

DIAGENETIC ALTERATION OF BIOSIGNATURES PRESERVED IN SPRING CARBONATES: IMPLICATIONS FOR MARS

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OUTLINE



- Two parts:
 - Spring deposit recognition
 - Microscopic biosignatures
- Introduce a unique field site
- Silcretes at Murray-Stimson contact
- Diagenetic alteration of biosignatures

RATIONALE



- Springs -> excellent preservation potential
- Biosignatures are ambiguous
- Most research done on modern OR ancient
- Diagenetic alteration may be significant



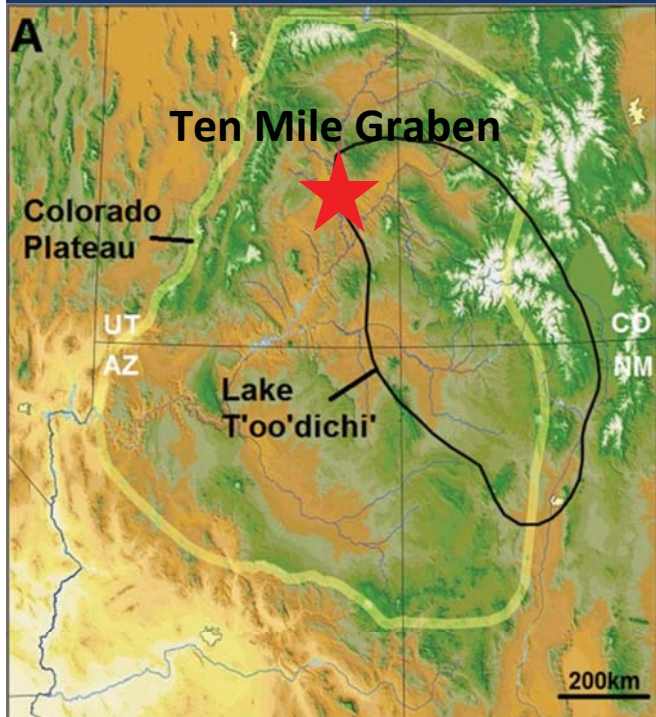
Jurassic silcrete with lamination and stromatolitic morphology

TEN MILE GRABEN SPRING SYSTEM



- Series of cold springs, geysers
- Near Green River, UT
- CO₂-, hydrocarbon-charged
- Circumneutral
- Microbial CaCO₃, FeO_x mats
- <400ka tufa terraces

BRUSHY BASIN MBR OF MORRISON FM



- Jurassic
- Colorado Plateau
- Upper part of Brushy Basin Mbr
- Edge of alkaline saline Lake T'oo'dichi'
- “Ten Mile Pond”
 - Groundwater-fed
 - Restricted lacustrine
 - <10 m thick
 - Topped with microbialite (<3m thick)
 - Silcretes interbedded in basal mudrock



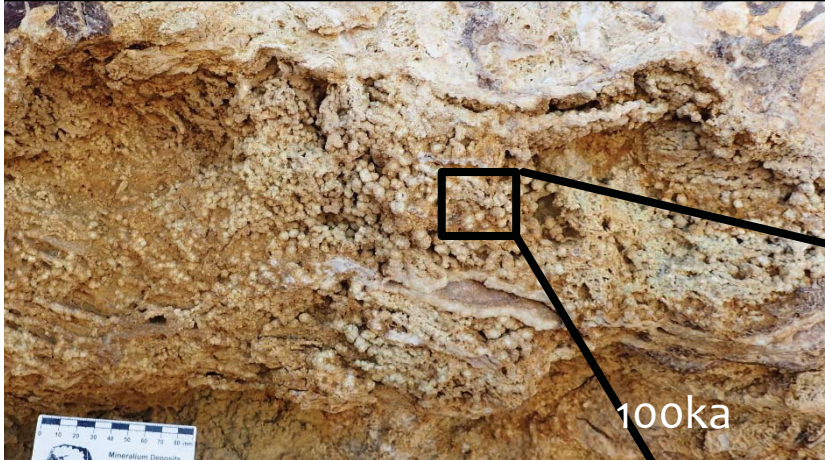
PURPOSE



1. Characterize spring deposits & biosignatures
2. Determine diagenetic changes in modern, Pleistocene, & Jurassic examples
3. Produce diagnostic criteria to recognize spring deposits, biosignatures in rock record

