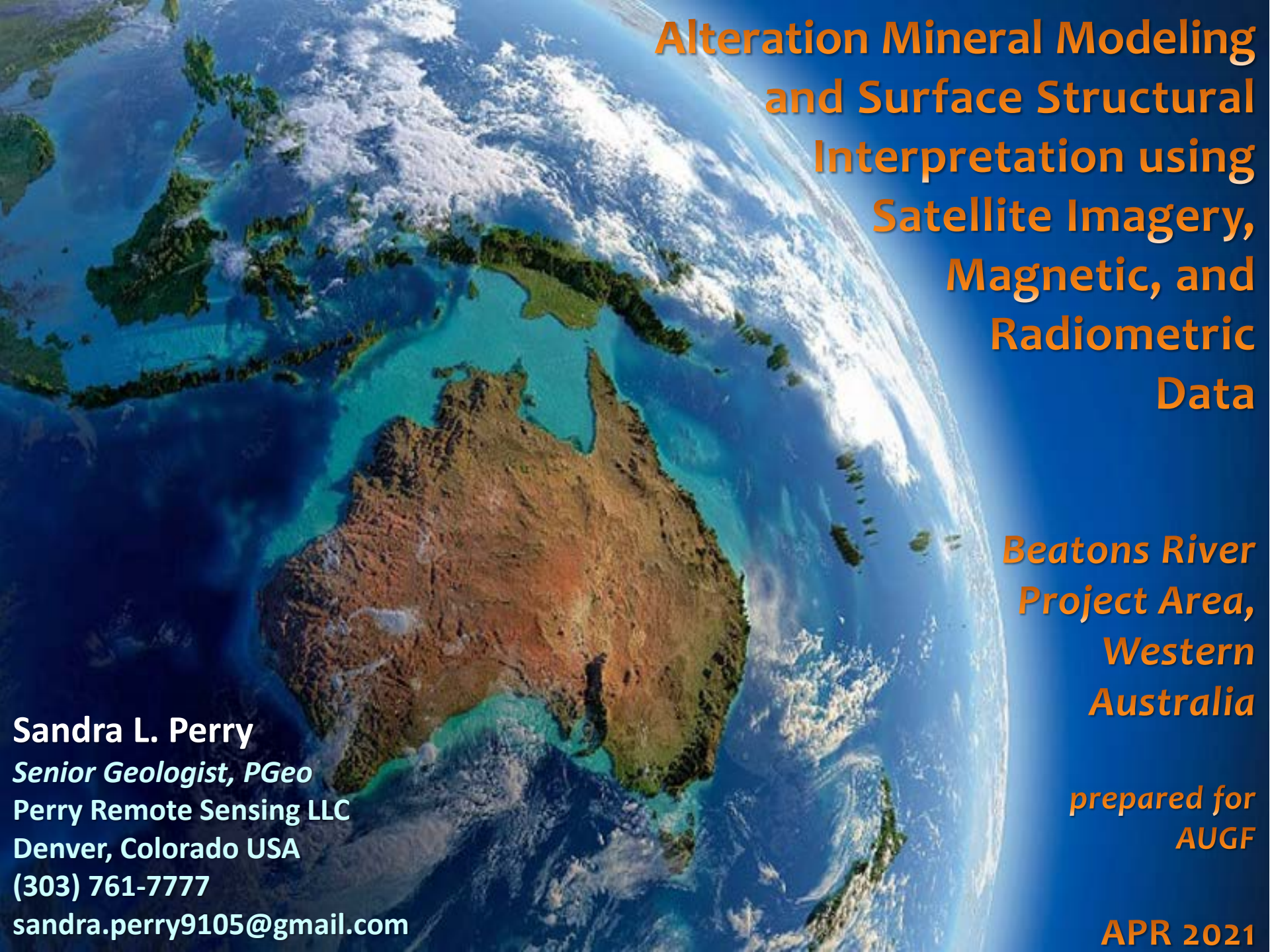

Alteration Mineral Modeling and Surface Structural Interpretation using Satellite Imagery, Magnetic, and Radiometric Data

Beatons River Project Area, Western Australia

prepared for AUGF

APR 2021

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PROJECT RESULTS

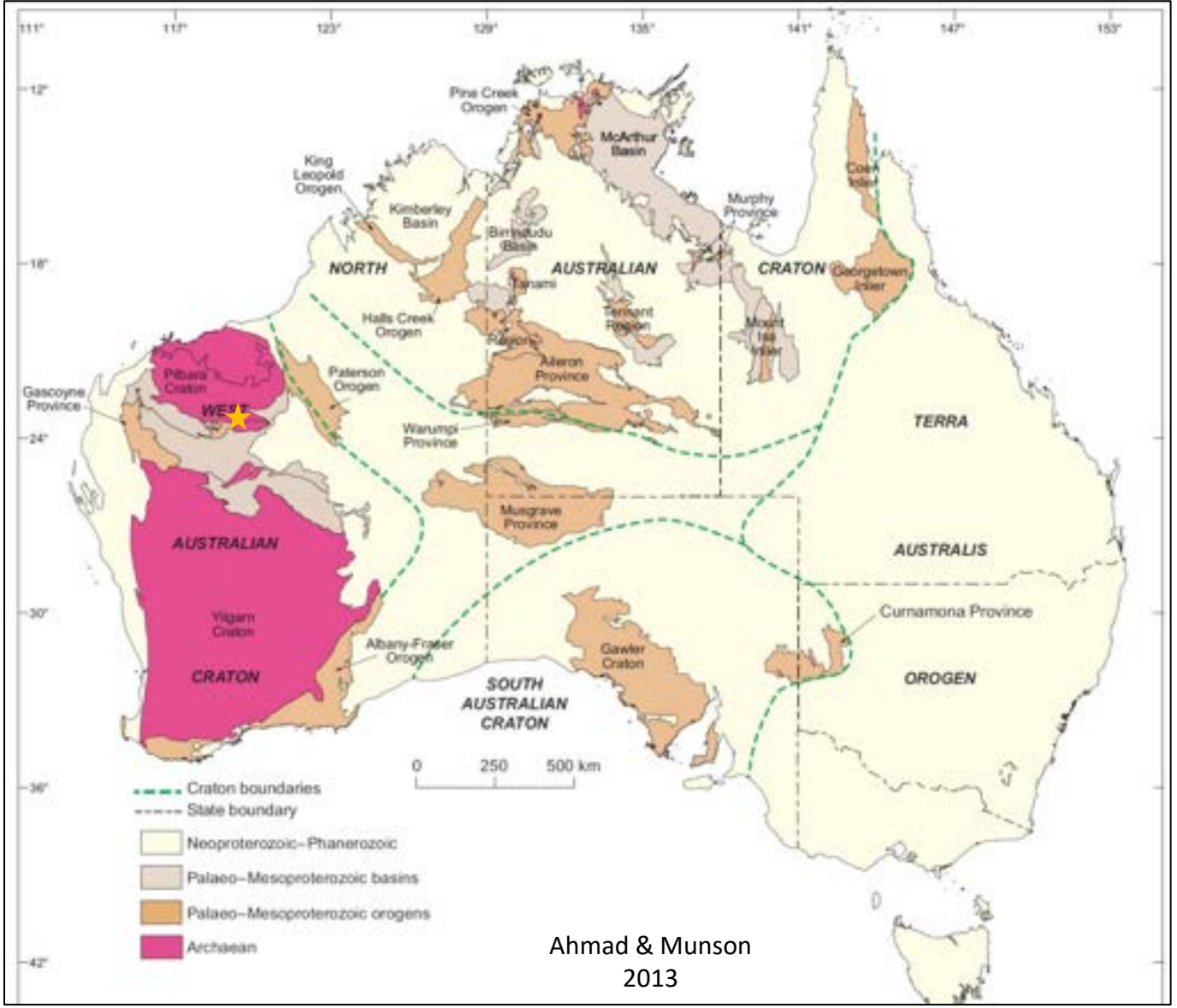
- Digital analyses of satellite imagery and airborne radiometrics have characterized & provided updated mapping of a Proterozoic-age pebble conglomerate, hosting Au nugget production in the Nullagine District that extends into AUGF's tenements E46/1215 & E46/1280
    - *updated mapping shows that the conglomerate occupies a central part of a regional syncline with highly altered flanks; within the two tenements, the central portion is prospective for nugget Au, & the western extent is highly prospective for epithermal precious metals*
    - *further review of airborne radiometrics indicates this conglomerate unit exhibits high uranium response, suggesting a potential sedimentary U deposit*
- A pronounced magnetic high occupies the western half of the two tenements and is interpreted as SW-tilting mafic intrusion; sericitic & argillic alteration mapped from satellite imagery is situated above & peripheral to the interpreted intrusion, also confirmed by high-K radiometric responses
    - *alteration modeling from satellite imagery suggests that a variety of intrusion-related precious/base metal prospects exist within this western tenement part*
- 45 exploration target areas are recommended for field investigation, based on modeled alteration and interpreted structural spatial relationships

PROJECT GOALS

- perform updated mapping for the Beatons Creek Member of the Proterozoic Fortescue Group that is prospective for nugget Au; evaluate the extent of this unit into AUGF's two tenement blocks, adjacent to the Nullagine Mining District
- provide alteration mineral modeling & structural interpretation throughout the tenements, using satellite imagery, DEM, and airborne magnetic & radiometric data sets
- incorporate mapped geology, pertinent geochemical sampling results, & field reports to further refine/constraint interpretation
- identify locations for field investigation, where modeled alteration coexists with mapped/interpreted structural features, likely revealing mineralized sites for sampling & geochemical testing

Presentation Plan

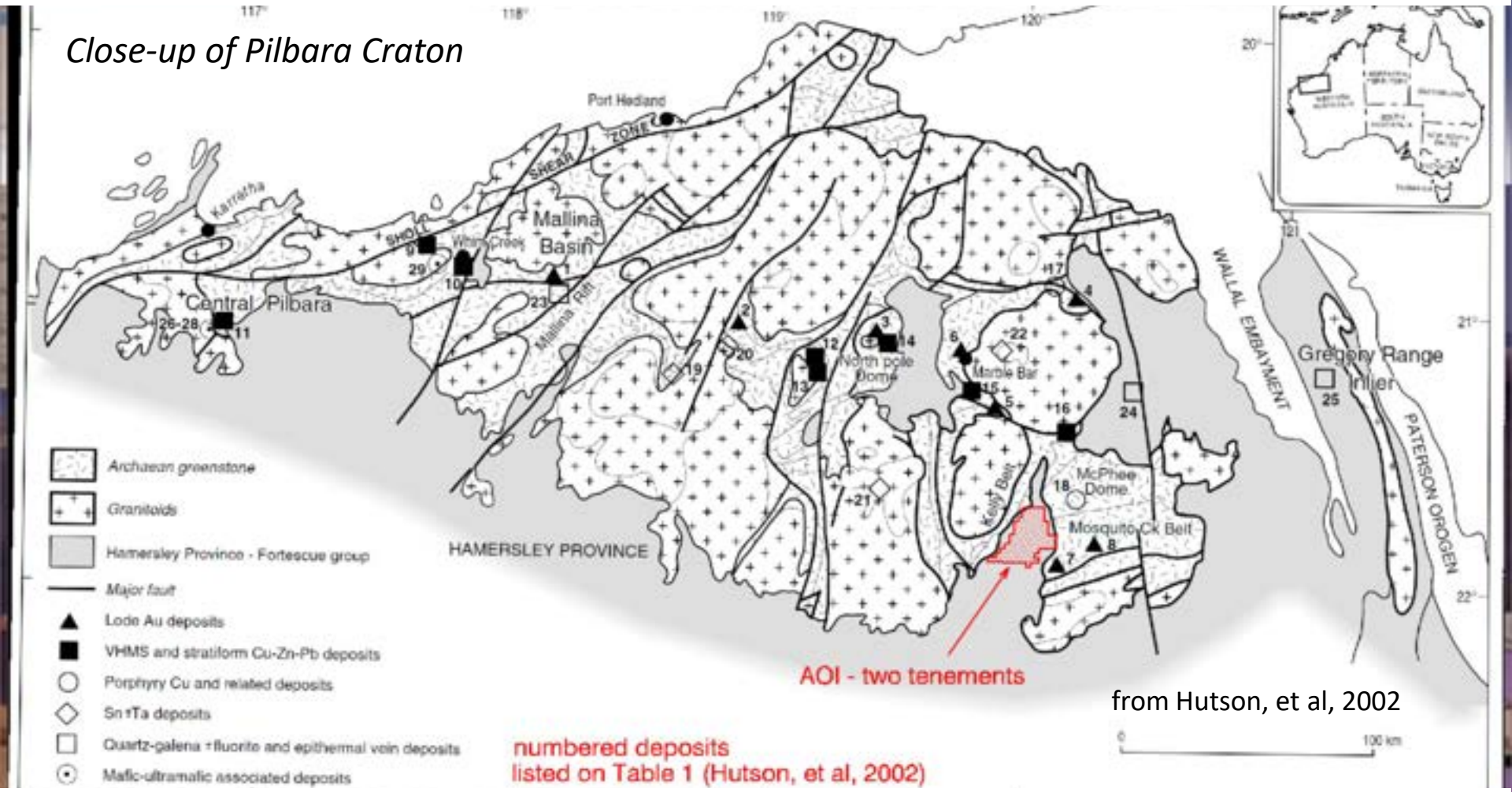
- Brief Tectonic & Geologic Overview of the AOI
- Digital Satellite Imagery Data Sets
- Potential-Field & Radiometric Data Sets
- Brief Discussion on Methods & Processing
- Integration of Modeled & Interpreted Features
- Proposed Exploration Target Areas for further field investigation



Ahmad & Munson 2013

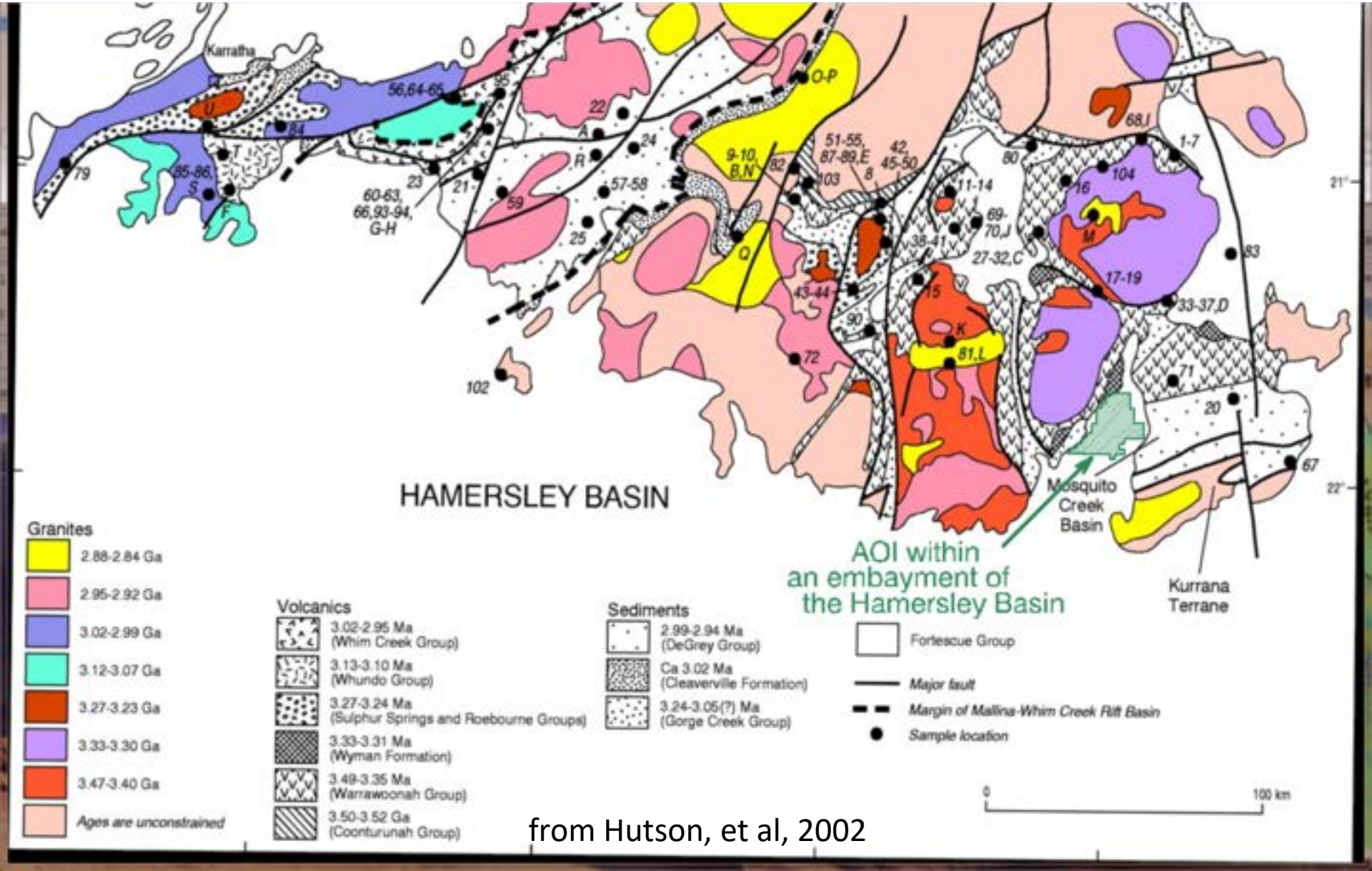
The Australian Continent is comprised of thick crustal domains, called provinces or cratons, which have reacted to various phases of tectonic activity over geologic time. During phases of compression & orogeny, mountain building occurred; during relaxation, vast basins resulted. The AOI★ is situated within a segment of the oldest Archean basement called the Pilbara Craton.

