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Title:	The Mars Science Laboratory Mission: Curiosity Rover
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Form 836 (7/06)

The Mars Science Laboratory Mission: Curiosity Rover

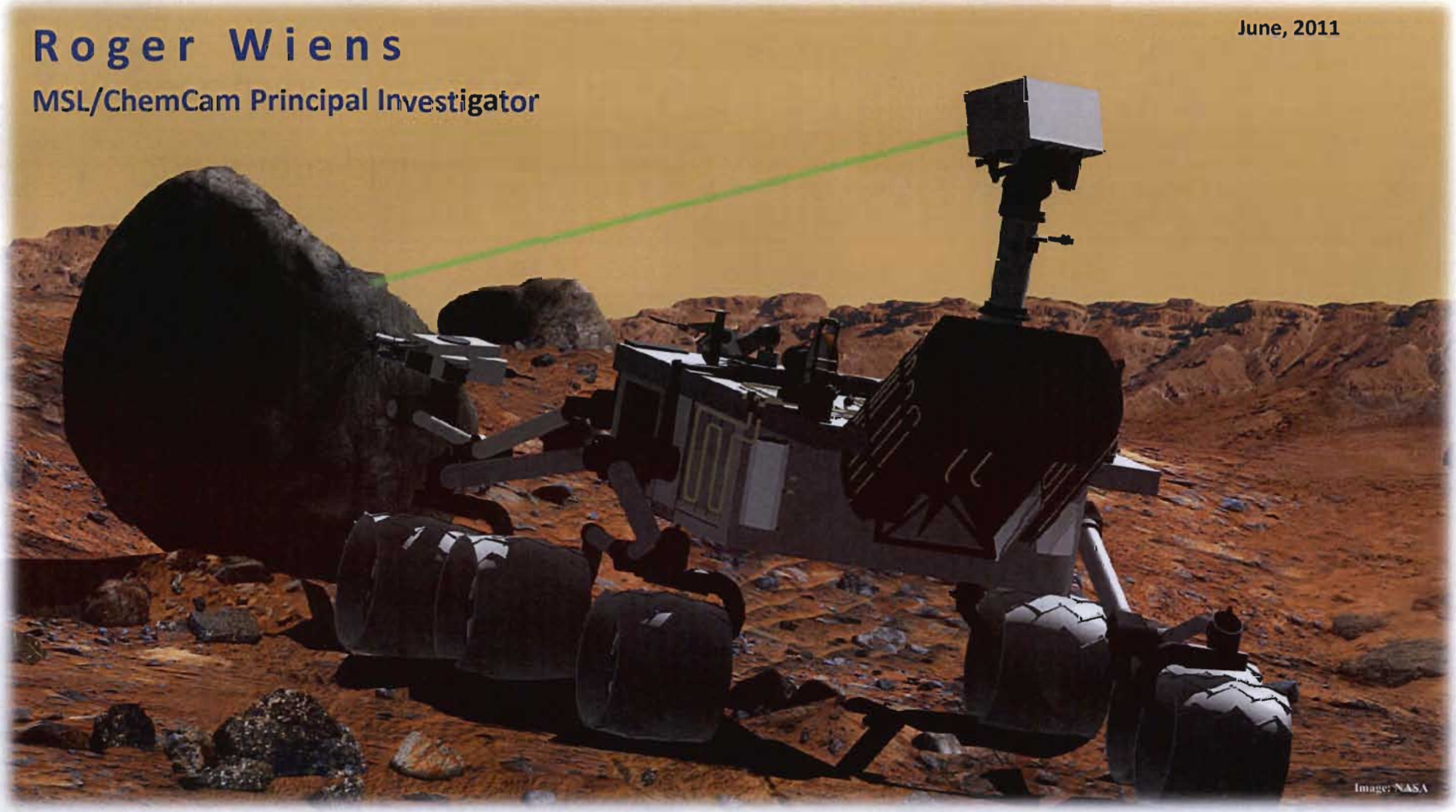
Abstract: This talk to a group of high school teachers, given by phone and video link, will discuss the goals of NASA's MSL mission which is due to launch later this year.

The Mars Science Laboratory Mission:
Curiosity Rover

Los Alamos
NATIONAL LABORATORY

Roger Wiens
MSL/ChemCam Principal Investigator

June, 2011



Outline

- MSL goals and context
- Landing sites overview
- Instruments
- Mission timeline
- Landing
- Operations plans
- Conclusion

Habitability & *"Taphonomy"?*

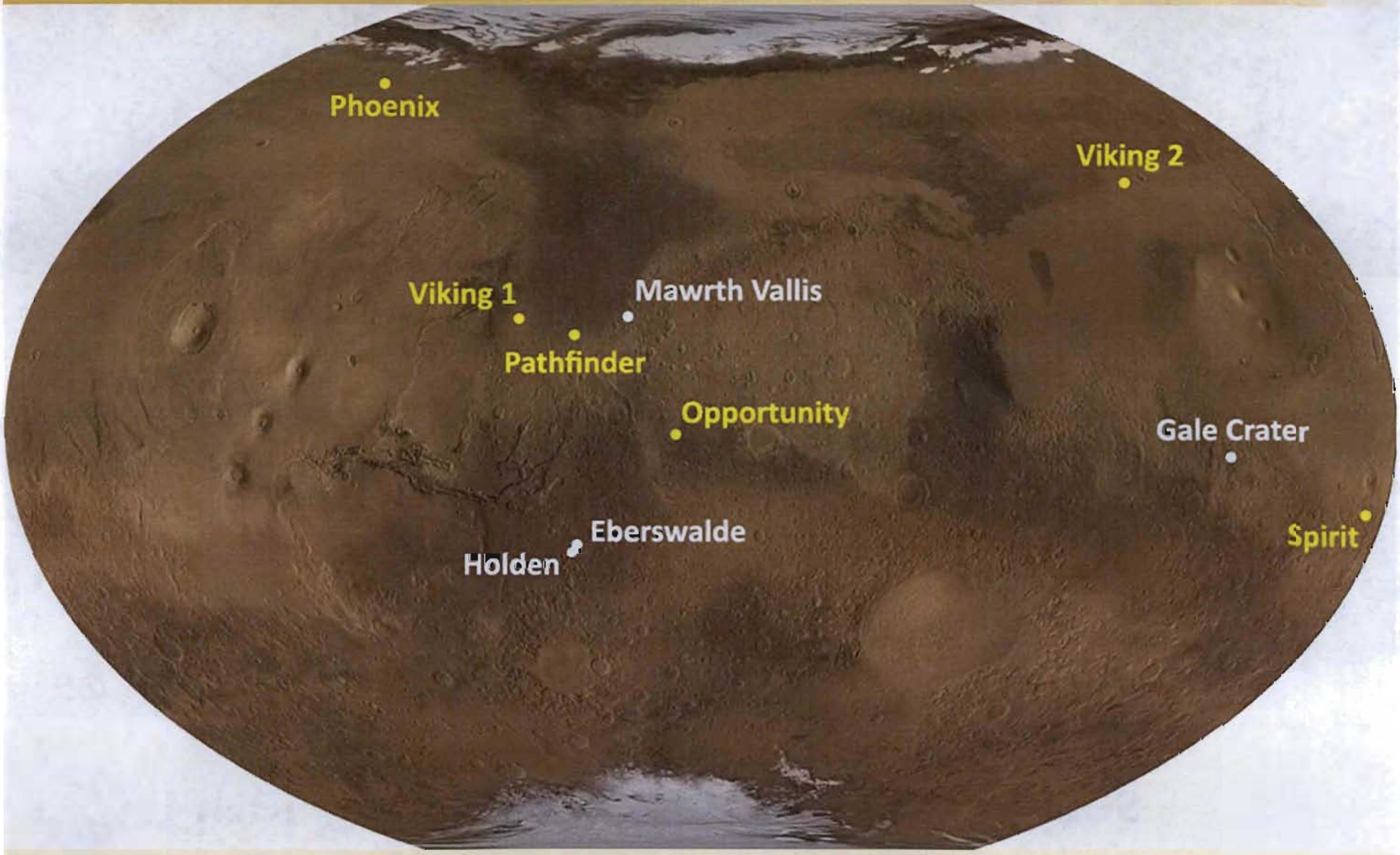
Ταφος (Greek) = burial

- Taphonomy: study of the environmental conditions affecting the preservation of animal or plant remains
- If we want to find evidence for ancient life on Mars, we must study and understand taphonomy
- Some conditions favorable to life are the most unfavorable for preserving the evidence of life!
  - On Earth rapid mineralization (fossilization) is one of the best taphonomic processes
  - Processes that concentrate organic materials are also likely to preserve evidence (coal- or oil-bearing strata on Earth)

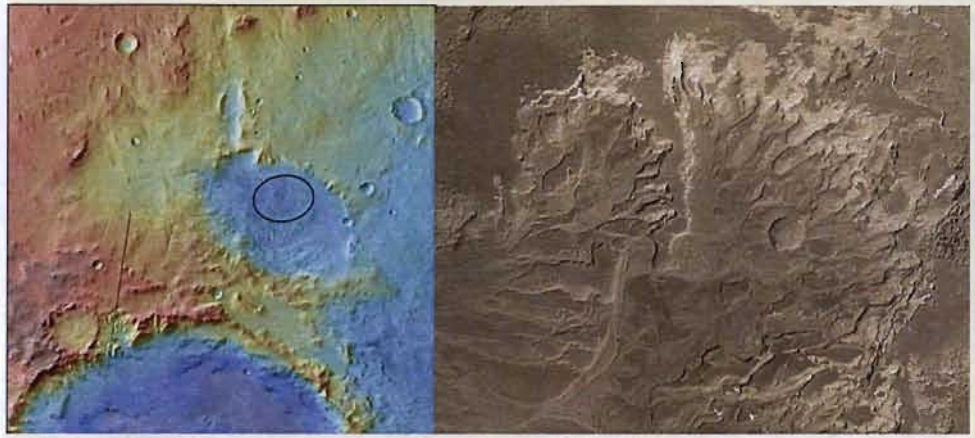
How Much Water, How Long?

