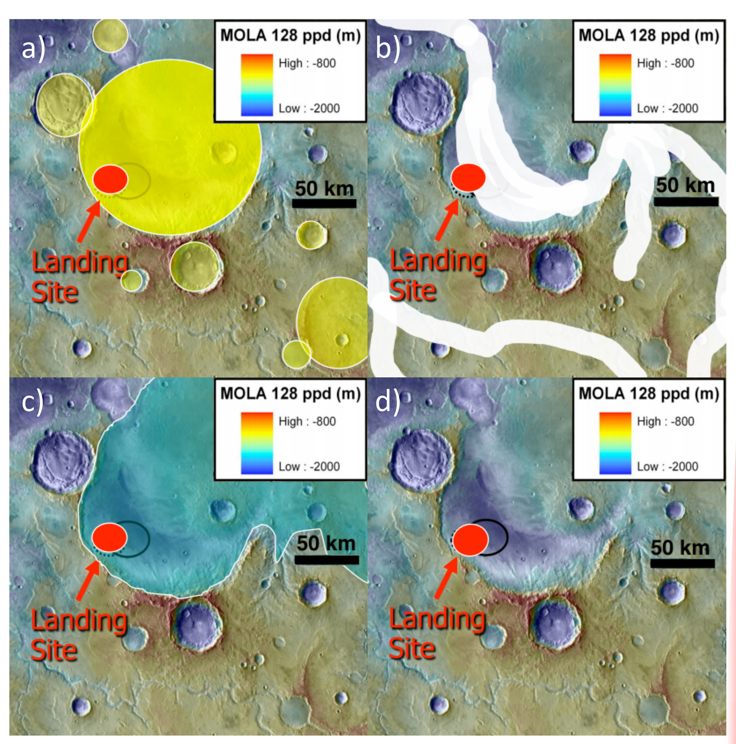


Fig. 1: Possible geologic history of Miyamoto Crater in 4 stages [1]

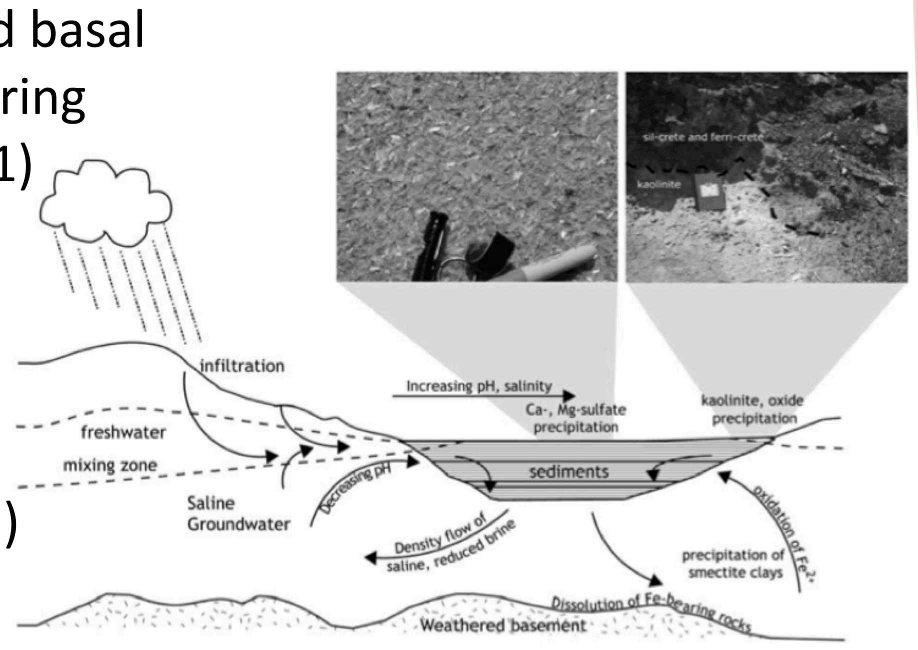


Fig. 2: Cartoon of mineral deposition in acid playa lake in Australia. Could this be similar to a mechanism on Mars? [13]

4. Results

Western Interior Deposits (Fig. 4)