Area of Interest (AOI) consists of two tenements E46/1215 & E46/1280 (*shown in red*) located within a structural embayment of the Hamersley Basin filled with Fortescue paleo-sediments



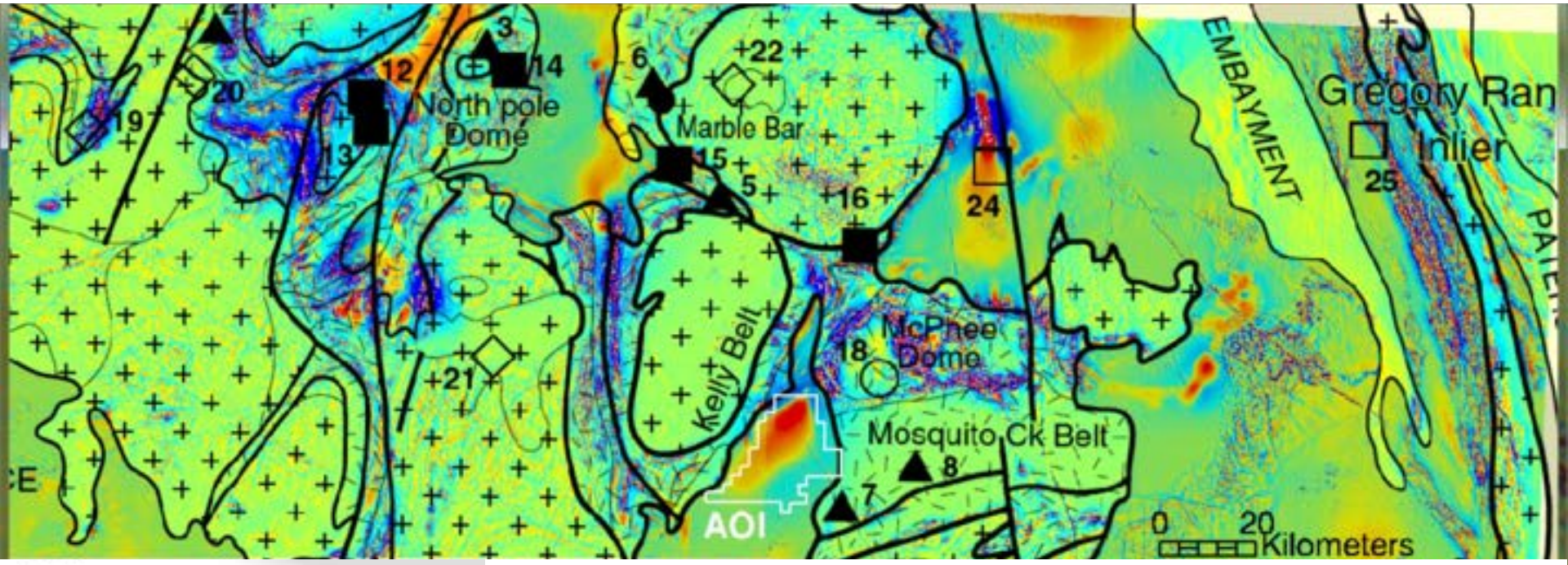
oldest granitoid bodies are regionally faulted & broken up, surrounded by Archean greenstone units & volcanics; dominant regional fault trend is N-NE; the AOI is situated within a paleo sub-basin that likely has deep structural roots and parallels the overall N-NE tectonic trend.

Regional Geologic Mapping
AOI located within a structural embayment of the Hamersley Basin



from Hutson, et al, 2002

Magnetic (RTP) Data Fused with Regional Geology

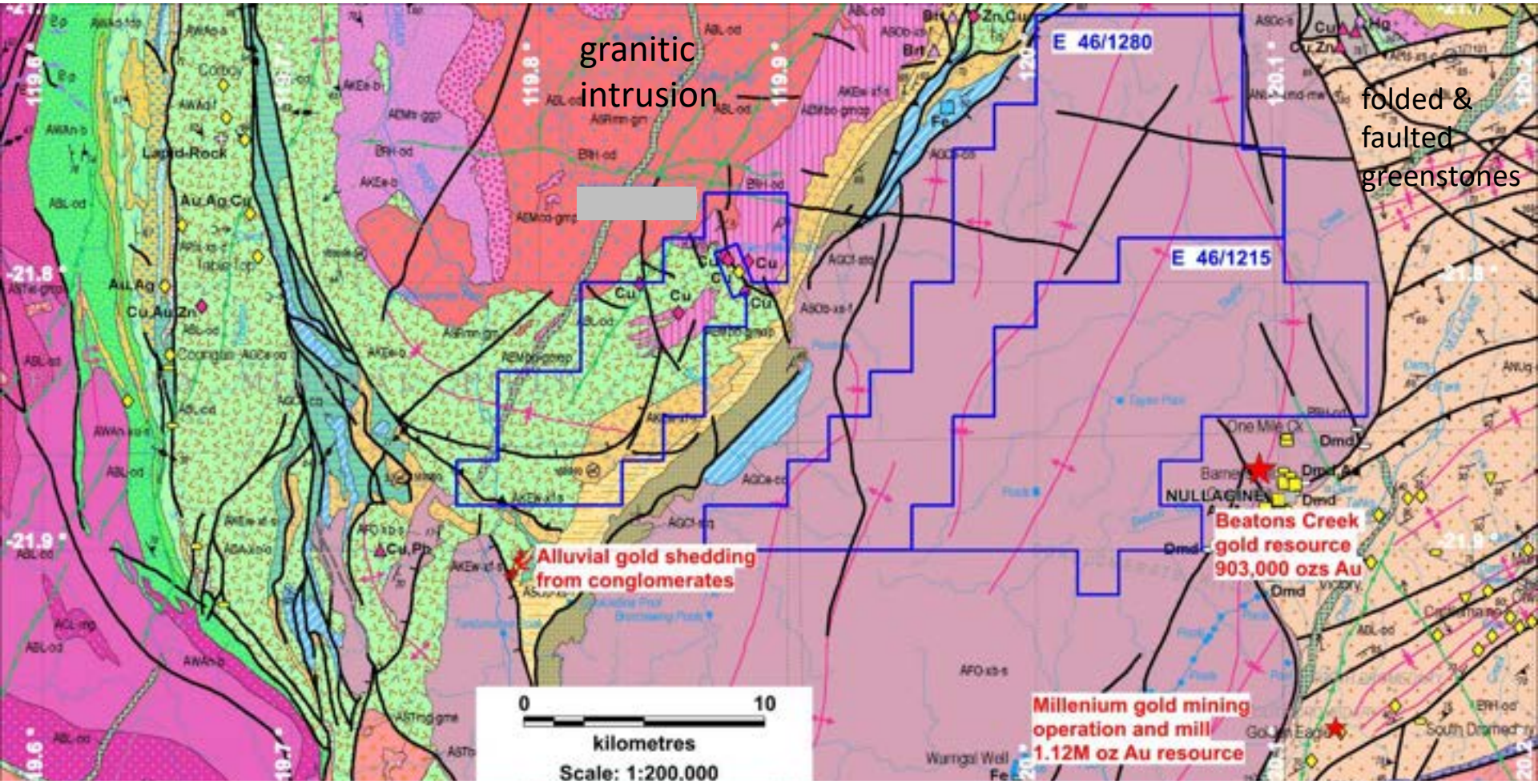


- Archaean greenstone
- Granitoids
- Hamersley Province - Fortescue group
- Major fault
- Lode Au deposits
- VHMS and stratiform Cu-Zn-Pb deposits
- Porphyry Cu and related deposits
- Sn ±Ta deposits
- Quartz-galena ±fluorite and epithermal vein deposits
- Mafic-ultramafic associated deposits

AUGF's tenements are dominated by an oblong magnetic high (*red oval above*) that parallels the axis of the sub-basin, suggesting a genetic relationship with the formation of the embayment. Magnetic data are useful for mapping volcanics & granitoids throughout the craton. The magnetic high within the tenements exhibits one of the highest magnetic susceptibilities in the region. The AOI is near several known mineral deposits: #7 load @ Au Golden Eagle; #8 lode Au @ Mosquito Creek; #16 VHMS/stratiform Cu/Zn/Pb @ Lennons Find; and #18 porphyry Cu @ Gold Show Hill.

Local Geologic Mapping

depicts tenements E 46/1215 & E 46/1280 situated within sediments of the Proterozoic Fortescue Group (dark pink)



Within the Fortescue sediments & conglomerates, NE-trending folds are mapped, indicating NW-SE directed compression. Au nugget-bearing conglomerates at Nullagine are mapped as the Beaton Creek Member, found along the axis of a mapped syncline that extends into tenement E 46/1215. Therefore, this unit is likely younger than other mapped members of the Fortescue Group.

Digital Satellite Imagery Radiometric & Potential-Field Data Sets *how they work*

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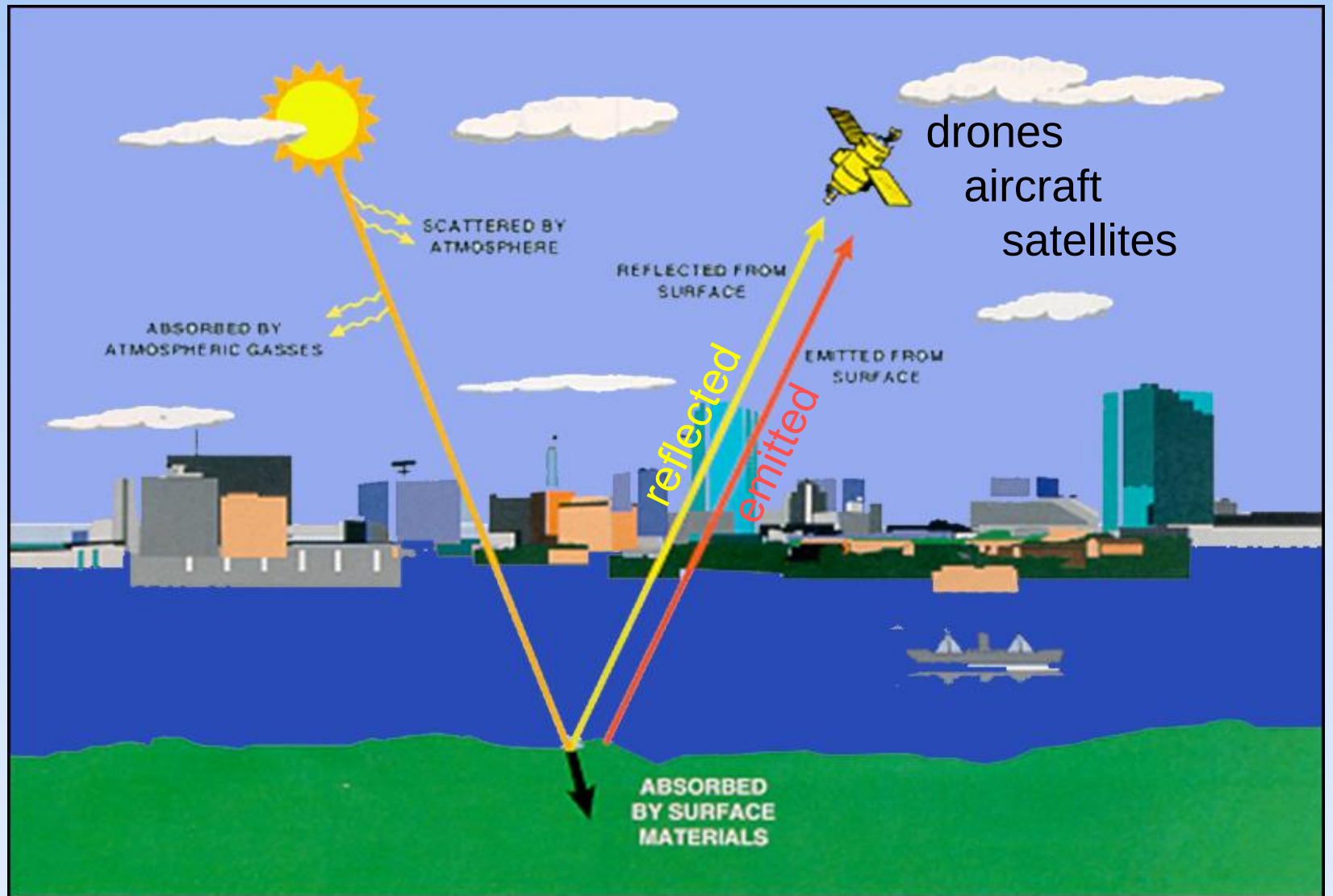
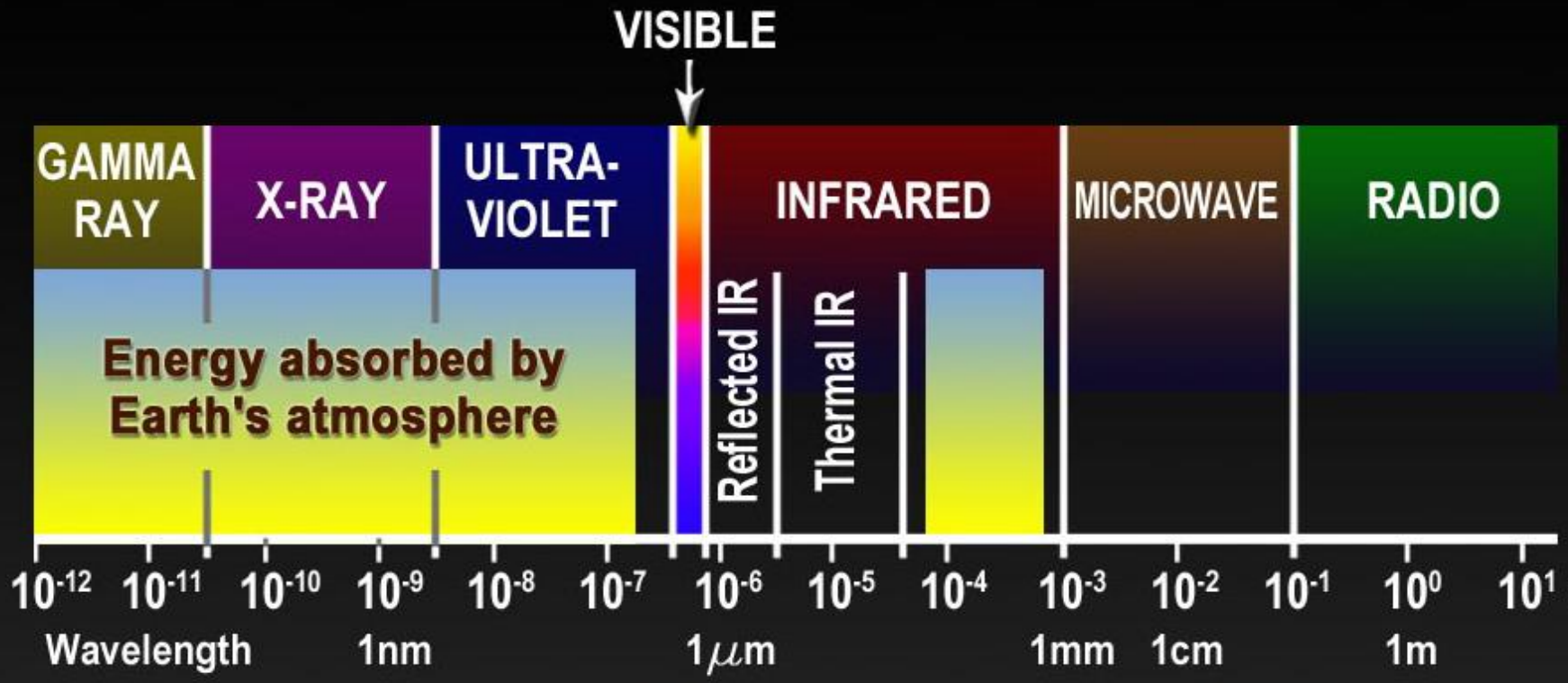
Geologic Exploration Using Satellite Technology