- *Previous Mars missions have shown abundant evidence for water, but how much water and for how long?*
- *The MER rovers found sedimentary rocks, but both the tools on board the rover and the geological interpretations of the landing sites have been inadequate*
  - *No cross-bedding*
  - *No clear indication of hydration states*
  - *Carbonates?*

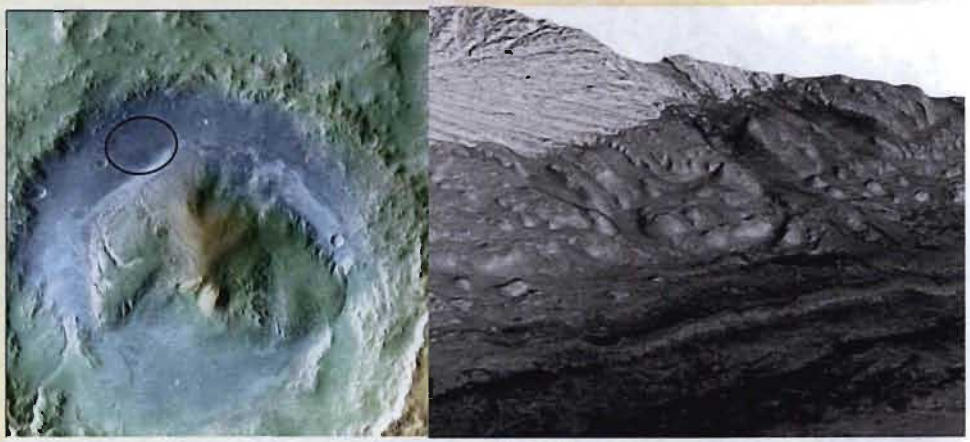
Previous and Future Mars Landing Sites



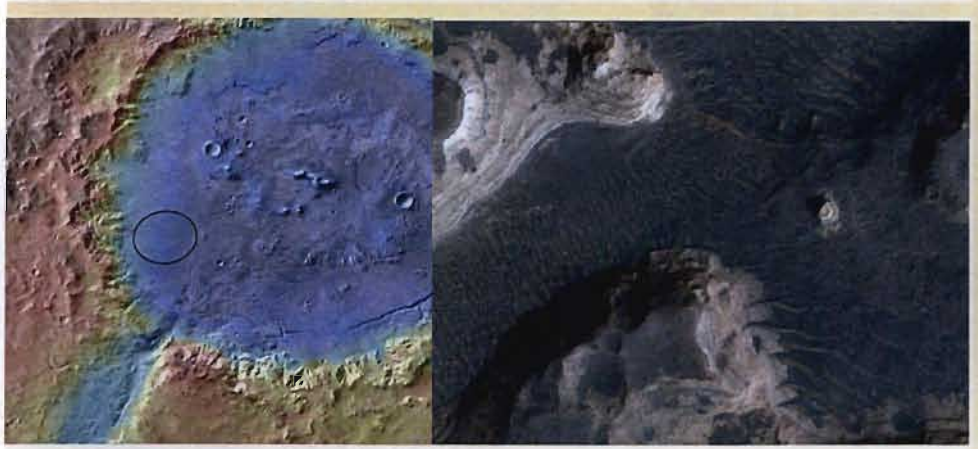
Final Candidate MSL Landing Sites



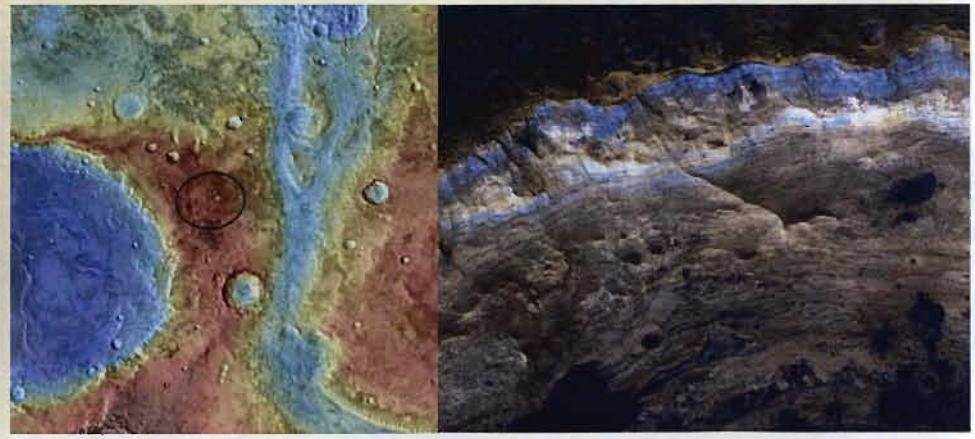
Eberswalde Crater (24°S, 327°E, -1.5 km) contains a clay-bearing delta formed when an ancient river deposited sediment, possibly into a lake.



Gale Crater (4.5°S, 137°E, -4.5 km) contains a 5-km sequence of layers that vary from clay-rich materials near the bottom to sulfates at higher elevation.



Holden Crater (26°S, 325°E, -1.9 km) has alluvial fans, flood deposits, possible lake beds, and clay-rich sediment.

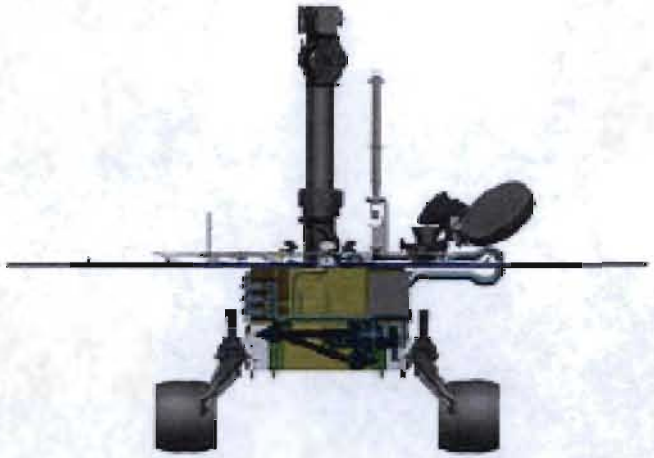


Mawrth Vallis (24°N, 341°E, -2.2 km) exposes layers within Mars' surface with differing mineralogy, including at least two kinds of clays.

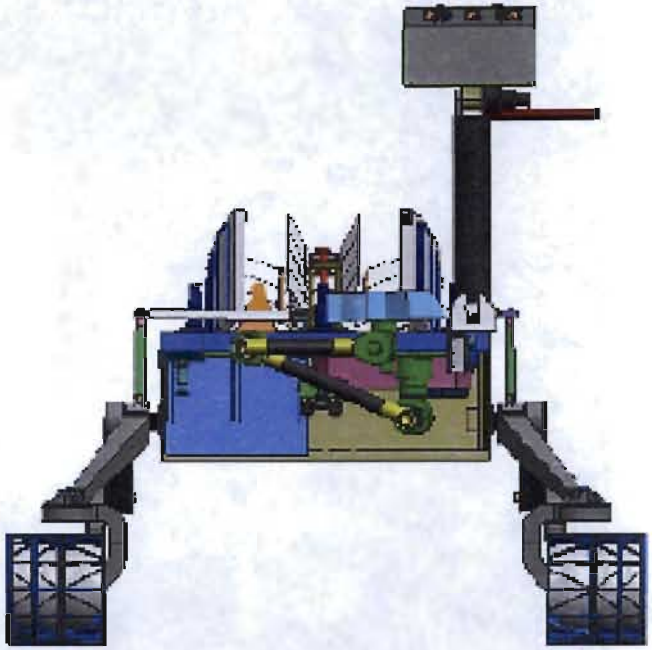

Introducing
the Curiosity Rover
2000 lbs
10 instruments
Nuclear powered
Range of >15 miles
Image: Wiens, Paris Air Show