- Nearly identical spatial distribution of OLINDEX (olivine) and D2300 (phyllosilicate)
- Phyllosilicates near higher, rougher terrain (green, fig.4a) around peaks, but also along the base of fluvial channels
- Flat lying beds inferred along section C-D, but not A-B
- Hydrated sulfates not dependent on elevation or morphologic features
- Multiple wetting, evaporation, and precipitation cycles over shorter timescales

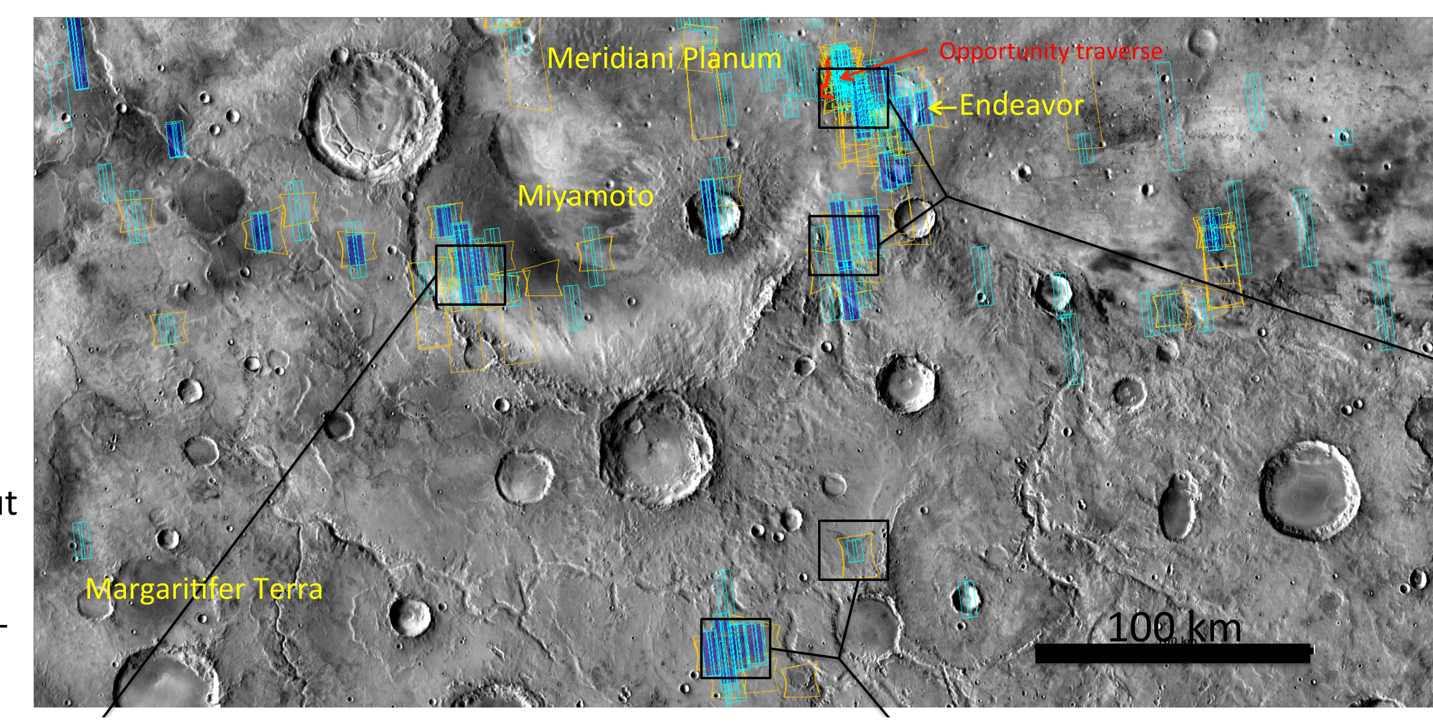


Fig. 3: JMARS map of the Miyamoto region with THEMIS day IR background. Gold outlines indicate CRISM FRT footprints, light blue outlines show HiRISE coverage, and dark blue indicates HiRISE anaglyphs.