Imaging Spectroscopy

utilizes remote sensing systems that measure reflected and/or emitted light in wavelength intervals for identifying and mapping earth-surface composition



ELECTROMAGNETIC SPECTRUM



Wavelength Terminology:

VIS - Visible

NIR - Near-Infrared

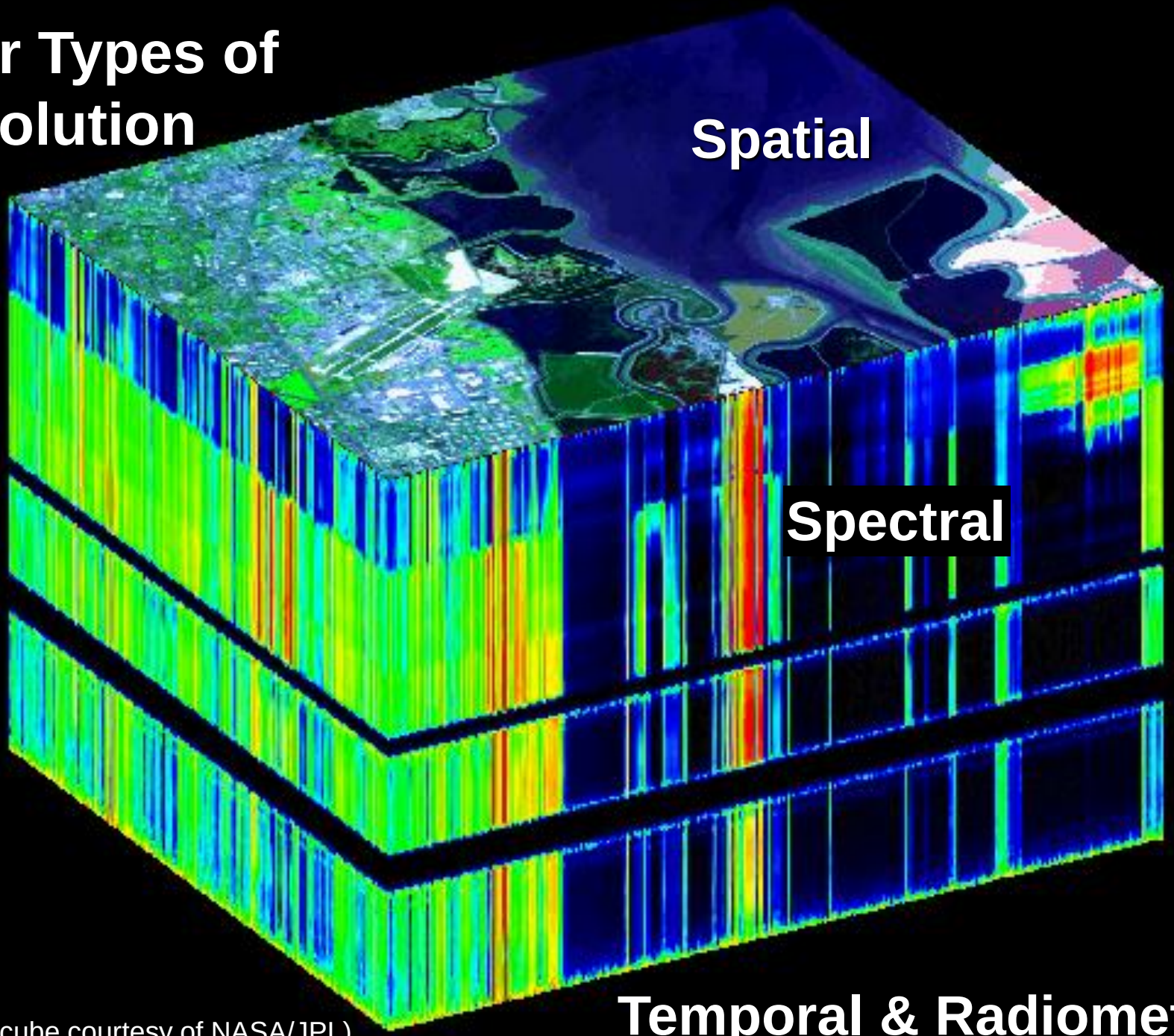
VNIR - Visible & Near IR

SWIR - Short-Wave IR

TIR - Thermal IR

RADAR - Radio detection & ranging

Four Types of Resolution



(image cube courtesy of NASA/JPL)

