Habitability and Preservation Potential of the Bottomset Deposits in Jezero Crater

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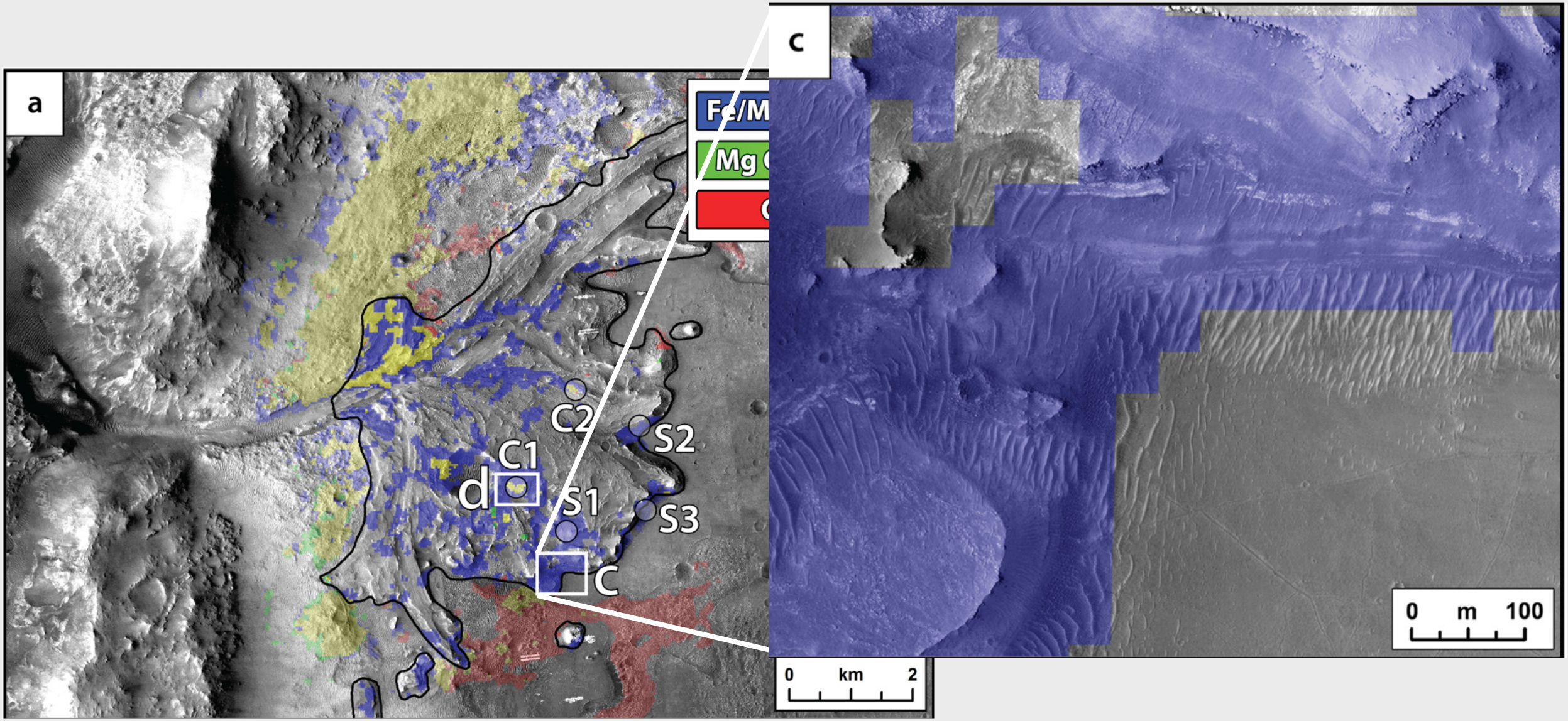
Biosignatures Preservation and Detection in Mars Analog Meeting, Lake Tahoe, NV
May 16-18, 2016

Hays et al., 2016, Astrobiology

Five Key Environments

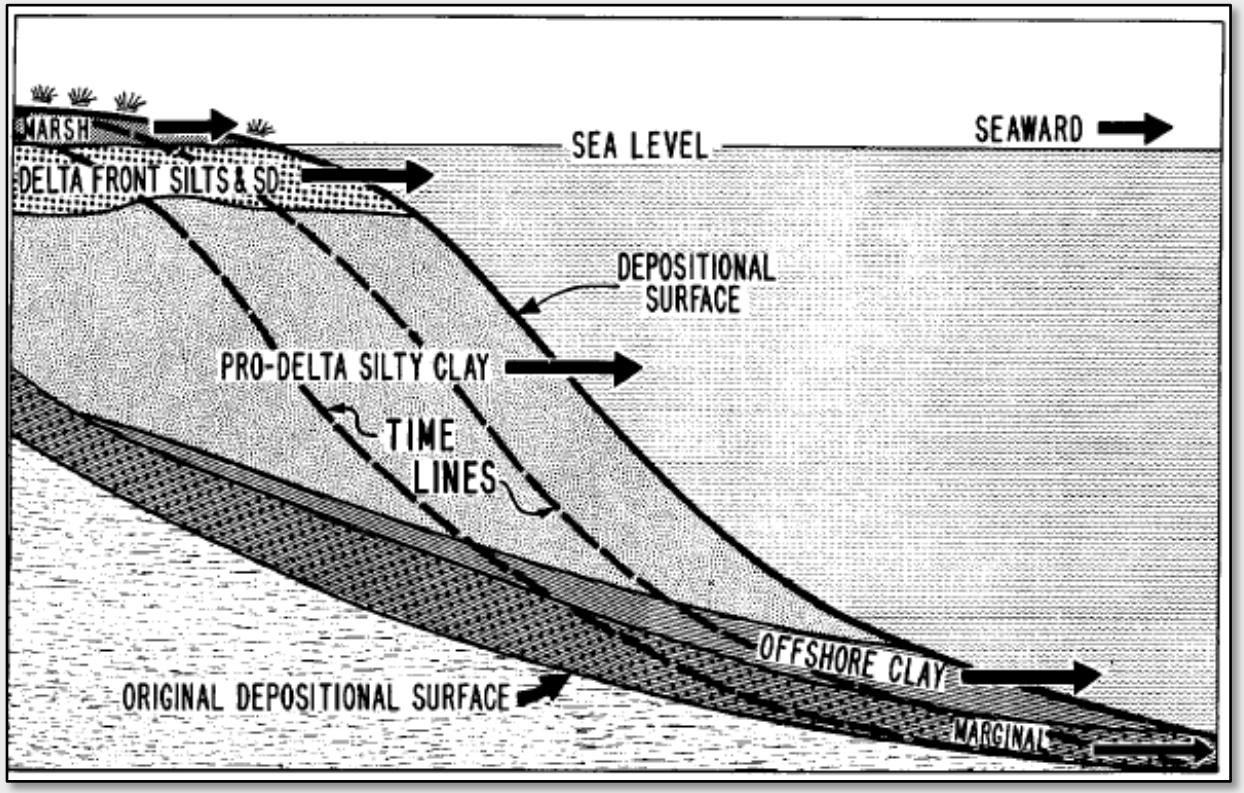
- Subaerial
- Iron Rich Systems
- Hydrothermal
- Subsurface
- Subaqueous