Rovers Compared

Sojourner

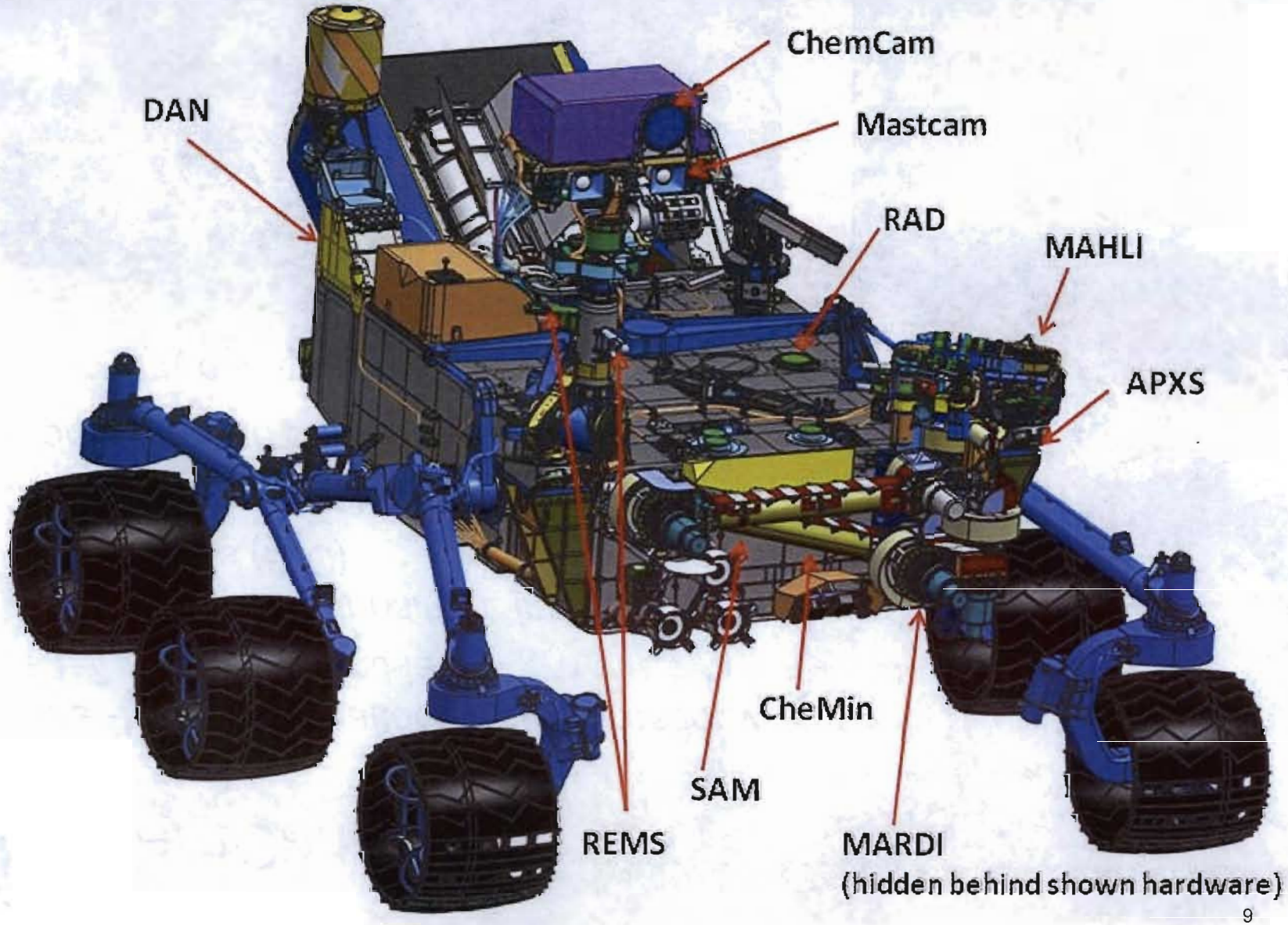


MER



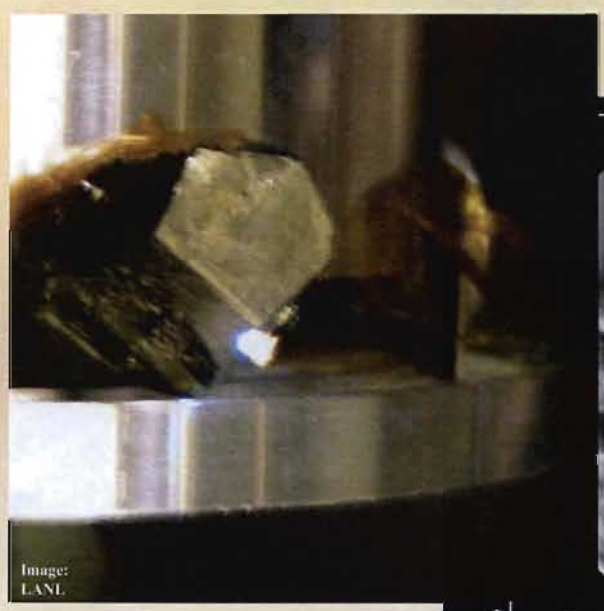
Curiosity

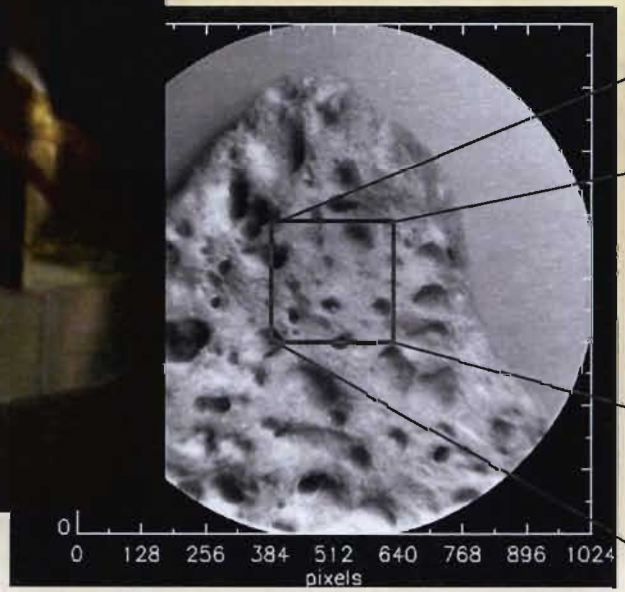
Instrument Locations

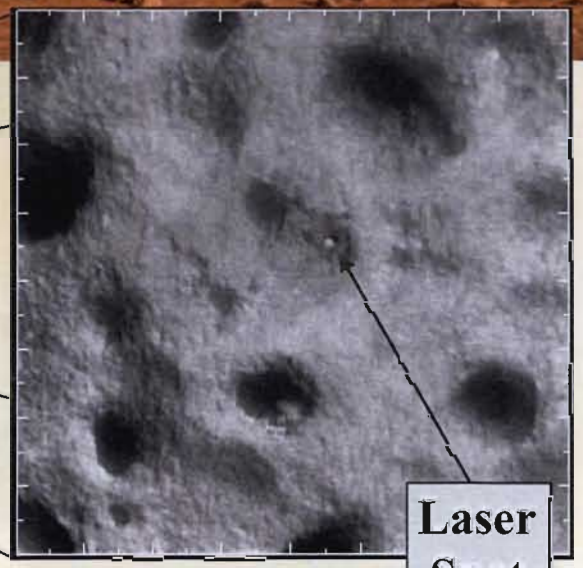


ChemCam

- *Laser-Induced Breakdown Spectroscopy at 1-7 m using 14 mJ laser*
  - *Elemental composition, including light elements (H,C)*
- *Context imaging with 100 µrad resolution*
- *Works through dust and weathering layers*

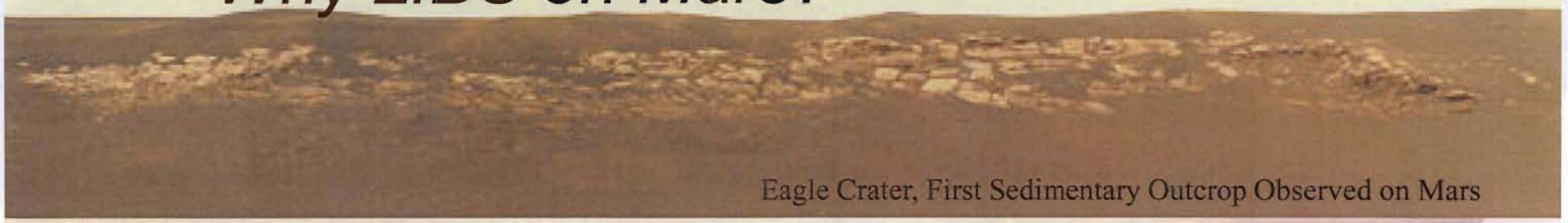






ChemCam RMI Images

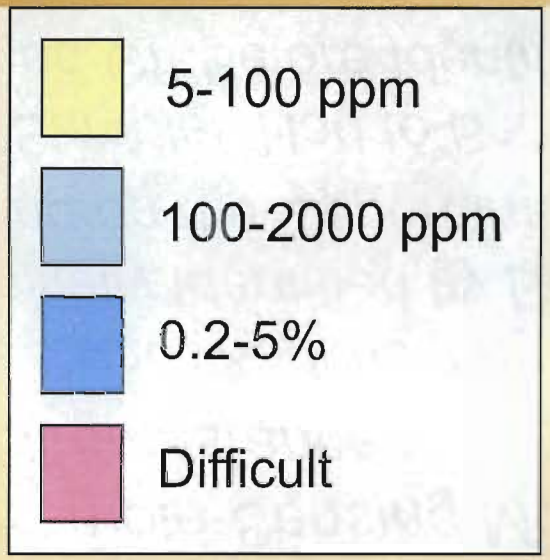
Why LIBS on Mars?