GEOLOGIC INFORMATION

COMPOSITIONAL MAPPING & ALTERATION PREDICTION

SPECTRAL RESOLUTION

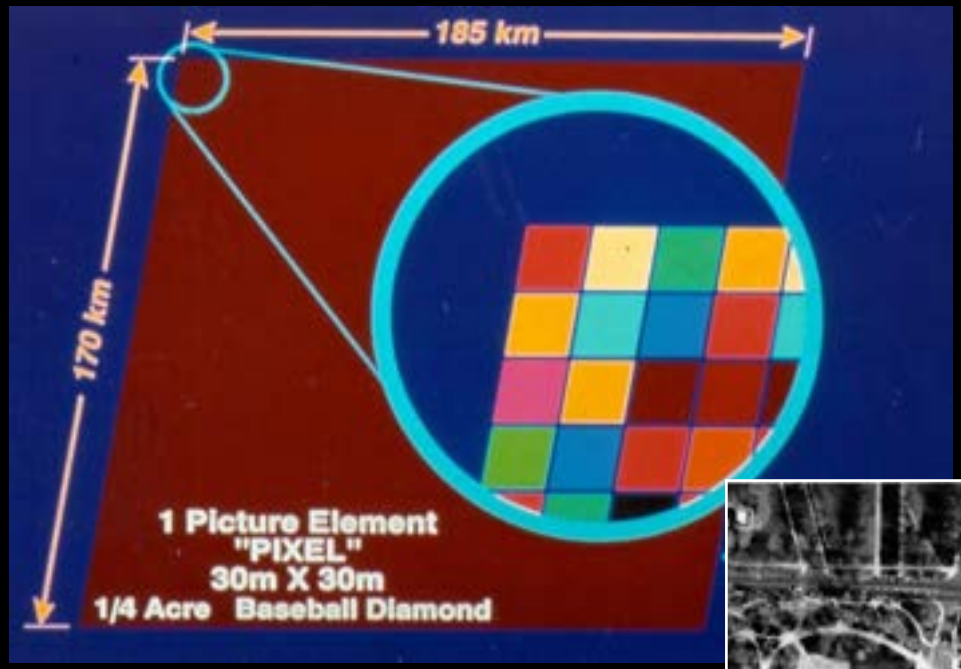
COLOR AND TONE

STRUCTURAL INTERPRETATION

SPATIAL RESOLUTION

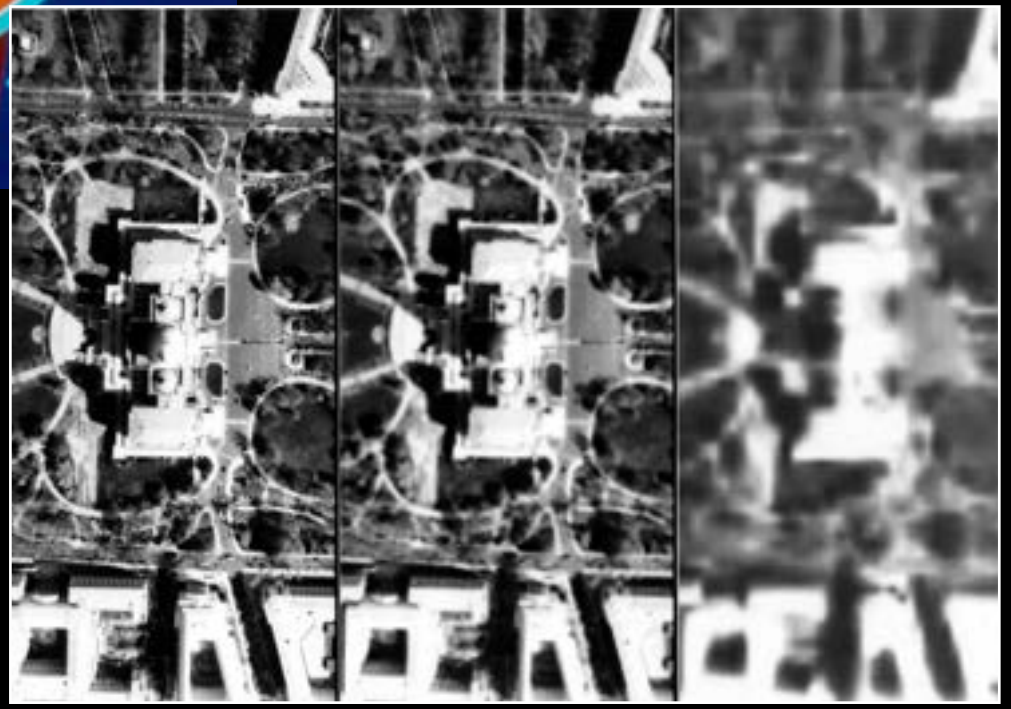
TEXTURE

Spatial Resolution



anatomy of a Landsat TM scene

pixel size comparisons



Exploration Scales

- ***Regional Reconnaissance***

  1:500,000 - 1:200,000 pixel size: >80 m

- ***District-Scale Geologic Mapping***

  ~1:100,000 pixel size: 25 - 30 m

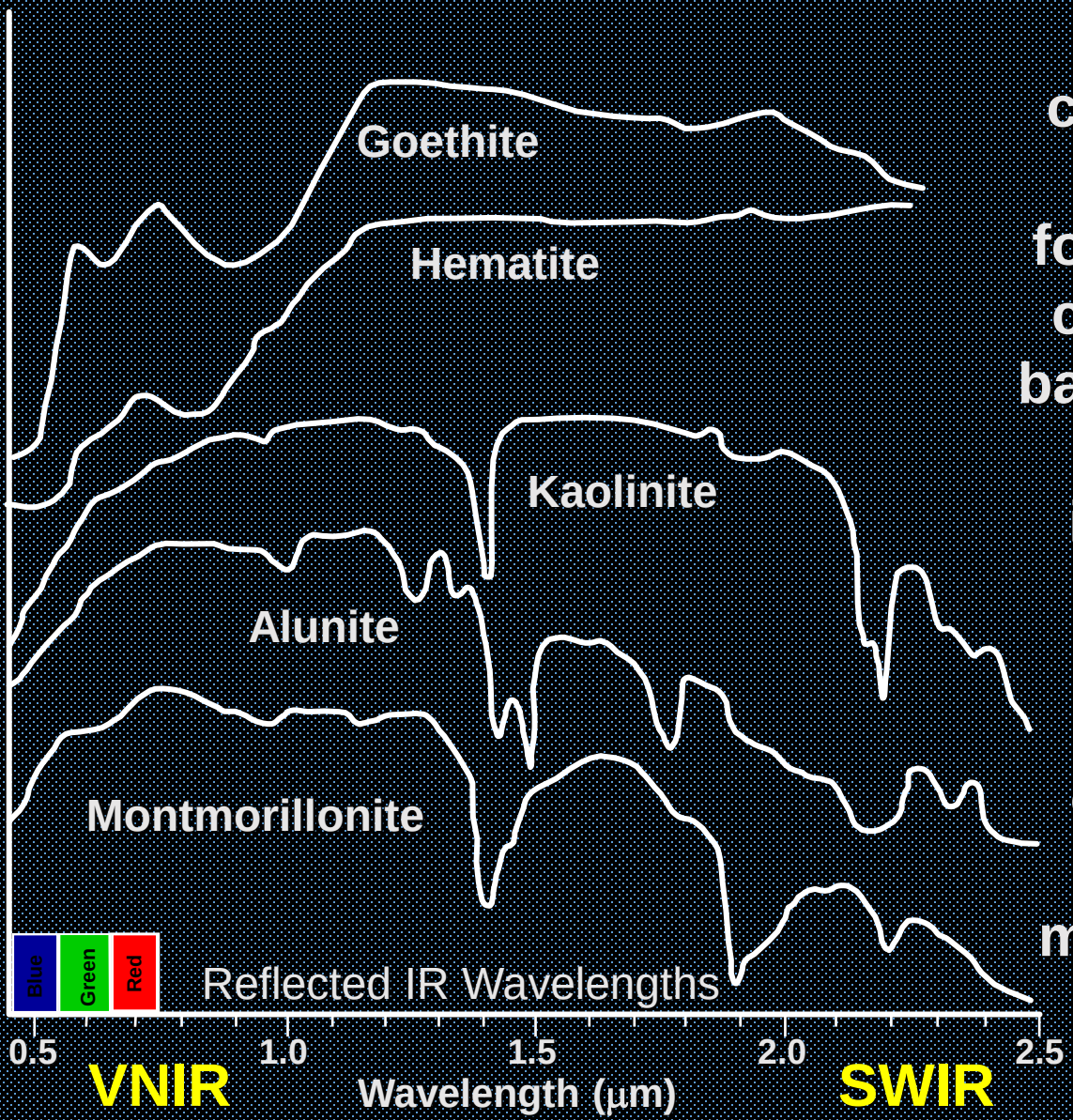
- ***Localized Fieldwork & Logistics***

  1:50,000 - 1:25,000 pixel size: 10 - 15 m

- ***Development Geology***

  ~1:10,000 - 1:2,500 pixel size: 5m - 50 cm

Minerals Identified by their Spectral Properties

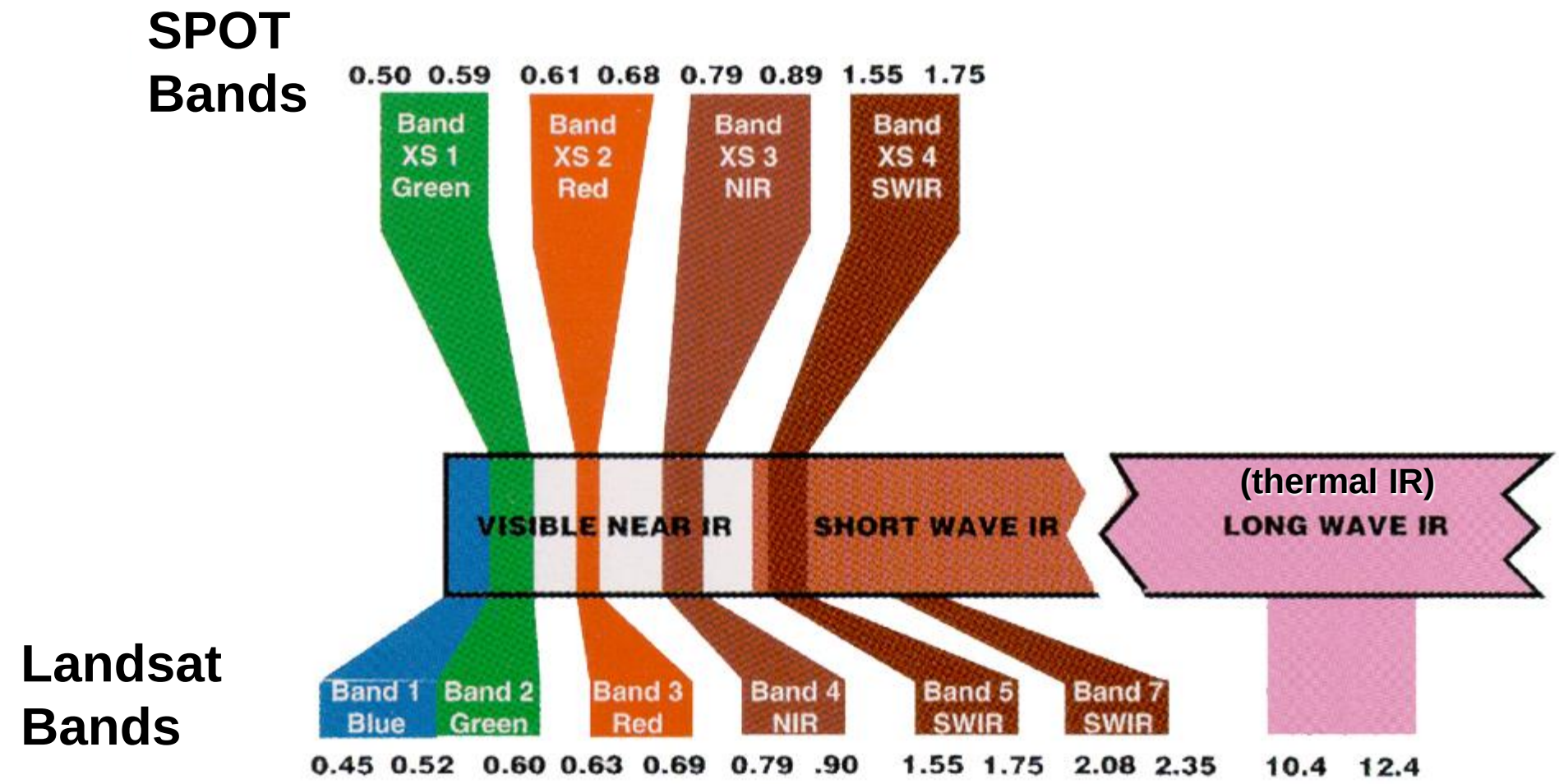


The spectral curve or profile is unique for minerals and constitutes the basis for spectral mineral identification.

The “valleys” or absorption features are most important.

Spectral Resolution

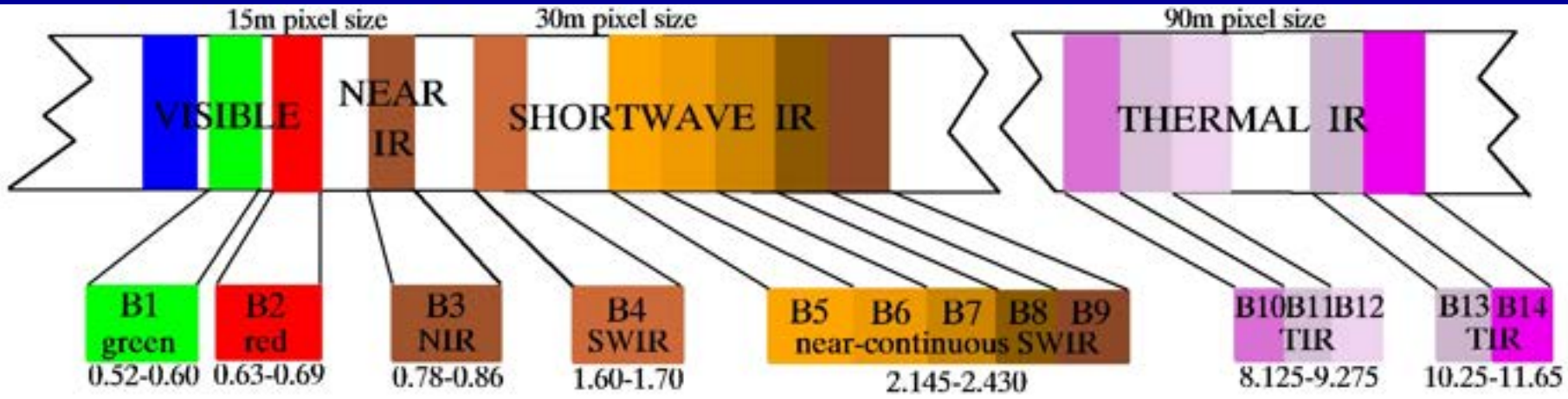
Multispectral Satellite Imagery Examples



Landsat ETM offers 6 spectral bands from 0.45 to 2.35 microns with broad wavelength intervals (~0.2 microns)

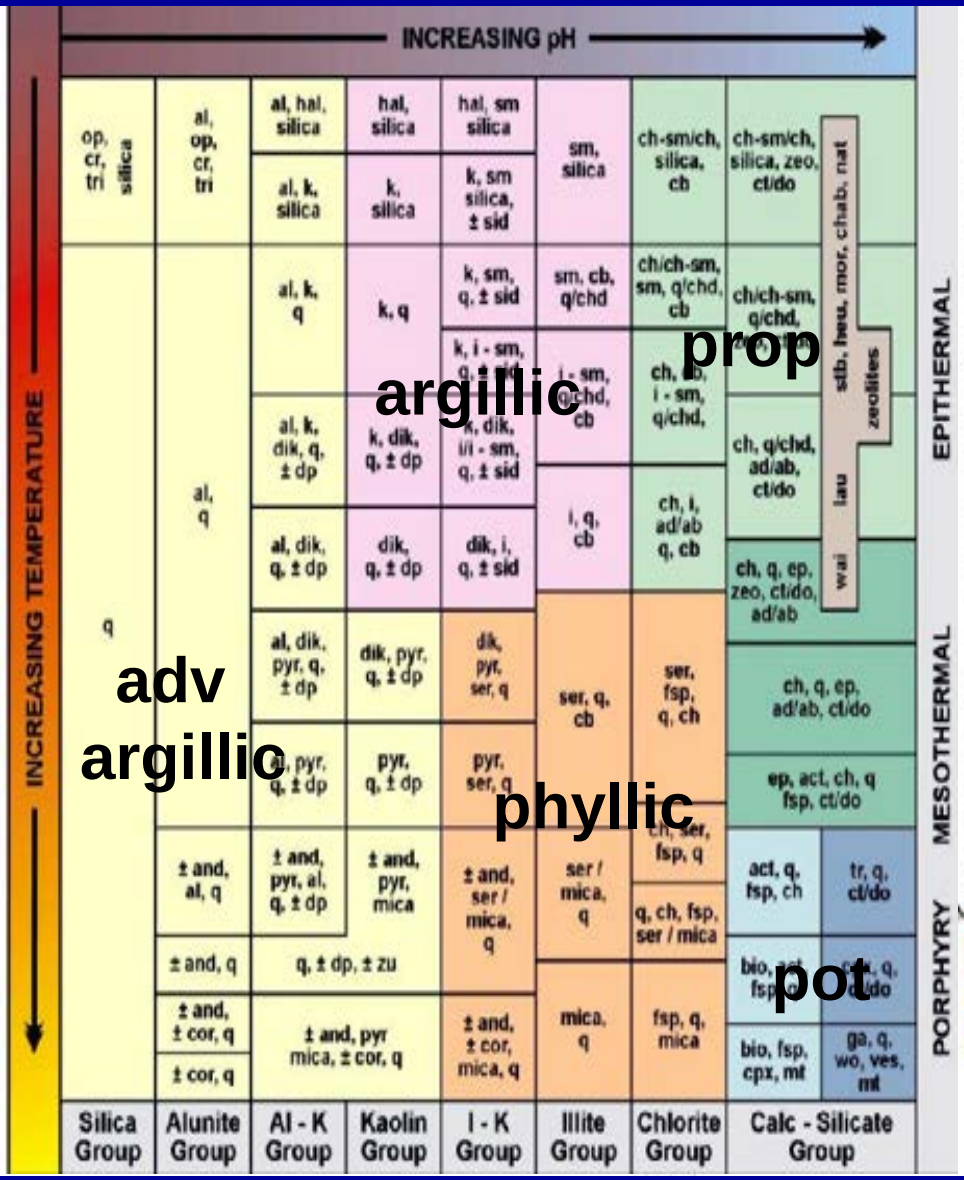
- designed & built by Japanese companies
- onboard NASA space platform Terra
- 14 spectral bands
- variable spatial resolution (or pixel size)
- night acquisitions of TIR

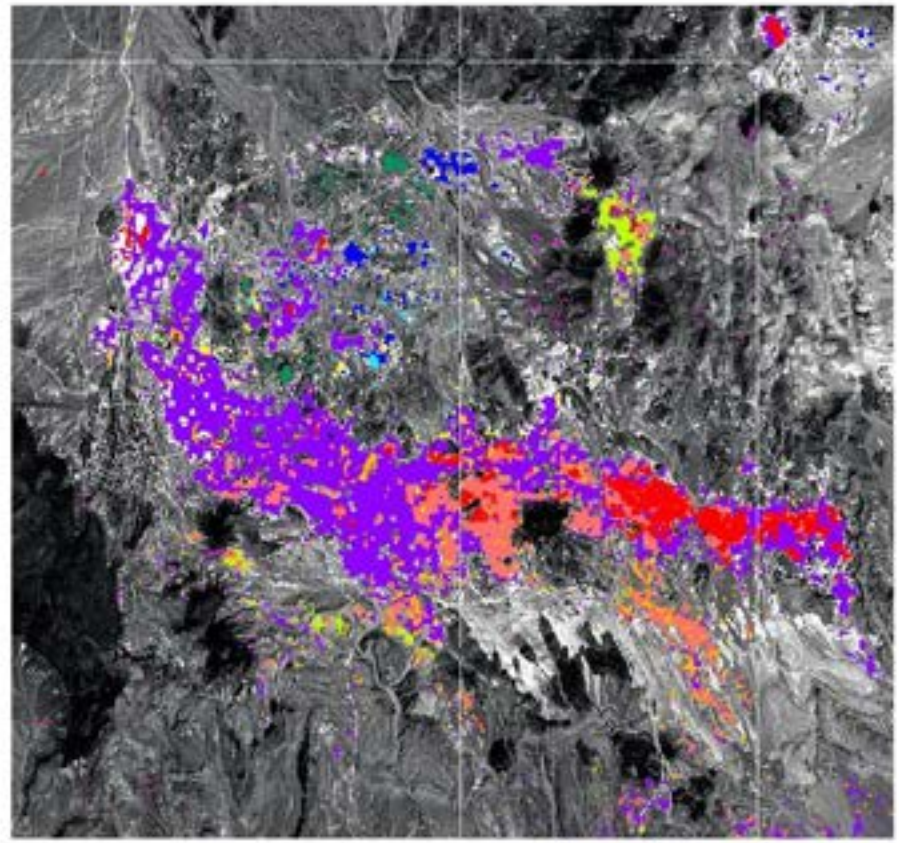
ASTER
JAPAN / USA



Hydrothermal Alteration

Goldfield, Nevada





(Perry, 2003)

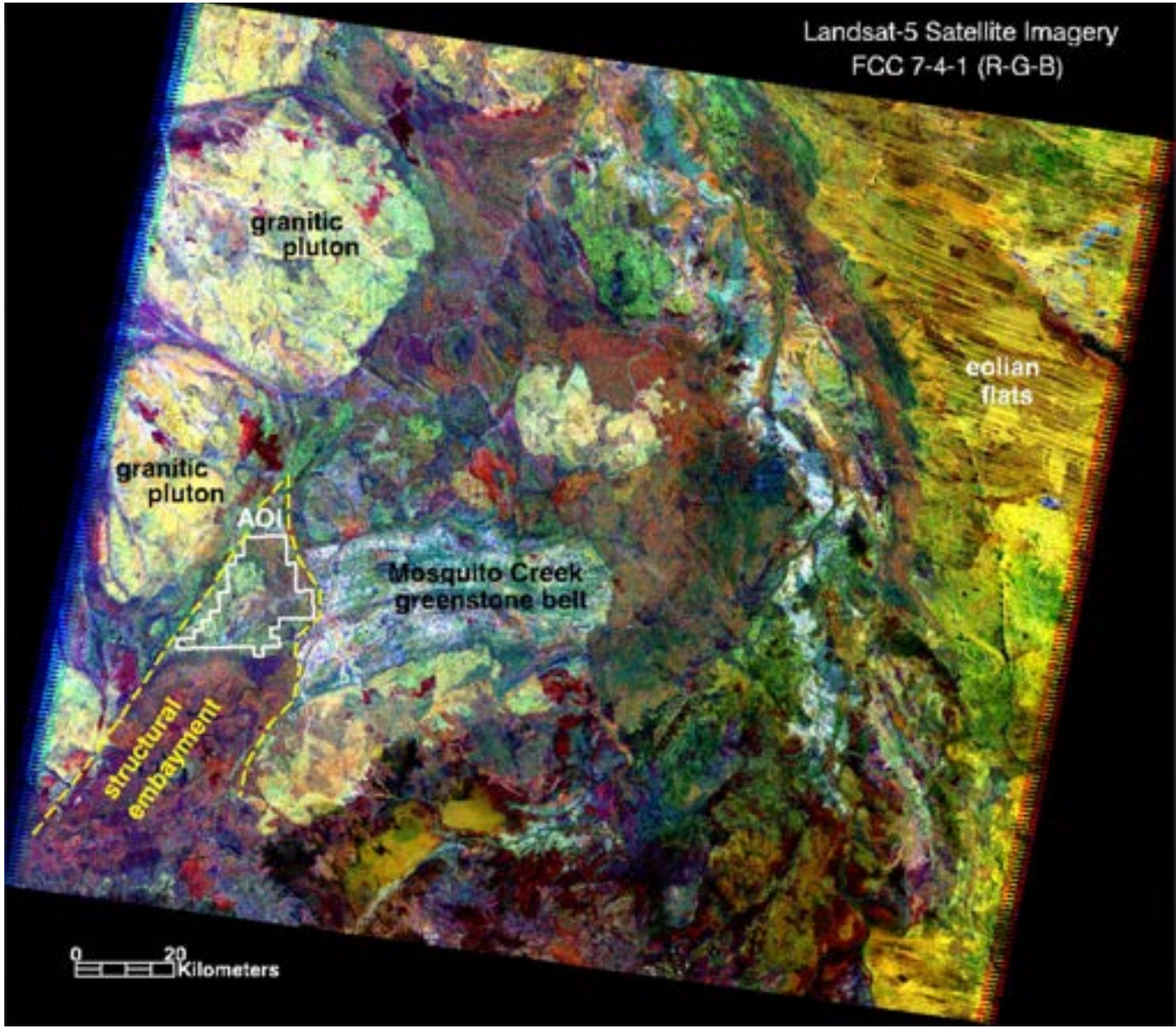
(Leach, 1995)

