



**Hyperspectral Airborne Survey
for Geological Mapping,
Musgrave Ranges,
South Australia**

**Mauger, Stamoulis & Cocks
5th Airborne Remote Sensing
Conference, Miami
May 2002**

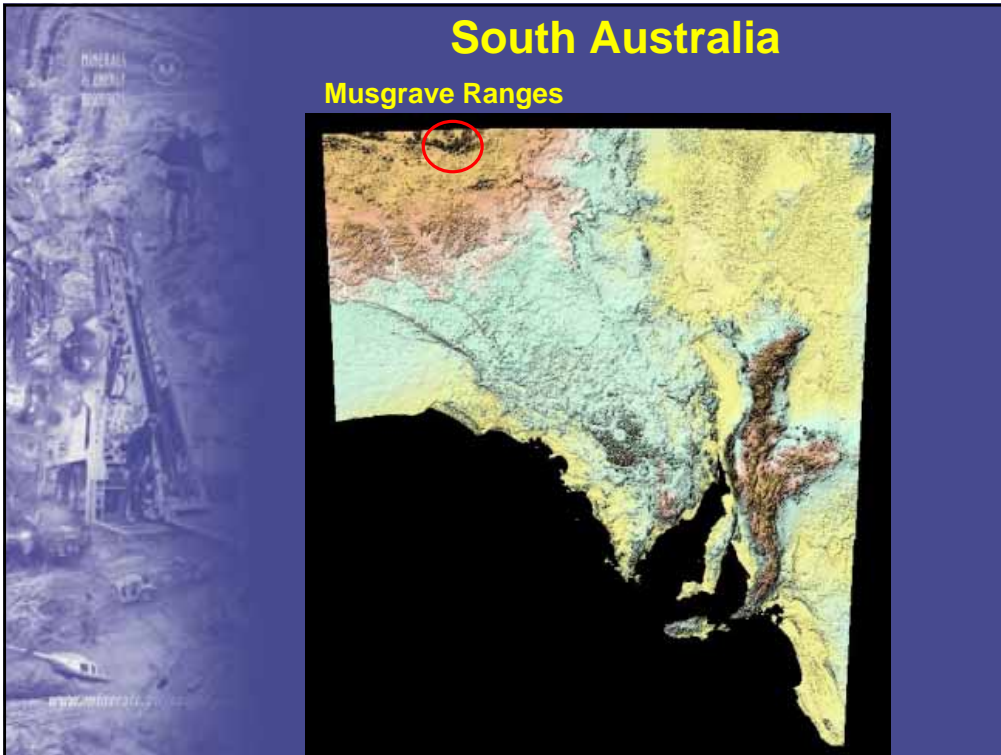


Introduction

- SA Government/ TEiSA
- Nov Dec 2000 Airborne Hyperspectral Survey
- Northern South Australia - Musgrave Ranges
- For geological mapping
- 22 Runs, approx. 25km x 2.5km each
- 1100 square kilometres