- Goudge et al.
- Implied...
- Tarnas et. al
- Brown et. al
- Horgan et. al


a
Fe/M
Mg
C2
C1
d
S1
S2
S3
C
0 km 2
c
0 m 100

Delta Bottomsets: Ideal for Preservation I

- Distal to the fluvial input → Quiescent Deposition
- Sedimentation of fine particulates (Phyllosilicates and Carbonates)
- High potential for reducing environment due to fine layer sedimentation

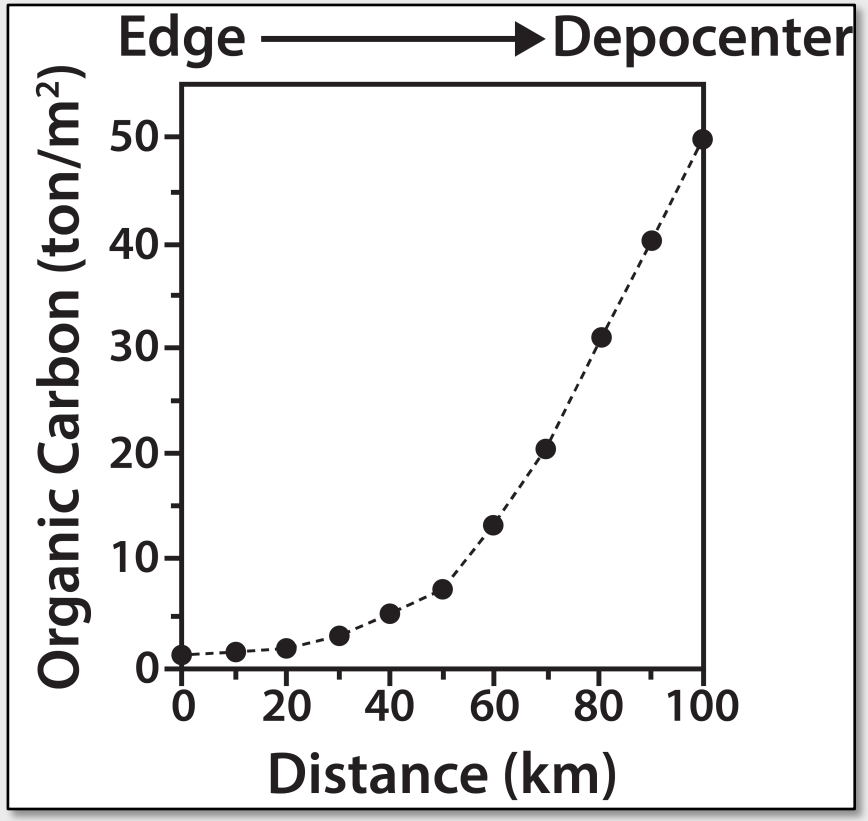


Scruton [1960]

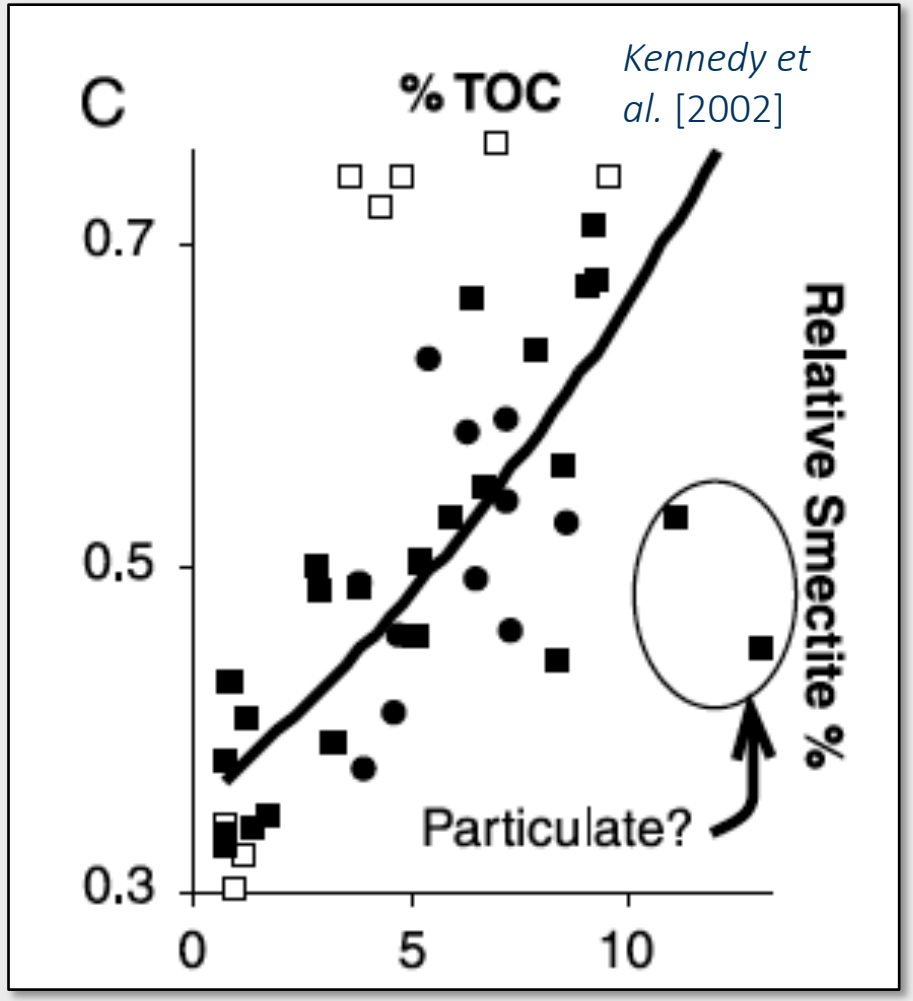
Delta Bottomsets: Ideal for Preservation II