Landsat-5 Satellite Imagery Coverage

the AOI measures 334 sq km, situated within one Landsat-5 scene: Path111/Row75 collected OCT 6, 2004

each Landsat scene measures ~185 km on a side

this False-Color Composite (FCC) image provides a stunning view of the dynamic geology & tectonics of the region



key tectonic and surface features are noted above
high Si exposures: shades of red; vegetation in greens; Fe-rich units in blue

ASTER Satellite Imagery Coverage

AOI required two ASTER scenes
acquired SEPT 19, 2014
P112/R209/V7 & P112/R208/V7

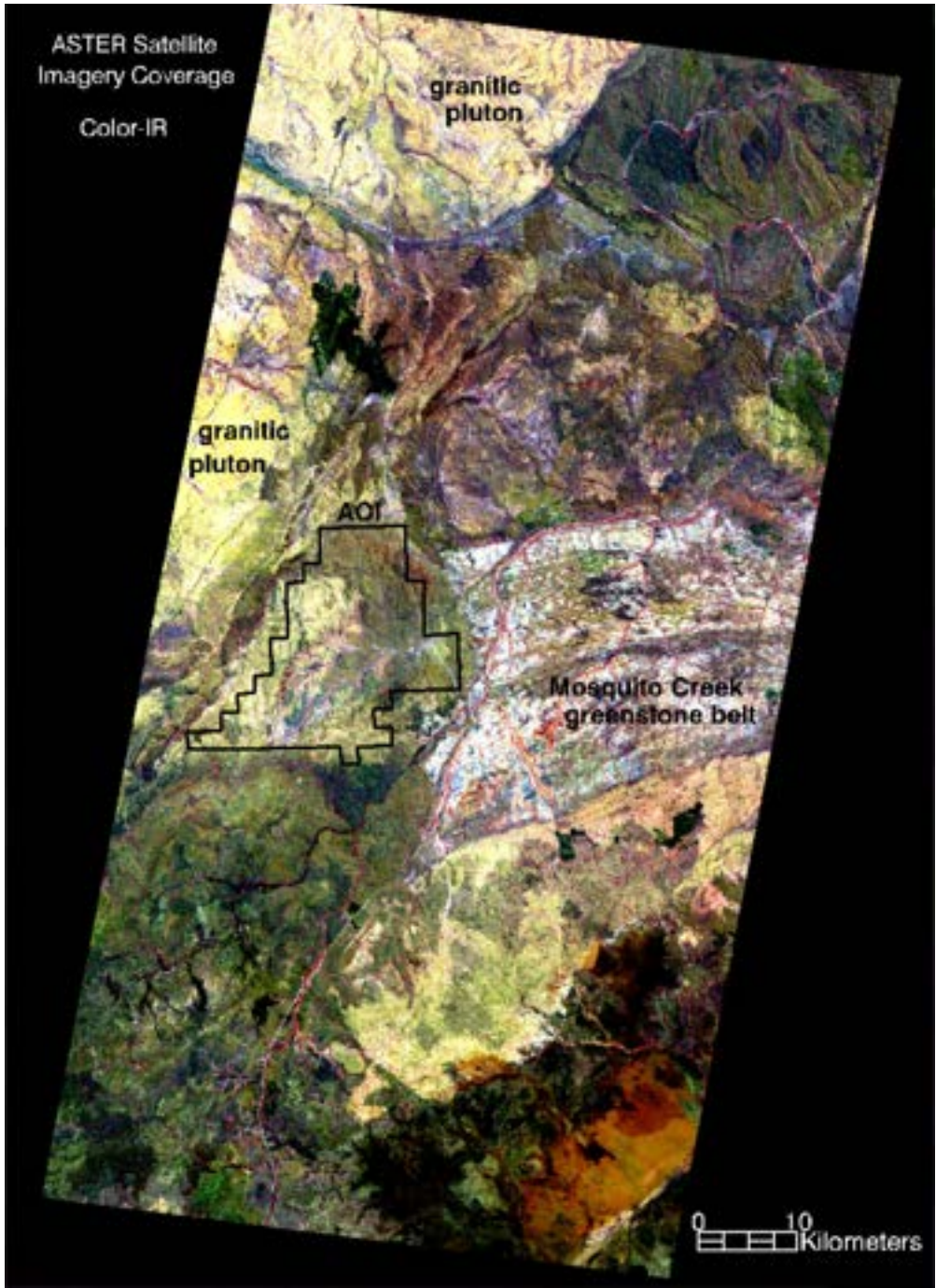
ASTER & Landsat dates of acquisition are similar to help offset temporal differences when combining Landsat VNIR & ASTER SWIR bands

AOI was subset to match Landsat data set, georeferenced to MGA 50/GDA94
(note: the project area straddles two Zones, 50 & 51; Zone 50 was selected for all resulting imagery & maps)

color-IR composite image depicts vegetation in red with Fe-rich exposures in shades of green; local range-fire burn areas in black

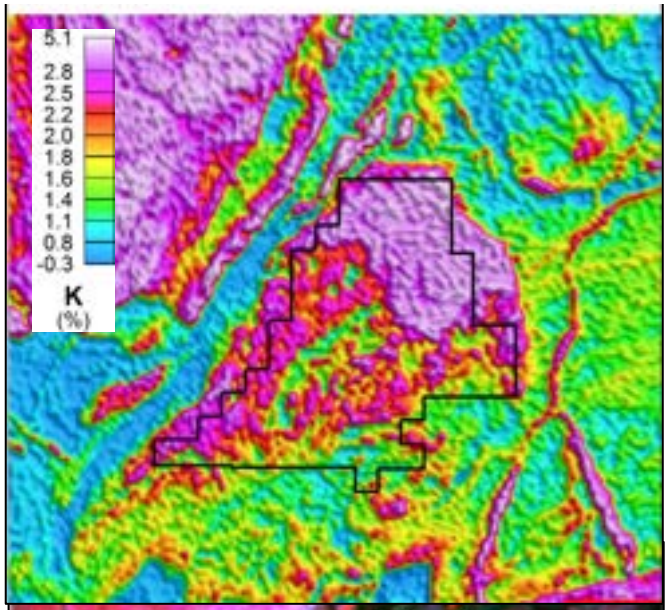
each ASTER scene covers 60 X 60 km

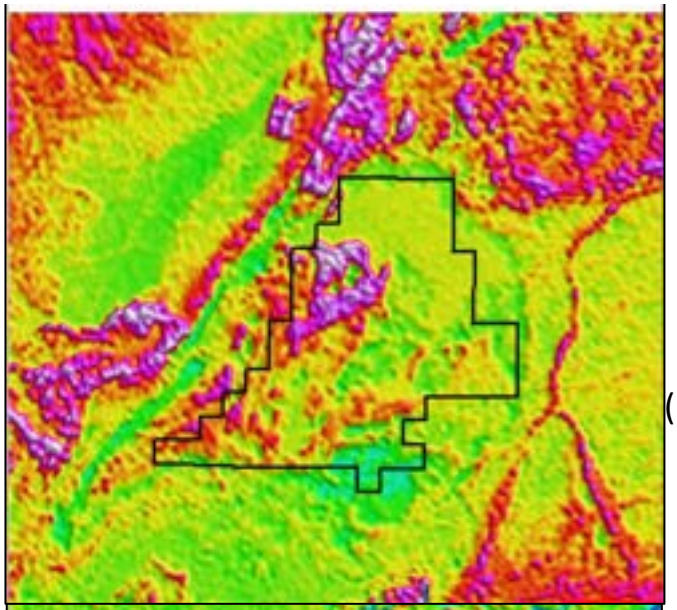
un-enhanced Landsat-5 true-color



Airborne Radiometric Data

processed & colorized K radiometric data

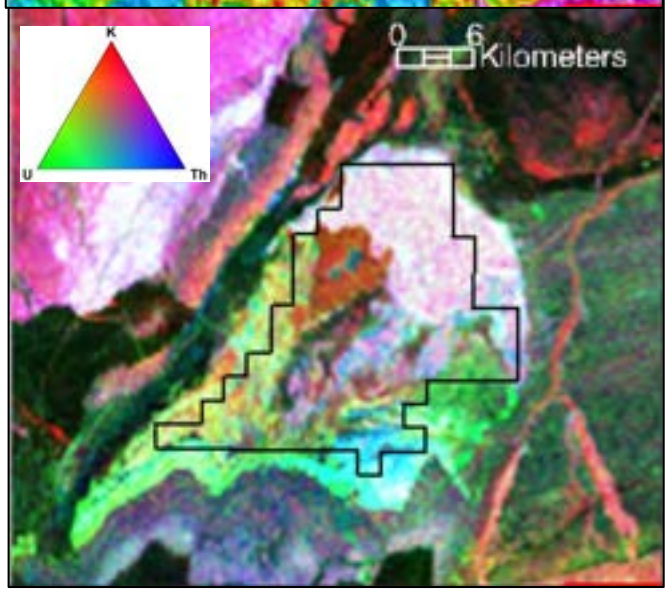


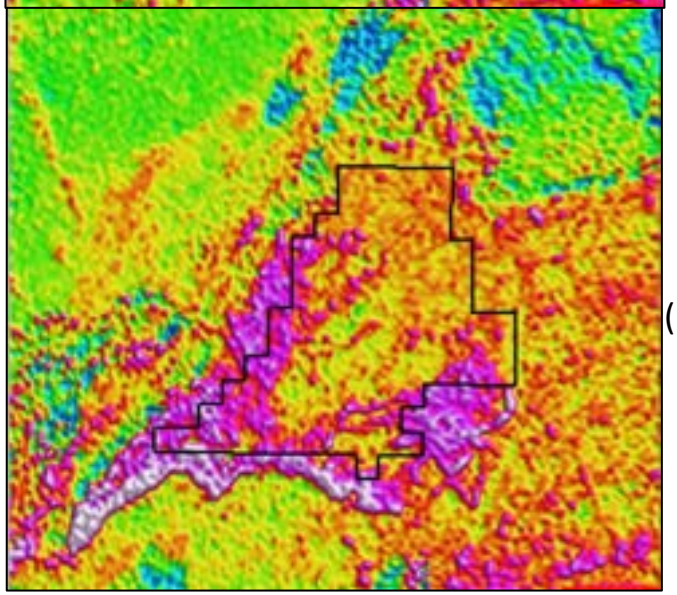


K/Th ratio best for predicting high K (red/magenta/pink)

Ternary K-U-Th elements

useful for predicting element content at surface





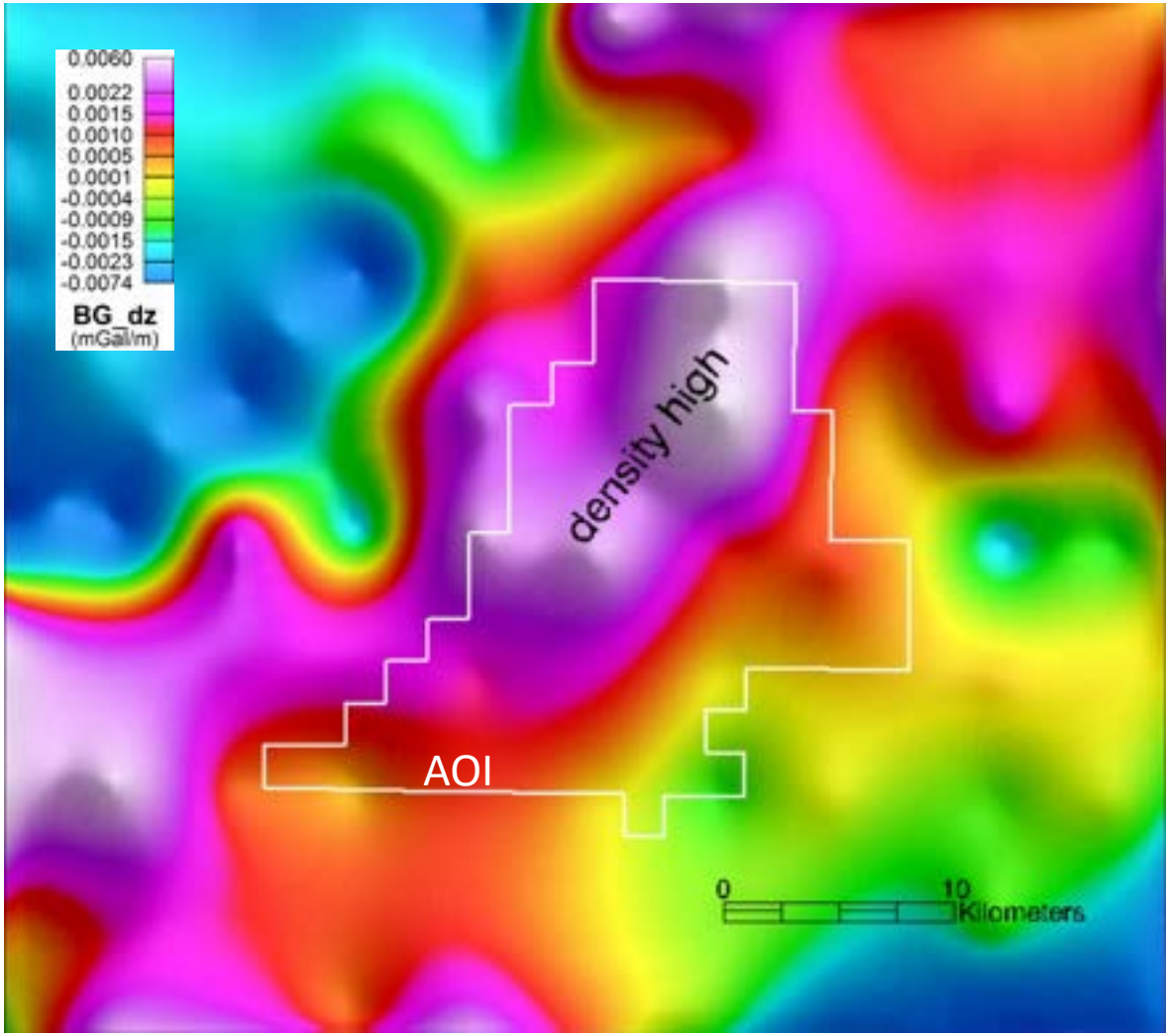
U/Th ratio best for predicting high U (red/magenta/pink)

Radiometric data are important to integrate with multispectral processing for predicting high U & K occurrences at surface, often associated with alteration minerals.