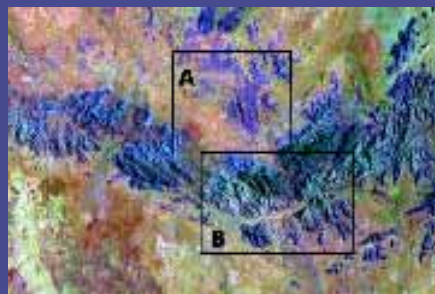
South Australia

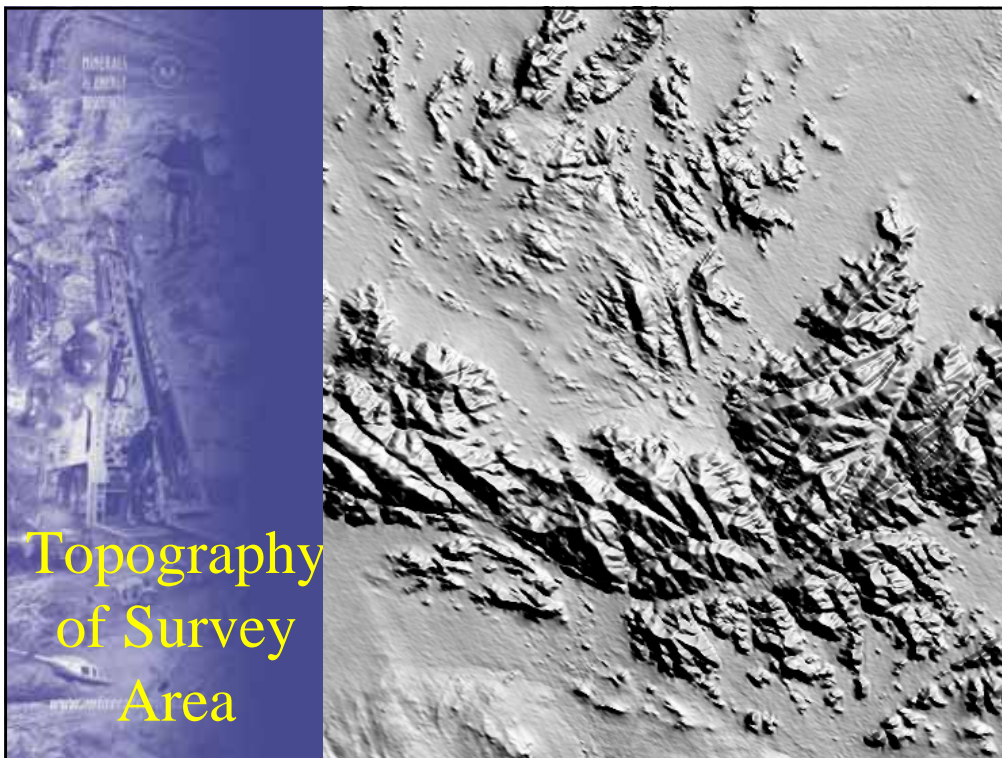
Musgrave Ranges



Survey

- Two blocks
 - e-w runs flown over 3 days
 - 500m overlap between runs
 - all data acquired in morning illumination
 - 15 Gigabytes of data



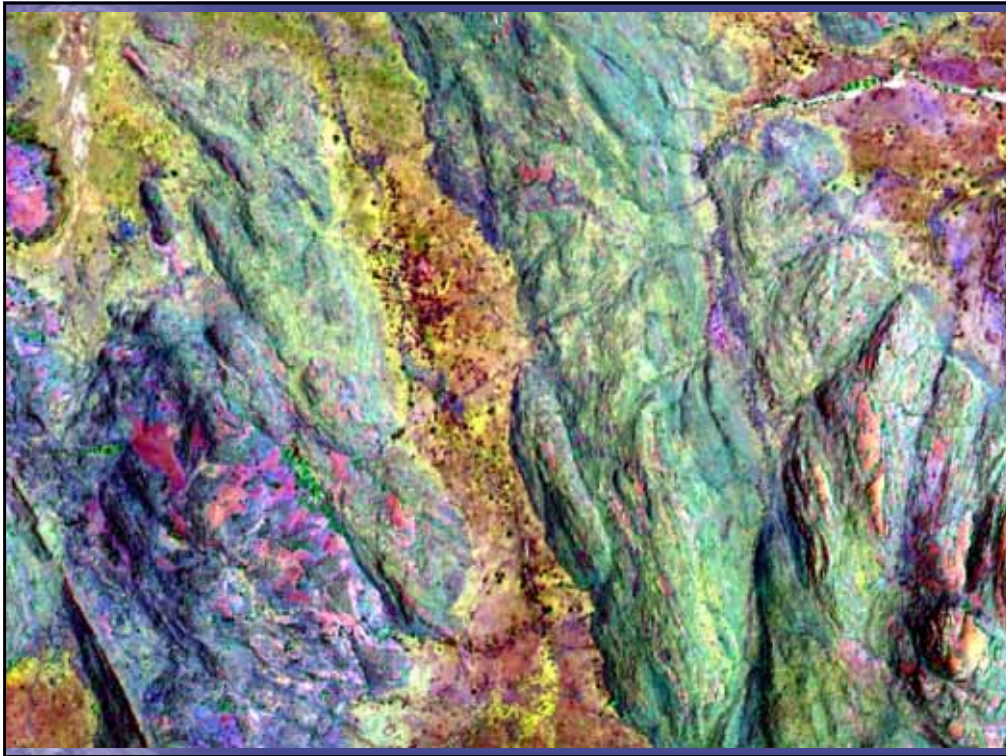
The background of this slide is a dark blue panel with a faint, semi-transparent image of a survey vessel, similar to the one in the top slide. The word "Instrument" is centered at the top in a yellow, serif font. Below it is a bulleted list of technical specifications in yellow text.

