Arctic Mars Analogue Svalbard Expedition
ASTEP funded participation in instrument testing.

PHYSICS OF GEOLOGICAL PROCESSES

Norsk Romsenter
NORWEGIAN SPACE CENTRE

emgs
ELECTROMAGNETIC GEOSERVICES AS

Science associated with Life detection investigations on Mars - PP and use of instrumentation for life detection and health and environmental monitoring

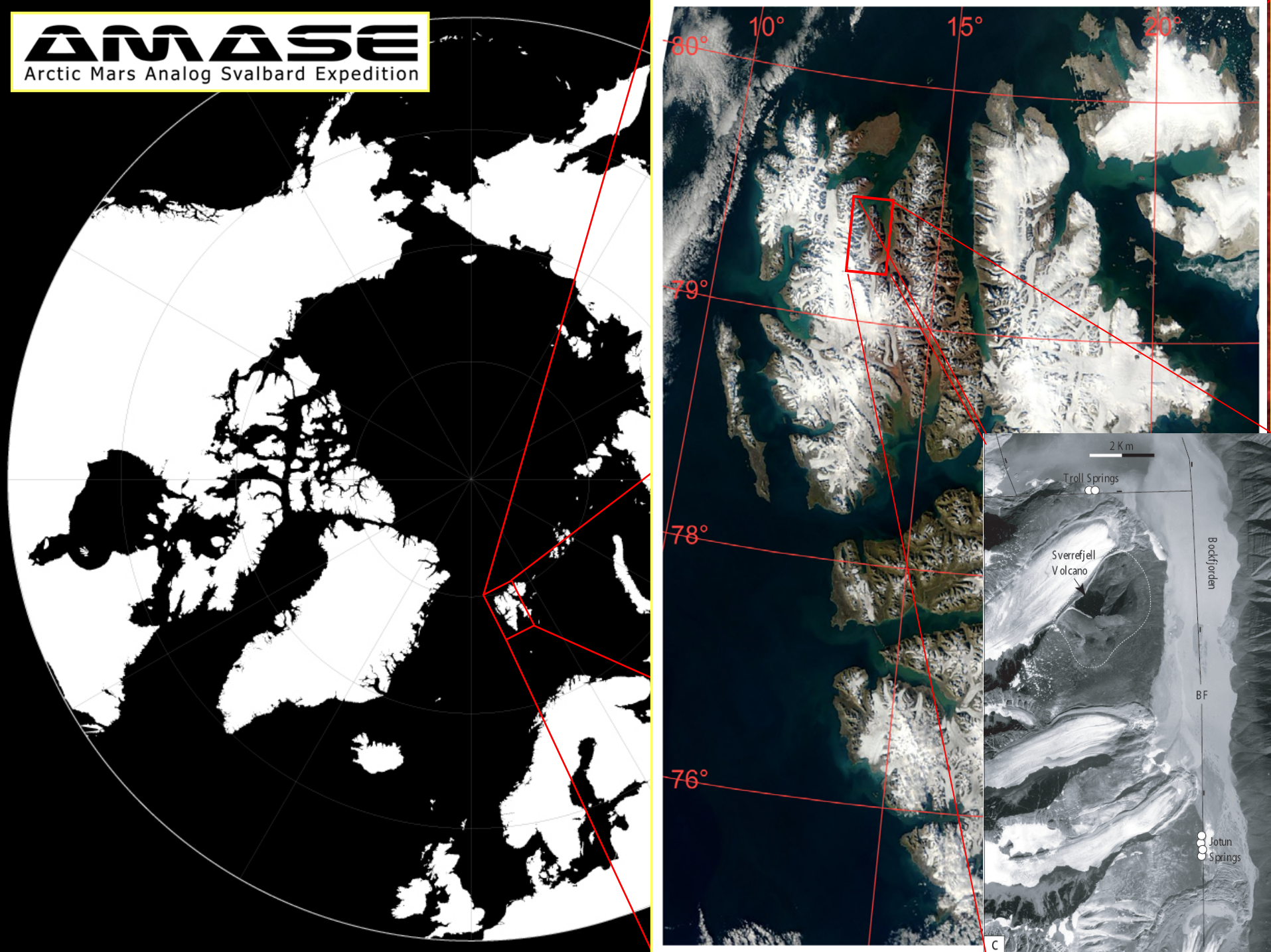
Instrument testing

Instrument to Rover integration

Rover / human interactions

Human / science instrument integration.

