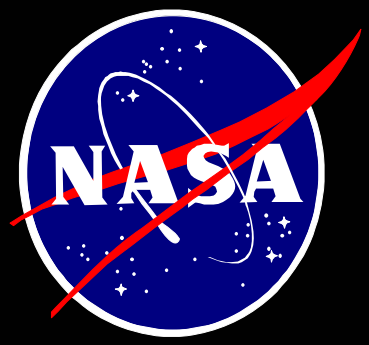
HyspIRI Workshop
Combined VNIR-SWIR and TIR
Combined Question 5
Surface Composition and Change

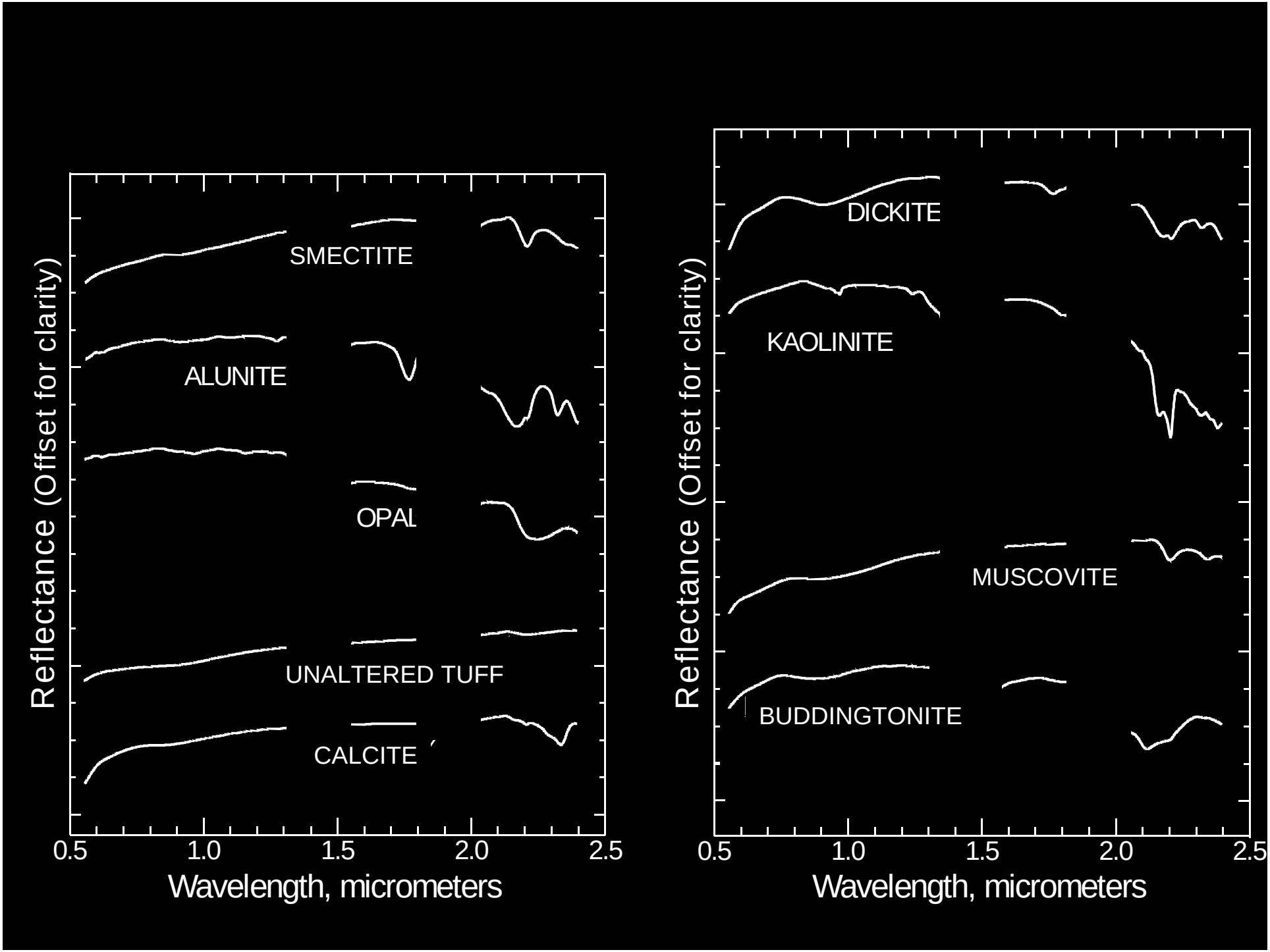
John Car"Lyle" Mars
and
Anupma Prakash



• What is the composition of the exposed terrestrial surface of the Earth? (DS 220)

SPECTRAL REGION/ SPATIAL RESOLUTION	BANDS - WAVE-LENGTH REGION, MICROMETERS	COMPOSITIONAL INFORMATION
VNIR /	~ 95 BANDS* 0.380 - 1.40 μm	- FERRIC-FERROUS IRON ABSORPTION - REE
SWIR / 60 m	~ 80 BANDS* 1.40 - 2.50 μm	- AL-O-H IN CLAYS, MICAS, SULFATE MINERALS - CO_3 IN CARBONATES - Mg-O-H IN AMPHIBOLES, MICAS - H-O-H IN EVAPORITES, CLAYS
TIR / 60 m	B1 - 3.98 μm B2 - 7.35 μm B3 - 8.28 μm B4 - 8.63 μm B5 - 9.07 μm B6 -10.53 μm B7 -11.33 μm B8 -12.05 μm	- SILICATE MINERALS, ESPECIALLY SHIFT TO SHORTER WAVELENGTHS - SULFATE MINERALS - CARBONATE MINERALS

* After removal of atmospheric absorption bands


SMECTITE
ALUNITE
OPAL
UNALTERED TUFF
CALCITE
Reflectance (Offset for clarity)
0.5
1.0
1.5
2.0
2.5
Wavelength, micrometers
DICKITE
KAOLINITE
MUSCOVITE
BUDDINGTONITE
Reflectance (Offset for clarity)
0.5
1.0
1.5
2.0
2.5
Wavelength, micrometers

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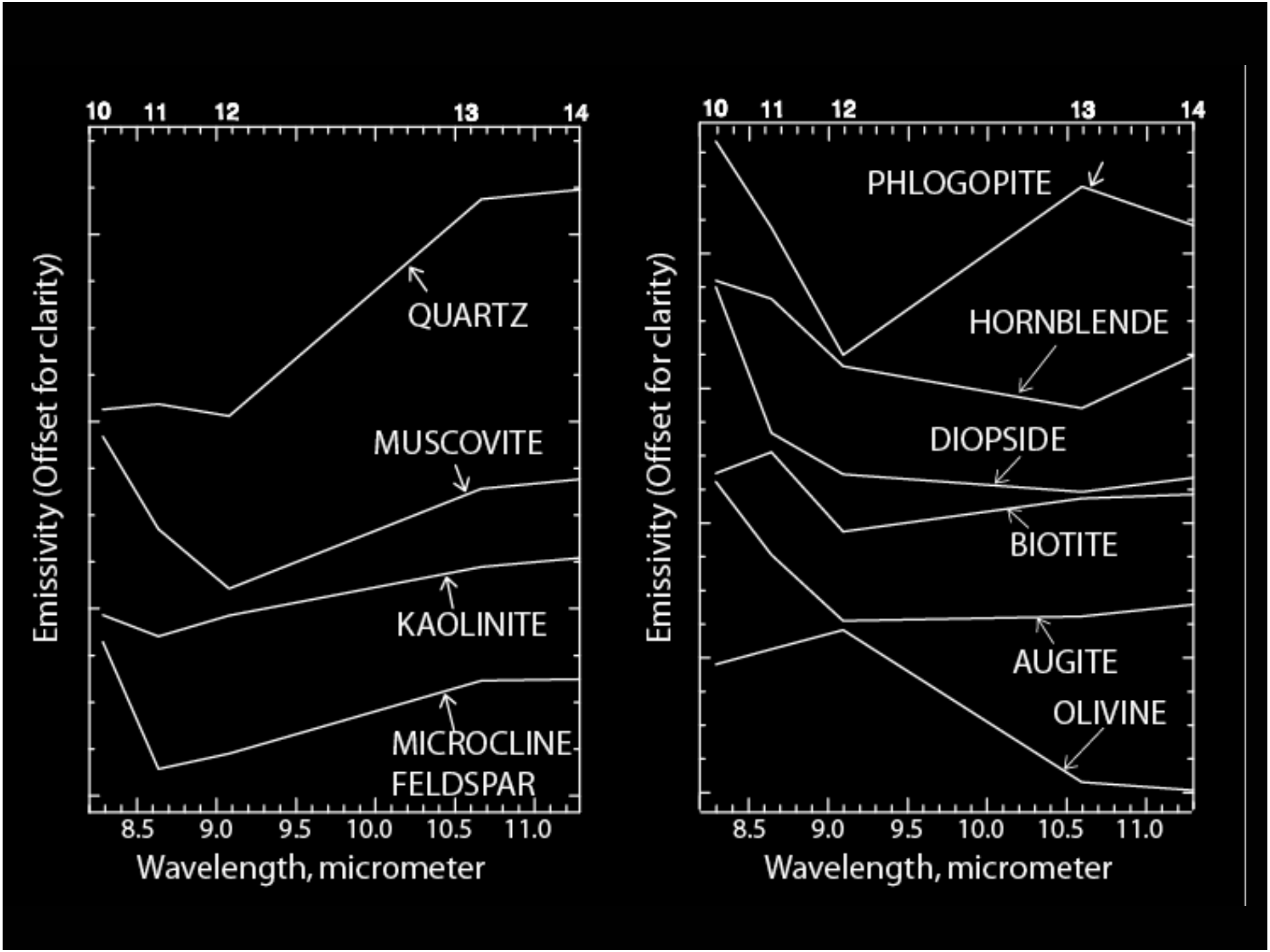
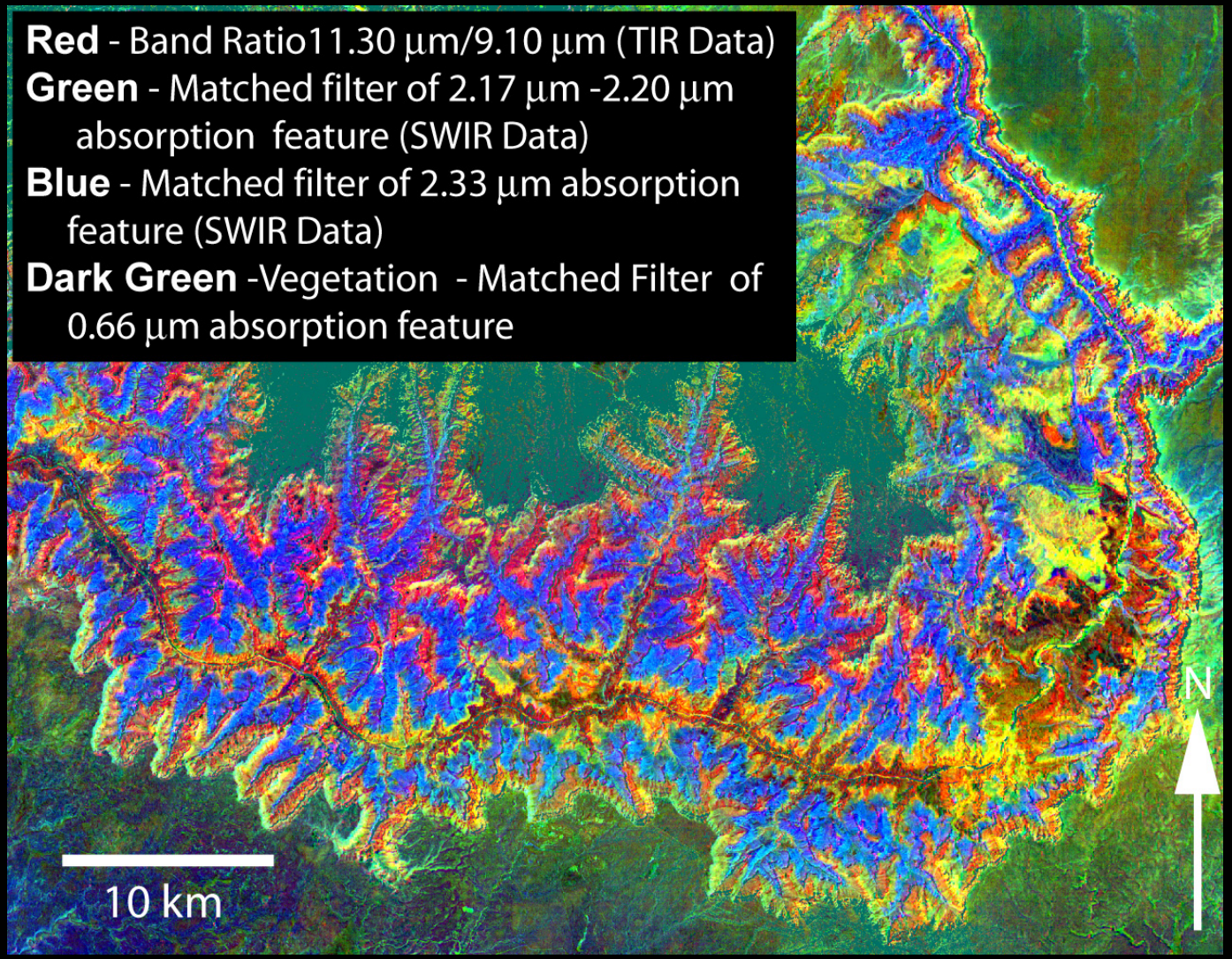