Potential-Field Geophysical Data

aids in identifying subsurface structures & intrusions, relating to density (gravity) and magnetic susceptibility

ground-based gravity



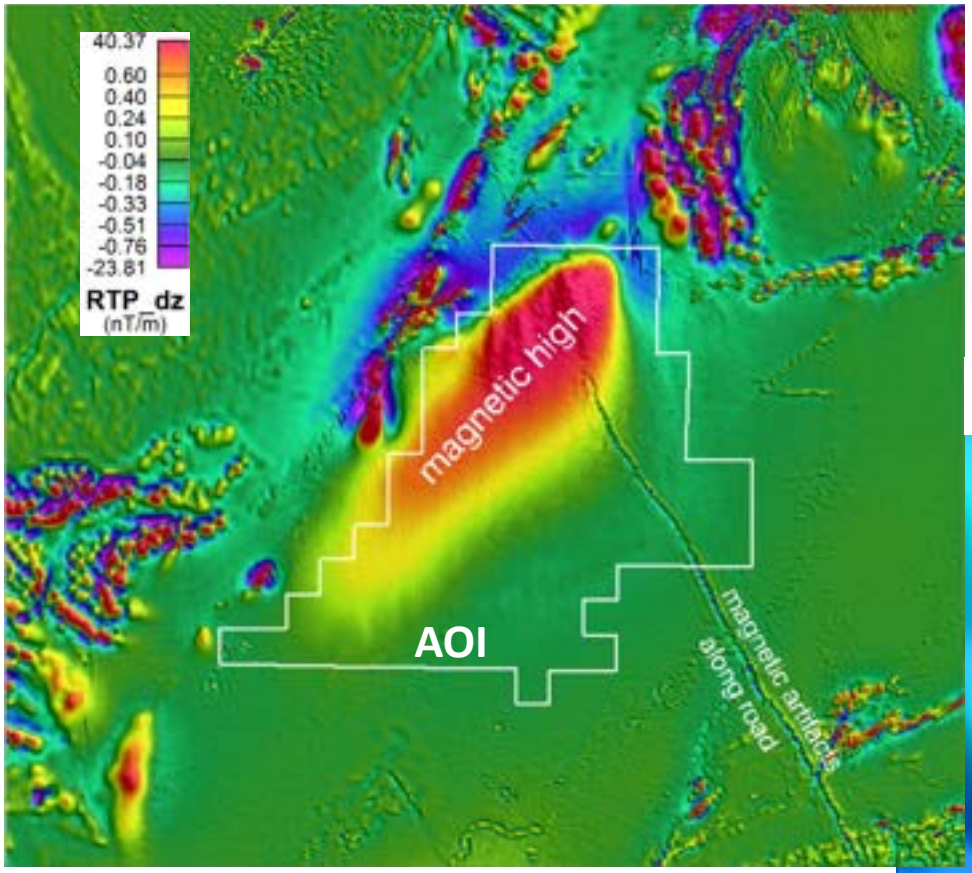
Bouguer Correction, First Vertical Derivative

gravity stations and grids were downloaded from the Geoscience Australia website and evaluated

gravity data throughout the AOI exhibit 4-km station spacing, too coarse for detailed interpretation

however on a regional scale, the data indicate a dense NE-trending feature along the north & west portions of the tenements.

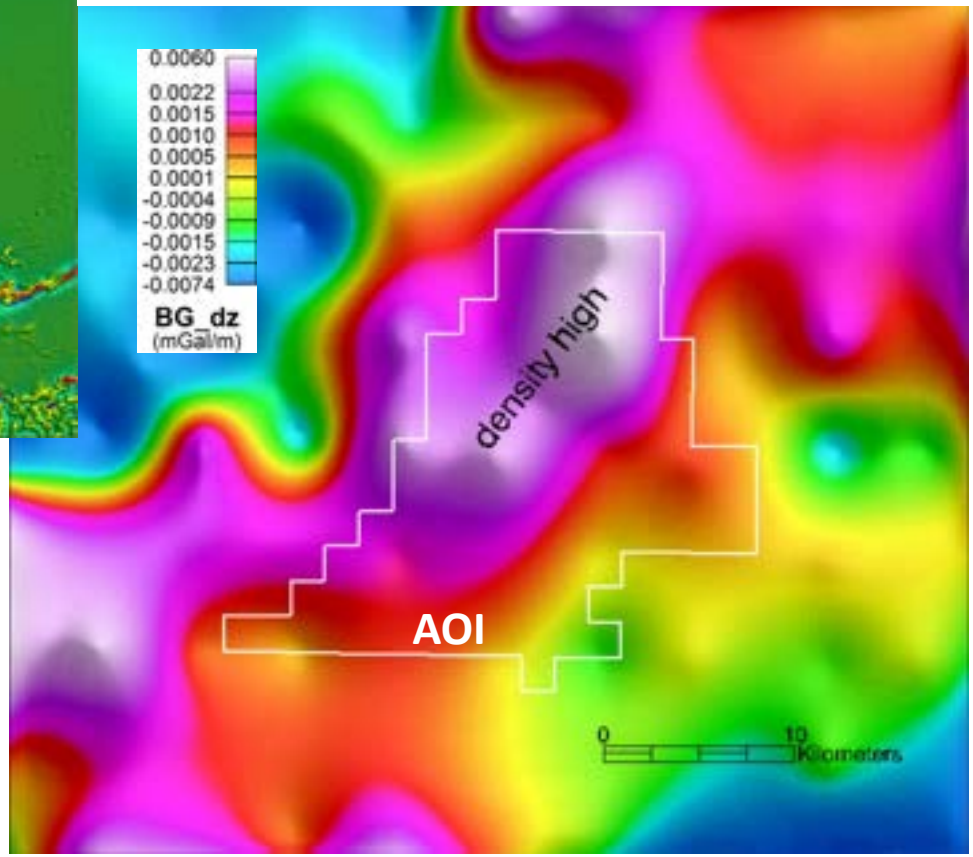
RTP magnetic data, 1st vertical derivative



Airborne Magnetic Data

compared to gravity data

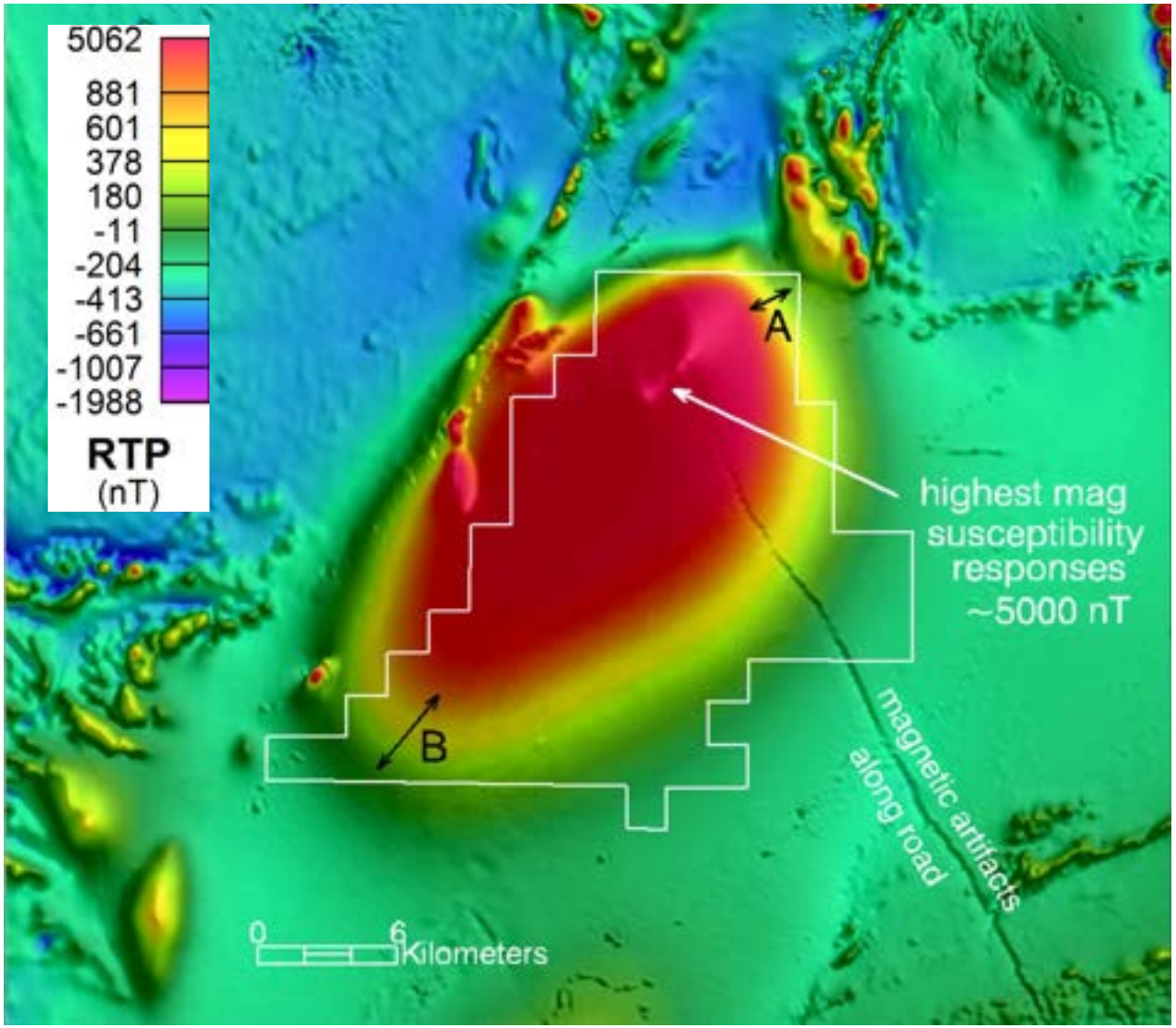
Bouguer gravity, 1st vertical derivative



magnetic data display an intense magnetic susceptibility high, trending parallel to the high-density feature on regional gravity (right)

typically, high density together with high magnetic susceptibility indicate a mafic intrusion at depth

RTP Magnetic Data



note gradients A & B; B is almost 3X as long as A, suggesting that the magnetic body is tilting to the SW

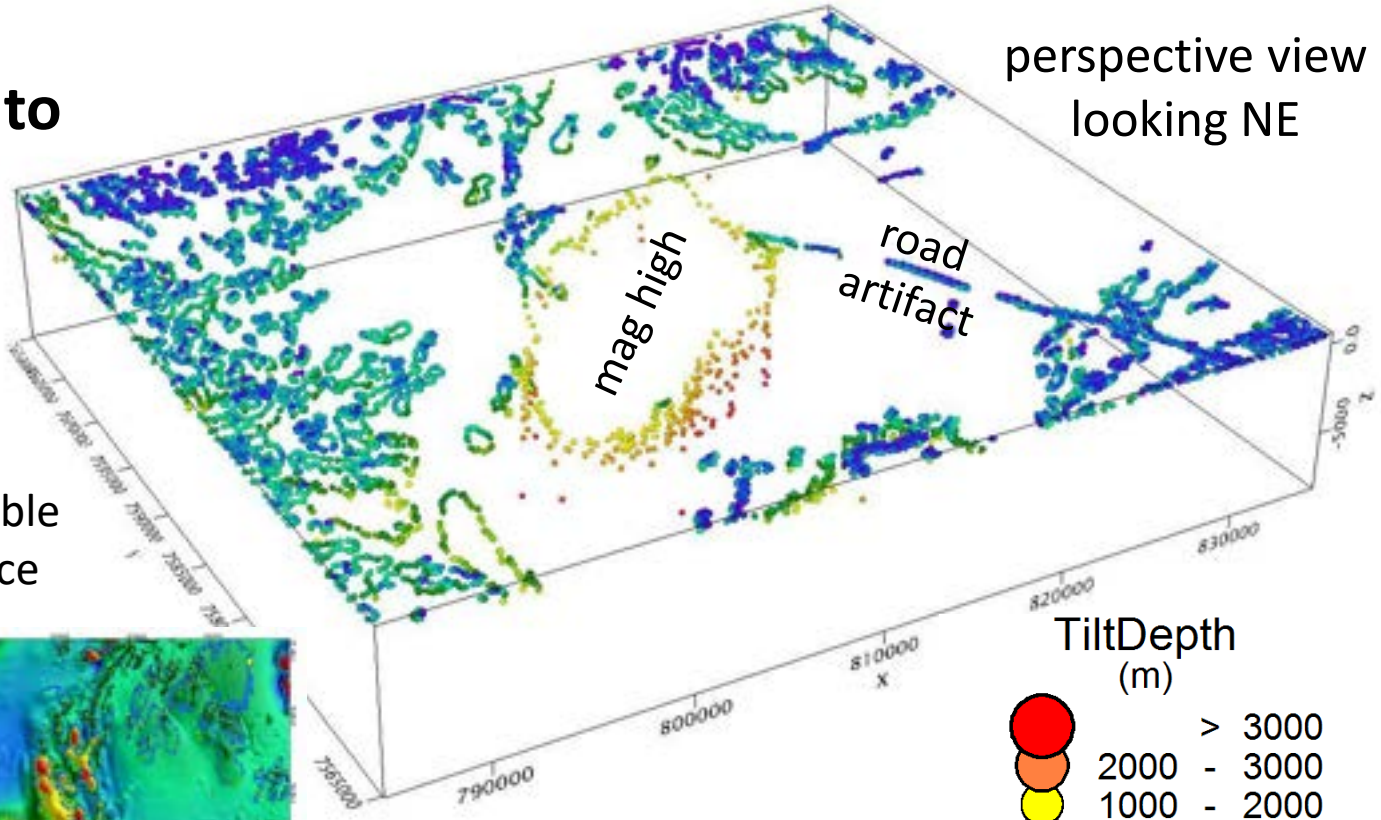
extremely high magnetic susceptibility is observed on the north end of the body at ~5000 nT

one hypothesis is that the magnetic body is tilting to the SW with the north end up and closer to the surface, owing to the extreme magnetic response there.

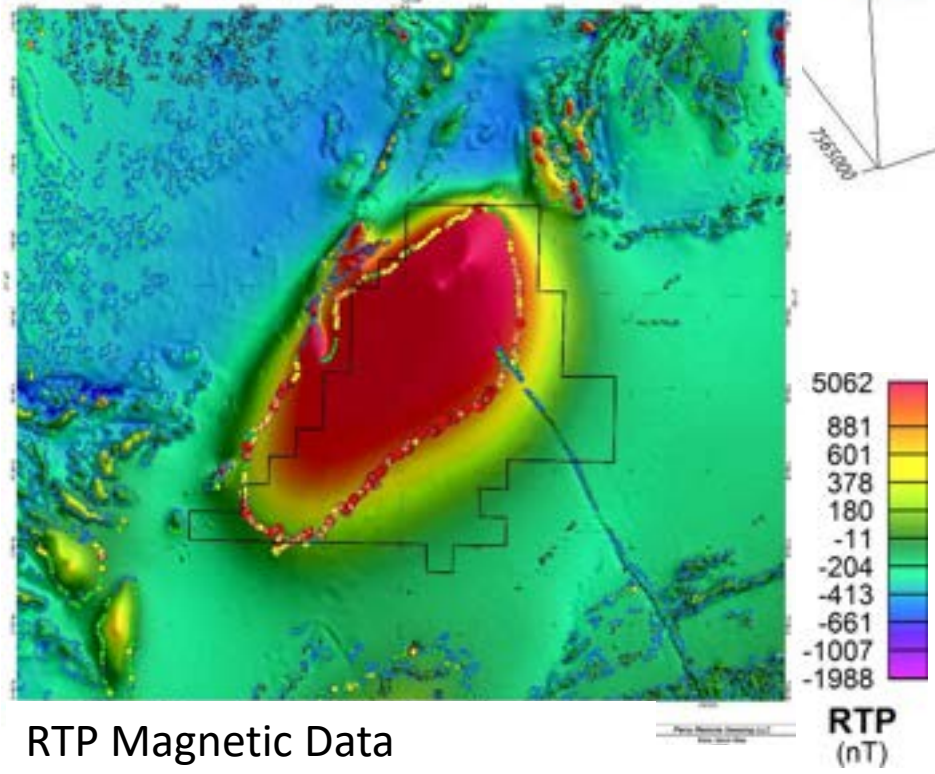
there is another magnetic modeling test to confirm this idea...