- HyMap flown by HyVista
- 126 channels 450nm - 2500nm
- 15-20nm width per channel
- Altitude set for 5m pixels
- C-MIGITS II INS with real time differential (Fugro Omnistar)
- S:N 50% refl @ 30deg SZA = 1000:1

HyMap in Cessna 404 Titan







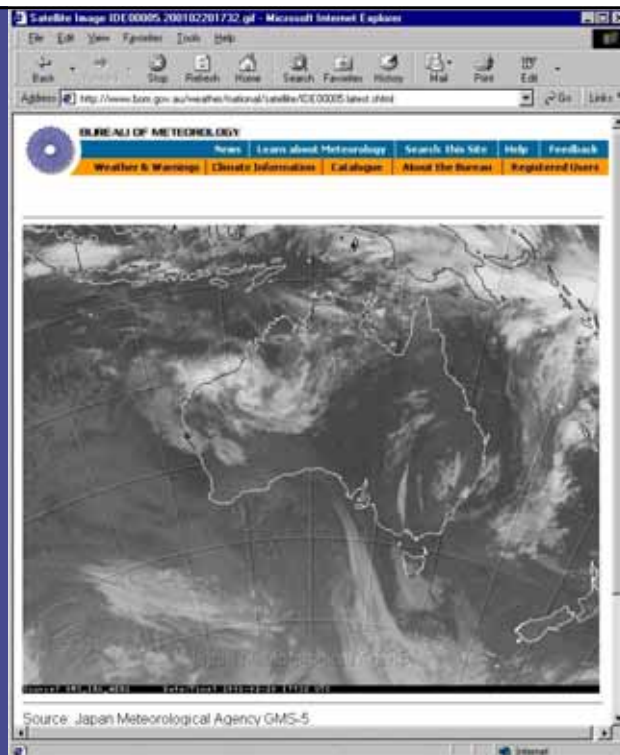
Applications

- Geological focus
- Regolith
 - soils mapping linked to geochemistry
- Bedrock mapping
 - clays/chlorite/epidote/micas/carbonates
 - fe oxides/amphiboles/serpentine
- Mineral distribution maps