10
11
12
13
14
Emissivity (Offset for clarity)
QUARTZ
MUSCOVITE
KAOLINITE
MICROCLINE-
FELDSPAR
8.5
9.0
9.5
10.0
10.5
11.0
Wavelength, micrometer
PHLOGOPITE
HORNBLENDE
DIOPSIDE
BIOTITE
AUGITE
OLIVINE

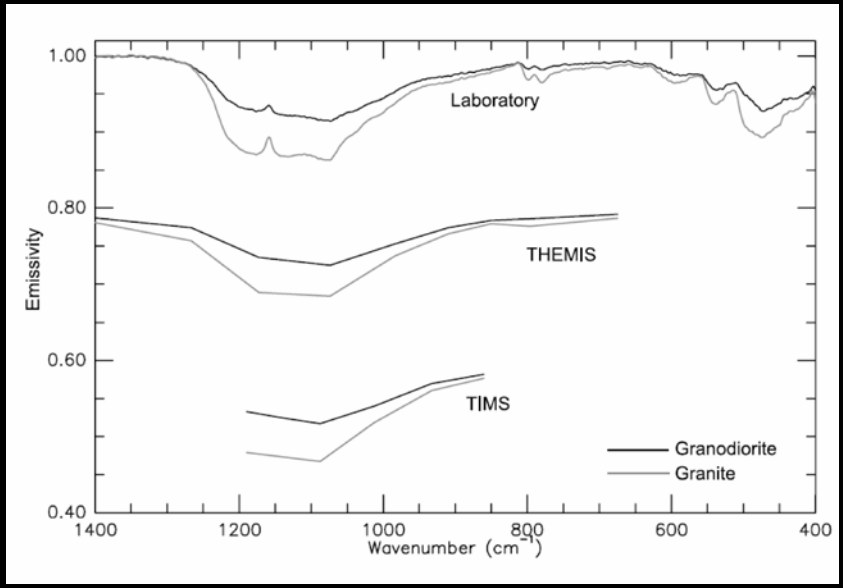
• What is the composition of the exposed terrestrial surface of the Earth? (DS 220)

False color composite HyspIRI simulated image of Grand Canyon, Arizona derived from TIR (red band - quartz-rich rocks), SWIR (green band - clay and muscovite-rich rocks; blue band - carbonate-rich rocks), and VNIR (dark green - green vegetation) data.

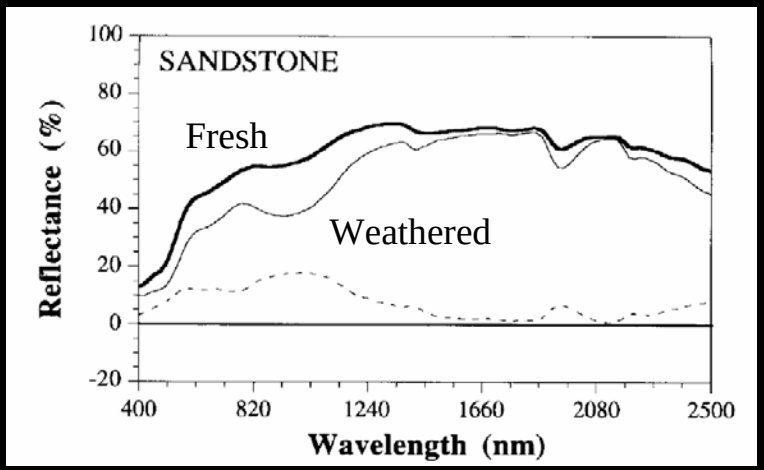


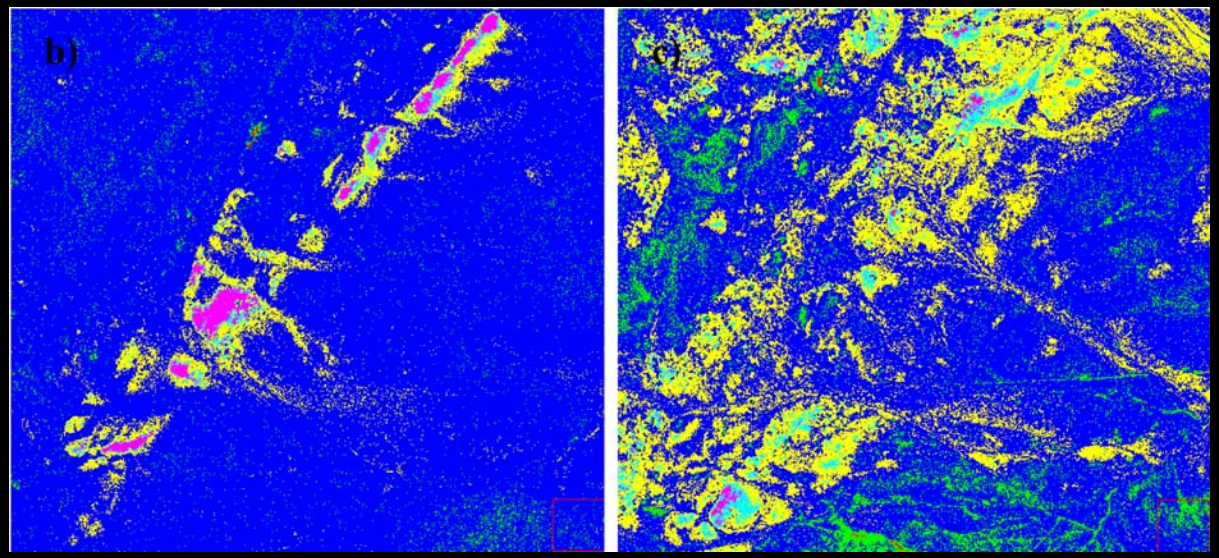
•How is the distribution of the primary minerals and mineral groups on the exposed terrestrial surface changing over time? (DS 218)