First Phase
Estimated Depth to Magnetic Source

perspective view looking NE



while only a relative estimate, tilt-derivative modeling can offer a viable depth-to-magnetic source



RTP Magnetic Data

this modeling also indicates that the oval-shaped magnetic body is tilting to the SW to depths of >3,000 m; shallower depths are encountered on the NE flank of the interpreted mafic intrusion, estimated from 1,000 to <500 m depth; it is proposed that a higher degree of alteration may be observed on or peripheral to this shallower NE part

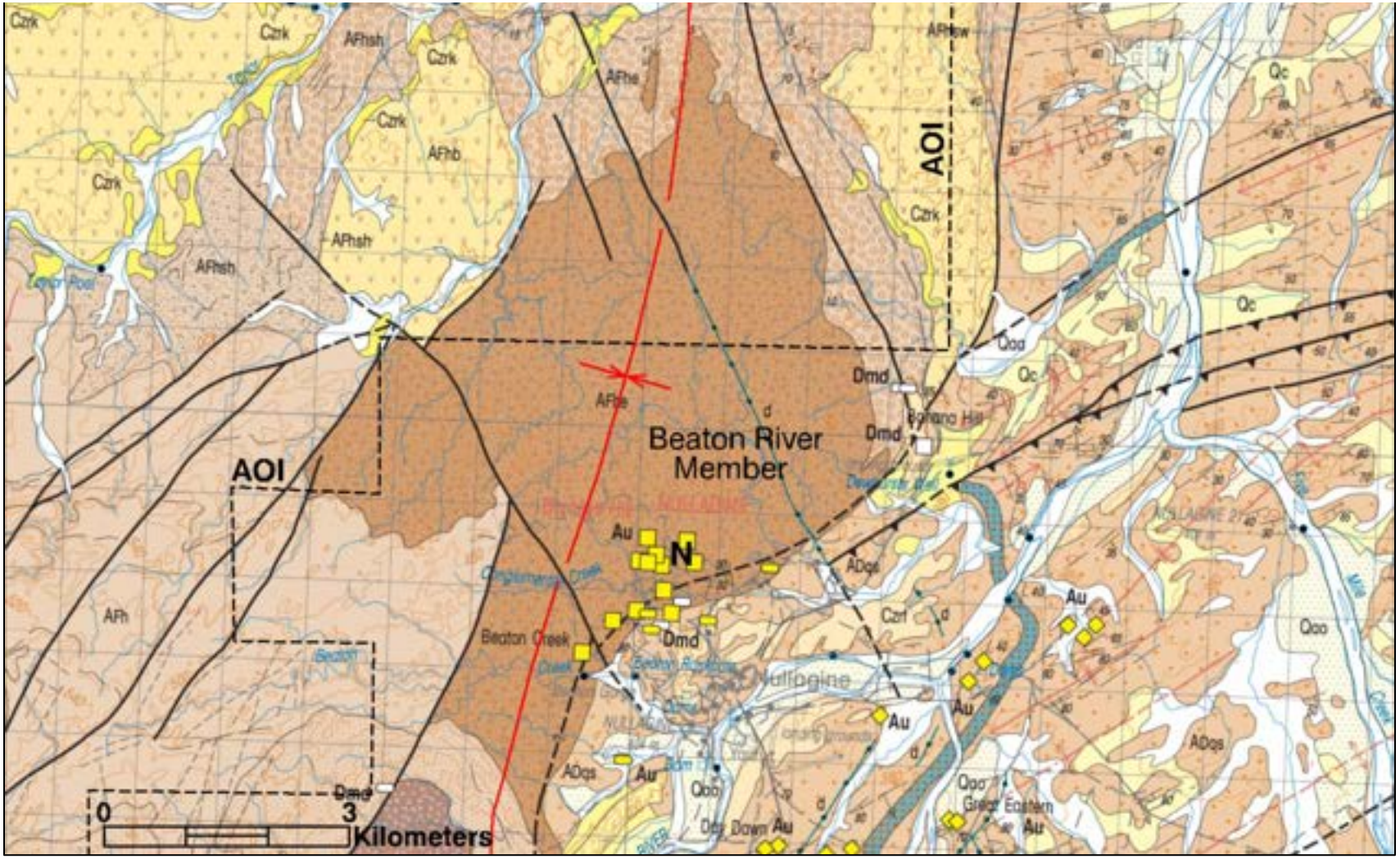
Multispectral Imagery Methods & Processing

First Task: model & map the extent of the Beaton River conglomerate unit

Second Task: model altered exposures

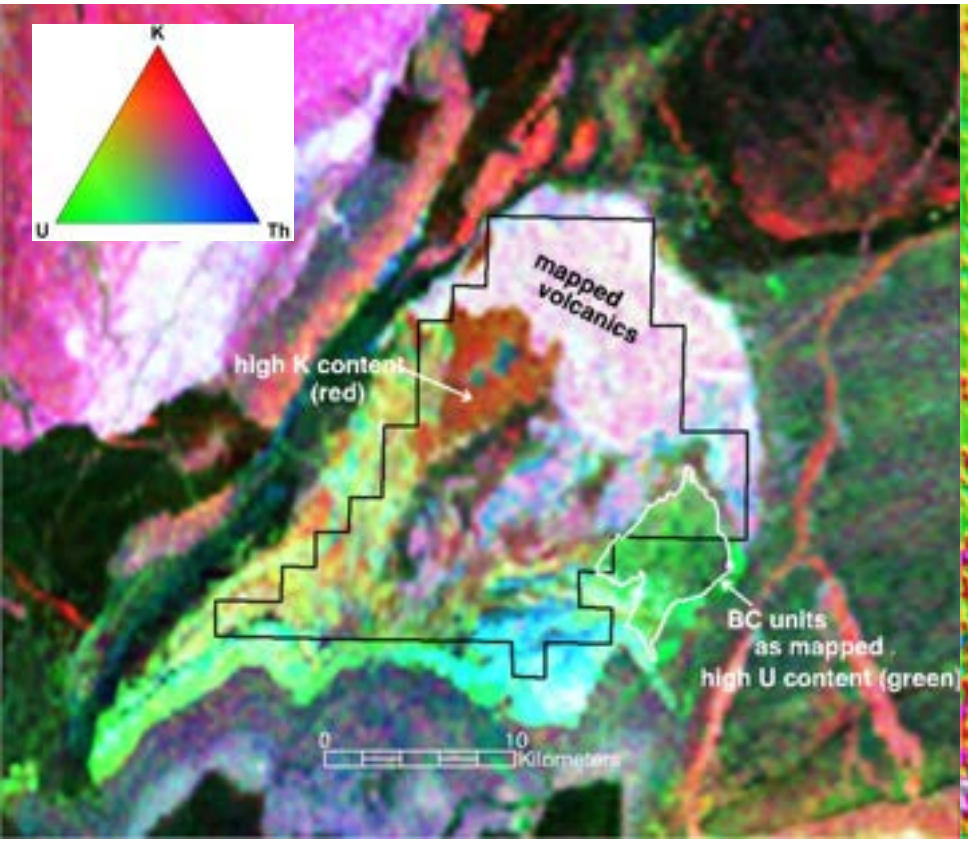
PERRY REMOTE SENSING, LLC.
Geologic Exploration Using Satellite Technology

Close-Up of Nullagine 1:250,000 scale Geologic Map

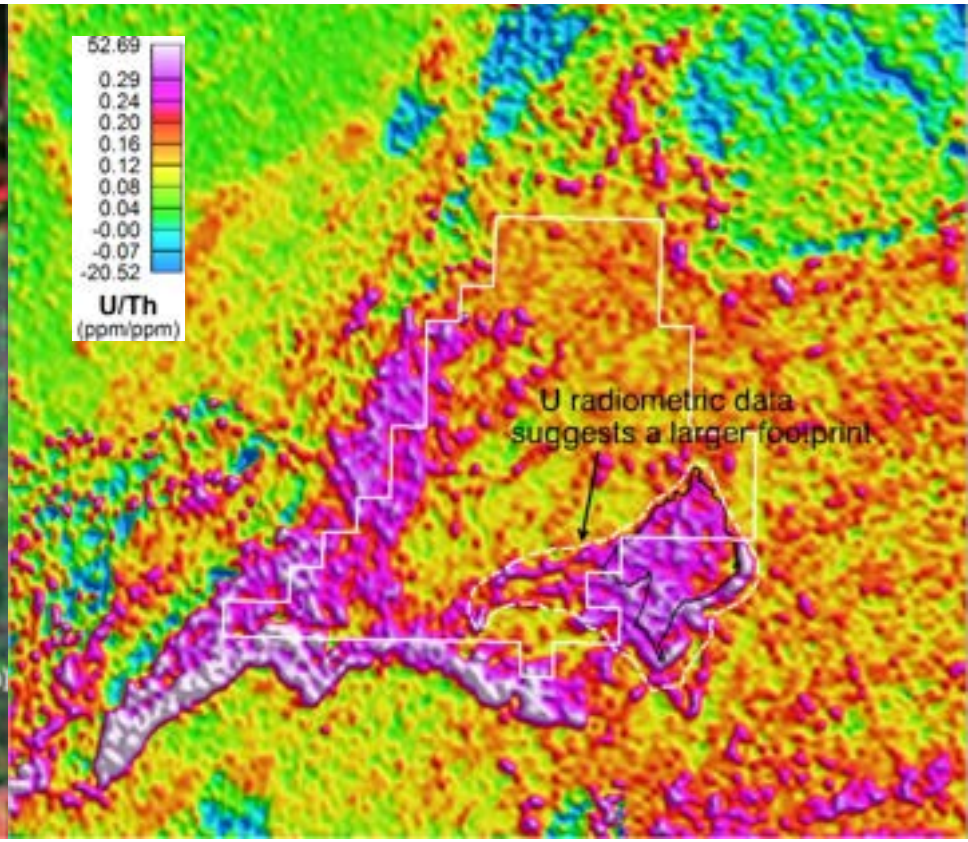


The Beaton River Member (*brown stipple pattern*) of the Fortescue Group is a pebble/cobble conglomerate that hosts Au (*yellow polygons*) in the Nullagine District ("N"). It forms the central part of a regional syncline & extends into the AOI. Mapping on this series of maps is often not field verified. Therefore, the first task is to spectrally & radiometrically model this unit to see if it has greater extent, especially within the AOI.

Airborne Radiometric Data *obtained from GeoScience Australia Website*



ternary image of K-U-Th elements (R-G-B)



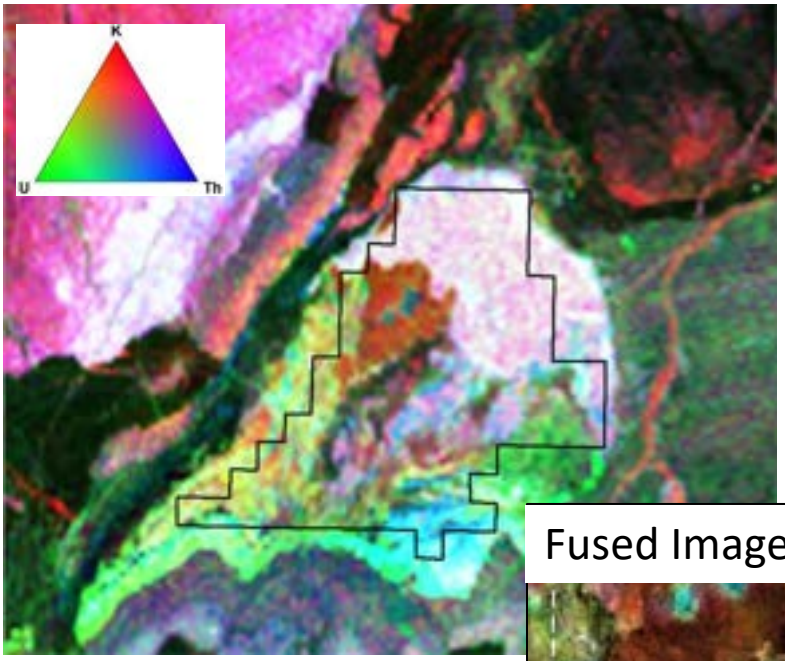
U/Th ratio showing high U content

(*red/magenta colors)*

The ternary radiometric image above reveals that the Beaton Creek (BC) unit shows high U content. It also suggests K alteration in red within the AOI, located in the vicinity of the northern part of the magnetic high, previously discussed.

The radiometric ratio image above predicts high U content in red & magenta colors. Note that this data suggests that the mapped extent of BC may have a larger footprint as compared to the published geologic mapping (*black outline*).

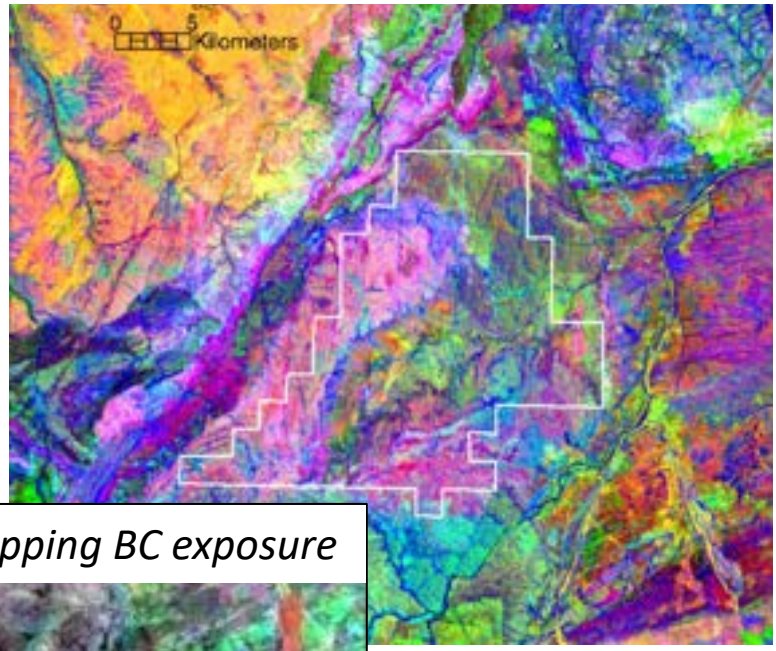
Ternary Radiometric Image



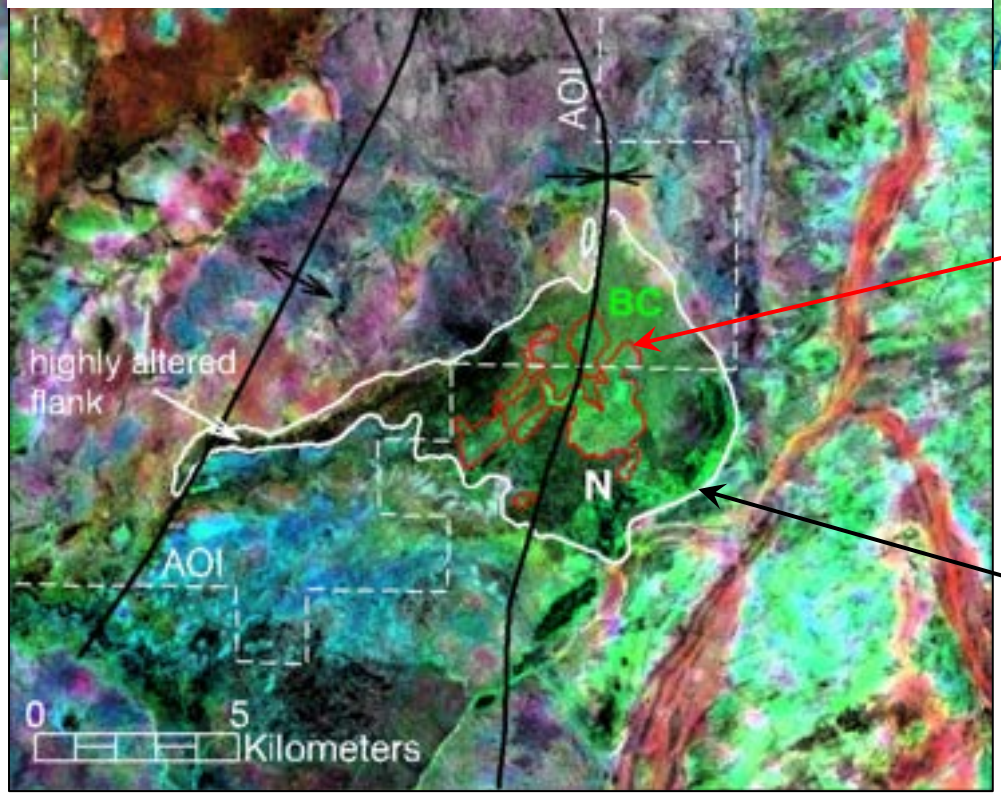
Combine Radiometric & Spectral Data

+

Decorrelated Landsat Reflectance Data



Fused Image Result *best for mapping BC exposure*



best characterization of the Beaton Creek (BC) conglomerate unit resulted by combining radiometric & spectral data sets