Issues with Flying

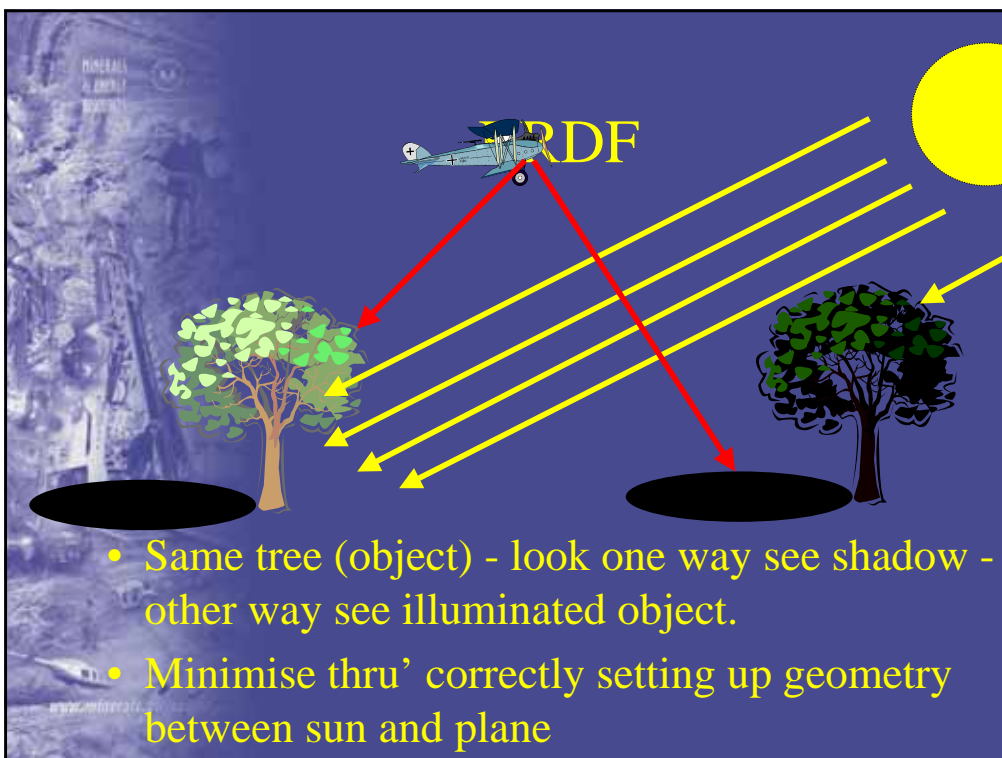
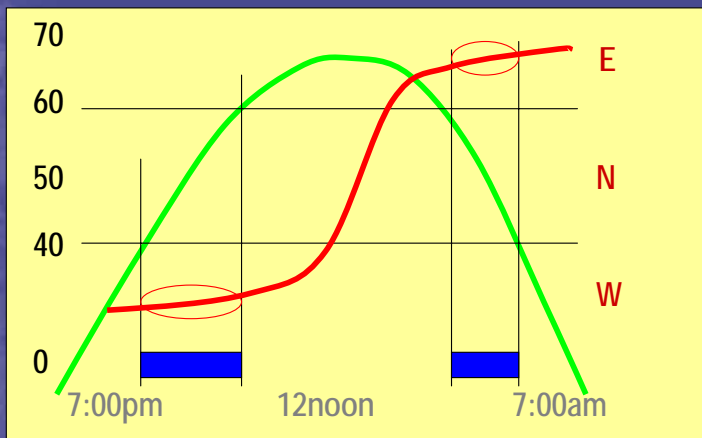
- Minimise cloud
- Maximise solar irradiance
- Minimise Bi-directional reflectance distribution function (BRDF) effects
- Eliminate “hot spot”
- Eliminate rain - dry soil
- Minimise vegetation
- Not all factors within your control

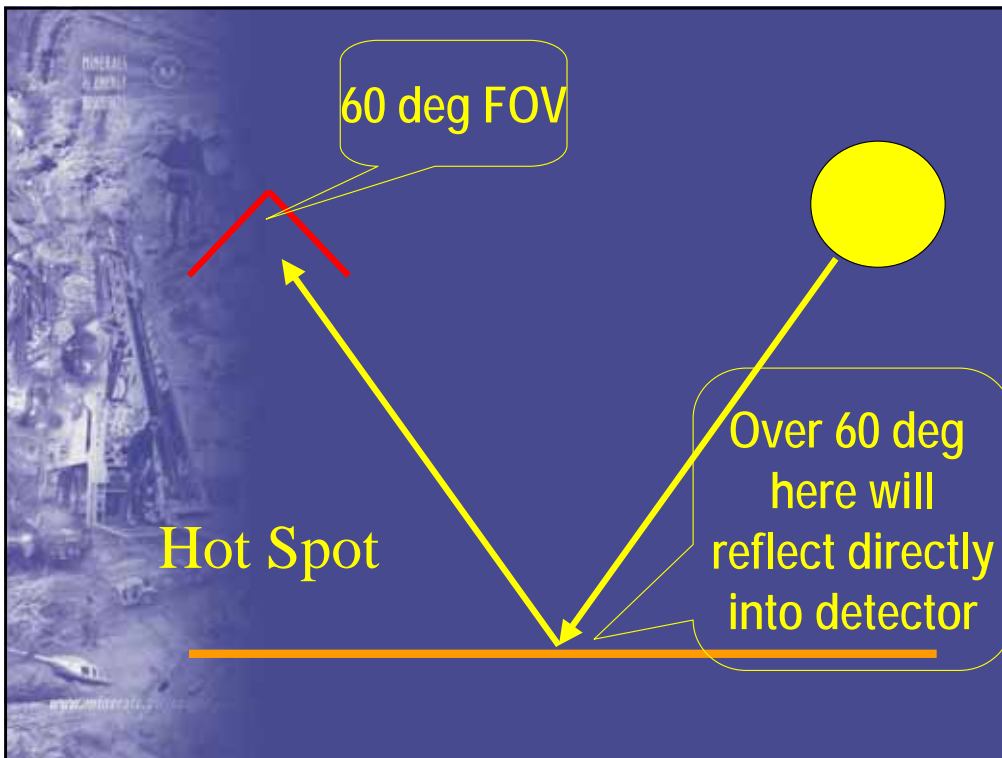
Minimising
Cloud
Cover:
Monitoring
the Weather
on the Web