Hydrodynamic Concentration Of Organic Matter

(Hays et al, 2016, Huc, 1988, Summons et al. 2011)



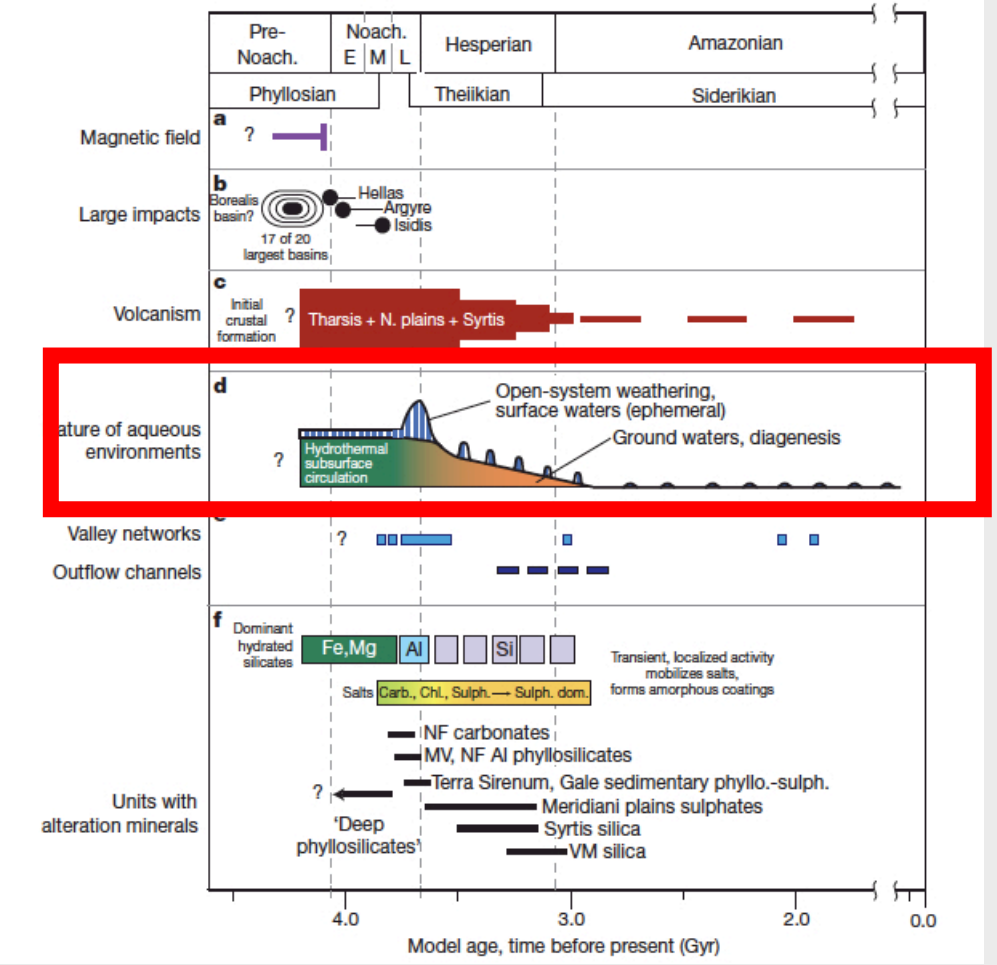
A. Y. *Huc* [1988]



