GEOLOGY TEAM
PRESENTED BY: MARK SETTLE
MULTISPECTRAL IMAGING SCIENCE WORKING GROUP

GEOLoGY TEAM

LONG TERM RESEARCH RECOMMENDATIONS

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

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

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

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

0 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
<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 (selected 0.01um bands)</td>
<td>0.05um</td>
<td>0.02um</td>
<td>0.5um</td>
</tr>
<tr>
<td>Spatial Resolution</td>
<td>30m</td>
<td>30m</td>
<td>30m</td>
<td>30m</td>
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<tr>
<td>Radiometric Sensitivity</td>
<td>1% of the incoming signal</td>
<td></td>
<td></td>
<td>NEDT=0.2K at 300K</td>
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<tr>
<td>Radiometric Calibration</td>
<td>RELATIVE</td>
<td></td>
<td></td>
<td>ABSOLUTE</td>
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</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 [FeO(OH)]

SHORTWAVE IR (2.0-2.5 MICROMETERS)

CLAY MINERALS
MONTMORILLONITE [Al₂Si₄O₁₀(OH)₂·nH₂O]
KAOLINITE [Al₄Si₄O₁₀(OH)₈]
ALUNITE [K₂Al₃(SO₄)₂(OH)₆]
JAROSITE [K₂Fe₃(SO₄)₂(OH)₆]

THERMAL IR (8-12 MICROMETERS)

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

IGNEOUS ROCKS
OCCURRENCE AND RELATIVE PROPORTIONS OF
QUARTZ [SiO₄]
MULTISPECTRAL IMAGING SCIENCE WORKING GROUP

GEOLOGY TEAM

WORKSHOP OUTCOME:

- SUMMARY OF THE CURRENT STATE-OF-THE-ART
- RECOMMENDATIONS CONCERNING NEAR-TERM EXPERIMENTAL IMAGING CAPABILITIES FROM ORBIT
- 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

MISWG GEOLOGY TEAM MEMBERS

MARK SETTLE*, NASA HEADQUARTERS
LARRY ROWAN, USGS (RESTON)
BOB SINGER, UNIVERSITY OF HAWAII
ANNE KAHLE, JPL
MIKE ABRAMS, JPL
BILL COLLINS, COLUMBIA UNIVERSITY
ALEX GOETZ, JPL
BILL KOWALIK, CHEVRON FIELD RESEARCH COMPANY
JOHN ADAMS*, UNIVERSITY OF WASHINGTON

INVITEES

HAROLD LANG, JPL
JIM CONEL, JPL
DIANE EVANS, JPL
HUGH KIEFER, USGS (FLAGSTAFF)
GARY RAINES, USGS (DENVER)
WENDELL MENDELL, NASA/JSC
ALAN GILLESPIE, JPL
HARRY STEWART, SUN EXPLORATION COMPANY

*CO-CHAIRMEN