Eagle Crater, First Sedimentary Outcrop Observed on Mars

- *Mars is a Difficult Place For Remote Sensing*
  - *Surfaces Typically Covered by Dust and/or Weathering Coatings*
  - *Active Remote Sensing Much Better Than Passive Under These Circumstances*
    - *Eagle Crater Sedimentary Rocks Not Initially Identified by Remote Sensing on the Opportunity Rover*
    - *Most Samples Had to Be Brushed Off Before Identification*

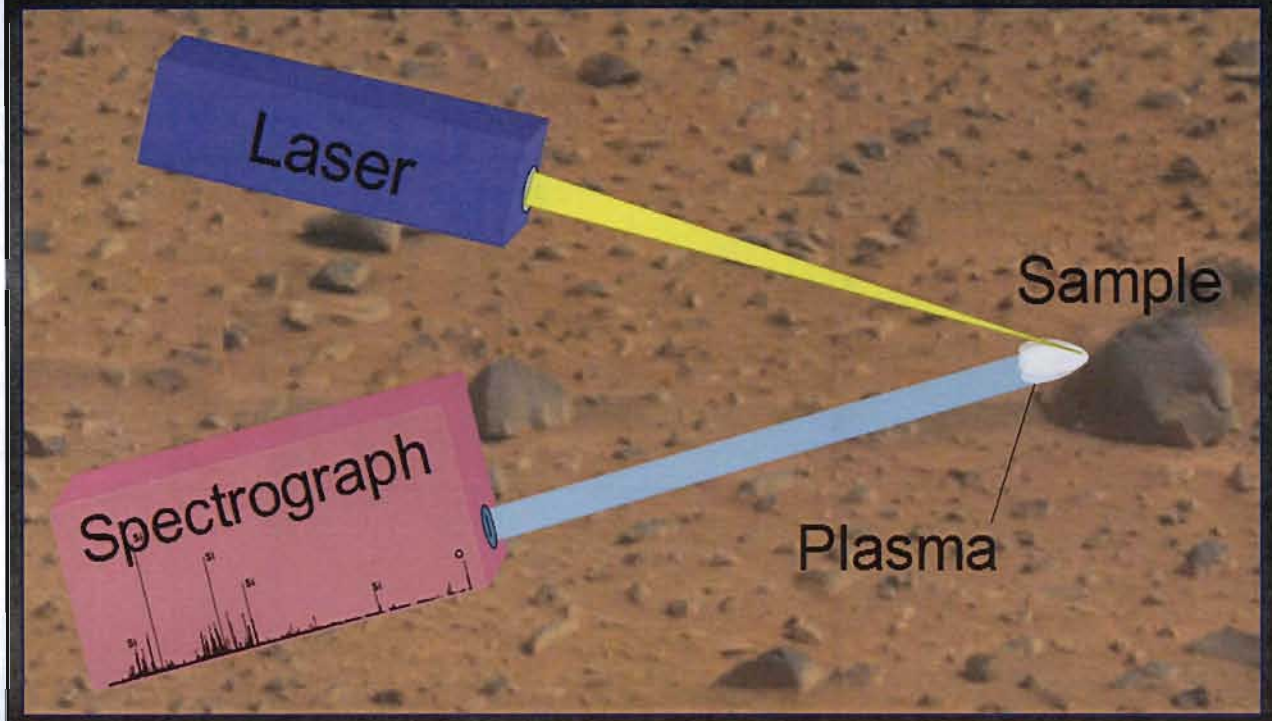
Elements Analyzable by LIBS

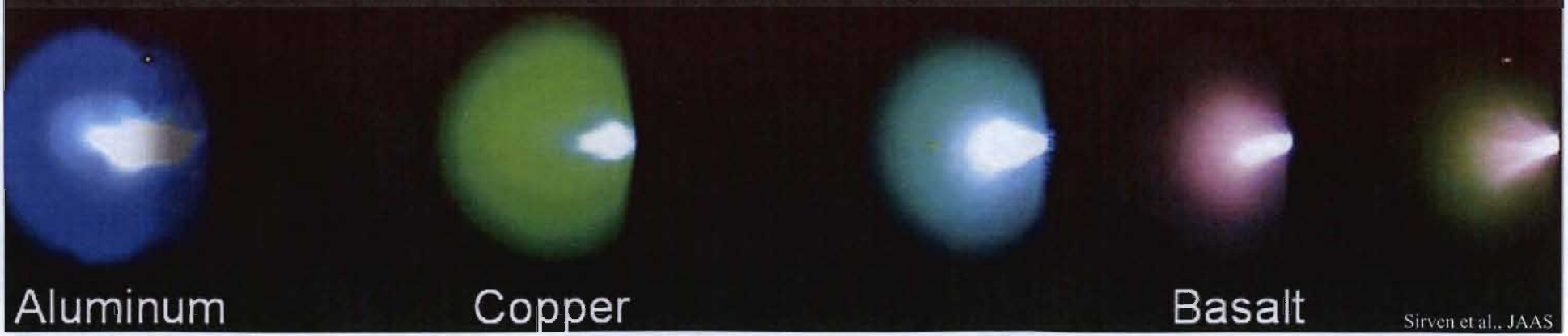


Approximate detection limits
at Mars atmospheric pressure
and at short distance

H																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo		Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi			

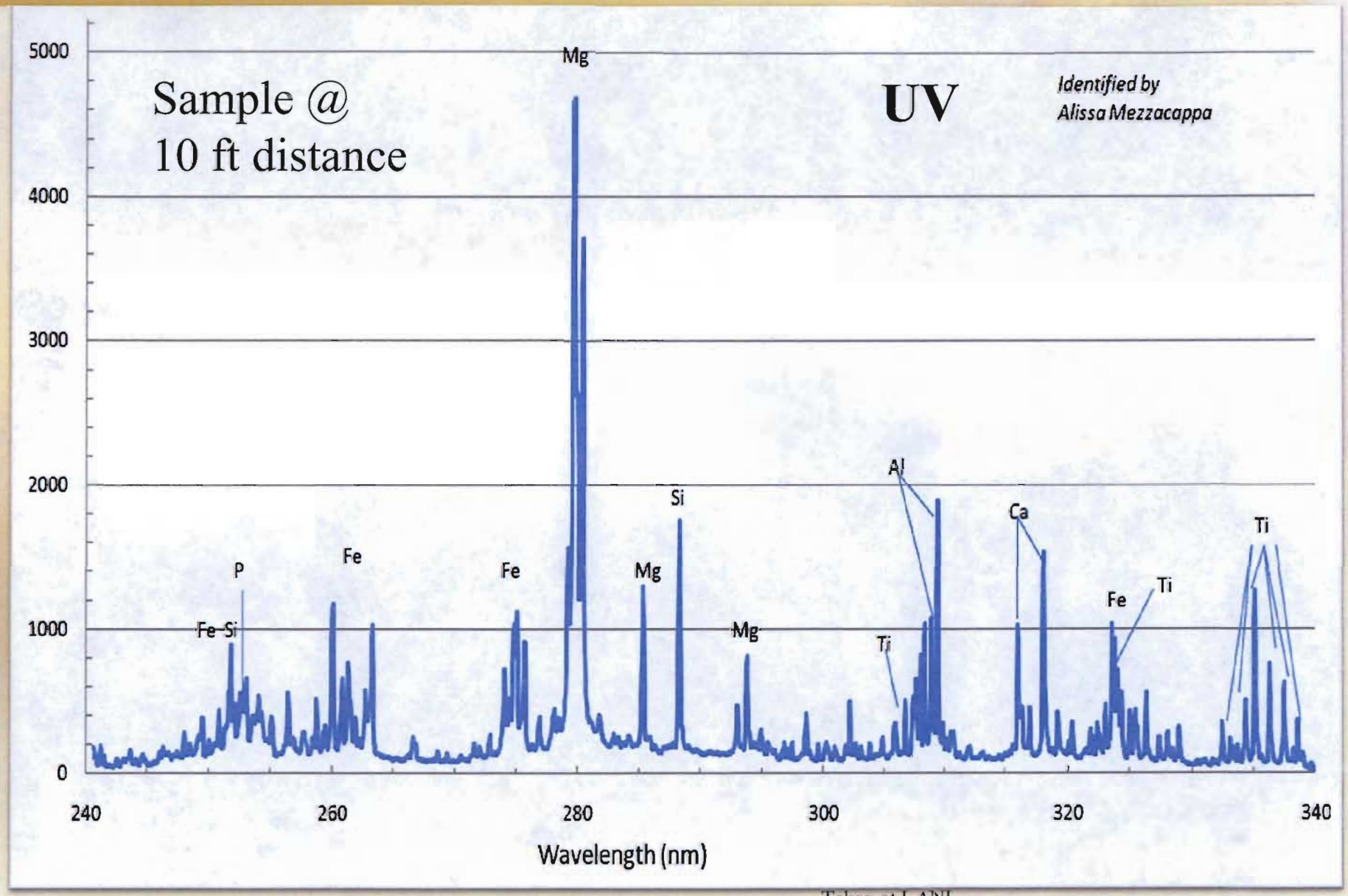
Laser-Induced Breakdown Spectroscopy (LIBS)