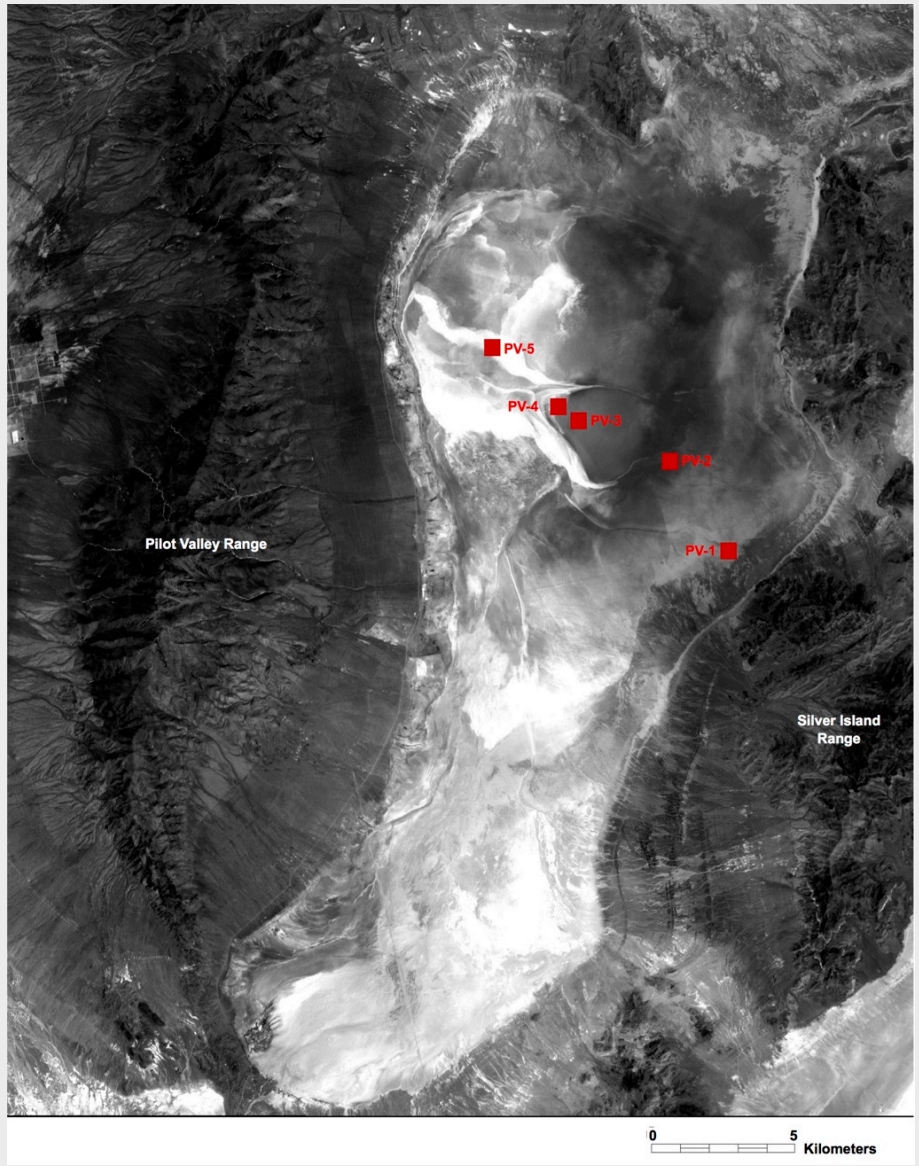
Grain Chemistry

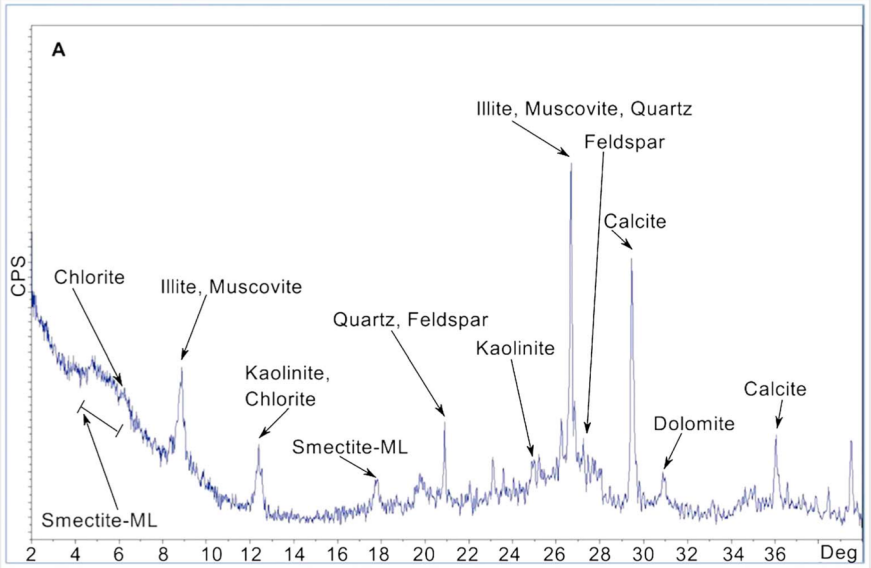
- Smectite clays can bind and stabilize organic matter *(Wattel-Koekkoek et al., 2001; Kennedy et al., 2002; Ehlmann et al., 2008a)*.
- Fe/Mg-smectite-rich delta bottomsets at Jezero provide ideal location to explore for concentrated and preserved martian organic carbon.

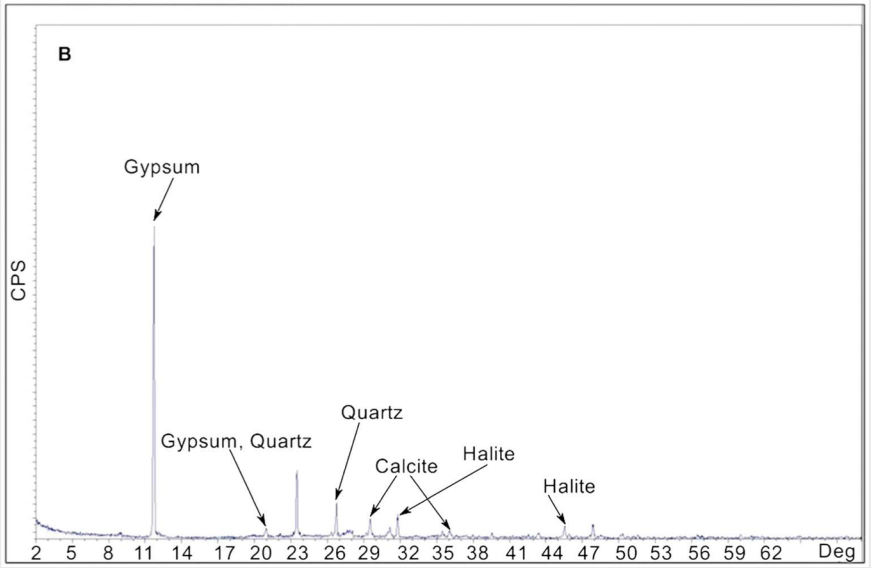
Bottomset Deposits: Transitional Habitable Zone