Michalski and others, 2004



Younis and others, 1997





Amphibolite

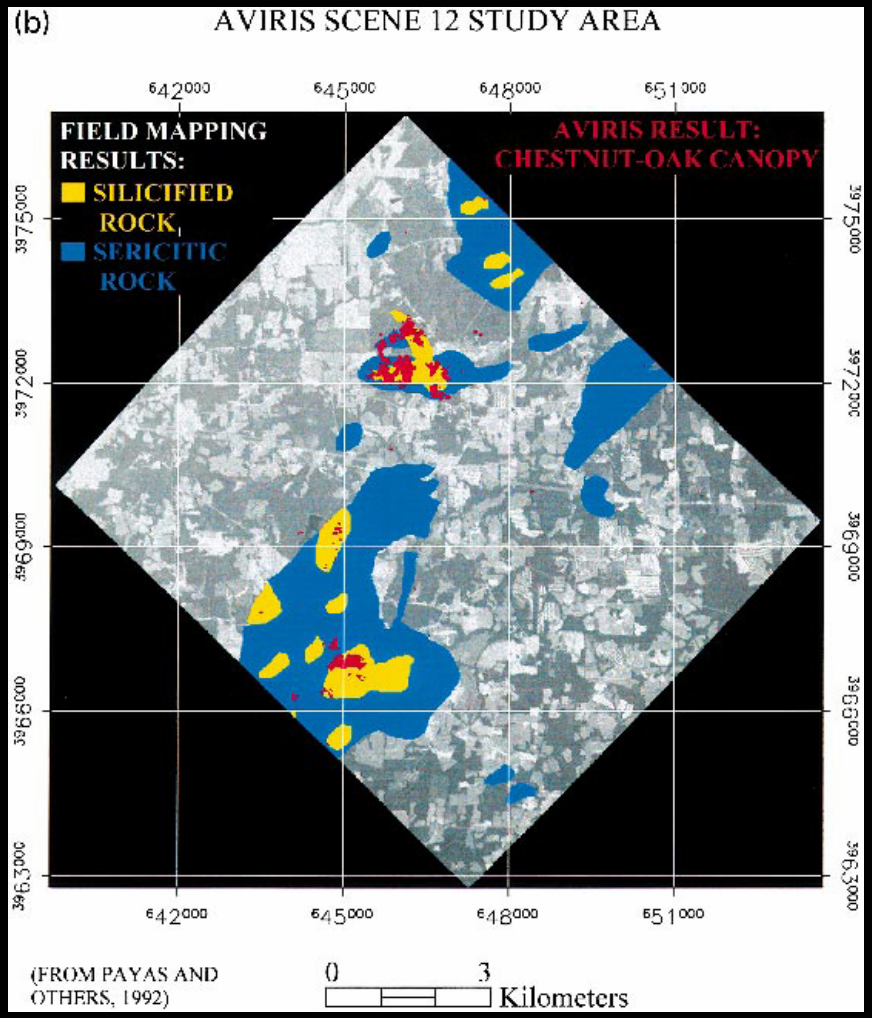
Goethite

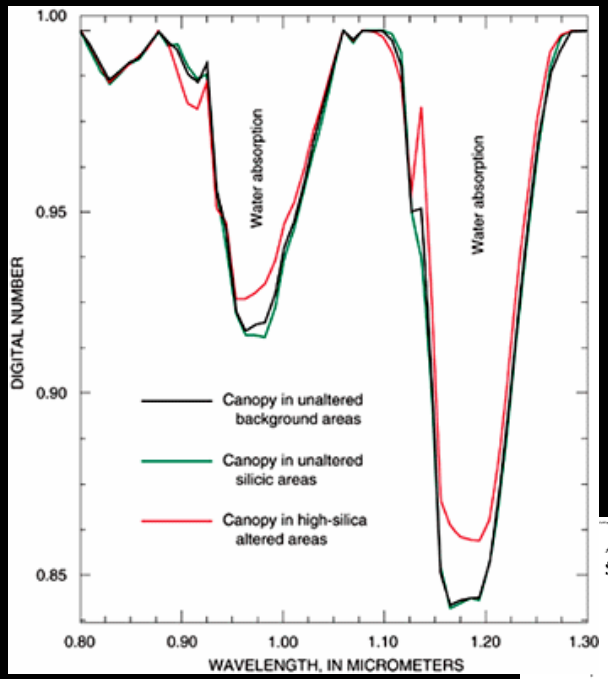
Illite

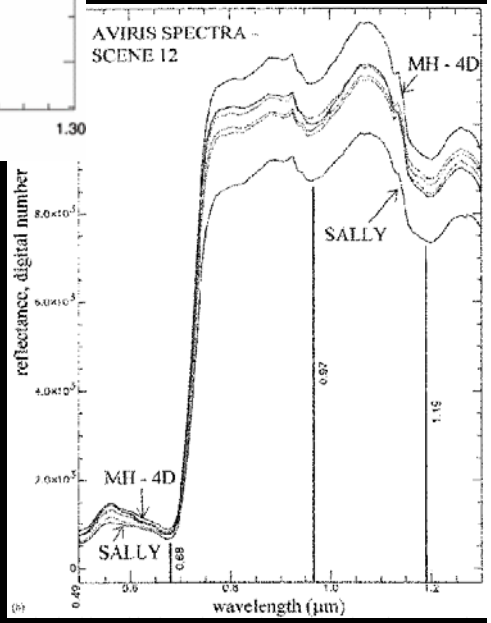
Papp and Cudahy, 2002

•How does the surface mineralogy relate to the plant physiology and function on the terrestrial surface of the Earth? (DS 114)

Rowan and others, 1998

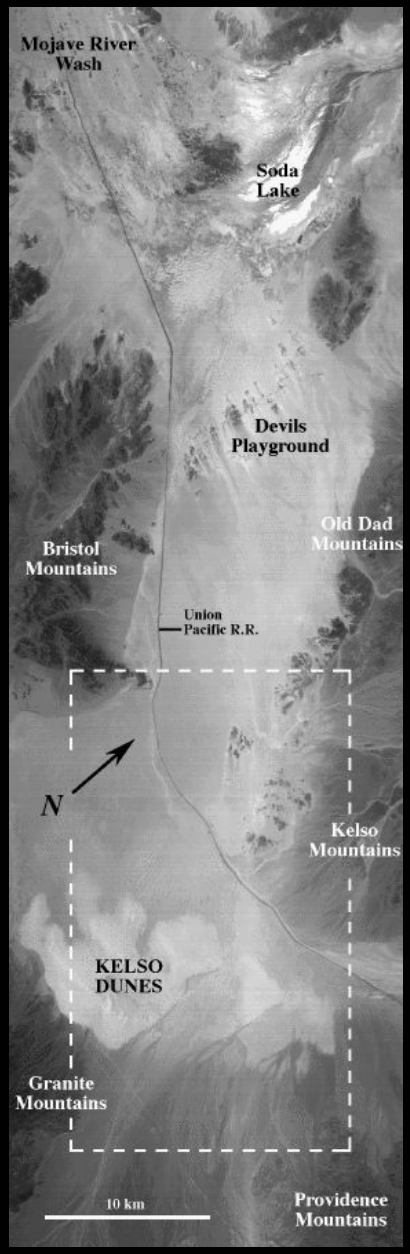






•How is the composition of exposed terrestrial surface responding to anthropogenic and non anthropogenic drivers (desertification, disturbance e.g. logging, mining)? (DS 114)

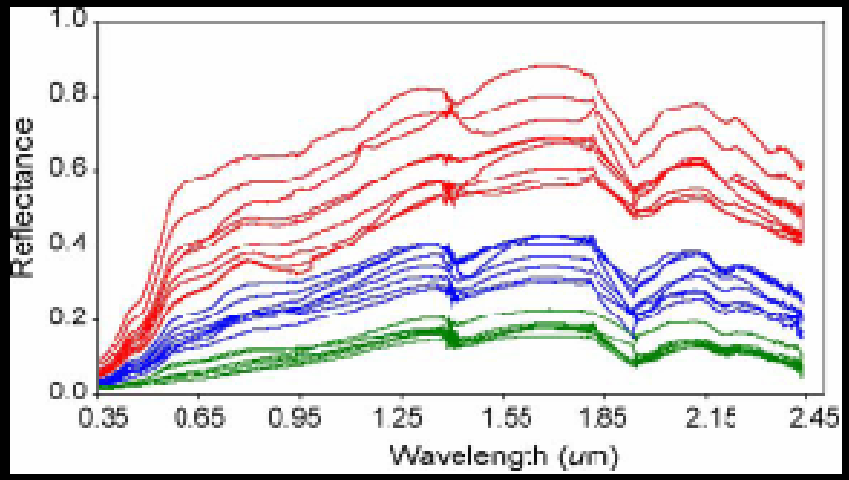
Ramsey and Lancaster, 1998

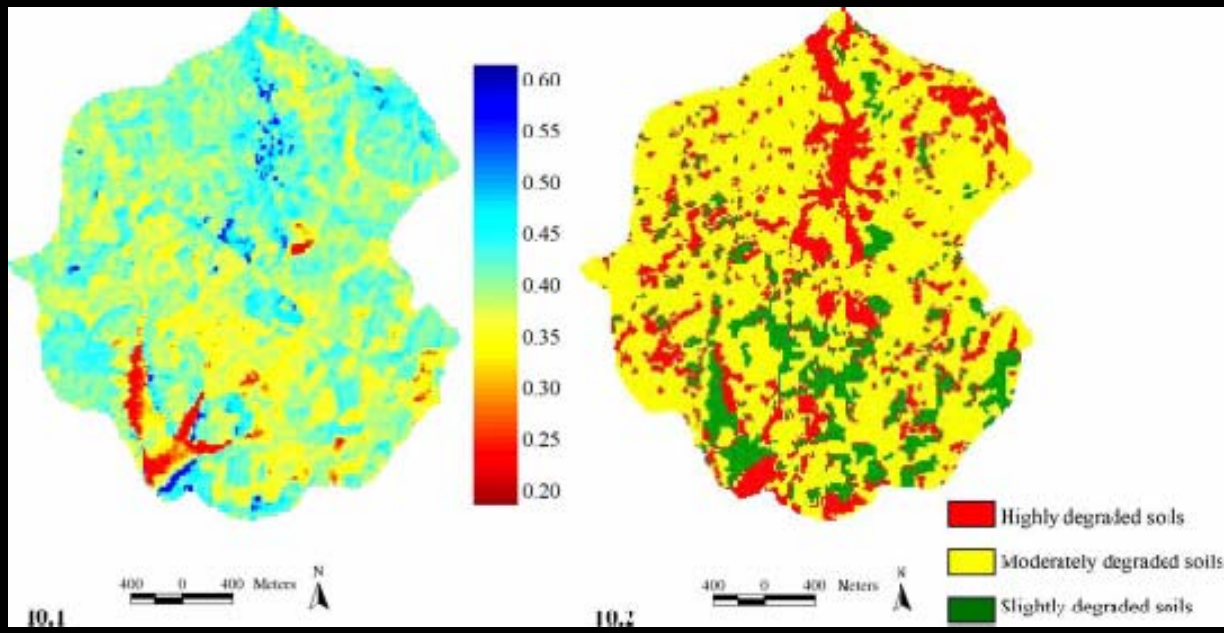


Dune migration in the Mojave Desert, California using TIMS data

Chikhaoui and others, 2005

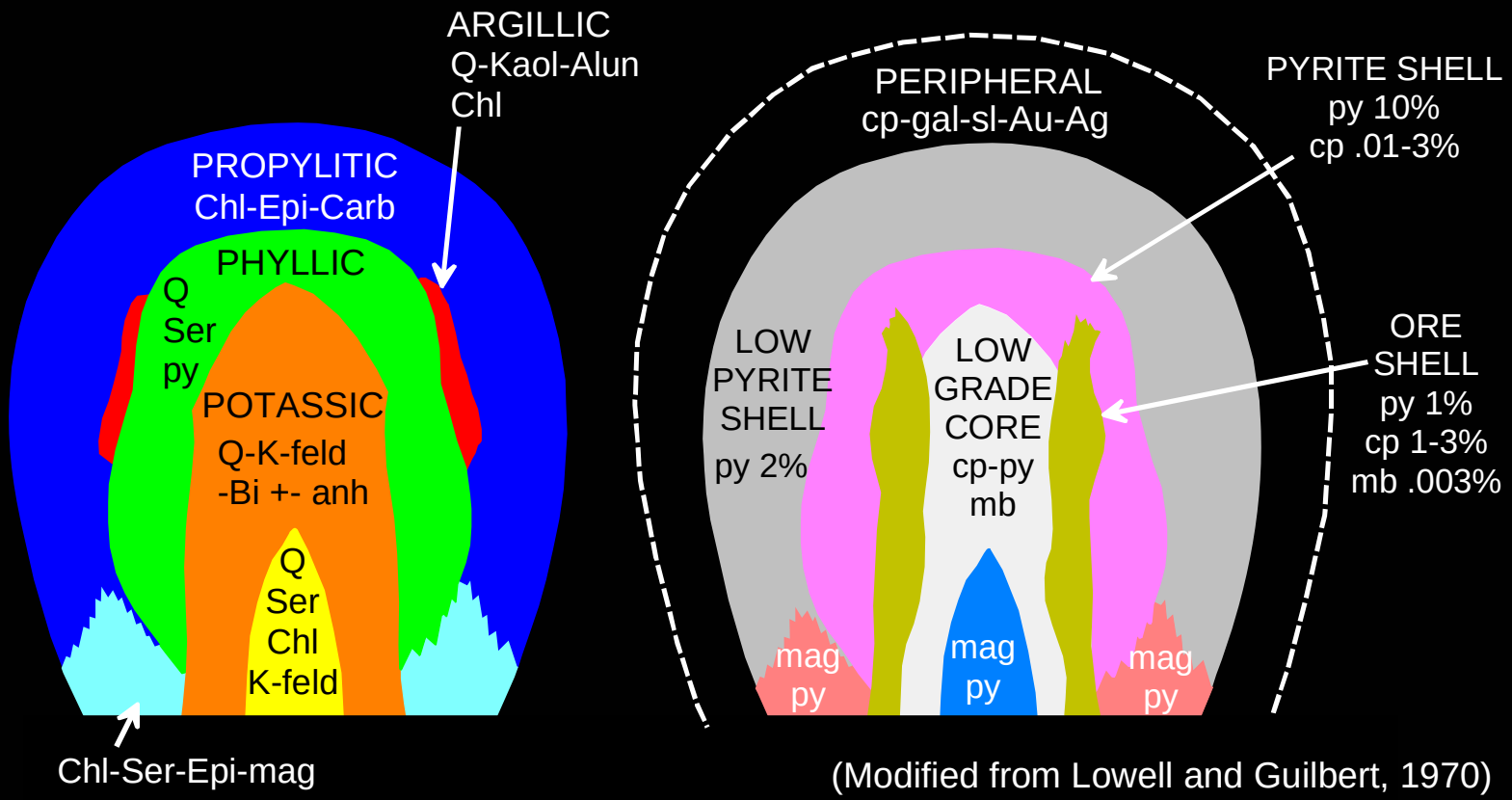
Land Degradation Index Study, Northern Morocco