MACROSCOPIC FEATURES: TERRACES

- Terracettes
- Degradation
 - Recrystallization
 - Ostwald ripening
- Some delicate features preserved



MACROSCOPIC FEATURES: MICROBIALITES



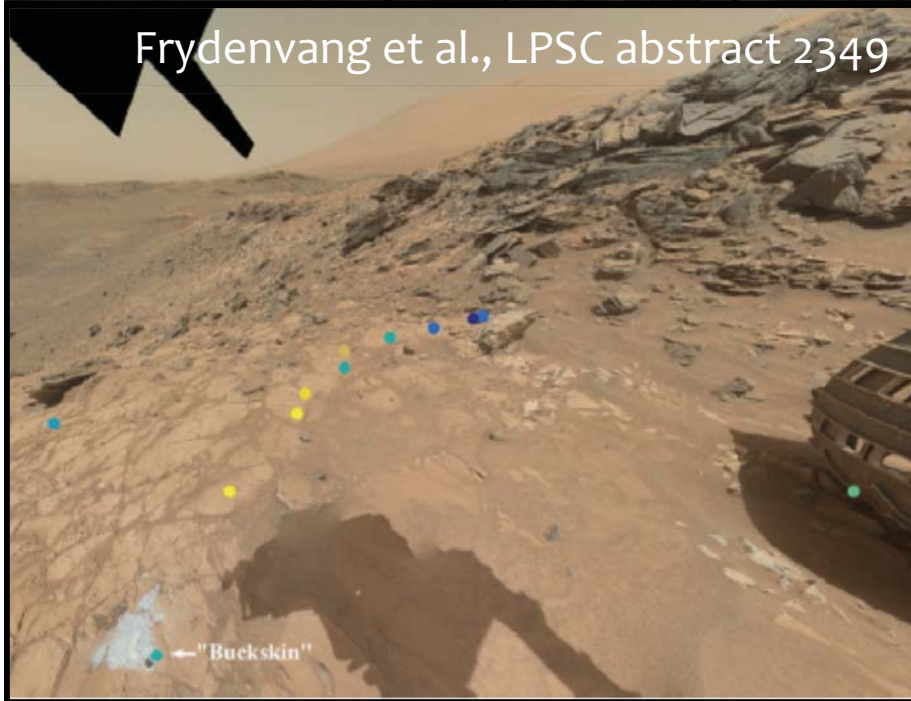
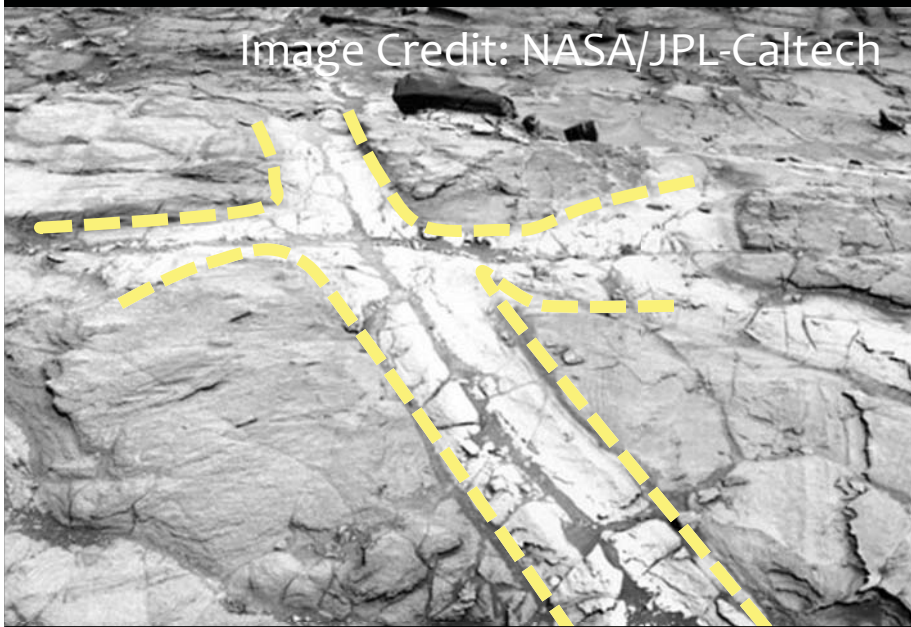
- Layered texture
- Preserved
- Some dissolution on millennial time scales
- Compaction in Jurassic
- Diagenetic vein-filling
 - 100ka → aragonite
 - Jurassic → chert

