
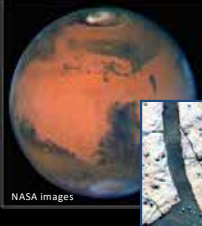
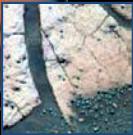



## Red Rocks and Marbles

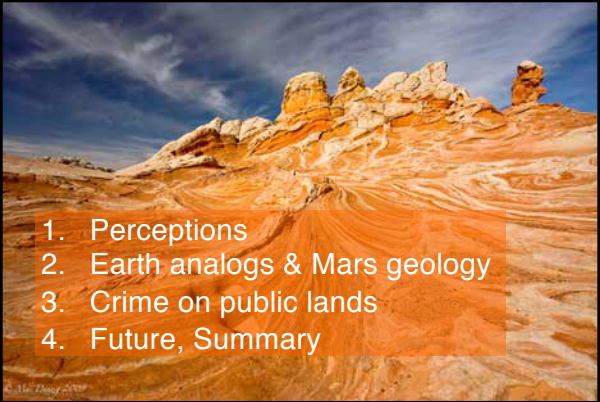
### From Earth to Mars: Tales of Science and Crime



**Dr. Marjorie A. Chan**  
Dept. Geology & Geophysics


Aug 9, 2018




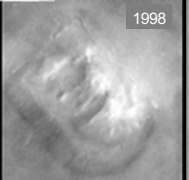
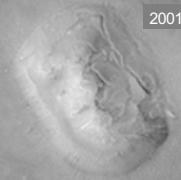
1. Perceptions
2. Earth analogs & Mars geology
3. Crime on public lands
4. Future, Summary

Acknowledgments: Students, colleagues, NASA MRF, NASA EPOESS & ACS-PRF

1976  
Viking 1,  
Cydonia



**Face of Mars**

A natural landform

**1. Perceptions:**  
based on available data

Year    Pixel resolution  
1970 = size of house  
2010 = size of copy paper

MGS (Mars Global Surveyor)

## New Era for Mars Explorations!

Ever increasing data, resolution, scientific findings




NASA Rovers

MER Opportunity    Sojourner    MSL Curiosity

Image credit: [http://mars.jpl.nasa.gov/msl/spotlight/images/MSL\\_20080512.jpg](http://mars.jpl.nasa.gov/msl/spotlight/images/MSL_20080512.jpg)

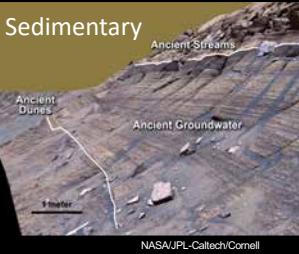
## A new perspective

Igneous (Basaltic)

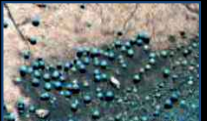


NASA/JPL/Main Space Science Systems

Sedimentary




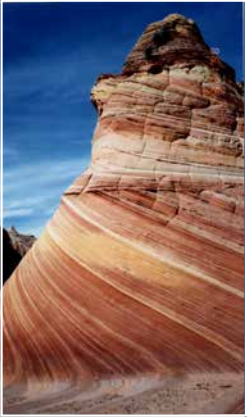
NASA/JPL-Caltech/Cornell



"Blueberries"

## 2. Earth analogs & diagenesis

- rocks = color coded
- reflect iron cycling
- "marbles" -> groundwater fluid flow
- applications to reservoirs, hematite on Mars





Concretion = cemented mineral mass


**NASA Explorations**

Opportunity rover  
Meridiani Planum:

- 2° S of equator
- crystalline hematite



- Iron = fluid flow indicator  
- Implications for groundwater, host rock properties, & pathways



NASA - JPL

Mars Blueberries vs. Utah concretions



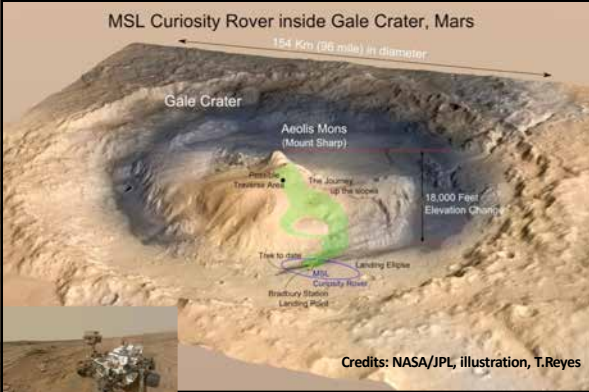
Mars

Utah

5 cm

Image: NASA/JPL/Cornell

MSL Curiosity Rover inside Gale Crater, Mars



Credits: NASA/JPL, illustration, T.Reyes

Curiosity ❤️ sedimentary rocks



**3. Case of the Missing Marbles**

Resources stolen from GSENM, S. Utah

Unique case, marbles had specific value

**Future for marbles:**

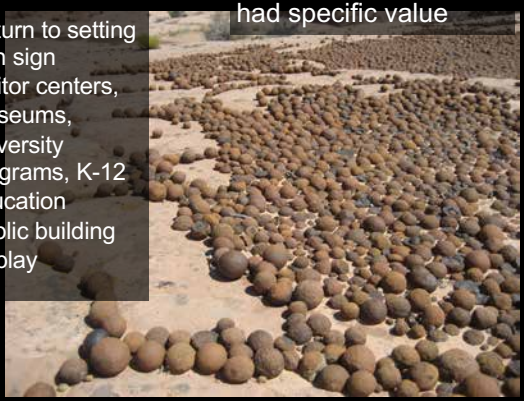
- Return to setting with sign
- Visitor centers, museums, university programs, K-12 education
- Public building display



**Future for marbles:**

Unique case, marbles had specific value

- Return to setting with sign
- Visitor centers, museums, university programs, K-12 education
- Public building display





#### 4. Future, Tech

- Drones, hi resolution imagery
- More information, awareness, social media
- New app TerraTRUTH : users report damage on Utah's public lands (e.g., outcrop damage, oil spills, stolen rock art, etc.)
- Future apps- combining science



## EXPLORE MARS TREK»

Check this out  
online,  
Also some youtube  
videos

See youtube: <https://www.youtube.com/watch?v=atOotI2ojbc>

Mars Trek Is NASA's Answer To Google Earth For Mars

### Cybertechnology & Science = HOT!

- Will allow our science new integrations, discoveries, visualization, & aid networking
- Exciting future!

Grand Prismatic Spring, Yellowstone

### Summary

- Red rocks tell about past groundwaters, chemistry
- Sedimentary records on Earth = important analogs for Mars
- Conserve & protect our heritage
- Integration, technology, & the next generation will guide us to new heights