•Can high-resolution alteration maps define regional trends in hydrothermal fluid flow for magmatic arcs and tectonic basins, better define hydrothermal deposit models, and assist in the discovery of new economic deposits? (DS 227)

HYDROTHERMAL ALTERATION ZONES, MINERALS, AND ORES IN A PORPHRY COPPER DEPOSIT



(Modified from Lowell and Guilbert, 1970)

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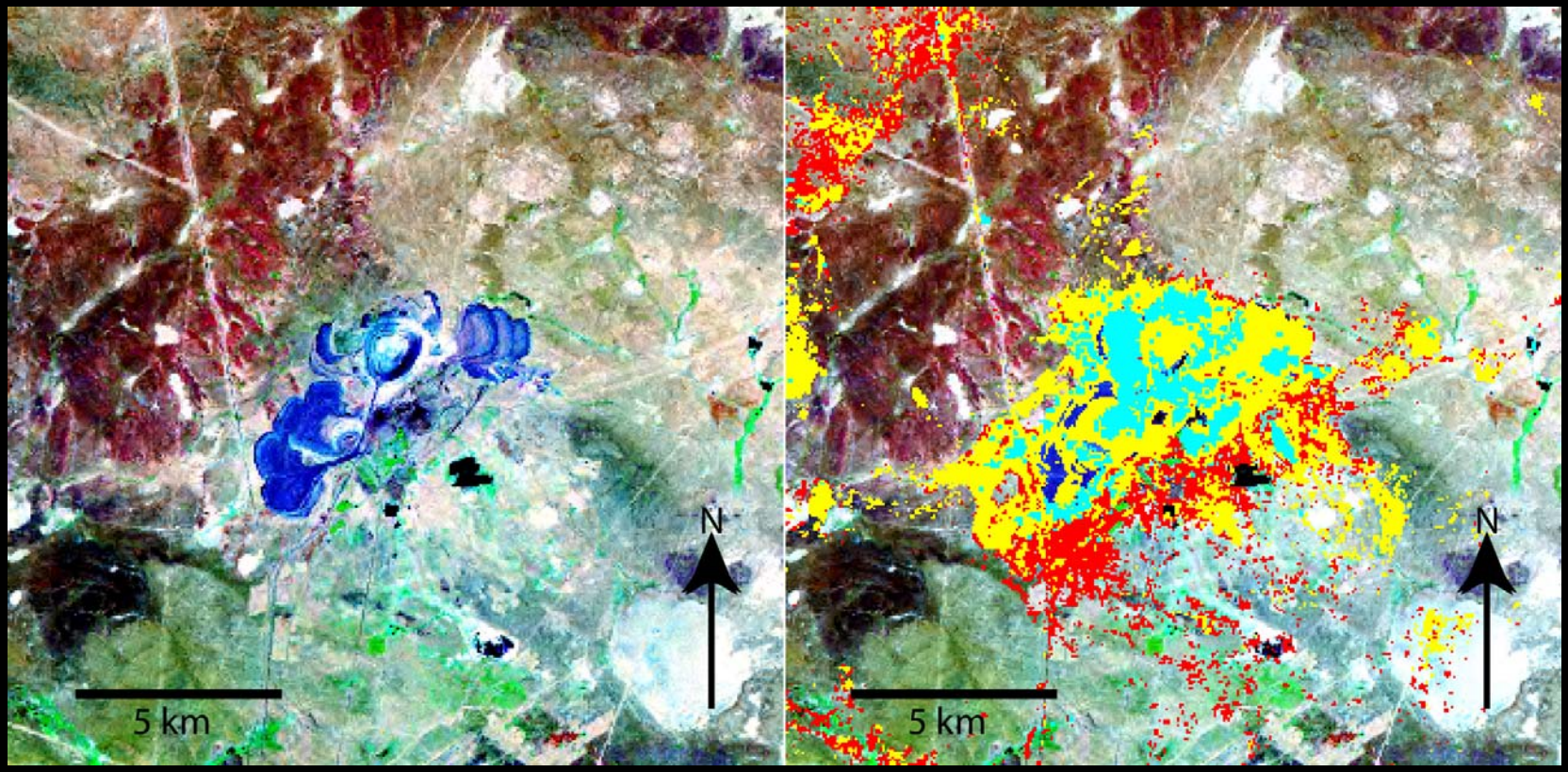

A. False color composite HyspIRI simulated image of the porphyry copper Konyrat Mine near Balaquash, Kazakstan.

Silicified rocks (TIR data)
Argillic-altered rocks (SWIR data)
Phyllic-altered rocks (SWIR data)

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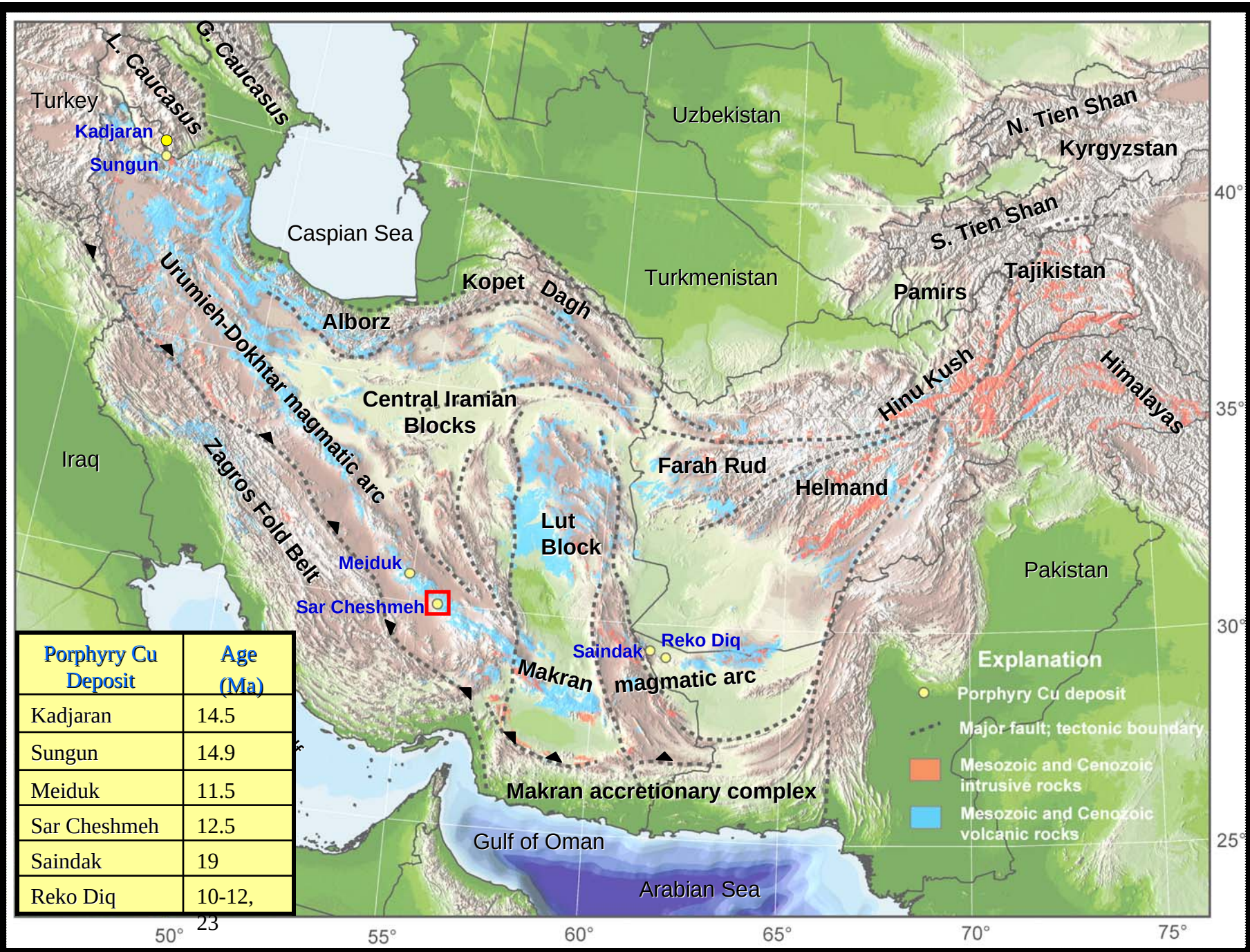

Porphyry Cu Deposit	Age (Ma)
Kadjaran	14.5
Sungun	14.9
Meiduk	11.5
Sar Cheshmeh	12.5
Saindak	19
Reko Diq	10-12, 23

