MULTISPECTRAL IMAGING SCIENCE WORKING GROUP
GEOLoGY TEAM

LONG TERM RESEARCH RECOMMENDATIONS

- LABORATORY RESEARCH
  - NEW METHODS OF FIELD SAMPLING
  - THEORETICAL MODELS OF MICROSCALE SPECTRAL MIXING

- UTILITY OF IMPROVED SPATIAL RESOLUTION
  - MULTISTAGE FIELD EXPERIMENTATION EMPLOYING PORTABLE SPECTROMETERS, AIRBORNE SCANNERS, AND ORBITAL IMAGING INSTRUMENTS (MACROSCALE MIXING)

- UTILITY OF IMPROVED SPECTRAL RESOLUTION
  - DEFINE SPECTRAL THRESHOLD FOR THE IDENTIFICATION OF SPECIFIC MINERAL SPECIES THROUGH HIGH RESOLUTION SURVEYS OF SELECTED TEST SITES

- UTILITY OF IMPROVED RADIOMETRIC SENSITIVITY
  - CONDUCT MULTISPECTRAL SURVEYS OF SELECTED TEST SITES WITH VARIABLE SIGNAL QUANTIZATION (8-12 BIT)

- GEOBOTANICAL REMOTE SENSING RESEARCH
  - SEPARATION OF GEOLOGICAL AND BOTANICAL SPECTRAL SIGNATURES IN INDIVIDUAL PICTURE ELEMENTS
  - EXPERIMENTAL LAB STUDIES OF GEOBOTANICAL CORRELATIONS THAT MORE FULLY SIMULATE NATURAL CONDITIONS
  - TEST SITE STUDIES DESIGNED TO TEST SPECIFIC GEOBOTANICAL HYPOTHESES
**Multispectral Imaging Science Working Group**

**Geology Team**

**Desired Measurement Capabilities of the Next Generation of Orbital Imaging Sensors**

<table>
<thead>
<tr>
<th>Spectral Region (Wavelength, Micrometers)</th>
<th>0.4-1.0</th>
<th>1.0-2.0</th>
<th>2.0-2.5</th>
<th>8-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Resolution</td>
<td>0.05um</td>
<td>0.05um</td>
<td>0.02um</td>
<td>0.5um</td>
</tr>
<tr>
<td>(selected 0.01um bands)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Resolution</td>
<td>30m</td>
<td>30m</td>
<td>30m</td>
<td>30m</td>
</tr>
<tr>
<td>Radiometric Sensitivity</td>
<td>1% of the incoming signal,</td>
<td>NEDT=0.2K at 300K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiometric Calibration</td>
<td>RELATIVE</td>
<td>ABSOLUTE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NEAR TERM RECOMMENDATIONS CONCERNING FUTURE ORBITAL IMAGING CAPABILITIES

EXPERIMENTAL OBJECTIVES

- Evaluate the combined utility of narrowband multispectral imaging in both the visible and infrared for lithologic identification of geologic materials.
- Evaluate the combined utility of multispectral imaging in the visible and infrared for lithologic mapping on a global basis.

GROUND RULES

- Recommendations are firmly based on past research results.
- Recommendations focus on desired resolution and sensitivity, not on specific measurement bands.
- Recommendations specify generic measurement capabilities desired in different spectral regions, and do not represent a proposal for a monolithic sensor.
- Team did not consider technical design challenges or associated data reduction problems.
CURRENT LITHOLOGIC MAPPING CAPABILITIES

- Discrimination of iron oxides based on reflectance variations in the visible and near infrared (0.5-1.0 micrometer wavelength region)
- Discrimination of clay minerals based on reflectance variations in the shortwave infrared (2.0-2.5 micrometer region)
- Discrimination of quartz-bearing rocks based on emissivity variations in the thermal infrared (8-12 micrometer region)
- Experimental detection of geobotanical stress based on reflectance variations in the visible and reflected infrared (0.5-2.0 micrometer region)
CURRENT LITHOLOGIC MAPPING CAPABILITIES

VISIBLE-NEAR IR (0.5-1.0 MICROMETERS)

IRON OXIDES

HEMATITE [Fe₂O₃]
GOETHITE [Fe₉(OH)₆]

SHORTWAVE IR (2.0-2.5 MICROMETERS)

CLAY MINERALS

MONTMORILLONITE [Al₂Si₄O₁₀(OH)₂·nH₂O]
KAOLINITE [Al₄Si₄O₁₀(OH)₈]
ALUNITE [KAl₃(SO₄)₂(OH)₆]
JAROSITE [KFe₃(SO₄)₂(OH)₆]

THERMAL IR (8-12 MICROMETERS)

SEDIMENTARY ROCKS

SILICATE VS. NON-SILICATE ROCKS
[SANDSTONES] [CARBONATES]
[SILTSTONES]
[SHALE]

IGNEOUS ROCKS

OCURRENCE AND RELATIVE PROPORTIONS OF QUARTZ [SiO₄]
MULTISPECTRAL IMAGING SCIENCE WORKING GROUP

GEOLoGY TEAM

WORKSHOP OUTCOME:

0. SUMMARY OF THE CURRENT STATE-OF-THE-ART

0. RECOMMENDATIONS CONCERNING NEAR-TERM EXPERIMENTAL IMAGING CAPABILITIES FROM ORBIT

0. LONGER TERM RESEARCH REQUIRED FOR THE DEVELOPMENT OF ADVANCED SENSORS DURING THE 1990'S
WORKSHOP ON THE USE OF FUTURE MULTISPECTRAL IMAGING CAPABILITIES FOR LITHOLOGIC MAPPING
CALIFORNIA INSTITUTE OF TECHNOLOGY
APRIL 20-21, 1982

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