MACROSCOPIC FEATURES: SILCRETES

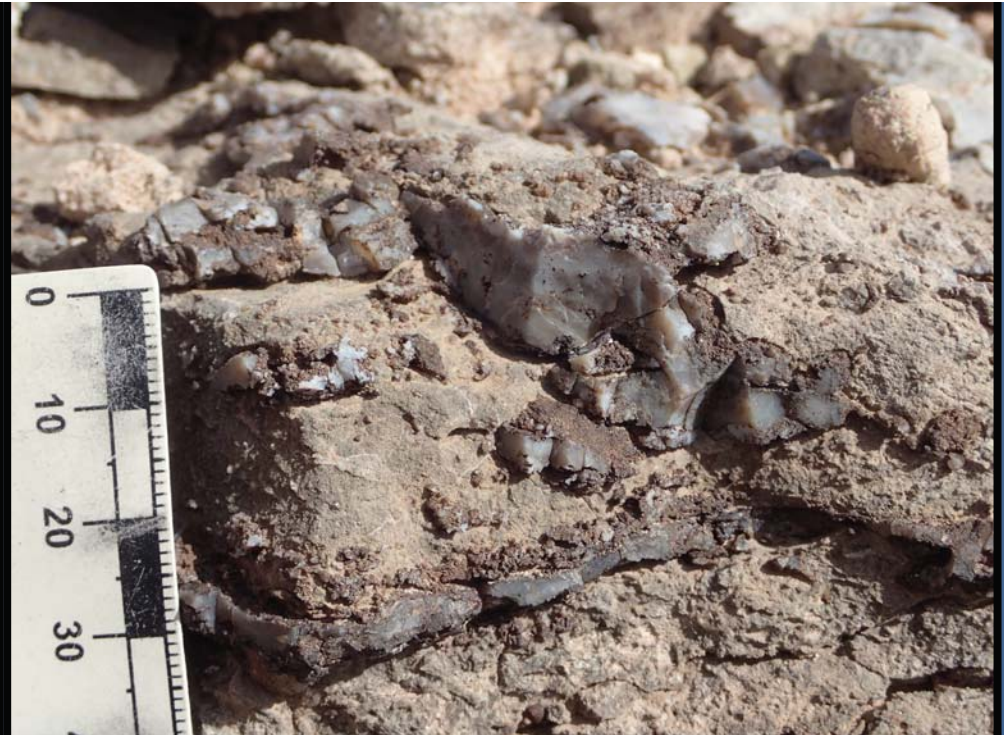


- Present only in Jurassic
- Within mudrock below CO_3
- 1-3 m thick
- Bedded, some lamination
- Analog for silica-rich layered deposits at Murray-Stimson contact