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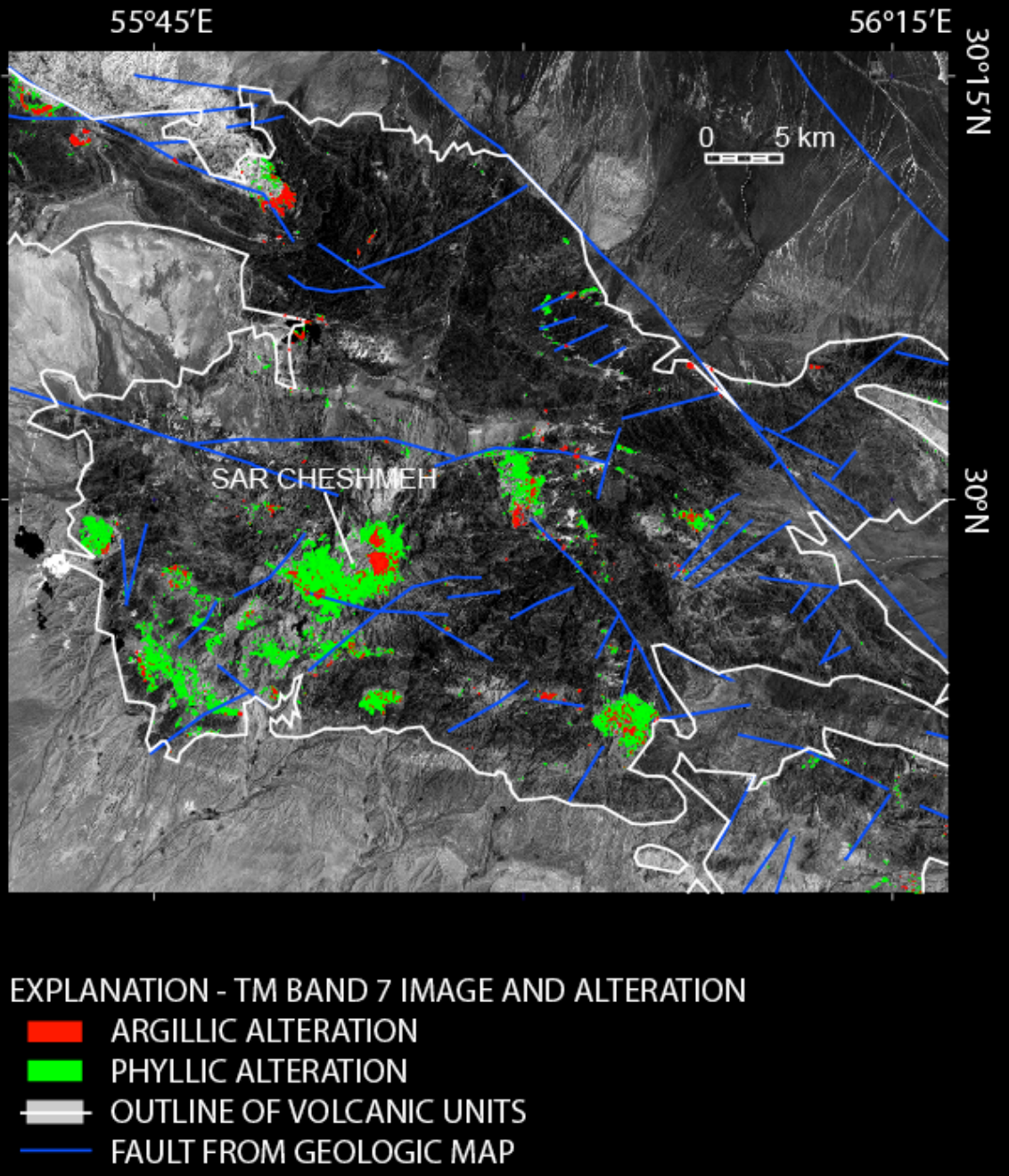

Mars and Rowan, 2006

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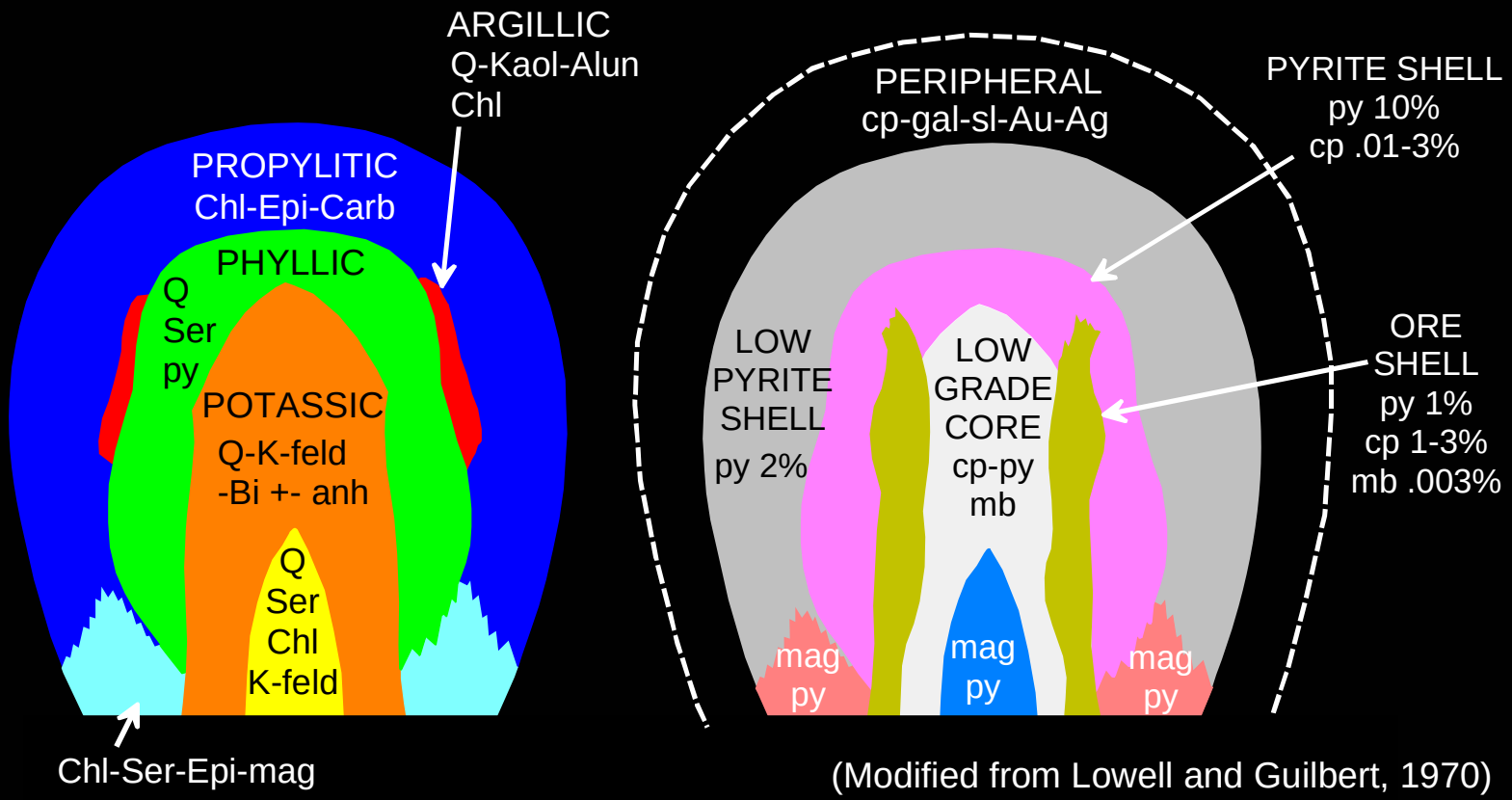

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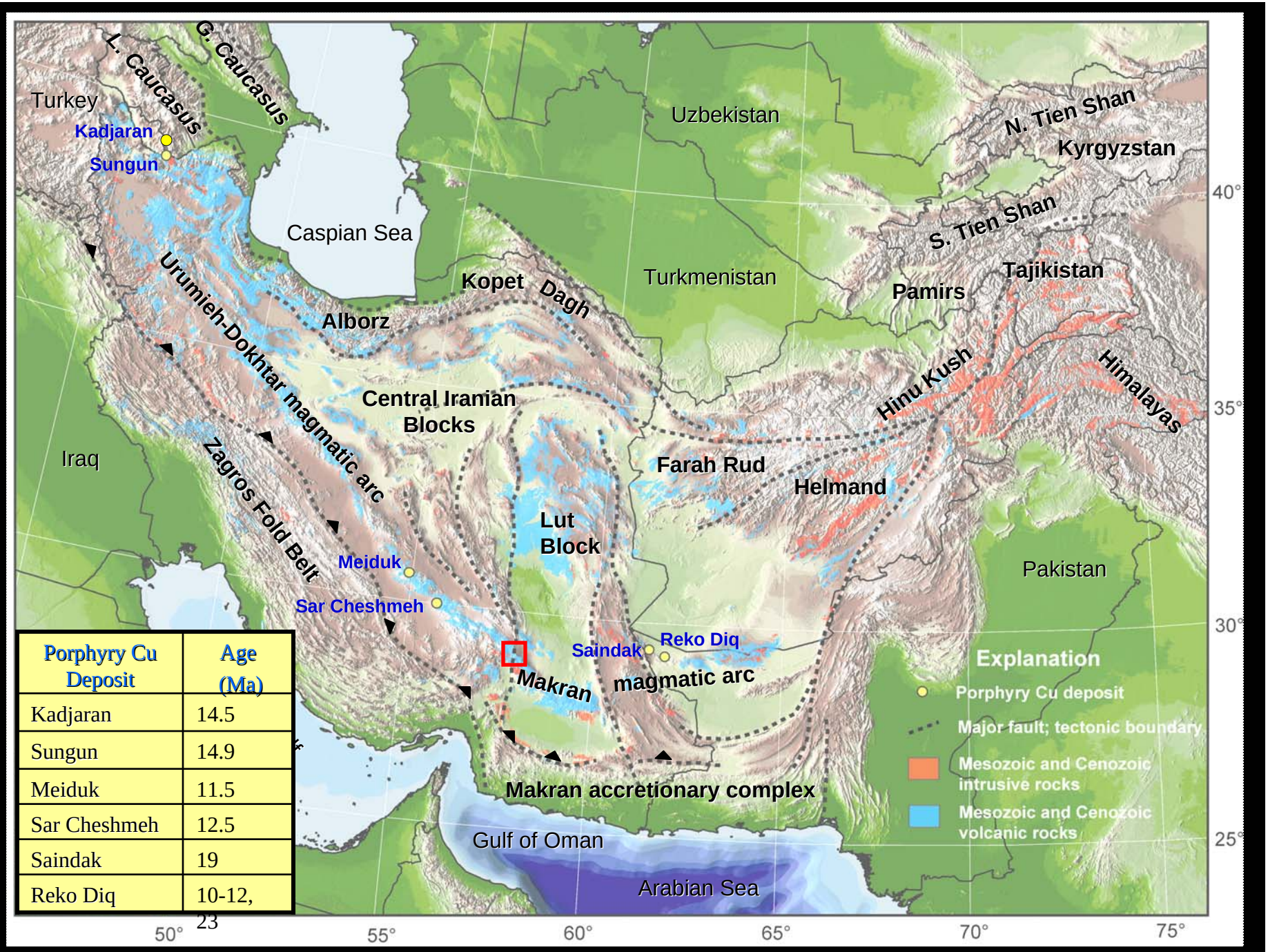