Solar Position Plot

- Elevation and Azimuth vs Time





Processing

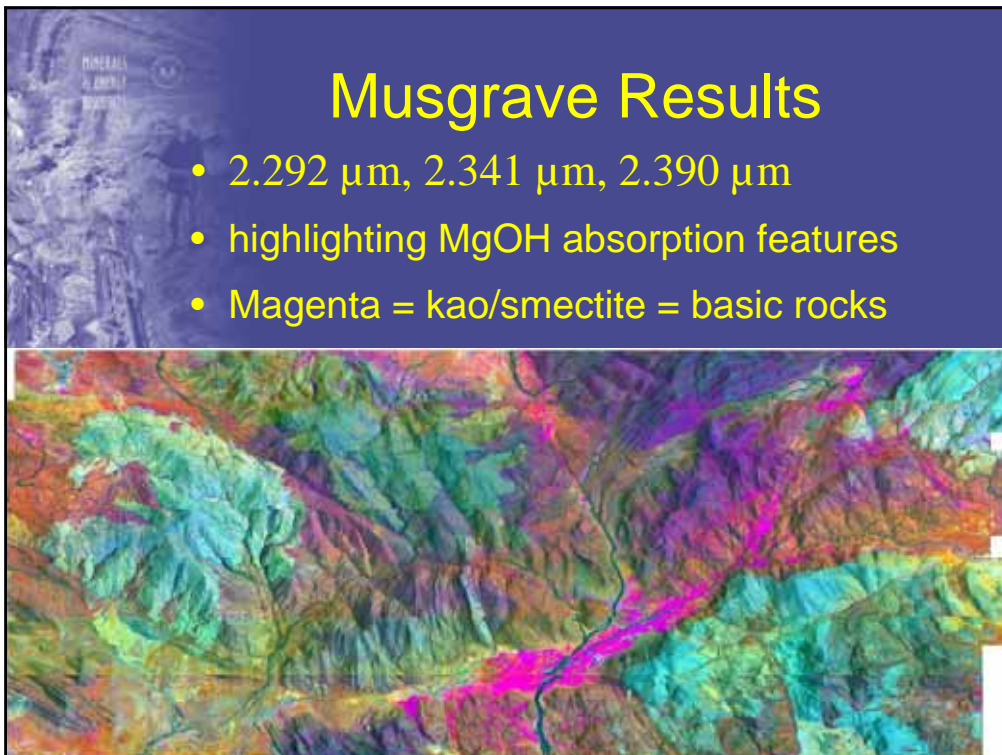
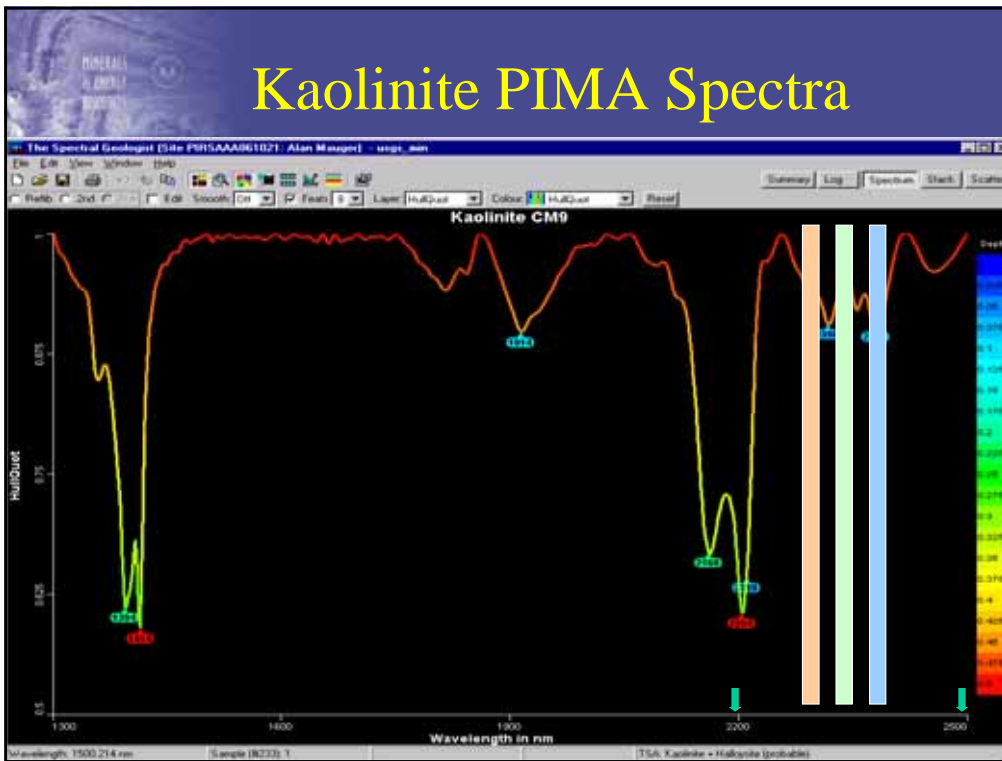
- HyCorr (FeOX dominated/H₂O)
- QD Products – rotate/flip, AlOH, MgOH
- Hourglass
- MNF, PPI, NDVIS, MTMF
- Spectral Indices
- Georeference