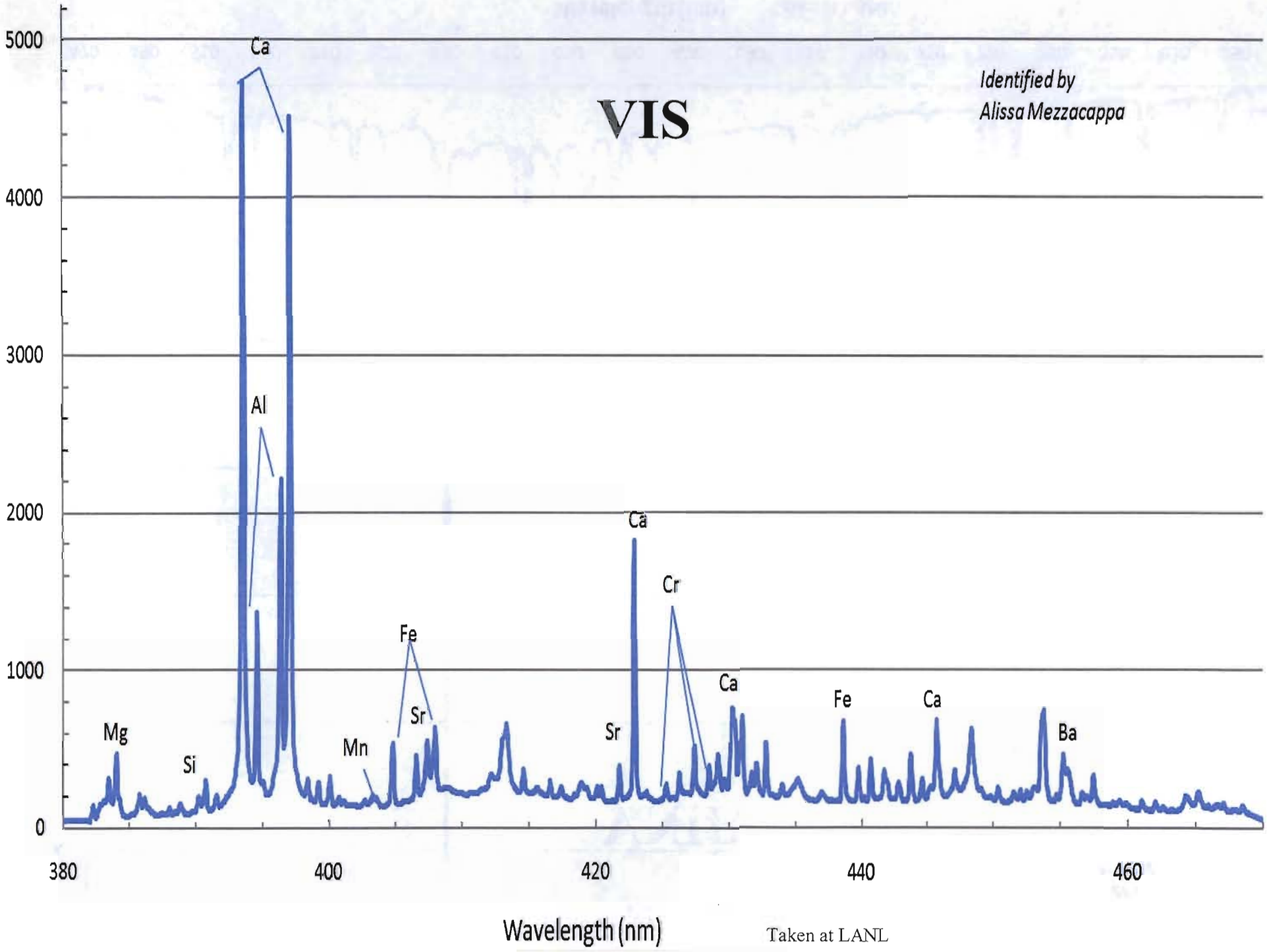


LIBS Spectrum

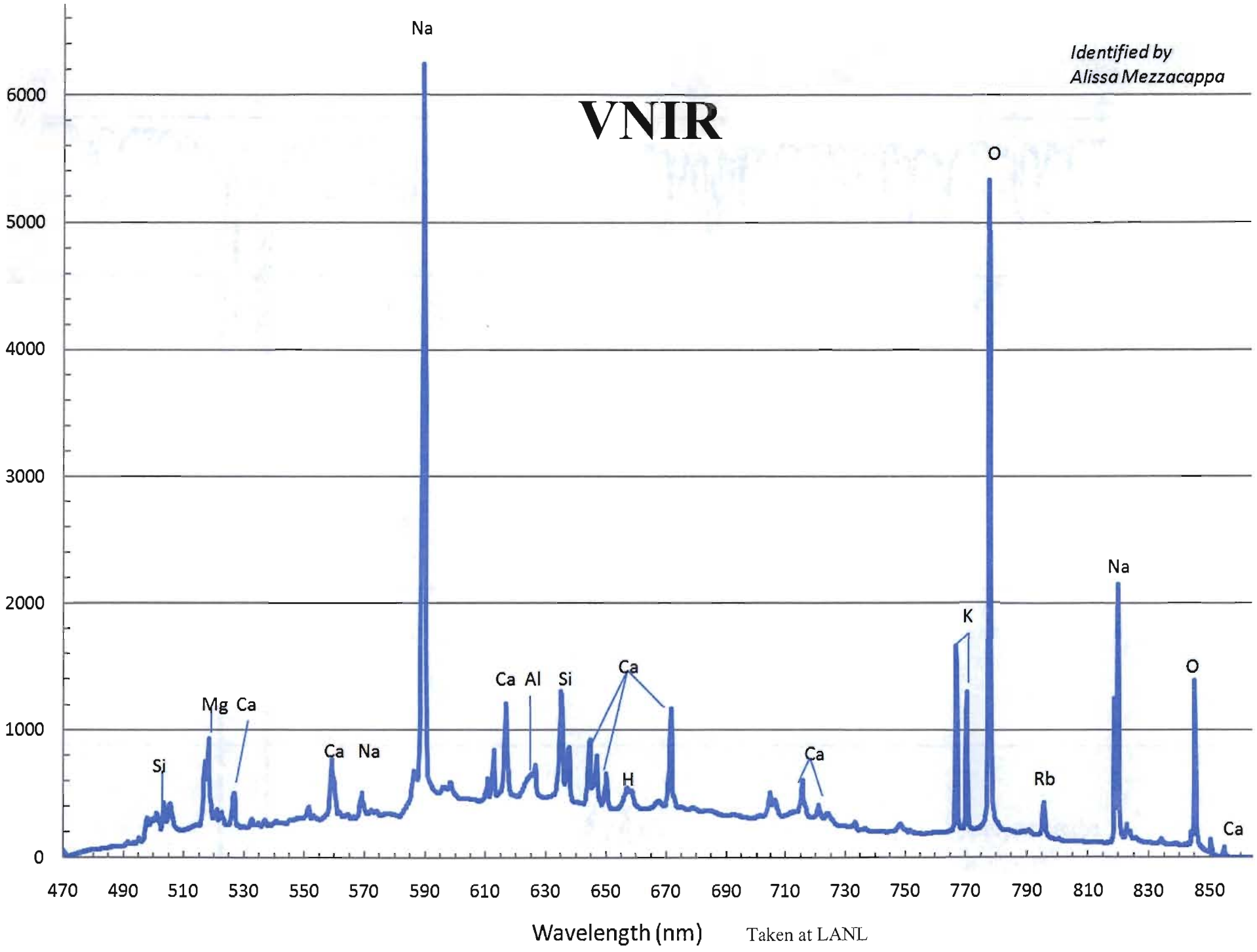
BT-2 basalt pressed powder
3 m, 95 A during thermal tests
In 7 Torr CO2
No instrum. resppone correction