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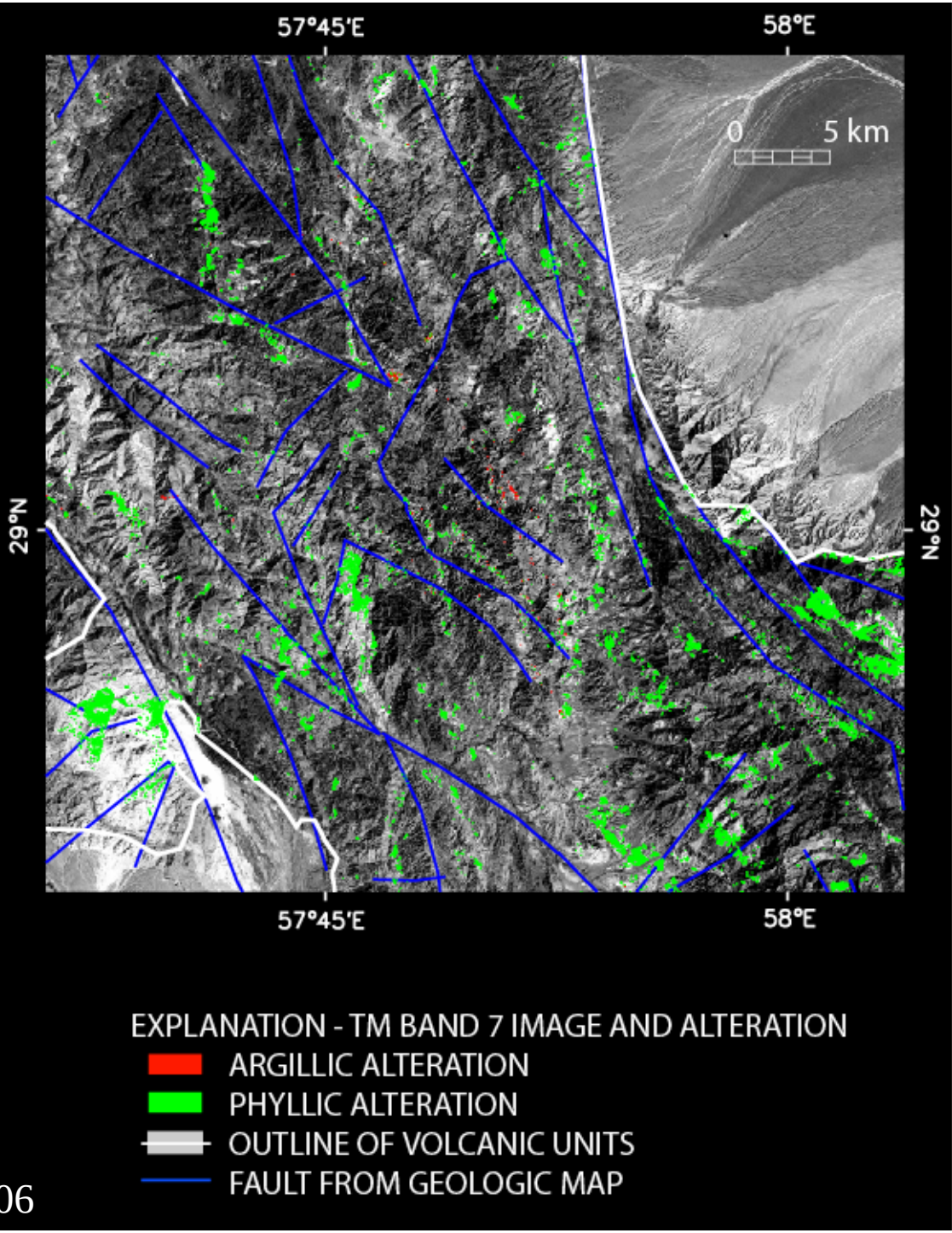

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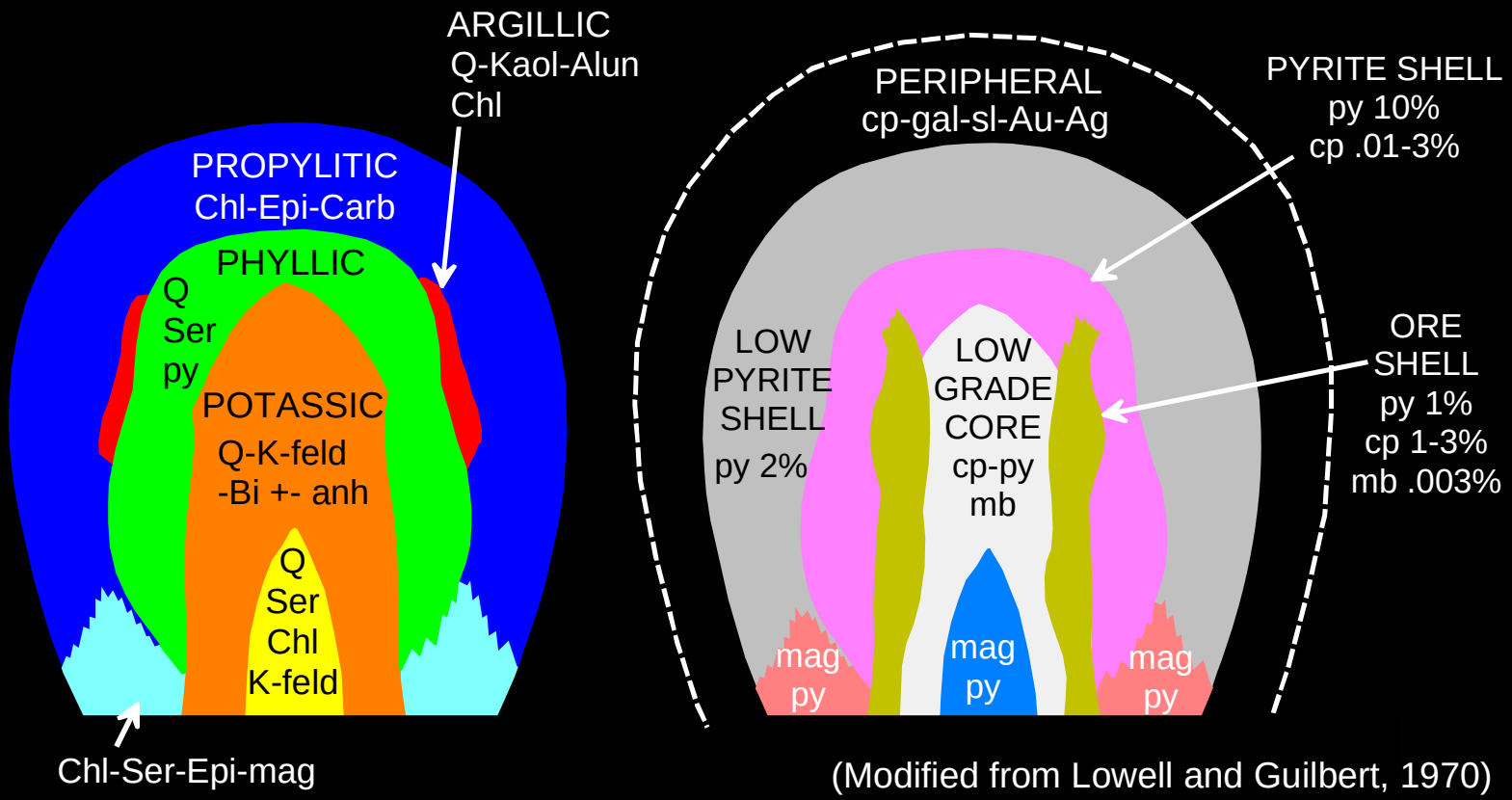

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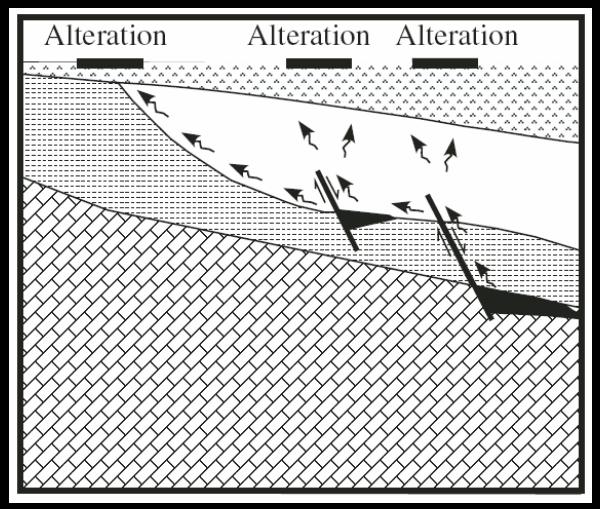
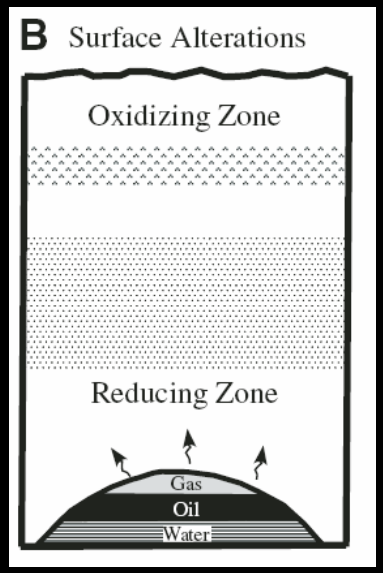
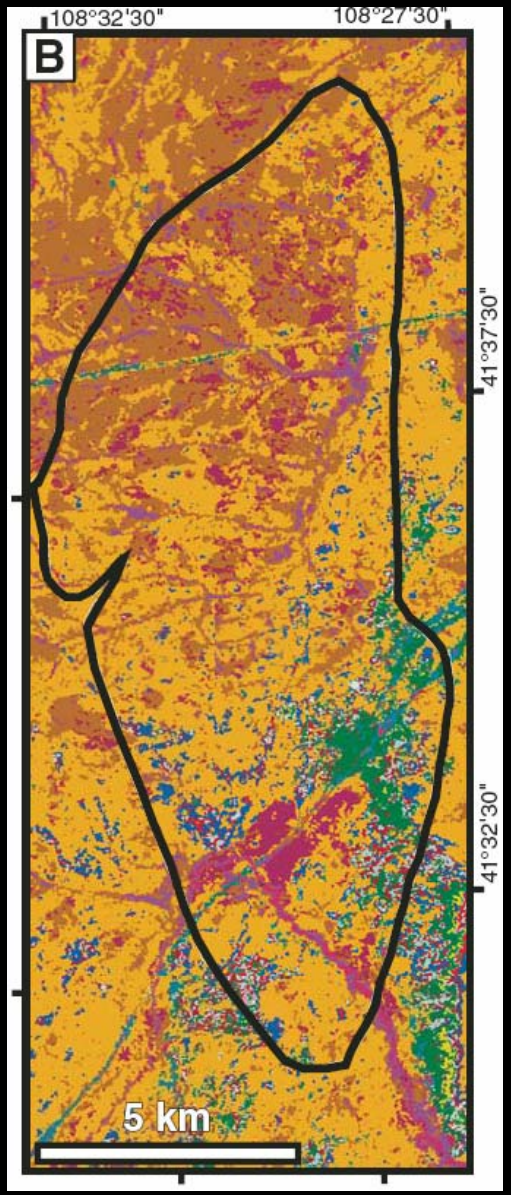
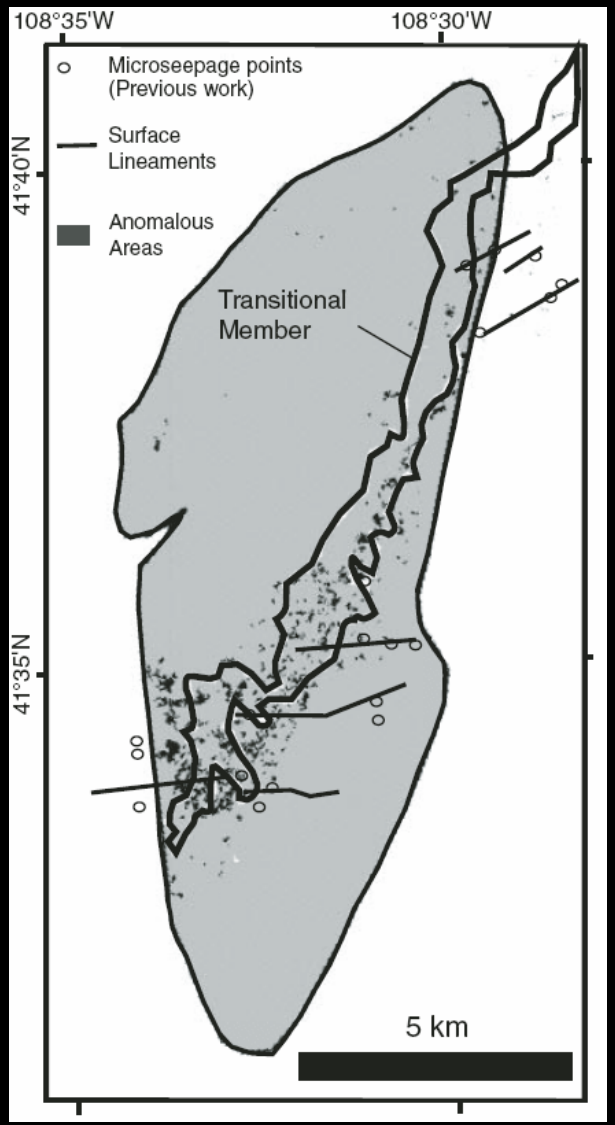
•Can regional high-resolution lithologic and thermal maturity maps of basins better define depositional models and assist in the discovery of new hydrocarbon reserves? (DS 235)