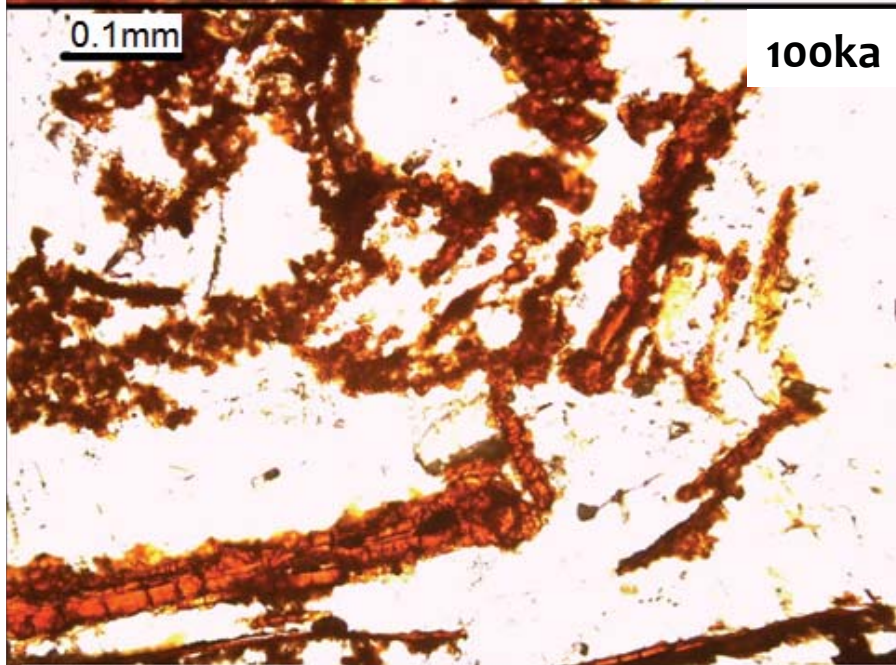
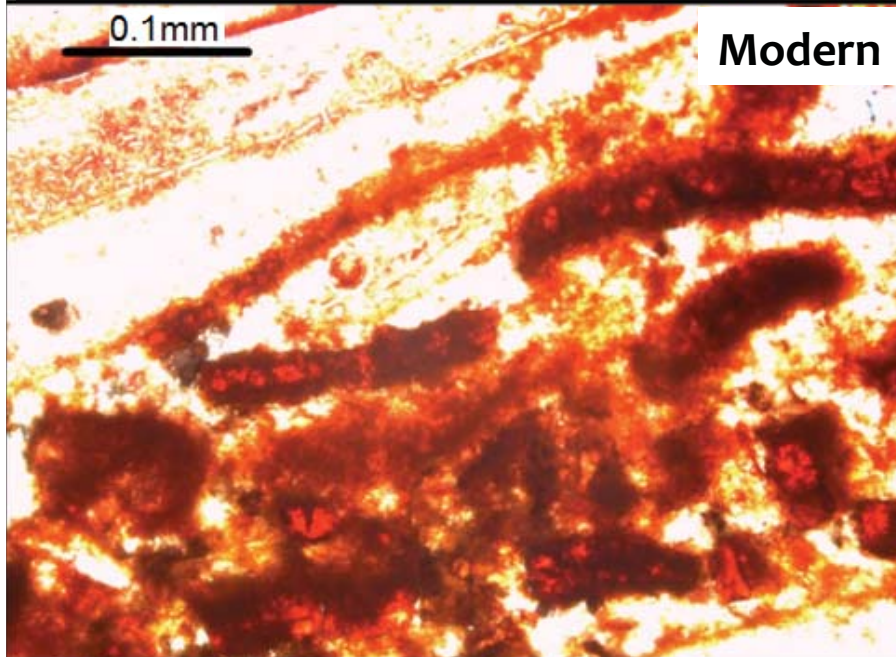
MACROSCOPIC FEATURES: SILCRETES



- Murray-Stimson contact
- Laminated Si-rich mudrock
- Si-rich fracture fill
- Trydimite
- Possible spring deposit