Taken at LANL



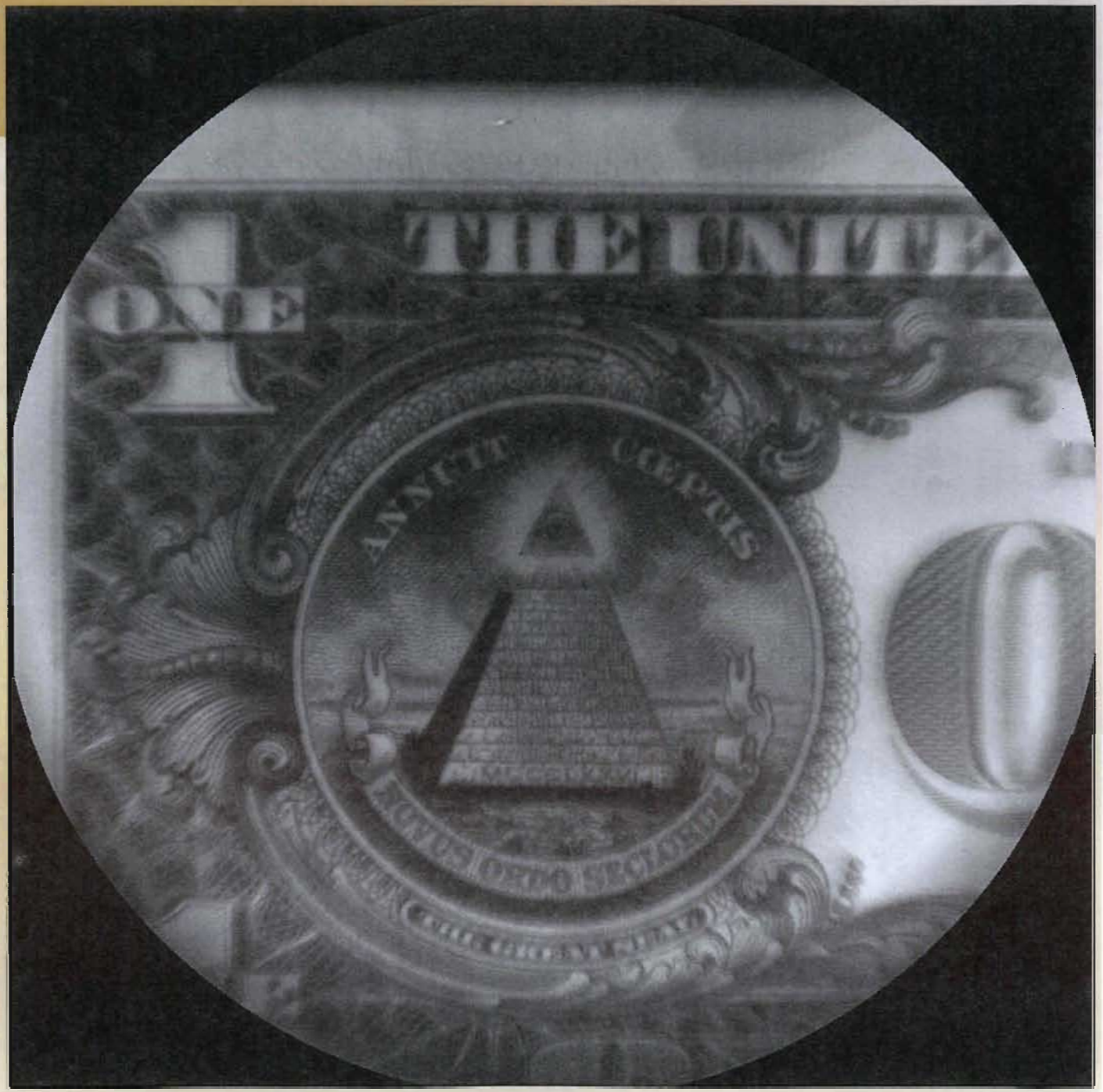
Taken at LANL



Taken at LANL

ChemCam Micro-Imager Performance

$1 @ a distance of 10 ft!