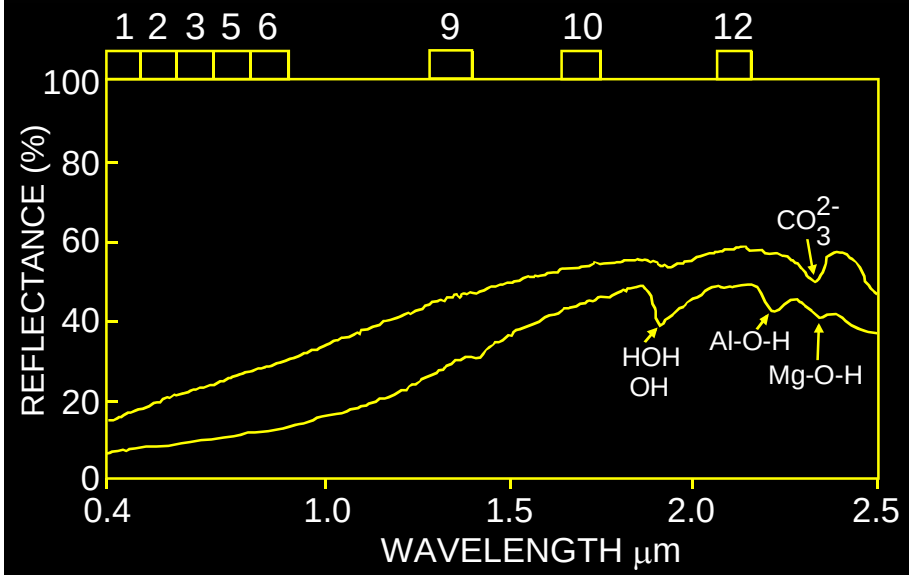








Khan and Jacobson, 2008



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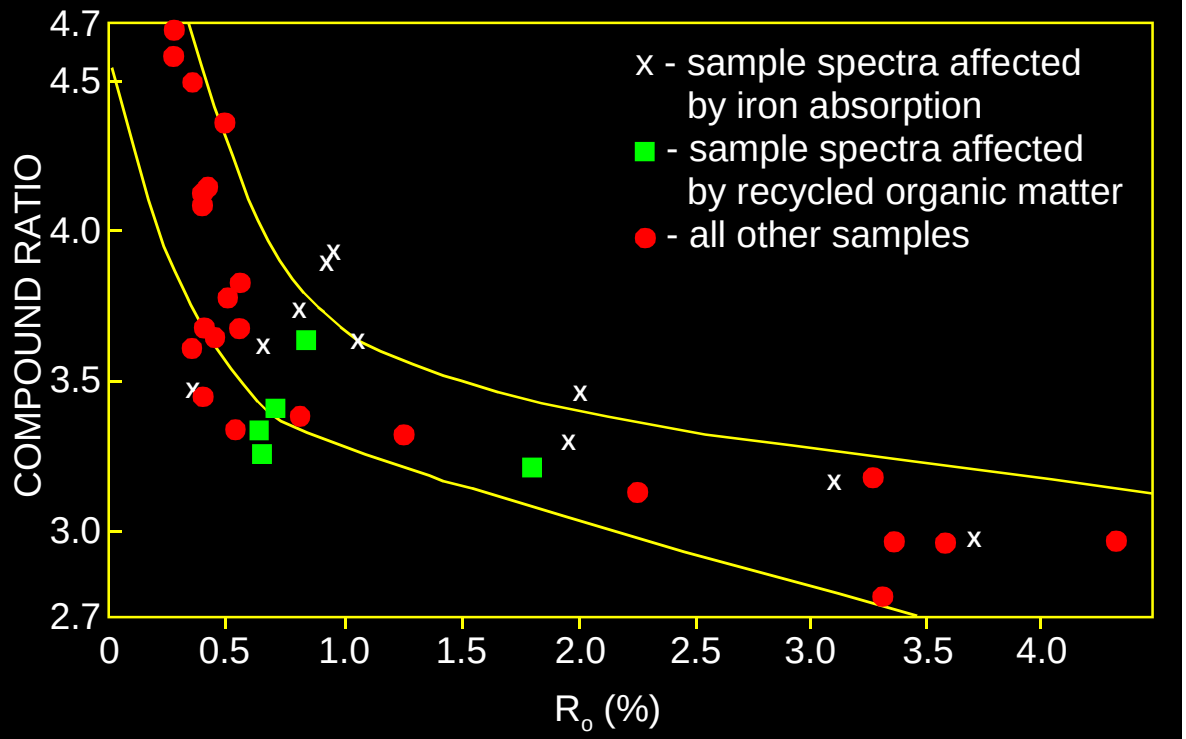
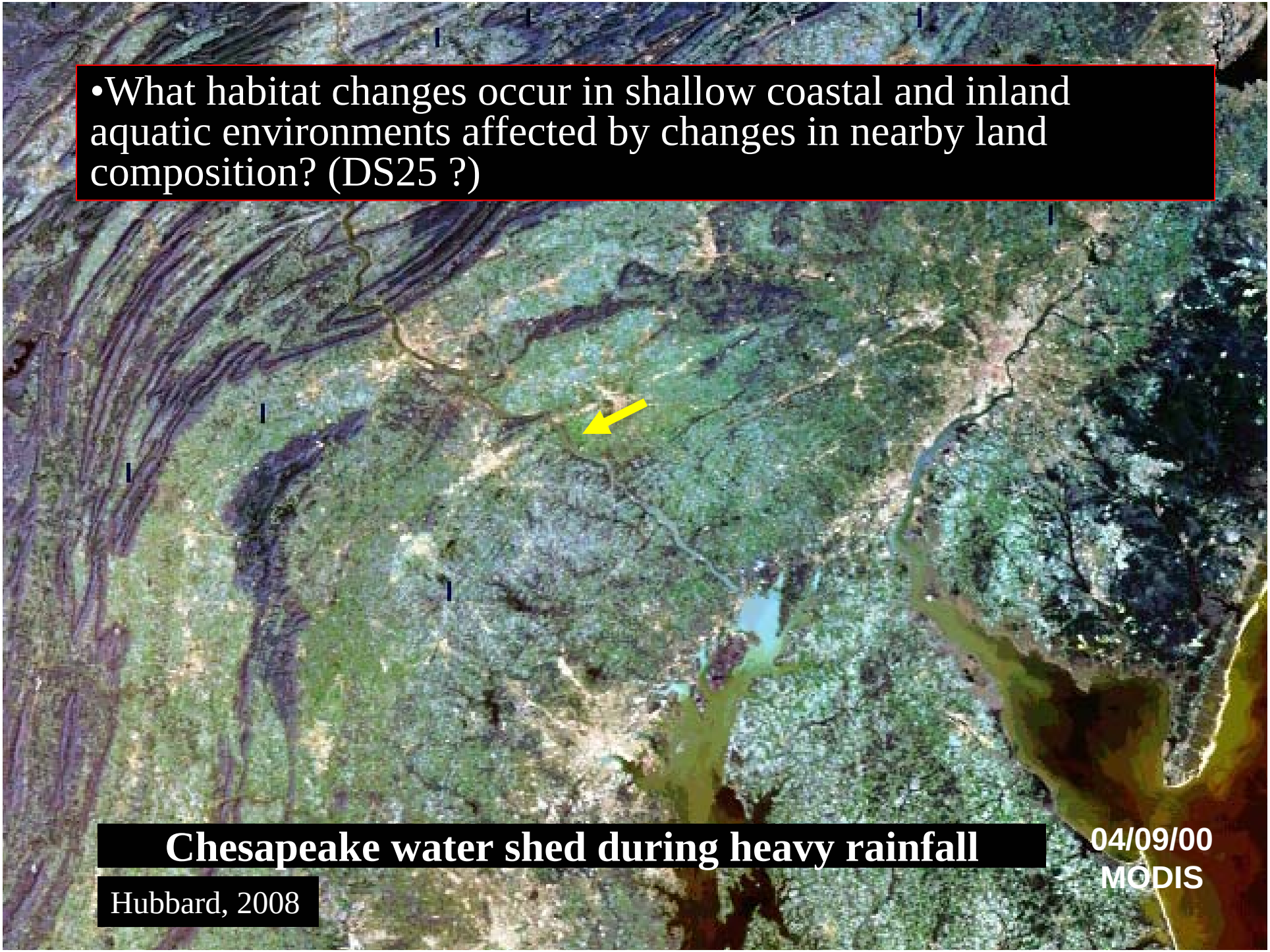
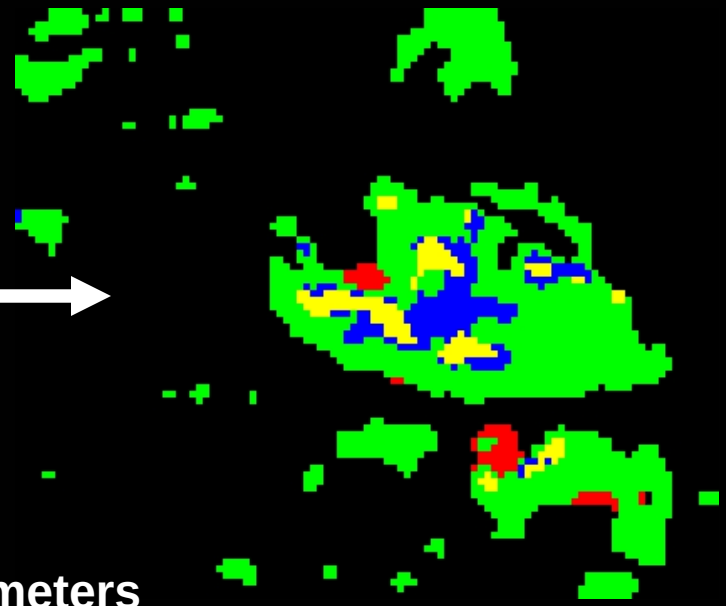
Compound Ratio:
(Ch3/Ch1+(Ch5/Ch3)
+(Ch6/Ch5)+(Ch10/Ch9)
-(Ch12/Ch10)