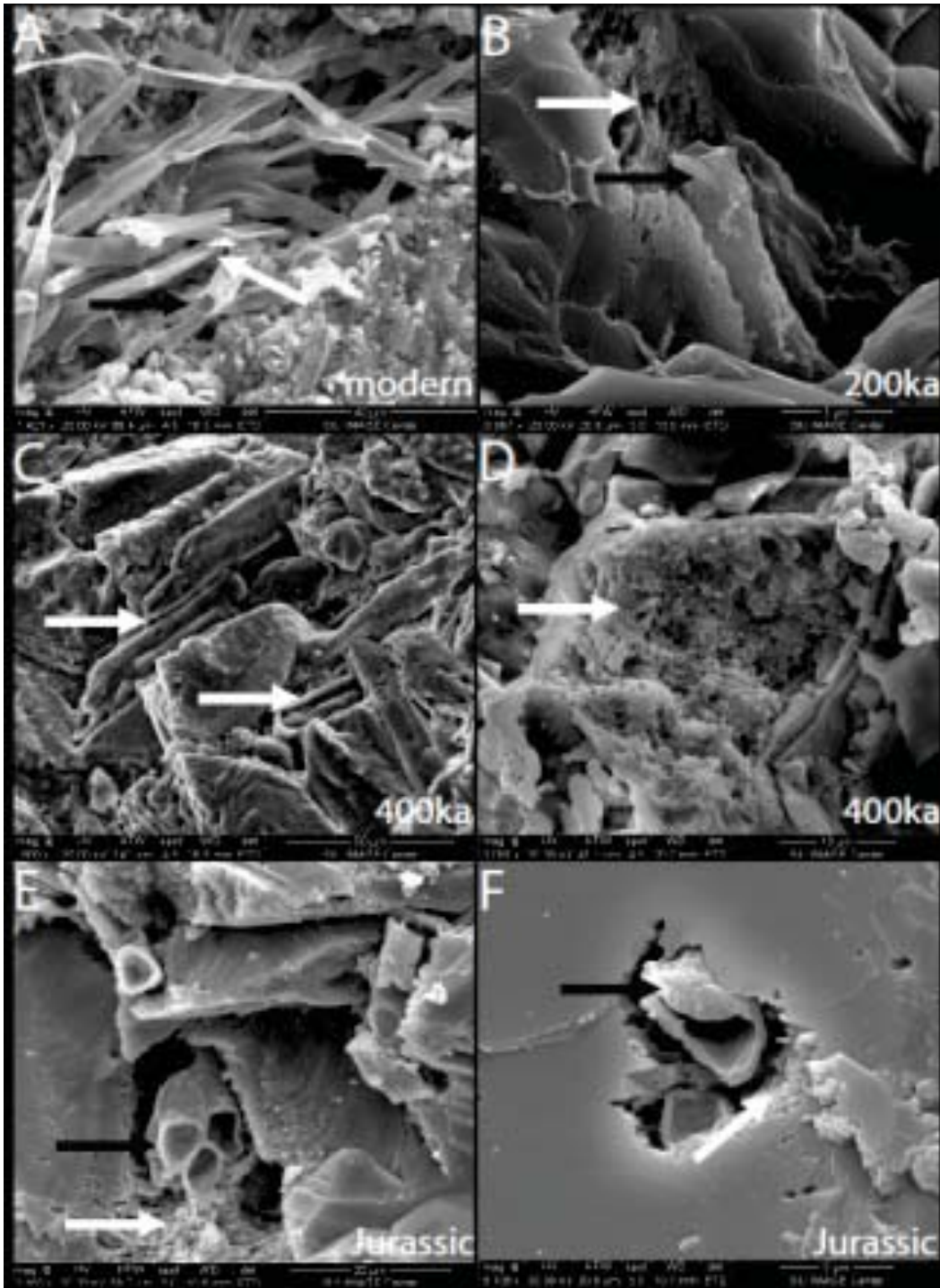


MICROSCOPIC FEATURES: MICROBIALITES



- Modern features
 - Segmented
 - Diffuse FeO_x
- Ancient features
 - Degraded
 - Recrystallized FeO_x
 - Ostwald ripening