Sample collection and initial charaterization and triaging


AMASE
Arctic Mars Analog Svalbard Expedition
80°
10°
15°
20°
79°
78°
76°
2 Km
Troll Springs
Sverrefjell
Volcano
Bockfjorden
BF
Jotun
Springs
C

Why Svalbard?

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

AMASE ASTEP

Platform:

Rover (plus camera and microscopic imager)

Astronaut

Wearable computing

Sample Preparation

Aseptic liquid sample handling

Drill

Portable instrumentation,

CHEMIN – Analytical – Context Mineralogy

SAM - Analytical - Gas and Organic compounds

McDUVE – Contact – initial organic characterization

Raman spectroscopy - contact

PCR – Analytical - Biosignature

LAL – Analytical - Biosignature

ATP – Analytical - Biosignature

Digital Color Microscopy – Contact / Remote - Morphology

Protein Microarray – Analytical – Organic and biosignature

Cleaning Method

Part I: physical, chemical, and biological cleaning

1. Deionized water wipes
2. Disinfectant wipes
3. Isopropyl alcohol wipes

Part II: Using clean-room grade sterile clothe wipes and 0.2-μ m filtrate of reagents:

4. Deionized water
5. Sodium Hypochlorite
6. Hydrogen Peroxide
7. Ethanol

stronger sterilization, chemical oxidation → chemical and physical removal of residual organics

AMASE 2006 / JPL Cliffbot

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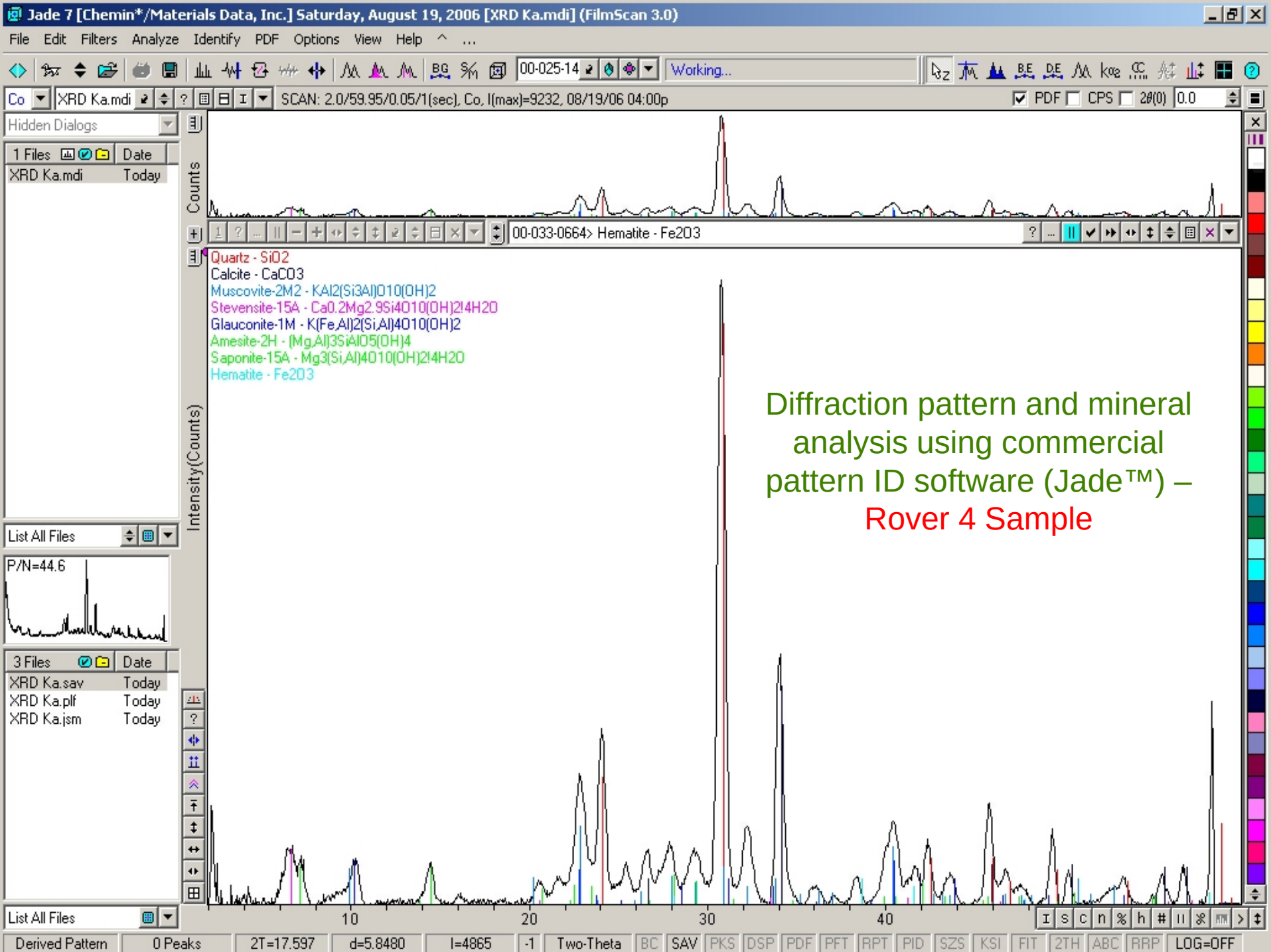
TIFF (Uncompressed) decompressor
are needed to see this picture.