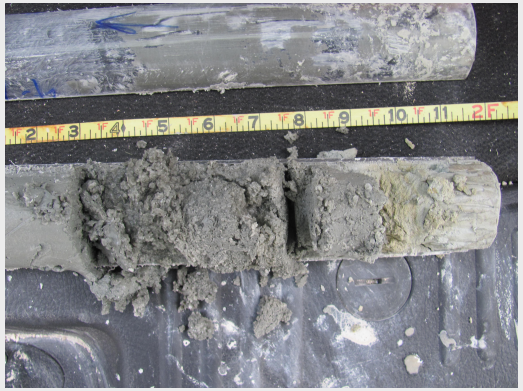
Ehlmann et al., Nature, 2011

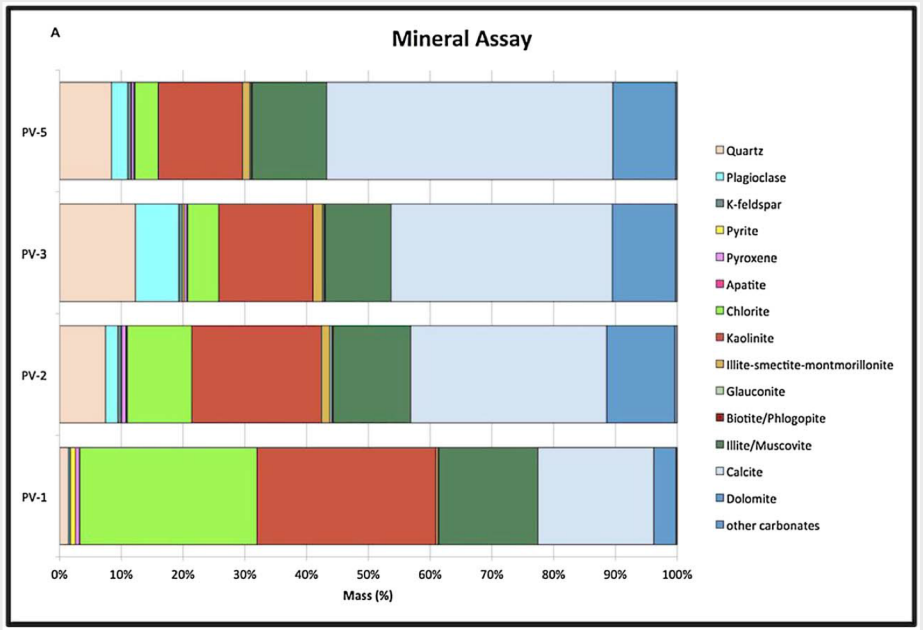


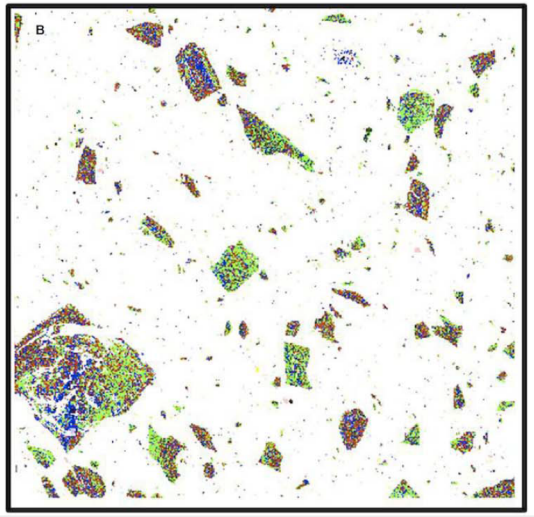


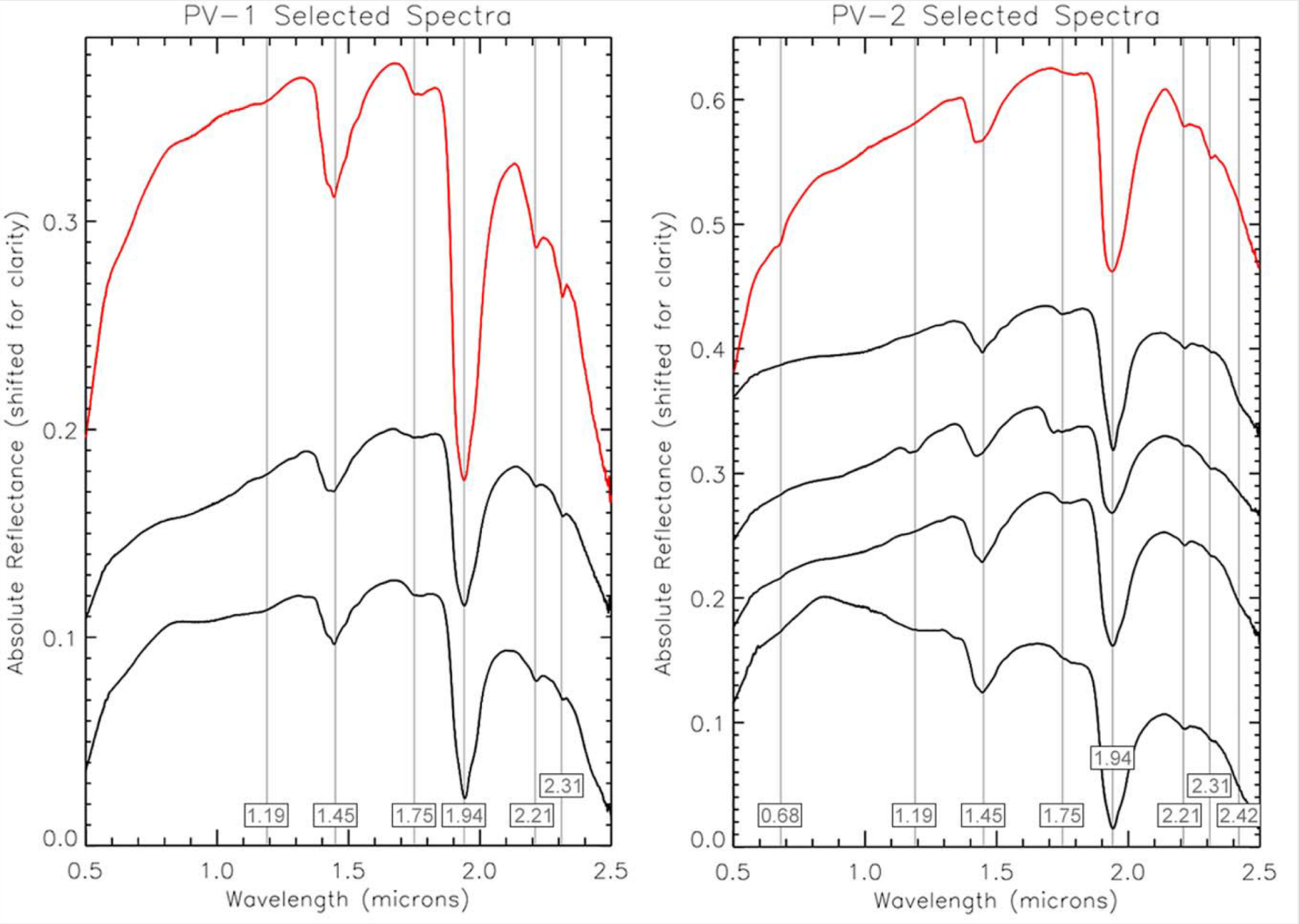


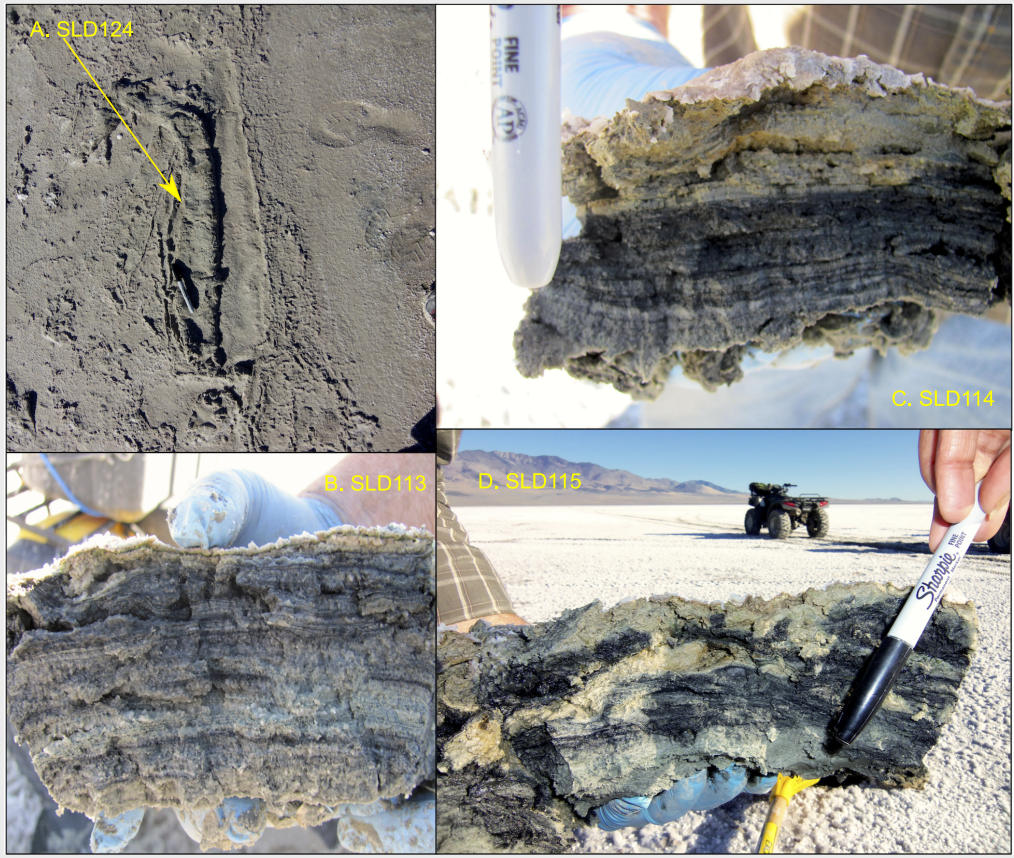
Lynch et al, 2015, JGR Planets



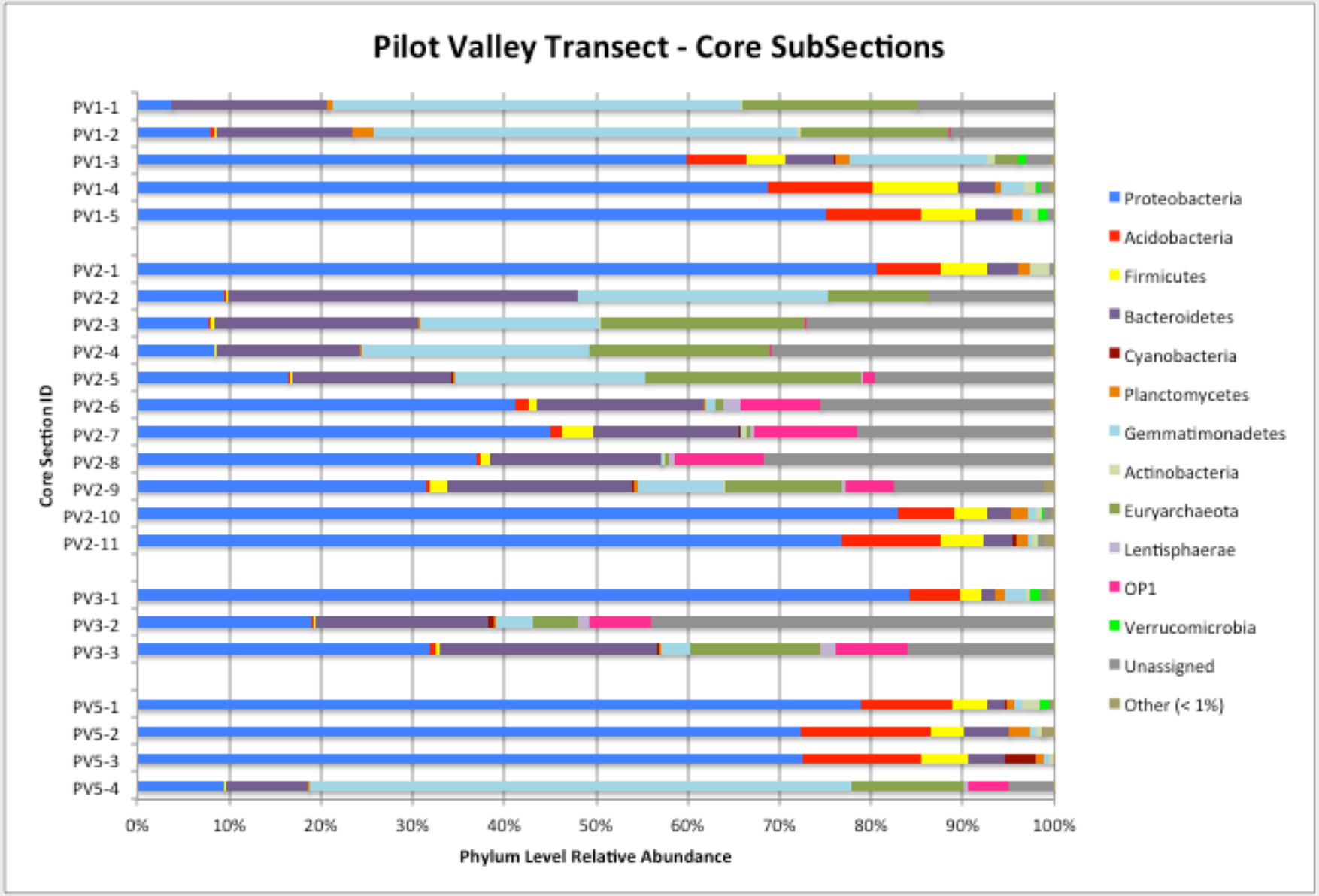


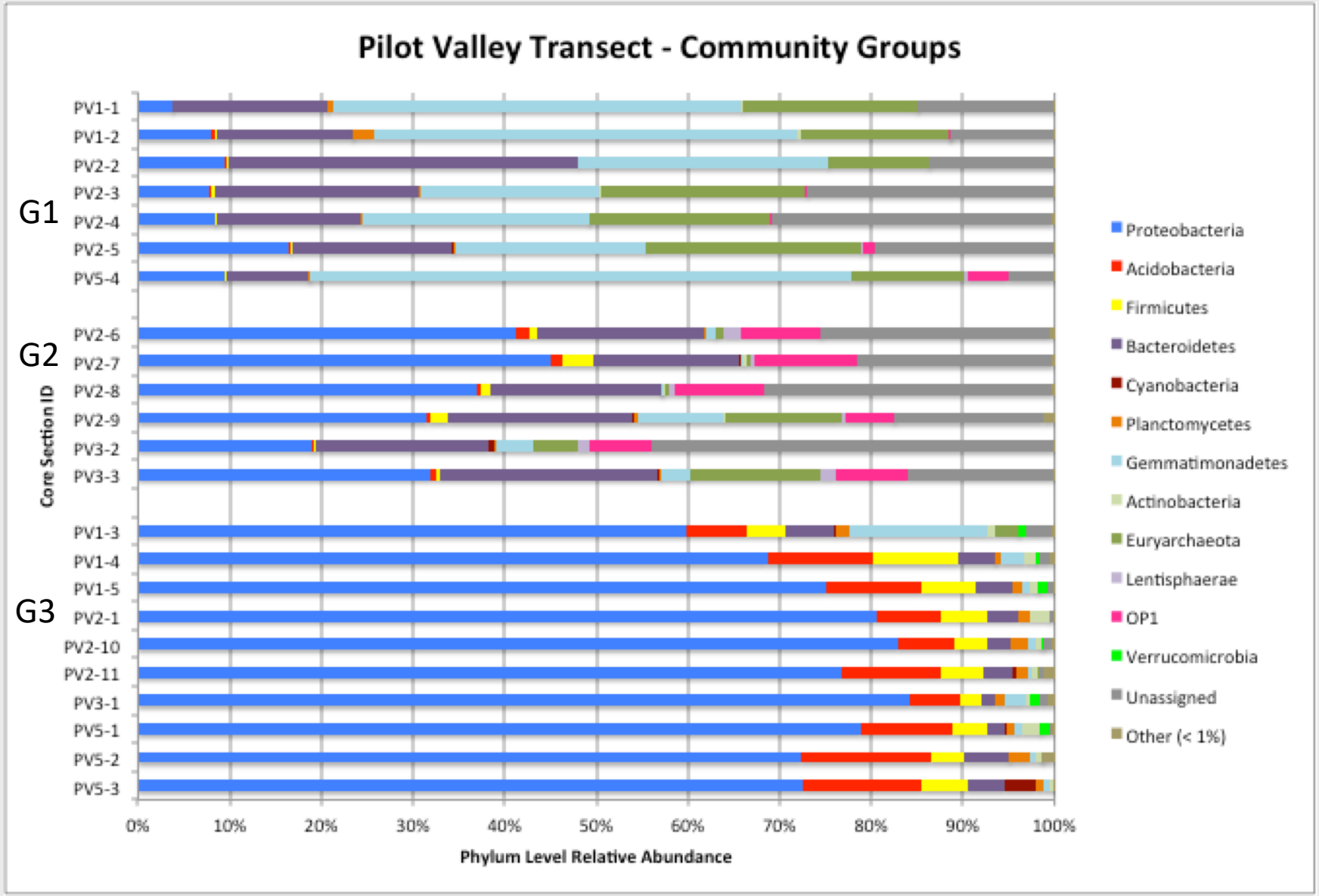




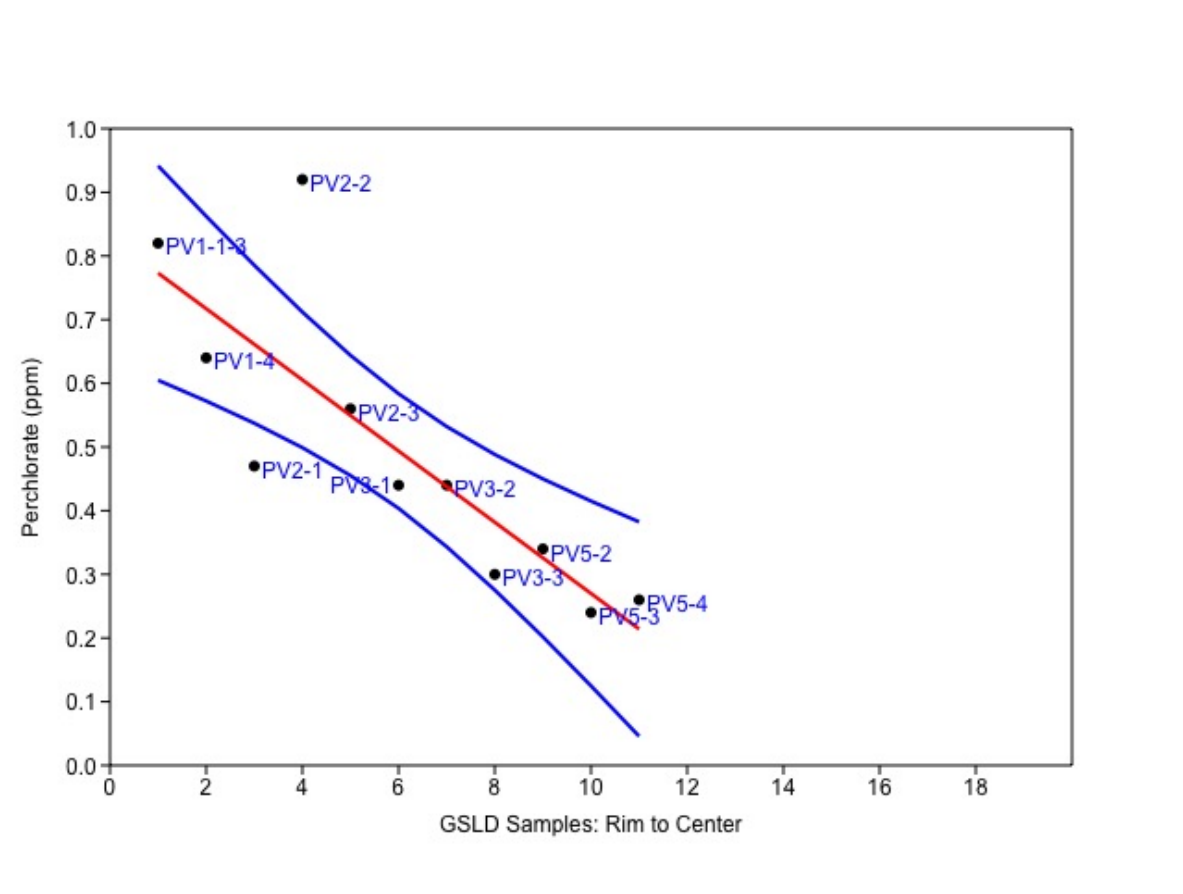


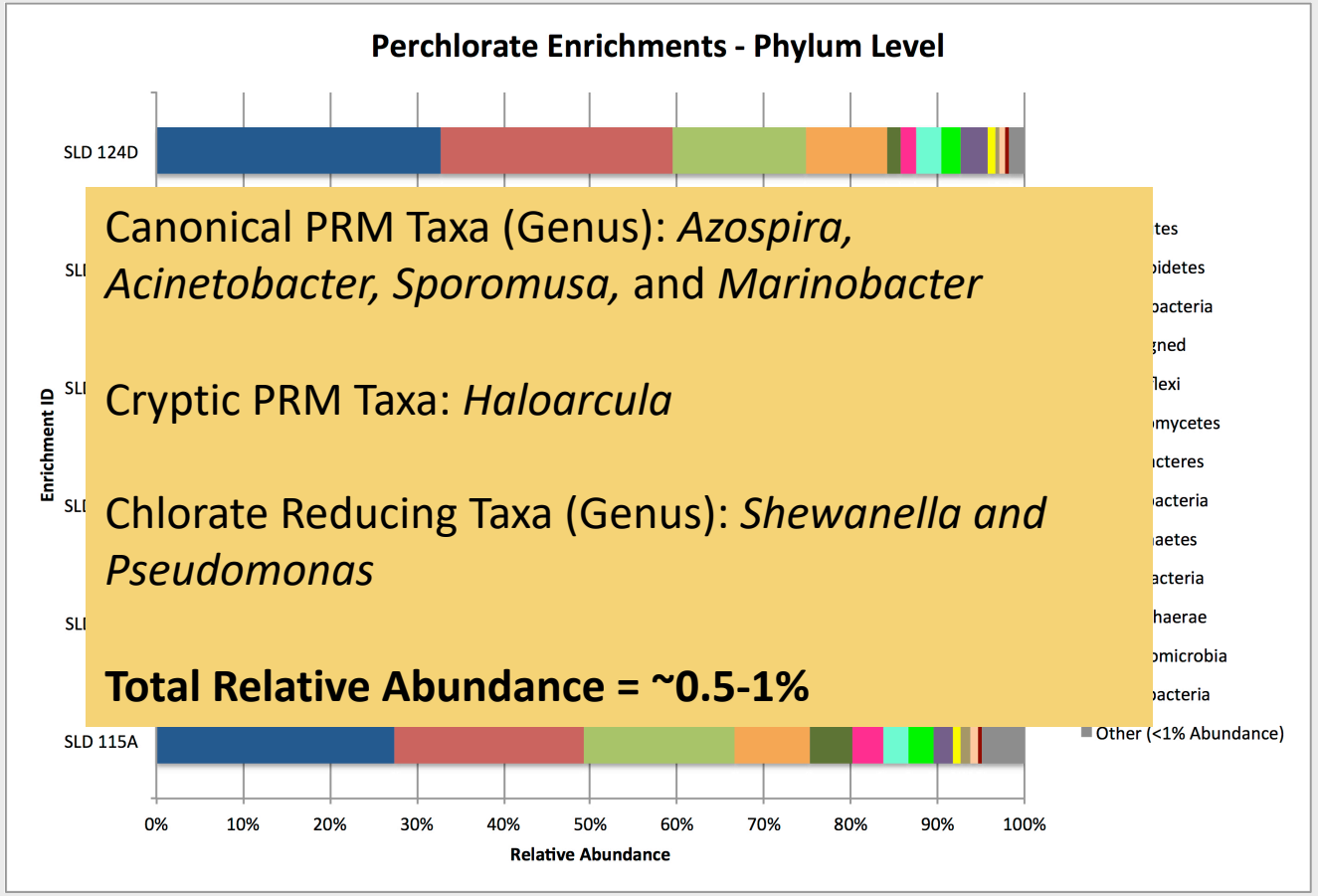
Lynch et al, 2015, JGR Planets


Pilot Valley Transect - Core SubSections
Core Section ID
PV1-1
PV1-2
PV1-3
PV1-4
PV1-5
PV2-1
PV2-2
PV2-3