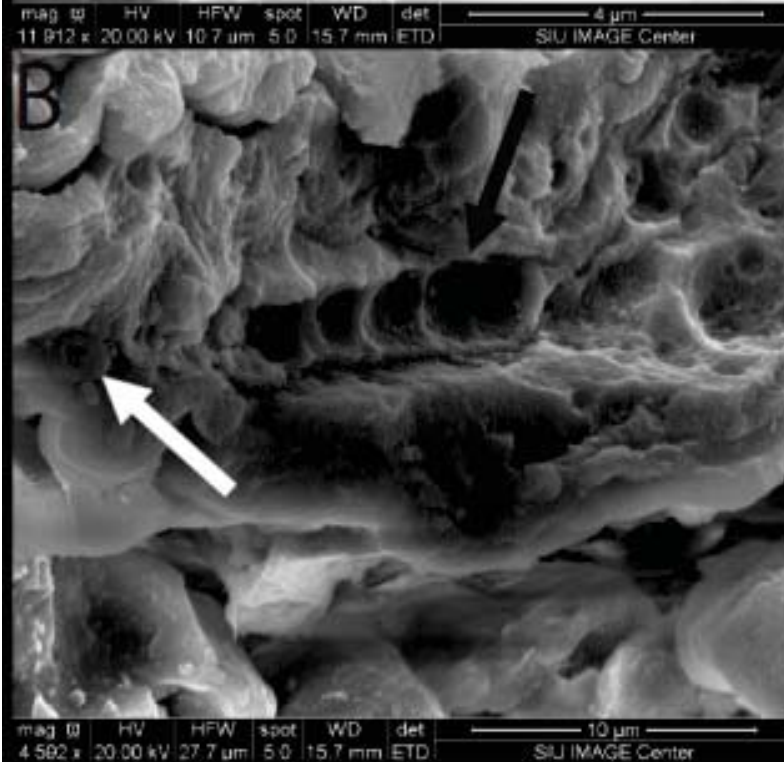
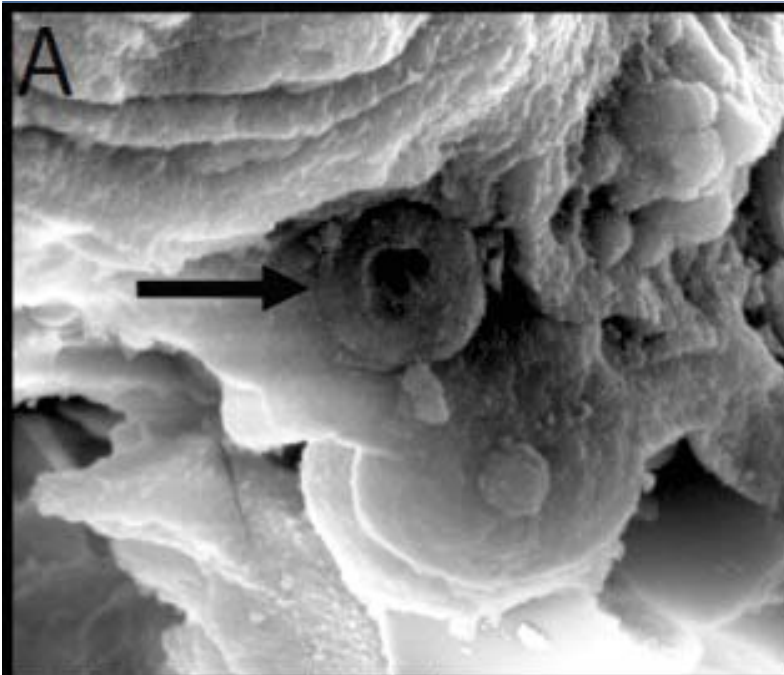
MICROSCOPIC FEATURES: TUBES



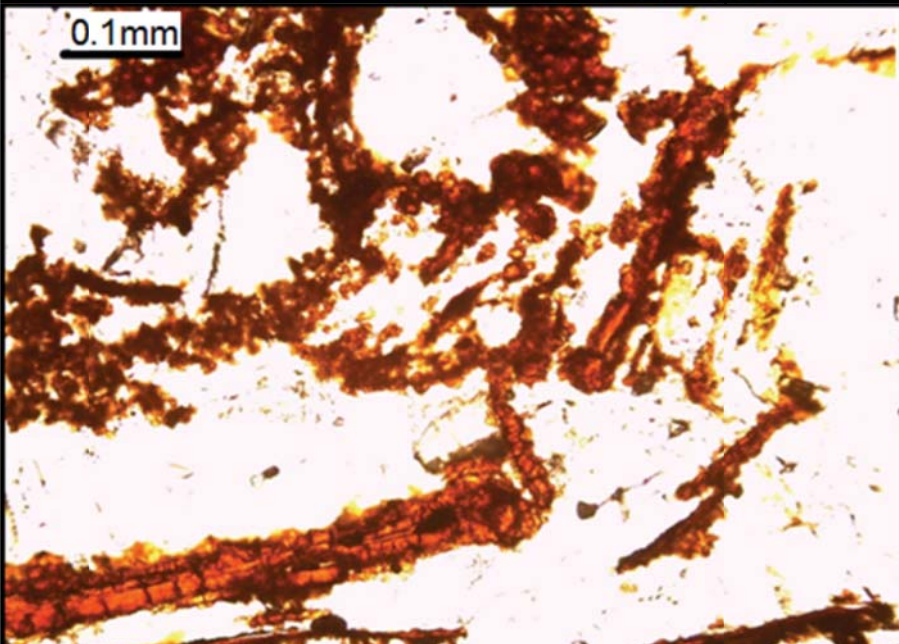
- FeOx encrusted tubes
- Associated with honeycomb structures
- Preserved in all ages
- Ostwald ripening in Jurassic