Rowan and others, 1995


•What habitat changes occur in shallow coastal and inland aquatic environments affected by changes in nearby land composition? (DS25 ?)
Chesapeake water shed during heavy rainfall
Hubbard, 2008
04/09/00
MODIS

Quartz and clay mineral types mapped using ASTER spectral endmembers

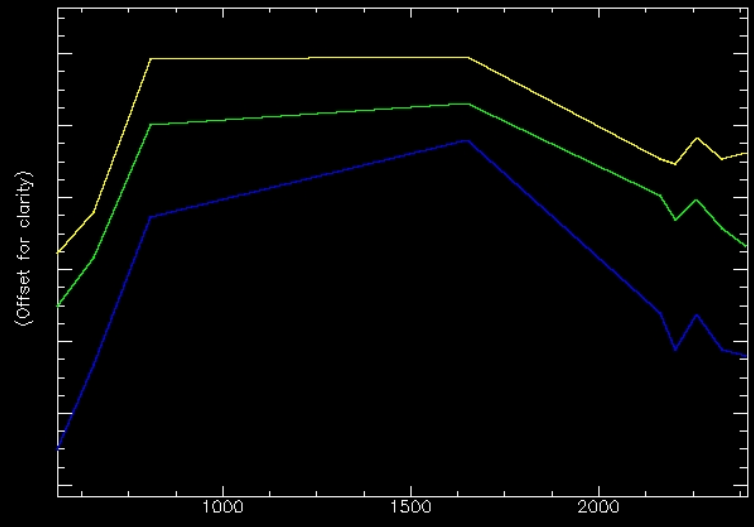


800 meters

Hubbard, 2008

intimate mixture classes:

- quartz
- smectite
- illite/musc
- kaolinite



clay mineralogy part 2: what's so important about smectite-bearing soils anyway?

- expandable clay with high dispersive forces
- forms a water impermeable seal or barrier
- prevents water infiltration
- increases runoff, especially on higher slopes
- leads to rilling and gullying on higher slopes
- seals become cracked, crusts when dry
- see papers by I. Shainberg, M. J. Singer, M. Ben-Hur, R. Karen, E. Ben-Dor M. Agassi and others

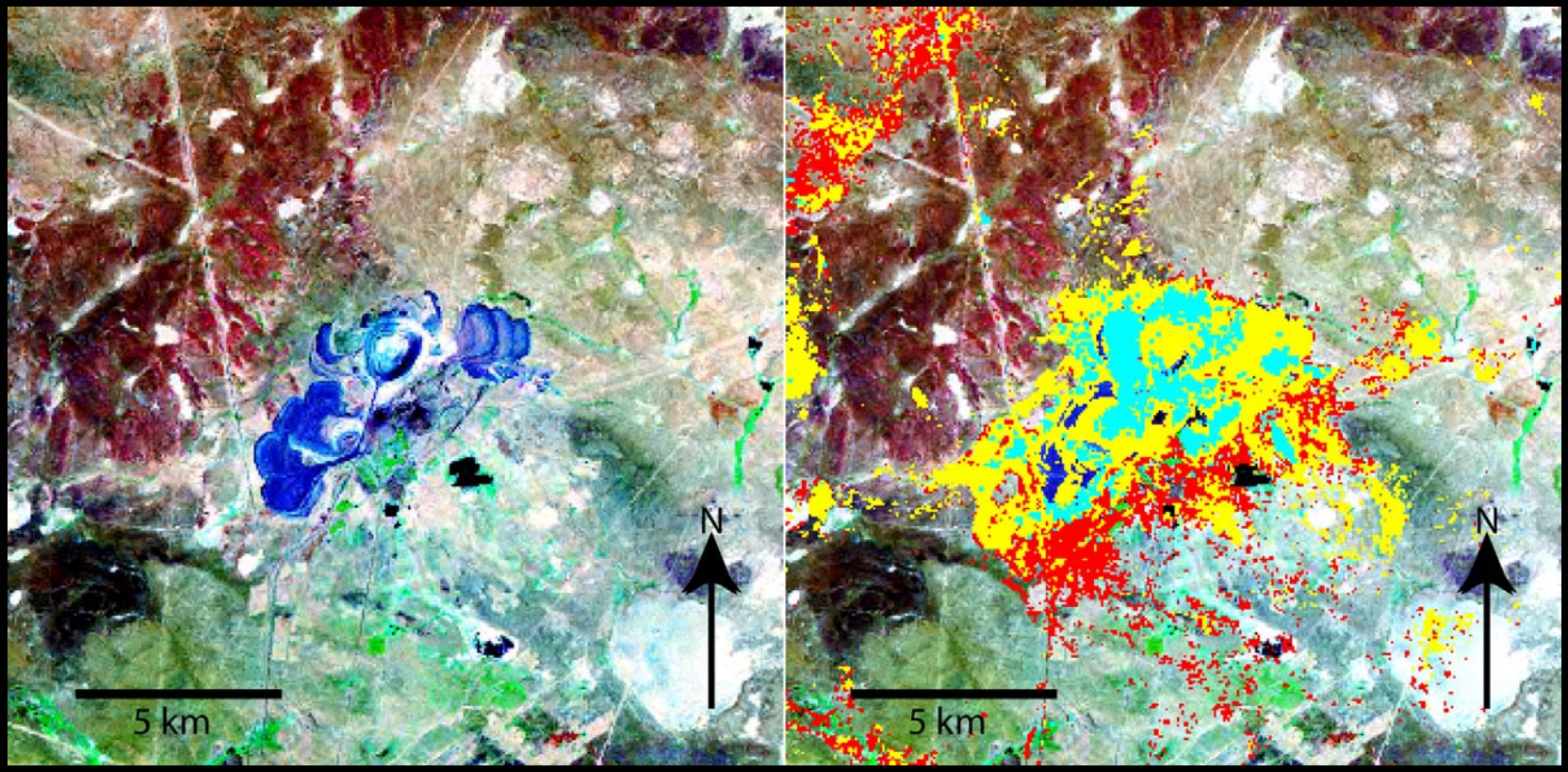
Hubbard, 2008

CONCLUSIONS:

HYSPIRI WILL BE ABLE TO REGIONALLY MAP THE GREATEST VARIETY OF MINERALOGY OF ANY SPACEBORNE SENSOR IN EARTH ORBIT

HYSPIRI WILL PROVIDE TEMPORAL DATA SETS TO MONITOR EARTH PROCESSES

•How is the composition of exposed terrestrial surface responding to anthropogenic and non anthropogenic drivers (desertification, disturbance e.g. logging, mining)? (DS 114)



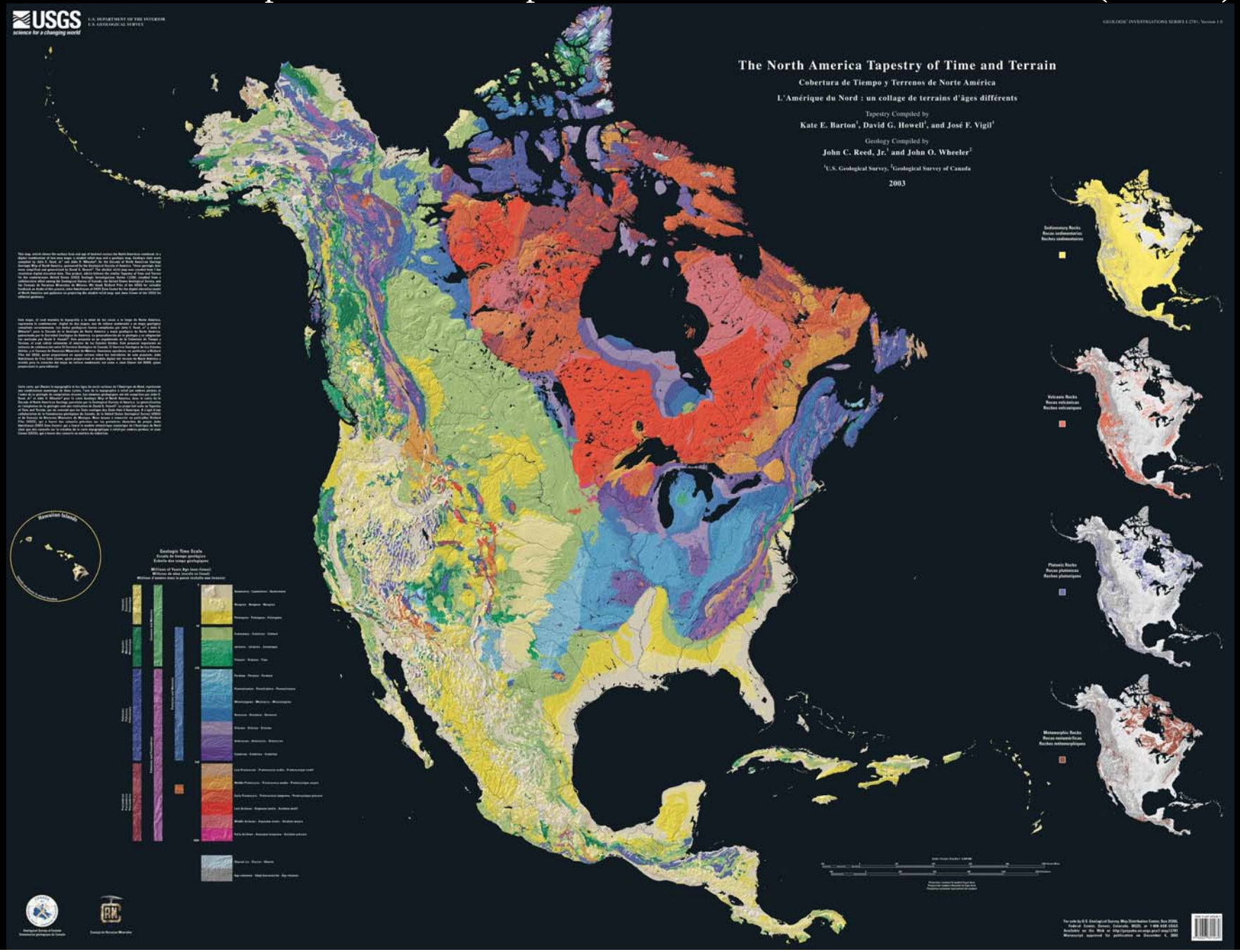
False color composite HispIRI simulated image of the porphyry copper Konyrat Mine near Balaquash, Kazakstan.

Silicified rocks (TIR data)

Alunite and kaolinite-rich rocks (SWIR data)

Sericite-rich rocks (SWIR data)

- What is the composition of the exposed terrestrial surface of the Earth? (DS 220)




Plutonic Rocks
Rocas plutónicas
Roches plutoniques


Volcanic Rocks
Rocas volcánicas
Roches volcaniques


Metamorphic Rocks
Rocas metamórficas
Roches métamorphiques


Sedimentary Rocks
Rocas sedimentarias
Roches sédimentaires