PV2-4
PV2-5
PV2-6
PV2-7
PV2-8
PV2-9
PV2-10
PV2-11
PV3-1
PV3-2
PV3-3
PV5-1
PV5-2
PV5-3
PV5-4
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Phylum Level Relative Abundance
Proteobacteria
Acidobacteria
Firmicutes
Bacteroidetes
Cyanobacteria
Planctomycetes
Gemmatimonadetes
Actinobacteria
Euryarchaeota
Lentisphaerae
OP1
Verrucomicrobia
Unassigned
Other (< 1%)


Pilot Valley Transect - Community Groups
G1
G2
G3
PV1-1
PV1-2
PV2-2
PV2-3
PV2-4
PV2-5
PV5-4
PV2-6
PV2-7
PV2-8
PV2-9
PV3-2
PV3-3
PV1-3
PV1-4
PV1-5
PV2-1
PV2-10
PV2-11
PV3-1
PV5-1
PV5-2
PV5-3
Core Section ID
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Phylum Level Relative Abundance
Proteobacteria
Acidobacteria
Firmicutes
Bacteroidetes
Cyanobacteria
Planctomycetes
Gemmatimonadetes
Actinobacteria
Euryarchaeota
Lentisphaerae
OP1
Verrucomicrobia
Unassigned
Other (< 1%)

Potential Energy Sources





Canonical PRM Taxa (Genus): *Azospira, Acinetobacter, Sporomusa,* and *Marinobacter*

Cryptic PRM Taxa: *Haloarcula*

Chlorate Reducing Taxa (Genus): *Shewanella and Pseudomonas*

Total Relative Abundance = ~0.5-1%

Lynch et al. 2018, ACCEPTED TODAY – Astrobiology

Key Takeaway Points

- Jezero Crater has the potential to house 5 key types of habitable environments and preserve biosignatures from each of them.
- The bottomset deposits specifically are ideal for high concentration of preserved organics.
- Bottomsets deposits could have also harbored a transitional subsurface habitable zone, adding to the diversity of environments to explore in Jezero Crater.

Links to Reports and Presentations

- Conference Archived Website: https://www.hou.usra.edu/meetings/biosignature2016/
- Workshop Report Presentation: https://ssed.gsfc.nasa.gov/BELOW/docs/Mars_Biosig_DesMarais.pdf