Eastern and Northeastern Deposits (Fig. 6)

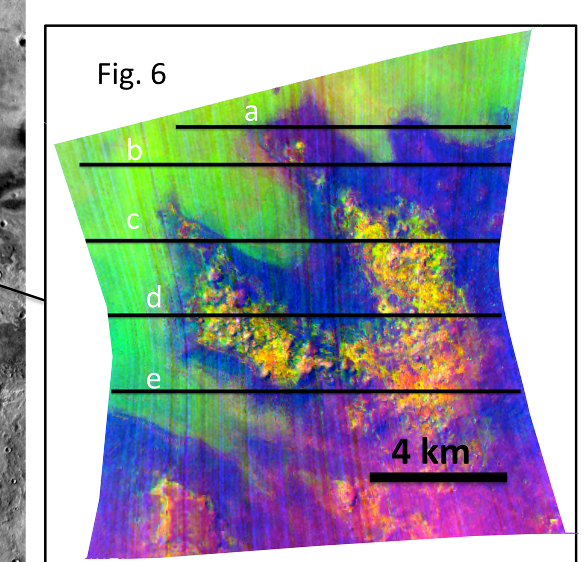
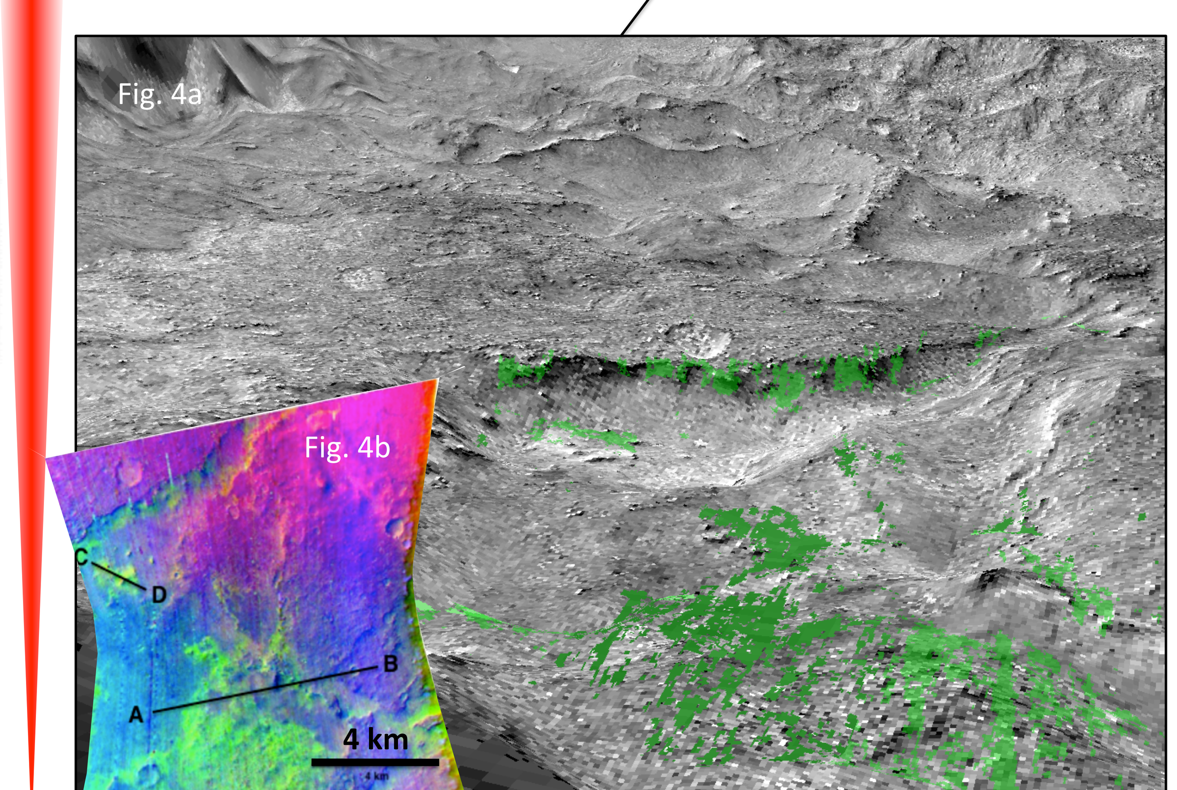
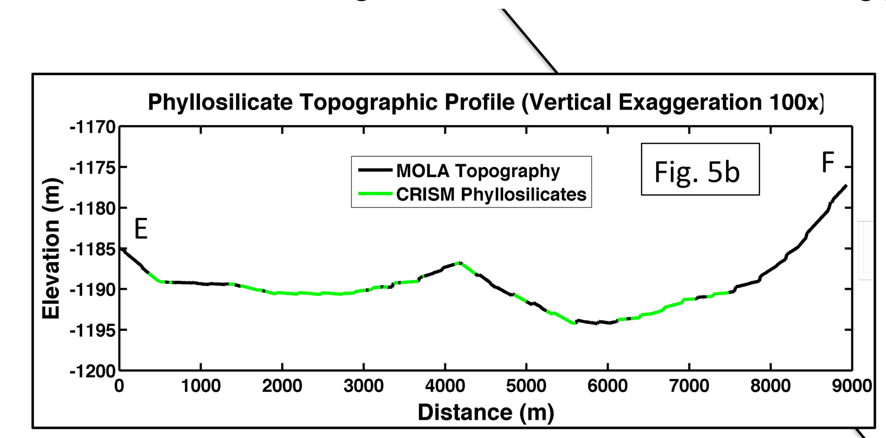