JPL
Propulsion Laboratory

CheMin Field Deployment

David Bish completes the first fully-quantitative, start-to-finish XRD-based mineralogical analysis in the field


Jade 7 [Chemin*/Materials Data, Inc.] Saturday, August 19, 2006 [XRD Ka.mdi] (FilmScan 3.0)
File Edit Filters Analyze Identify PDF Options View Help
Working...
SCAN: 2.0/59.95/0.05/1(sec), Co, I(max)=9232, 08/19/06 04:00p
Counts
00-033-0664> Hematite - Fe2O3
Quartz - SiO2
Calcite - CaCO3
Muscovite-2M2 - KAl2(Si3Al)O10(OH)2
Stevensite-15A - Ca0.2Mg2.9Si4O10(OH)2!4H2O
Glauconite-1M - K(Fe,Al)2(Si,Al)4O10(OH)2
Amesite-2H - (Mg,Al)3SiAlO5(OH)4
Saponite-15A - Mg3(Si,Al)4O10(OH)2!4H2O
Hematite - Fe2O3
Intensity(Counts)
10
20
30
40
Diffraction pattern and mineral analysis using commercial pattern ID software (Jade™) – Rover 4 Sample
P/N=44.6
Derived Pattern
0 Peaks
2T=17.597
d=5.8480
I=4865
Two-Theta
LOG=OFF