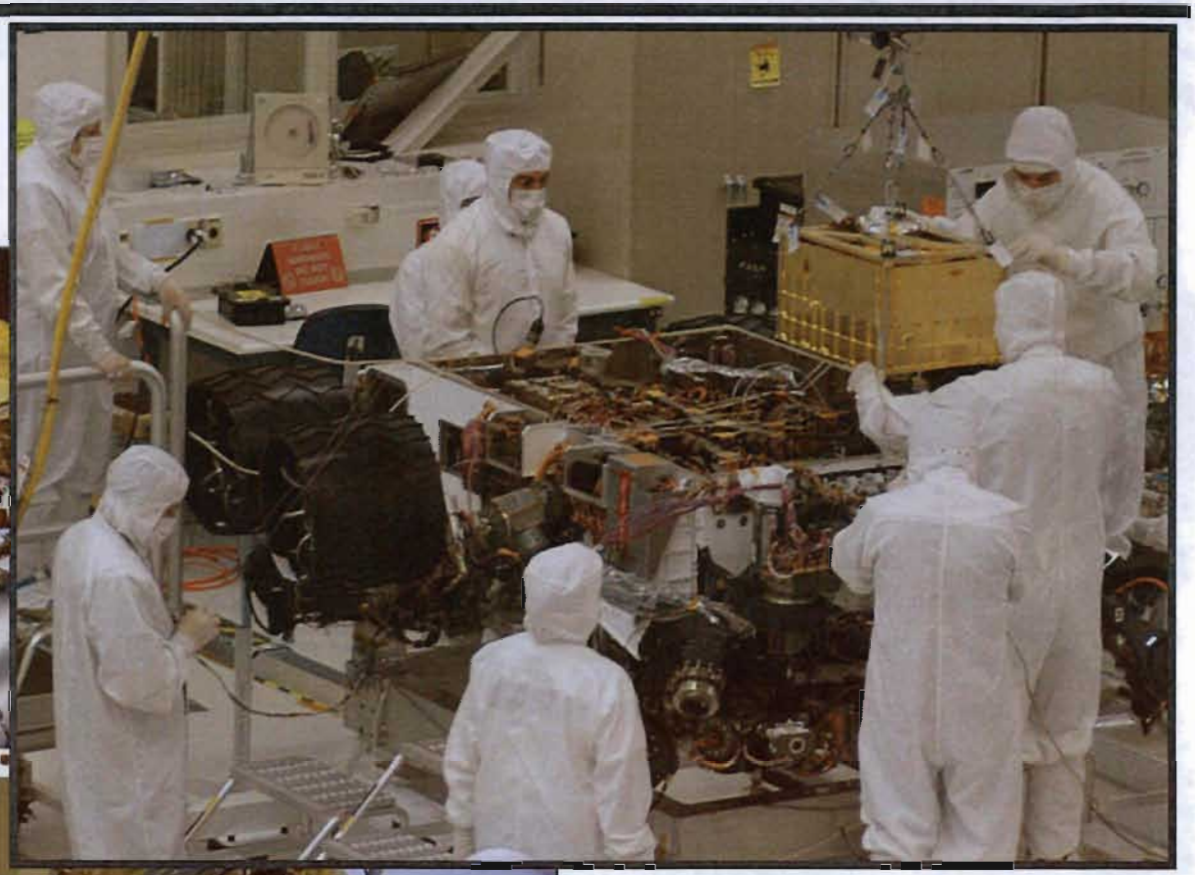


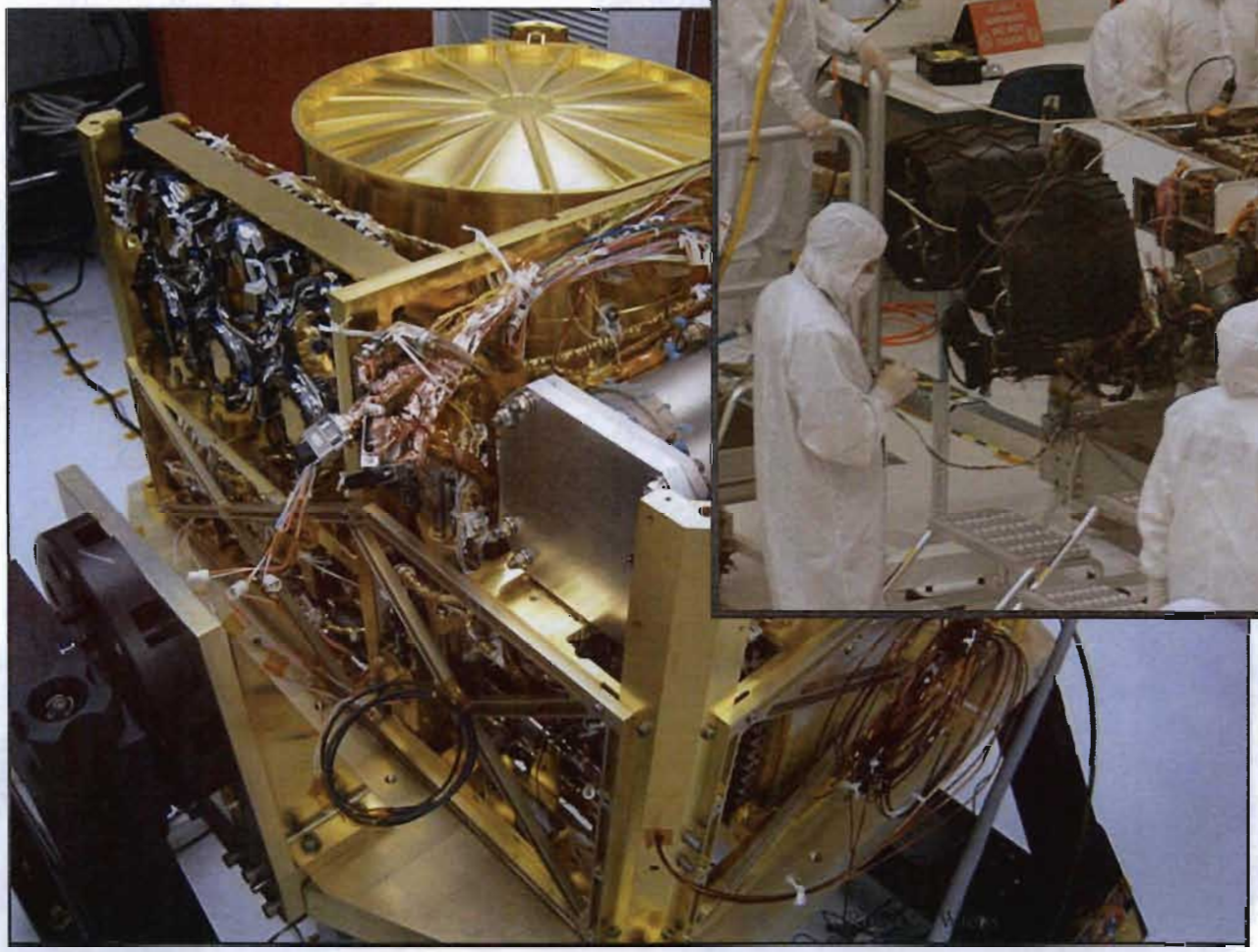
ChemCam Micro-Imager

Stretched Difference Image

SAM Instrument

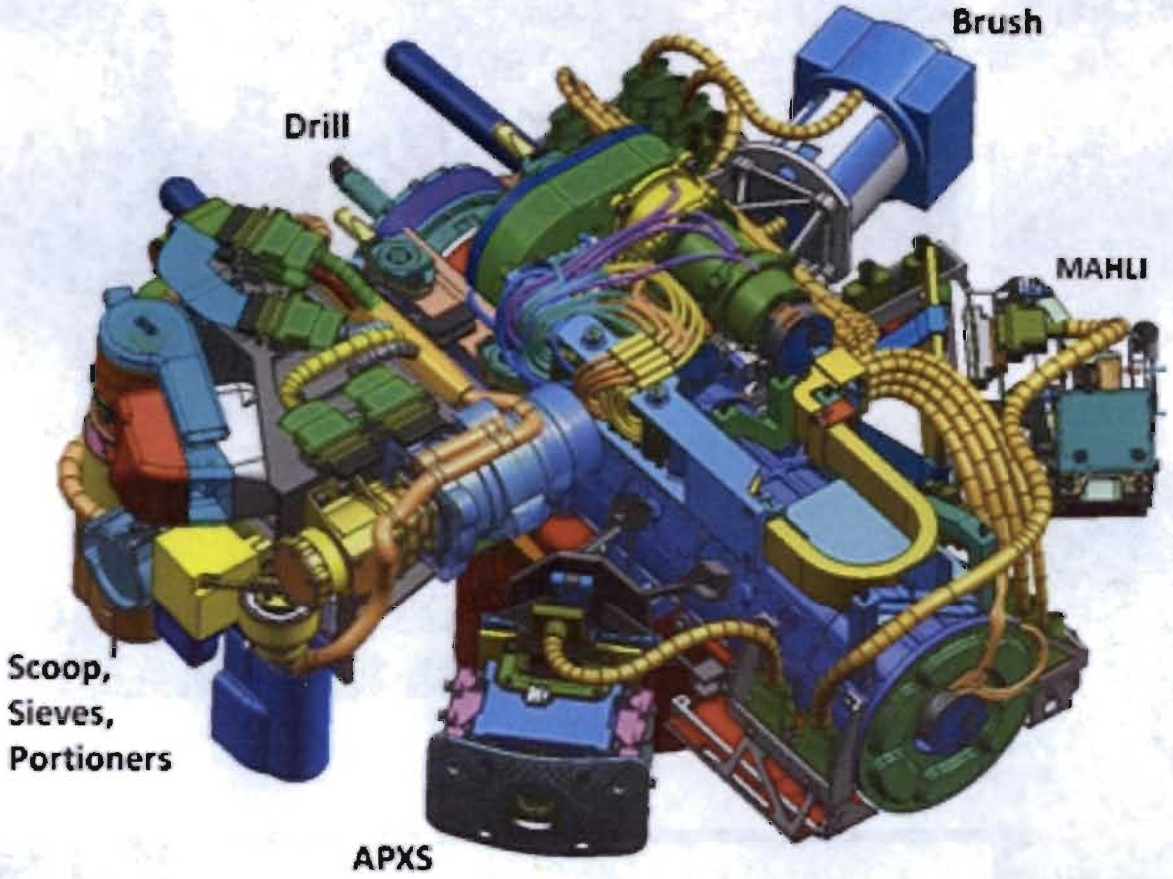
Sample Analysis on Mars (SAM)





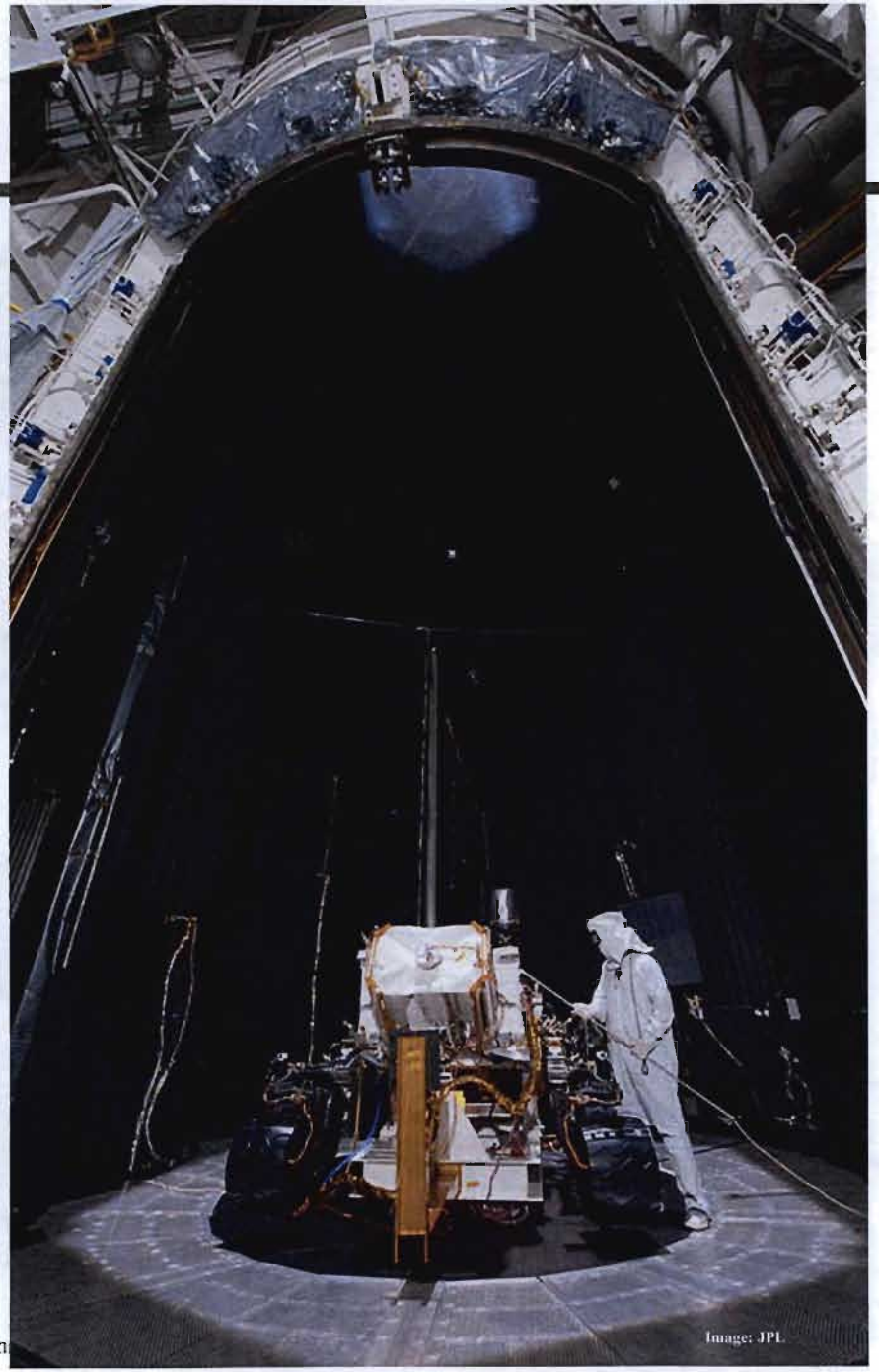
Rover Arm

Rover Arm Turret



- *Holds a microscopic imager (MaHLI), composition analyzer (APXS), a brush, a scoop, sieves, and a drill*
- *Extends 6 ft at end of arm*
- *Weighs 150 lbs*
- *Drill produces fine powder that is sieved and delivered to the sample inlets for instruments*

Thermal Tests



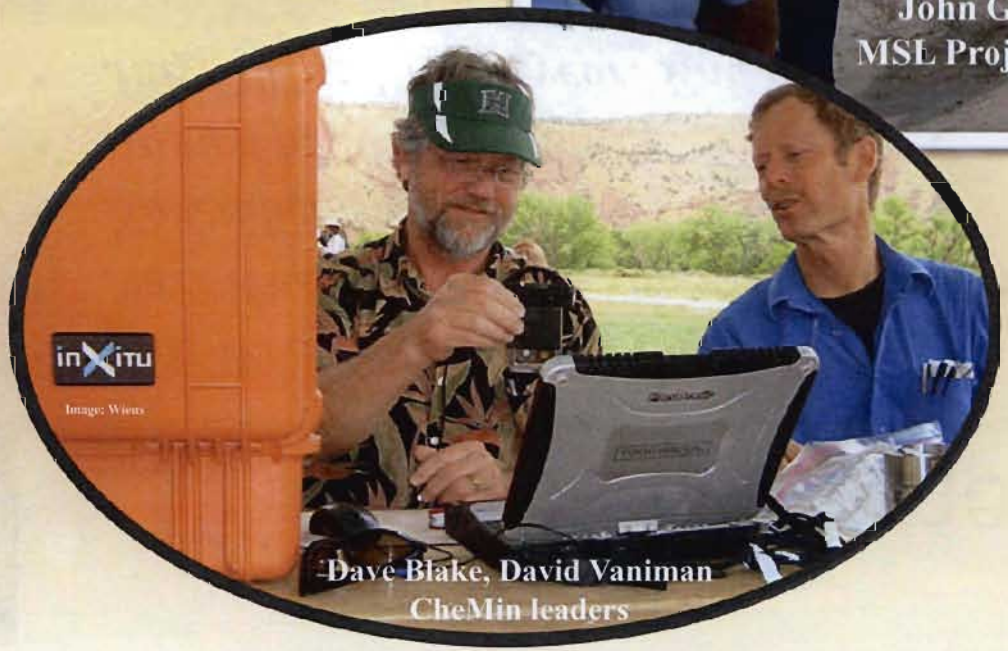
Curiosity Timeline

- ***This Week!: Travel to Florida***
- ***Next Week!: Landing Site Announcement***
- ***November 25-December 15: Launch***
- ***August 6, 2012: Landing***
- ***July, 2014: 1 Mars year: End of nominal mission***