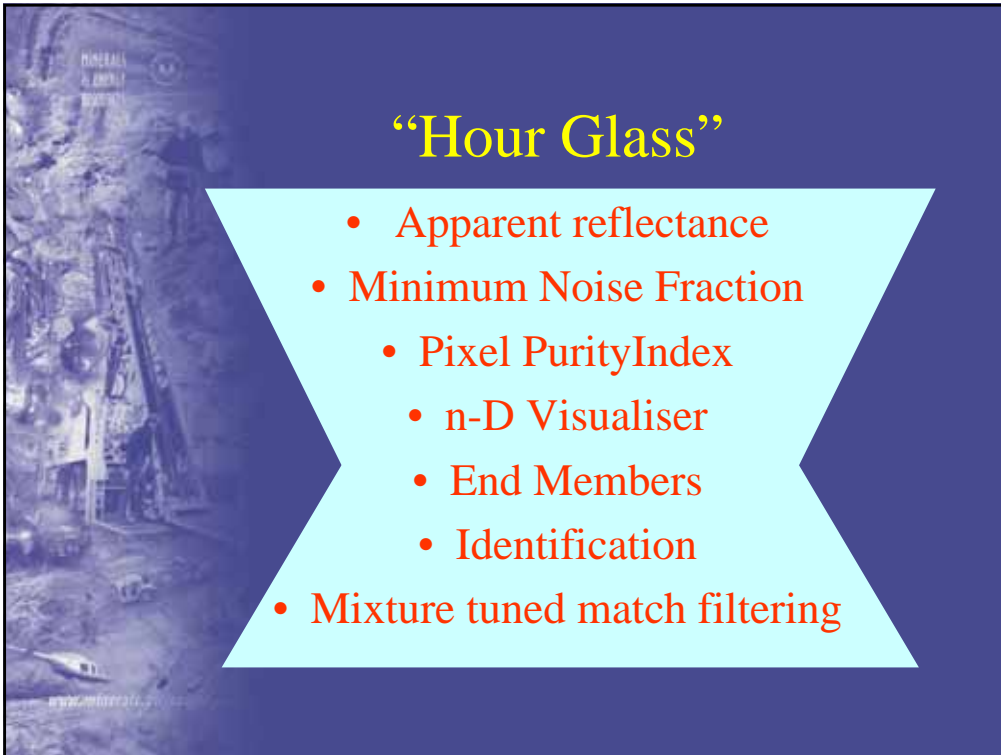
Preliminary Processing

- epidote, chlorite, amphibole, kaolinite and carbonate
- PIMA spectra from surface samples
- three channels to define shape of 'MgOH' absorption features:
- 2.292 μm , 2.341 μm , 2.390 μm
- decorrelation stretched
- displayed as RGB