MICROSCOPIC FEATURES: 400 KA

- Hollow spheres
- Mold of spheres (trace fossils)
- Potential source of honeycomb texture

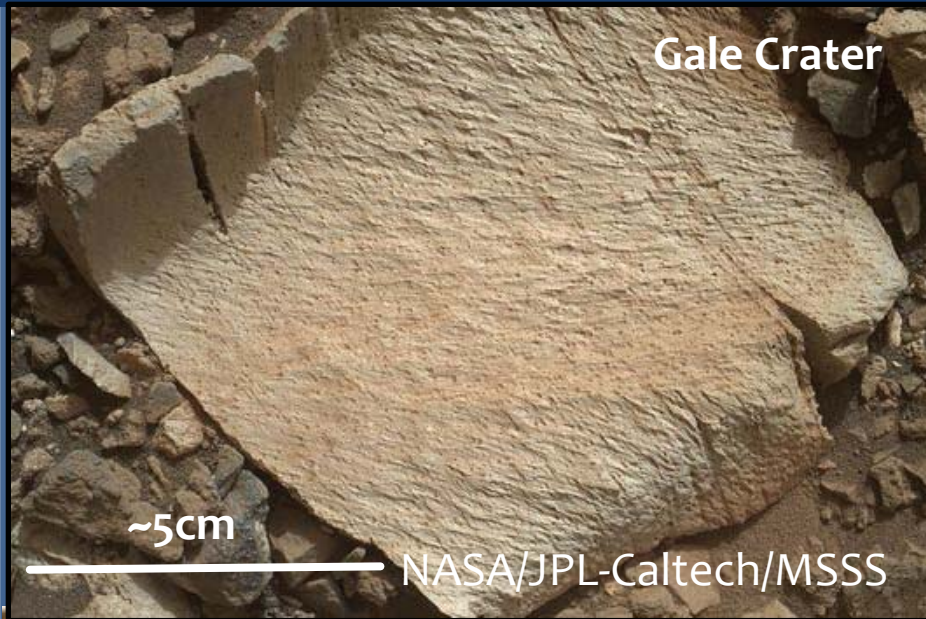


SUMMARY



- Preserved Macroscopic Features
 - Terraces
 - Mats
 - Silcretes
 - Si-rich bedded deposits in mudrock
 - Overlying Si-rich fracture fills
- Preserved microscopic features
 - Microbial fossils
 - Trace fossils
 - Ostwald ripening

IMPLICATIONS FOR MARS



- Macroscopic recognition criteria for spring deposits
- Ostwald ripening, early mineralization entombing features – long-term protection
- Potential spring deposits at Murray-Stimson contact
- Ma time scale deposition
- High preservation potential

GSA SESSION: PAST AND PRESENT BIOSIGNATURE RECOGNITION ON EARTH AND MARS



Description:

This forum will discuss advances in the search for life focusing specifically on Earth and Mars.

Questions: Tom McCollom
or Sally Pottter-McIntyre

Abstract Deadline: July 12!!

ACKNOWLEDGMENTS



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(to Potter-McIntyre)



Engaged field assistants: the
next generation of geology
Mars explorers?