Some Ways to Observe Mars

“Naked” eye
Telescopes on Earth
Telescopes orbiting Earth
Spacecraft above Mars
Spacecraft landing on Mars

Part I: Visits to Mars

Viking Lander (1976)

Viking Astrobiology Expts. (1976)

GCMS = Gas Chromatography and Mass Spectrometry

http://www.chemsoc.org
Conclusions

No Detectable Organics
Reactive Surface Material
Hydrogen Peroxide ($H_2O_2$) ??

How ???

$2\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{H}_2\text{O}_2$

$H_2$ floats away
... but $H_2O_2$ doesn’t

Consistent With Red Rocks

$H_2O_2$ Helps Convert Iron-Containing Minerals to Iron Oxide

Some Viking Lessons

Repeating measurements
Different experiments
More than one landing site
Importance of controls (blanks)

And then what happened?
Orbiters and Rovers 1997 - 2008

Three New Developments
- Salts
- \( \text{H}_2\text{O}_2 \)
- \( \text{CH}_4 \)

Mars Phoenix Lander
May - August of 2008
- \( \text{H}_2\text{O} \) ice sublimation seen
- Perchlorate ion (\( \text{ClO}_4^- \)) detected

Mars Science Laboratory (MSL)
- MSL Launch: Nov. 2011
- Mars Landing: Aug., 2012
  - Curiosity (rover)
- Plan = 1 Mars year (687 Earth days) … still in operation!
- Laboratory instrument suite to assess potential habitat

Evolution of Mars Explorers

Assess Mars
- Temperature = - 200 to 50 °F
- Atmospheric pressure = 0.006 atm
- Little protection from cosmic rays and UV
- Radiation
- Molecules
- Liquid \( \text{H}_2\text{O} \)
- UV from Sun
For the Future

The Search for Liquid Water on Mars

“I see no evidence of water.”

2003

Life on Mars?

Part II: Visits from Mars

The Importance of Impacts

Martian Impact Crater
(Northern Elysium Planitia)
Martian Meteorites

Another Check = Isotopes
Atoms of same element, but with different mass

Martian meteorites isotopes match Mars, not Earth, not Moon, etc.
Carl Sagan (1934 - 1996)

“Extraordinary claims require extraordinary proof.”

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Images

Clearwater, FL (now gone)

Turin, Italy

A Door

VMGCS
What's the deal with that Mars face?

It's 3 km long.

1976 (Viking) 2001 (MGS)

What's the deal with that Mars face?
happy

The Martian Rabbit

Frogs are from Mars ...
and pigs are from Venus.

Asteroid Eros
Feb. 13, 2000
Feb. 14, 2004
Mars Photo
Sources of Material

Most of the images used here are either original, from our class’s textbook, or in the public domain. Material not fitting into these categories has been credited in cases where I knew the sources. The drawings of the Viking experiments are from the Goldsmith and Owen astrobiology book. The credits for some images will be obvious. The graph with Shergottite glass data is from H. McSween’s *Stardust to Planets*. Danny Glavin of NASA is thanked for the MSL slides. -- I will be glad to add any credits missed!