Chlorite PIMA Spectra

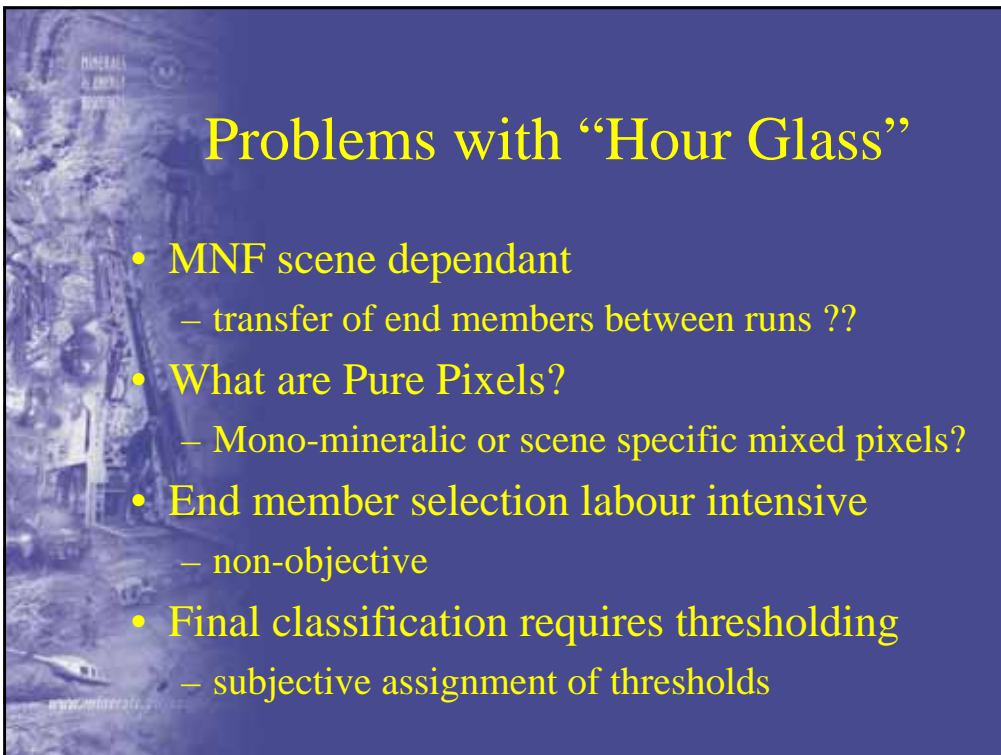






“Hour Glass”

- Apparent reflectance
- Minimum Noise Fraction
 - Pixel Purity Index
 - n-D Visualiser
 - End Members
 - Identification
- Mixture tuned match filtering