Fig. 6: CRISM RGB composite image. Red: IRA (infrared albedo), Green: Olindex (olivine), Blue: BD2100 (monohydrated sulfate).

- Similar spatial distribution of and olivine and phyllosilicates
- Hydrated sulfates in layer above olivine rich unit
- Sparse phyllosilicate outcrops



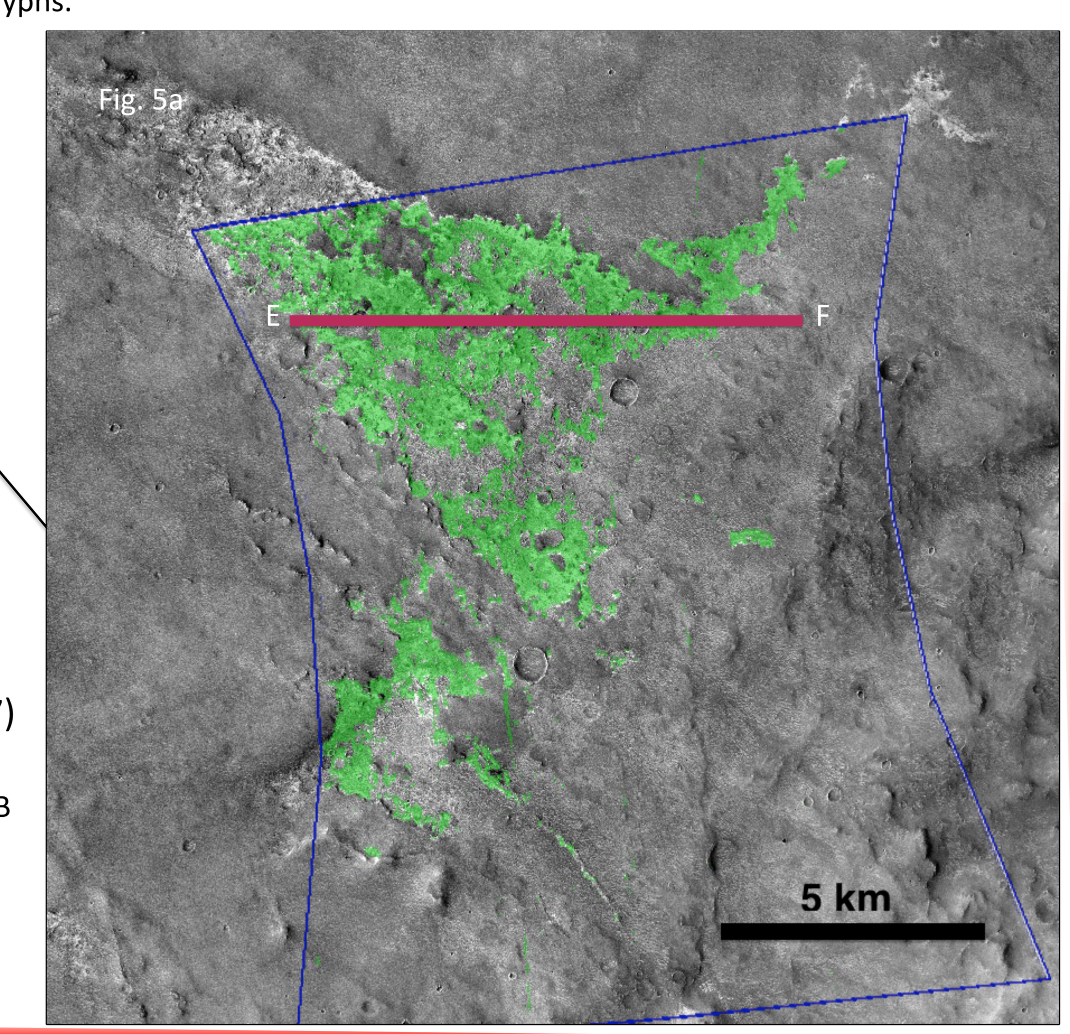


Southern Exterior Deposits (Fig. 5)

- Profiles of phyllosilicate outcrops indicate deposits at least 10m thick
- Elevation of deposit more than 400m higher than phyllosilicates detected in eastern region (see fig. 7)

Fig. 4a) Phyllosilicates on 10x vertically exaggerated DTM. 4b) RGB composite of CRISM FRT0000AE19. Red: IRA (infrared albedo), Green: Olindex (olivine), Blue: BD2100 (monohydrated sulfate).