SAM on AMASE 06

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

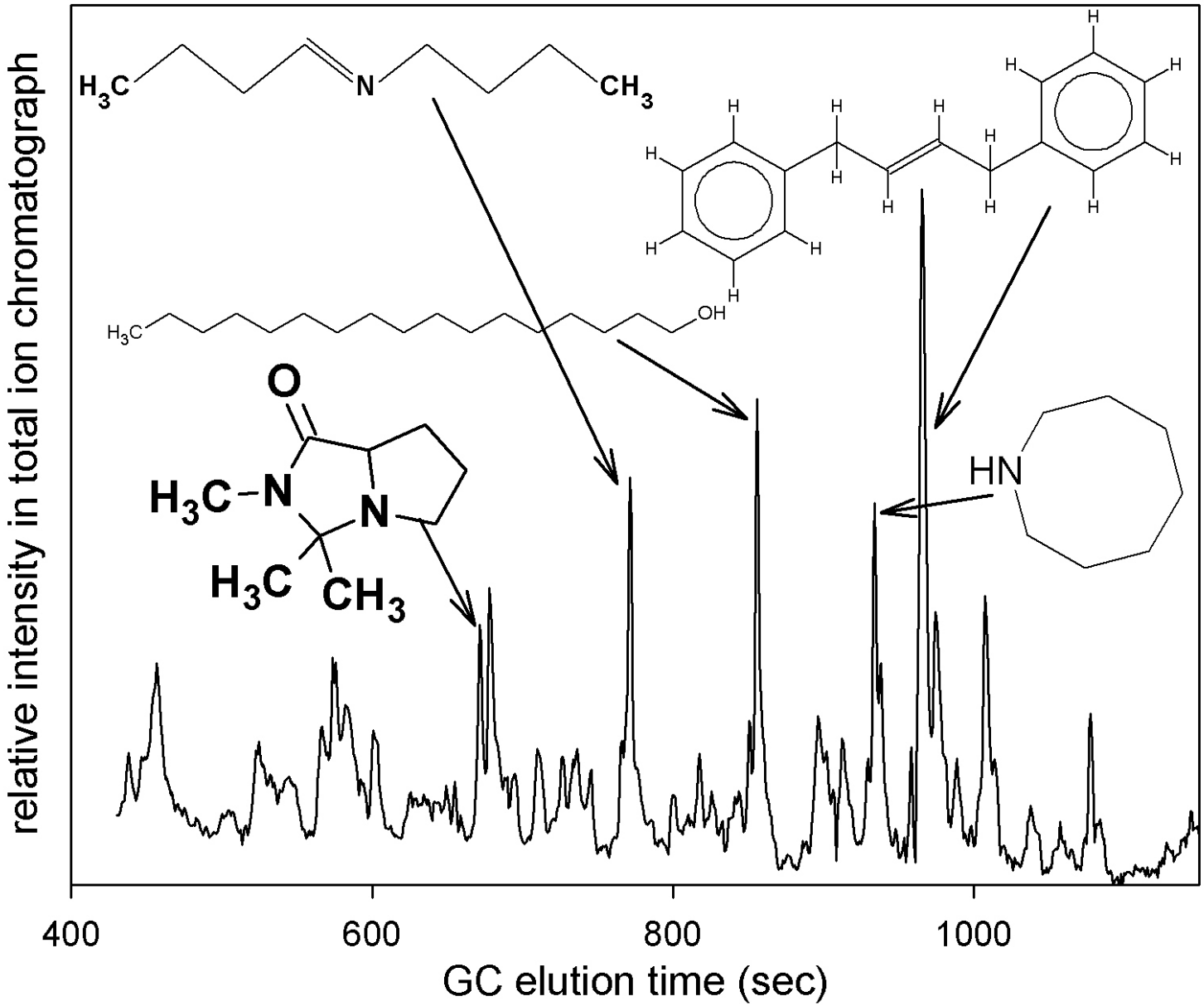
Goals for AMASE 06:

- Detect organics in the field
- Run GCMS analysis on Group Priority Samples
- Attempt field deployment of GCMS

Completed:

•Approximately 55 GCMS runs
•Successfully detected amino acids, fatty acids, and additional organics
•Successfully deployed GCMS in the field and ran

Kirstan Fristad poster


relative intensity in total ion chromatograph
GC elution time (sec)
400
600
800
1000
H3C
N
CH3
H3C
OH
O
H3C–N
N
H3C
CH3
HN

Integration of astrobiology with human space flight

- Extra-vehicular activity (EVA):
  - major mode of sample collection
  - transition from bio-rich to bio-poor environment
  - major potential source of sample bio-contamination - leaking suites etc
- Can we perform sample during EVA without bio-contamination?
- Can we perform real-time bio-analysis during EVA?
- Can we efficiently catalog samples and log data during EVA?
- Can we do all this and integrate with robotic vehicles?