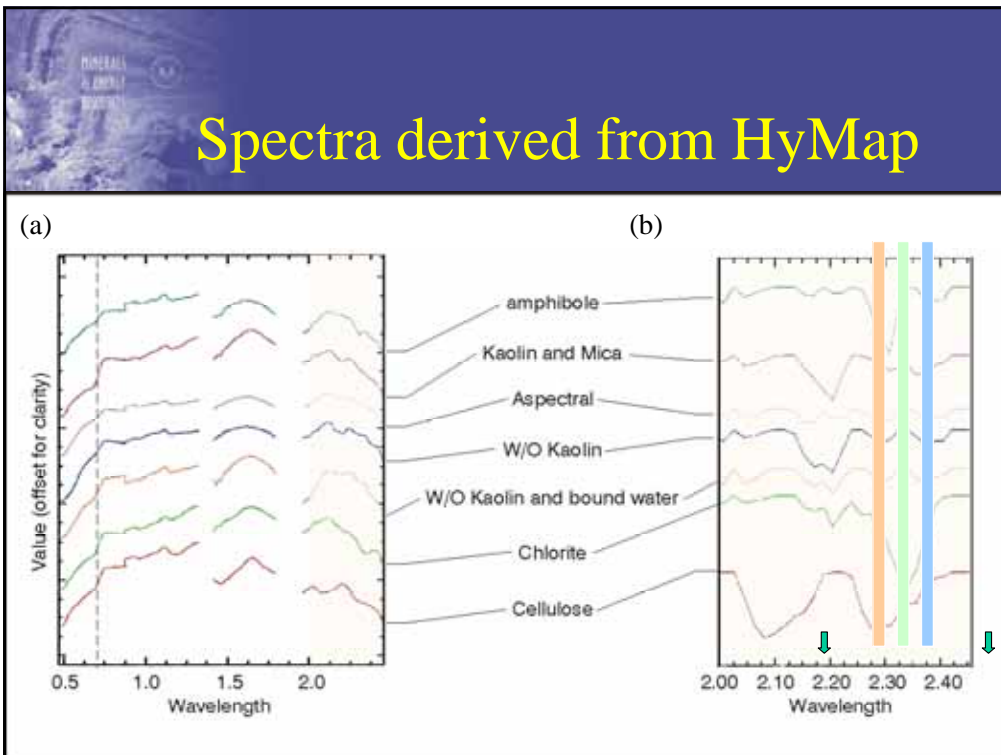


Problems with “Hour Glass”

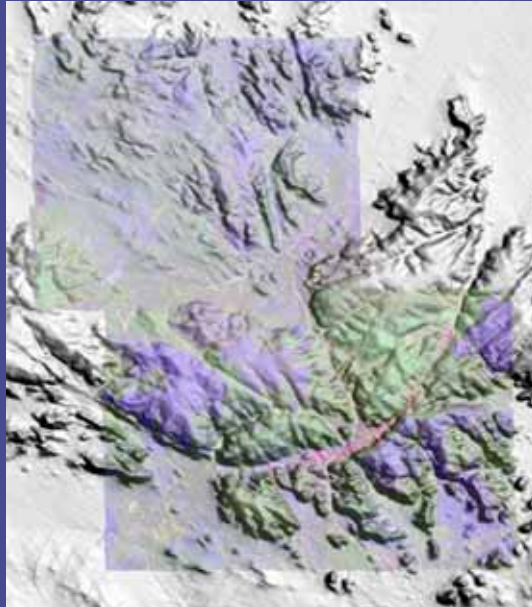
- MNF scene dependant
 - transfer of end members between runs ??
- What are Pure Pixels?
 - Mono-mineralic or scene specific mixed pixels?
- End member selection labour intensive
 - non-objective
- Final classification requires thresholding
 - subjective assignment of thresholds

Alternative Approach

- Spectral Indices
 - wavelength of dominant absorption feature
 - relative depth of absorption feature
 - relative area of absorption feature
 - wavelength of dominant peak
- Calculated from hull
- Use 4th order polynomial over 8 bands



Map using Spectral Indices



Kaolinite
Chlorite
Amphibole

Issues to be addressed

- Vegetation
 - at least 4 types of veg
 - green pic, spinifex, 2 generations of fire
- BRDF (run-to-run matching)
- Spatial locational accuracy - requires full photogrammetric solution



Conclusion

- highly successful mission
 - solar elevation greater than 40 degrees
 - less than 60 degrees above the horizon
 - maximised incident solar energy
 - eliminated 'hot' spot
- orientation of the survey flew
 - close to the solar azimuth (east-west)
 - minimised BRDF effects
- entire survey flown in the morning light
 - maintained consistent shadowing across the survey



Conclusions

- the survey was cloud free
- the area had dried out after recent rain thus minimising soil moisture discrepancies
- 500 metre overlap was maintained throughout the region thus leaving no gaps between runs
- DEM provided with airborne geophysical survey
- CMIGITS II INS/GPS data were successfully recorded.



Conclusion

The major challenges:

- vegetation in the landscape.
- fire management practises employed by the local inhabitants.
- data volume
- orthorectification.



Join us 'down under'

- 2nd Geological Hyperspectral Focus Group Meeting
- 11th ARSPC - Brisbane Australia
- Post Conference Workshop
- 9-13 September
- Flinders Ranges
- "From Spectra to Geology"