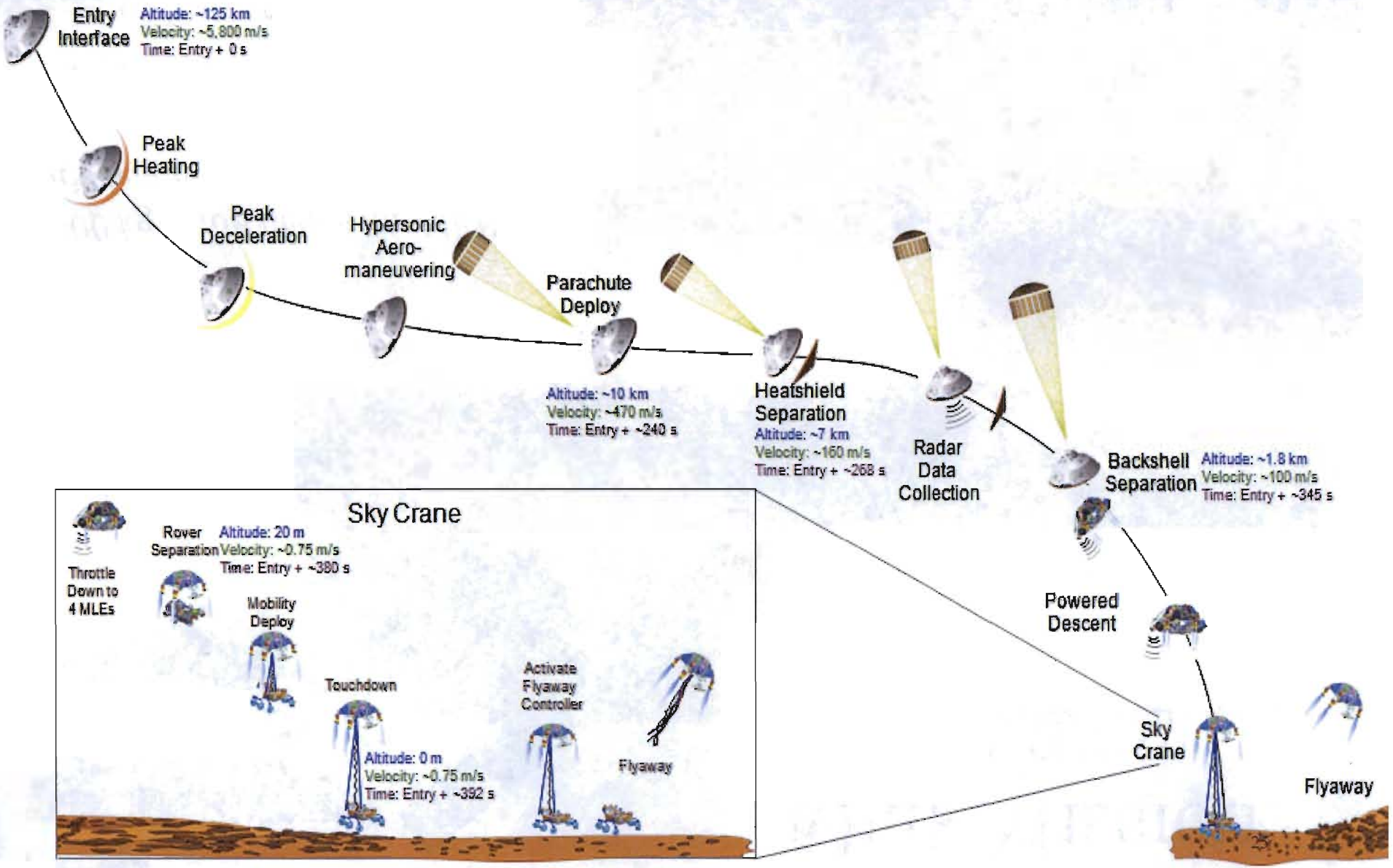
Packing for Shipping, June 16, 2011

Team Training

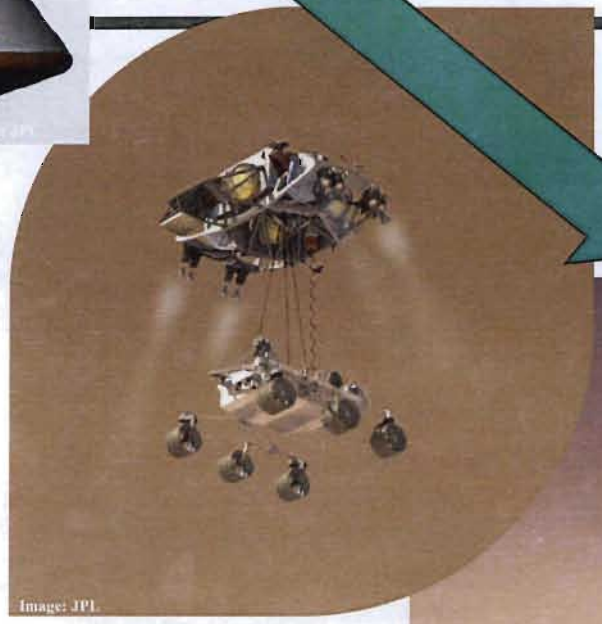
- Field trips to study geology
- Instrument tests on unknown samples (group activity)
- Software and operations training

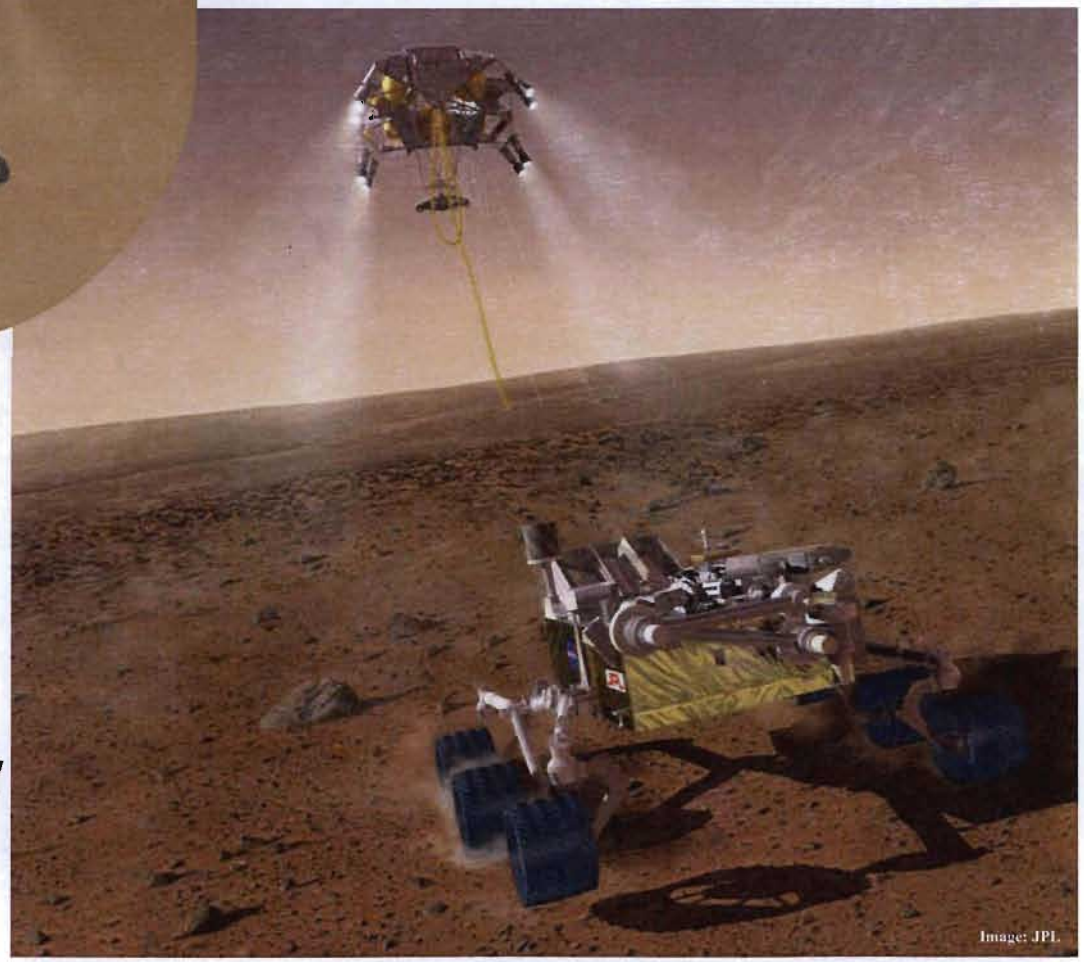


Mars Landing



Mars Mission: Landing





- *900 kg is too heavy for MER-type air bag landing*
- *MSL will use a "sky crane"*
  - *Cables will lower it from a retro-rocket package*
  - *MSL lands on its wheels, and the rope is cut*


The End
http://www.msl-chemcam.com
http://marsprogram.jpl.nasa.gov/msl