Fig. 5a) Phyllosilicates overlaid on CTX. 5b) Topographic profile from fig. 5a can be used to estimate layer thickness.



5. Future Work

- Generate annotated geologic map and cross section
- Include dune fields, inverted and non-inverted channels, craters, fans, and ridges from HiRISE and CTX images
- Add more CRISM overlays to DTM

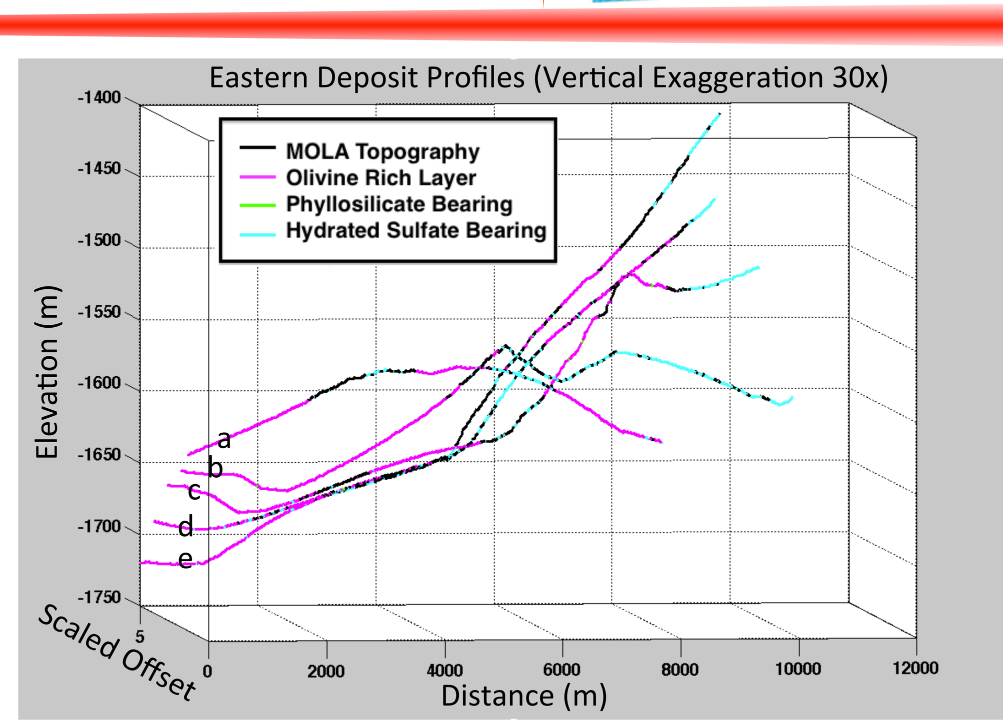


Fig. 7: Tool for future stratigraphic analysis. Profiles from fig. 6.

6. Conclusions

- Characteristic spectral absorption features identified
- Most western interior deposits not stratobound
- Hydrated sulfate signatures occur in wide variety of geomorphic features
- These models show local to regional deposition not necessarily consistent with global climate models

7. References

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