Arctic Mars Analogue Svalbard Expedition
ASTEP funded participation in instrument testing.
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 characterization and triaging
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-μm 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
QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.
David Bish completes the first fully-quantitative, start-to-finish XRD-based mineralogical analysis in the field.
Diffraction pattern and mineral analysis using commercial pattern ID software (Jade™) – Rover 4 Sample
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
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 suits 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?
<table>
<thead>
<tr>
<th>Sample</th>
<th>Endotoxin units (EU)/cm²</th>
<th>Coefficient of variation (%)</th>
<th>Cell equivalent / cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>CliffBot scoop pre-sampling</td>
<td>&lt; 0.002*</td>
<td>0.0</td>
<td>&lt; 4</td>
</tr>
<tr>
<td>CliffBot scoop post-sampling</td>
<td>0.167</td>
<td>1.7</td>
<td>334</td>
</tr>
<tr>
<td>Collected sample</td>
<td>&gt; 0.2</td>
<td>0.0</td>
<td>&gt; 400</td>
</tr>
</tbody>
</table>

*Post 7-step cleaning process (Liane Benning et al)
Sample collection, recording and triaging

Wearable computer

LOCAD PTS
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

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)
LOCAD-PTS: Rationale and Hypothesis

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

Rationale:
- Provide the crew with a tool available on-orbit which they can use at any time to detect a variety of biological and chemical compounds (some potentially hazardous).
- Promote crew autonomy and reduce reliance upon the ground; an important factor for human exploration beyond LEO.

Hypothesis:
- LAL data will have a positive correlation with microbial 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.