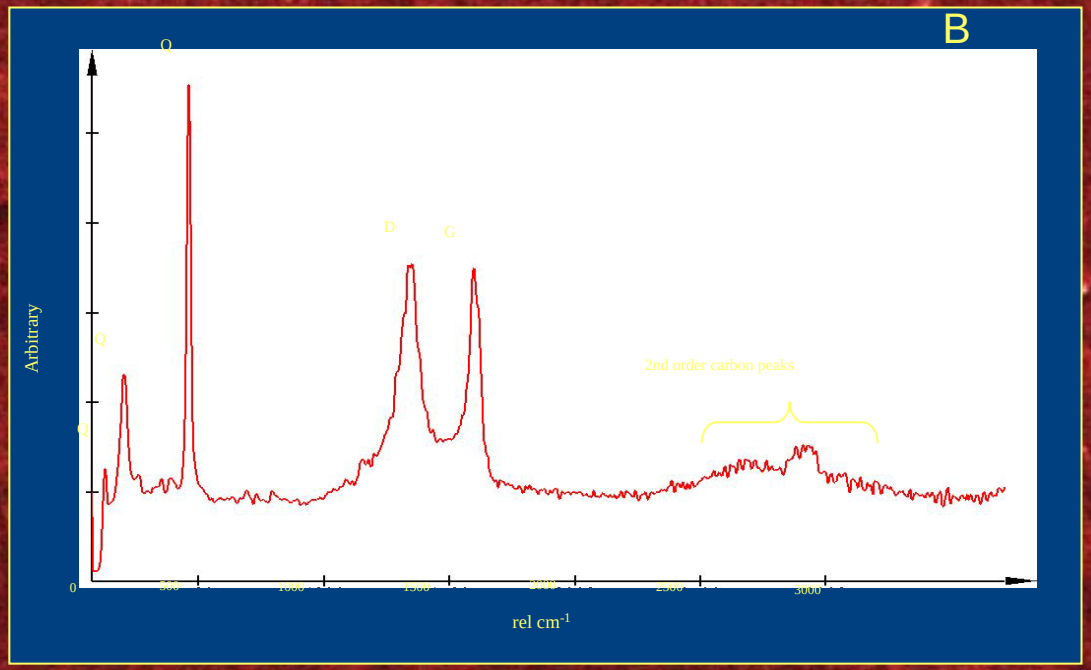
Sample	Endotoxin units (EU)/cm^2	Coefficient of variation (%)	Cell equivalent / cm^2
CliffBot scoop pre-sampling	< 0.002*	0.0	< 4
CliffBot scoop post-sampling	0.167	1.7	334
Collected sample	> 0.2	0.0	> 400

*Post 7-step cleaning process (Liane Benning et al)

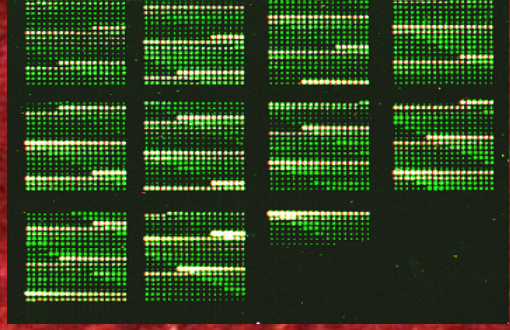
Sample collection, recording and triaging

Triaging samples

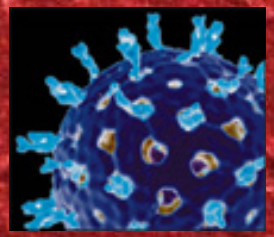
Limited number of samples to be returned.
Initial triaging of samples is a good idea.
Primary Triaging during sample collection.
Secondary triaging within science laboratory



Applications of Life Detection Technology in space flight



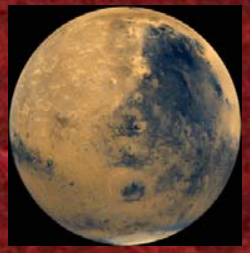
Carnegie 2004



1. **Astronaut tissue samples** (blood, urine, saliva, bone, muscle) during, pre and post flight

2. **Environmental samples** within spacecraft during flight

3. **Spacecraft surfaces** prior to launch to the Moon or other planets to prevent *forward* contamination and prior to return to Earth to prevent *back* contamination (Planetary Protection program)



4. **Traces of life** on the lunar or Martian surface (*in situ* analysis by robotic spacecraft)

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

LOCAD-PTS: Rationale and Hypothesis

- LOCAD-PTS is primarily a technology demonstration payload with a scientific

contamination measured by conventional culture methods.

COTS for Science Instrument

- Any instrument that has to be modified is at TRL 2.
- Many commercial instruments are not compatible with Space Flight
- Taking into account space flight issues during instrument development saves time and dollars
- Capitalize on existing programs.
- No commercial interest by companies in covering the costs of instrument development for Space.

Vast array of instrumentation developed for Mars research in PIDDP, MIDDP, ASTID and ASTEP.

Use it for Lunar research, health monitoring, environmental monitoring, sample triage.

Consolidate and fund concerted instrument development from resources already available…… cheaper in the end.

TEST