updated mapping indicates that the conglomerate extends west into the AOI

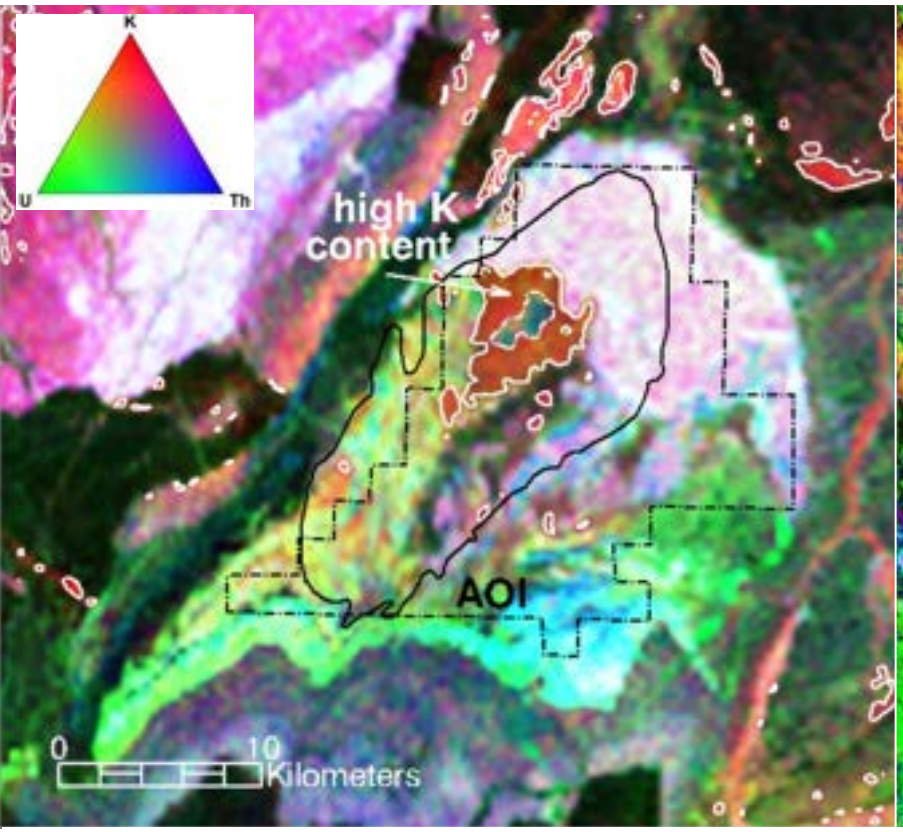
younger Fe-rich facies

updated mapping of BC exposure

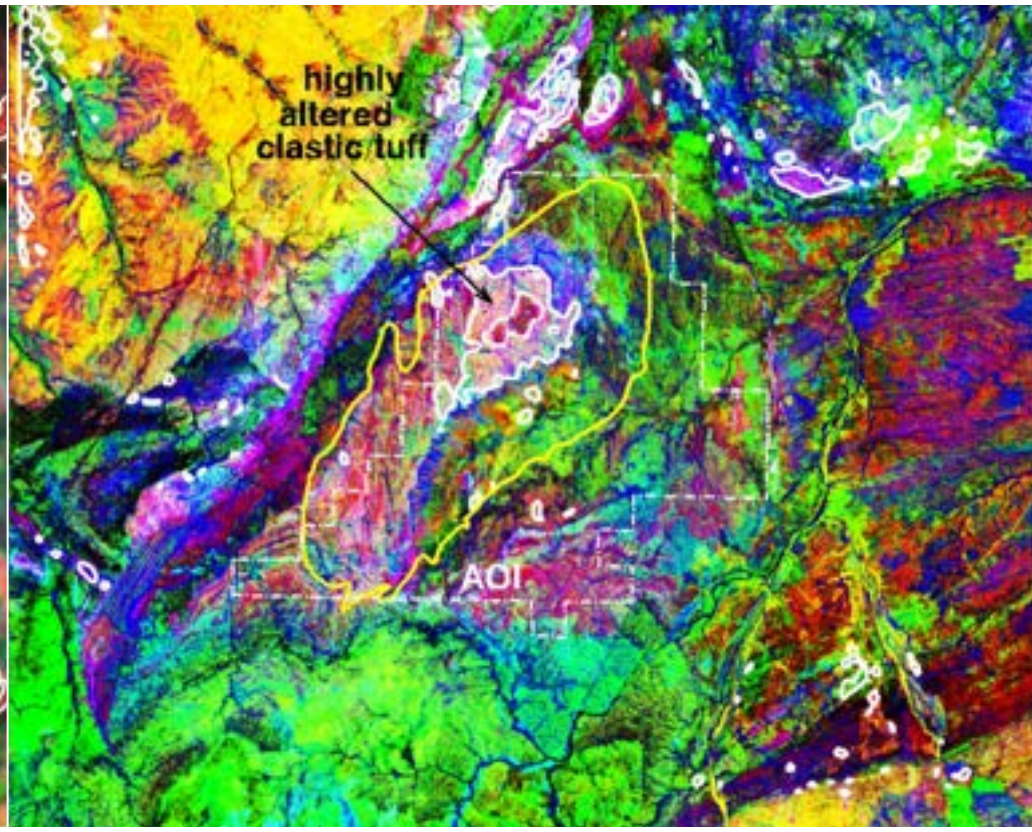
N - Nullagine

Predicting Surface Alteration Associated with Interpreted Mafic Intrusion using Radiometric & Multispectral Data Sets

Ternary K-U-Th Image



Decorrelated Reflectance Bands



high K content outlined in white on both images; proposed mafic intrusion (*interpreted from magnetic data)* outlined in solid black (*left*) & yellow (*right*) polygons above; radiometric data predict high K content that corresponds to highly altered clastic & tuff units (Proterozoic Afh); this predicted altered location lies above the northern portion of the interpreted mafic intrusion, suggesting a genetic relationship

Two Basic Approaches for Mineral Modeling & Alteration Mapping from Combined Landsat VNIR & ASTER SWIR Multispectral Bands

utilize
<u>ground truth</u>

review field report prepared in DEC 2020 as well as geochemical results from previous diamond exploration soil sampling

identify field locations that correlate to ASTER/Landsat mineral predictions

use selected field locations as training sites to conduct image classification, finding mineral spectral matches found elsewhere in the AOI

predict anomalous spectral responses (typical of altered exposures) <u>& identify mineral components</u>

this approach works well in areas with limited ground truth plus lack of alteration mineral understanding

Landsat reflectance bands are de-correlated using principle component analysis (PCA; similar to factor analysis)

statistical spectral outliers are isolated & outlined as anomalous relative to the AOI

pixels within these outliers are tested using prepared ASTER/Landsat spectral bands and mineral spectral libraries to find matches, thereby identifying mineral composition

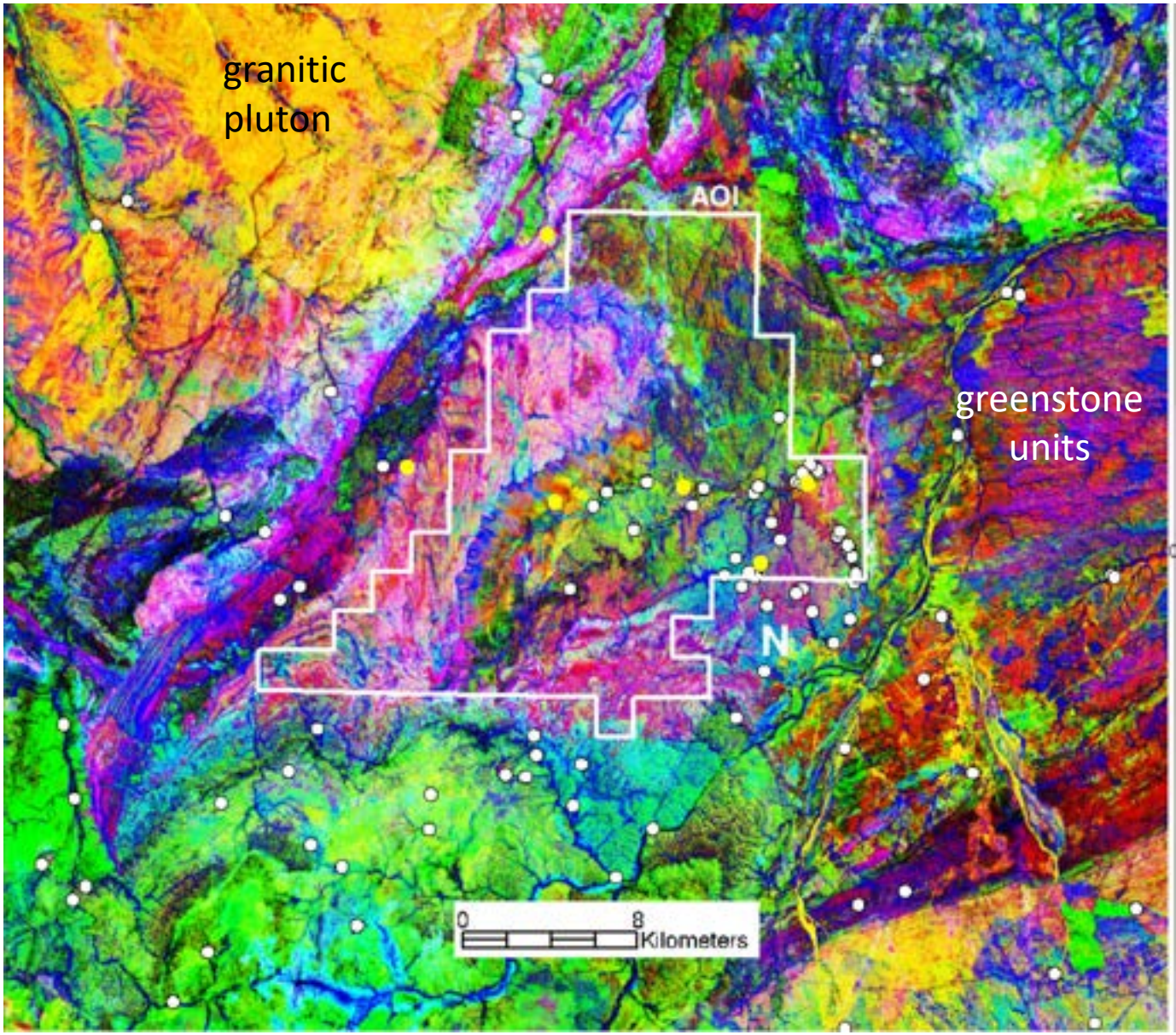
Utilizing Ground Truth and Predicting Altered Exposures

Landsat reflectance bands are decorrelated to identify anomalous spectral responses, typical of altered exposures

known Au values (*from geochem sample results in white dots*) are compared to predicted altered exposures (*pastel colors to white*)

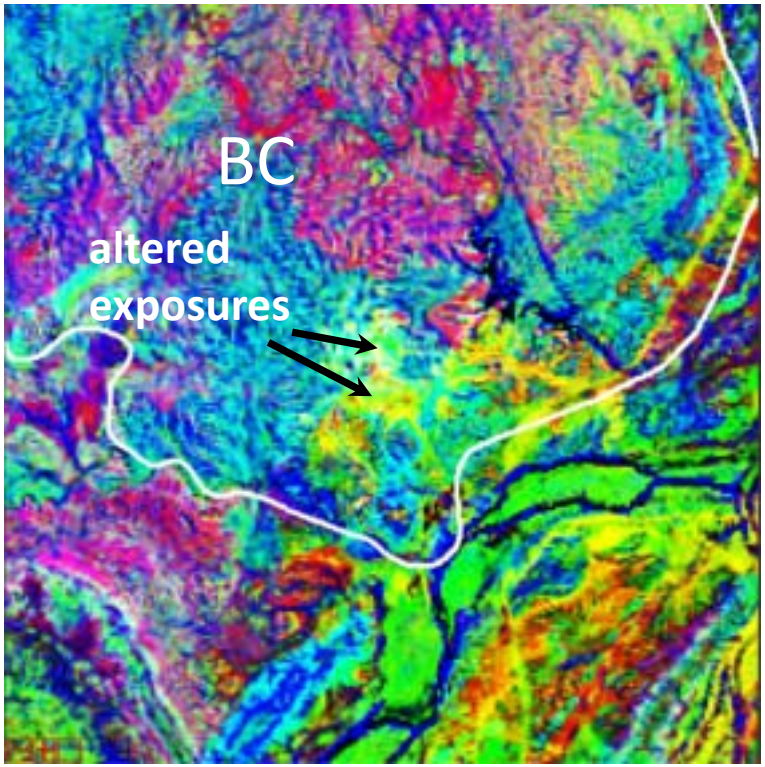
yellow dots reflect 6 training sites selected, where predicted alteration coincides with Au occurrence

Decorrelated Landsat Reflectance Bands

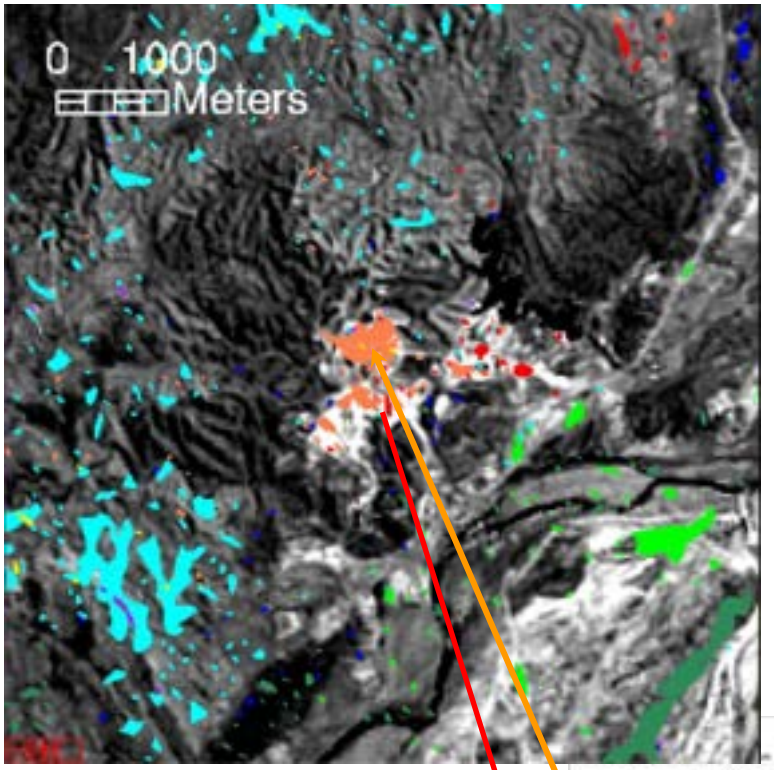


N - *Nullagine*

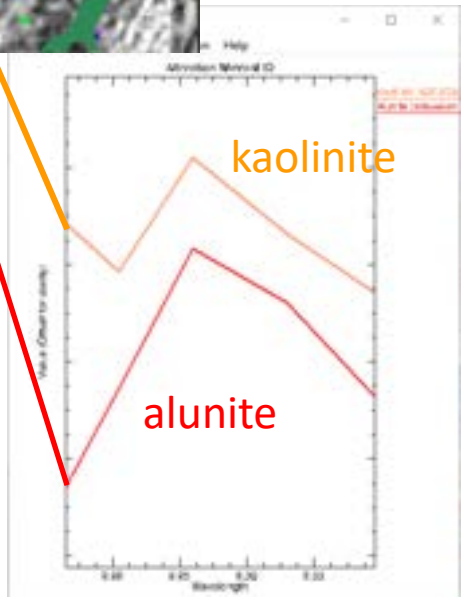
Close-Up of Nullagine Mining District in Sept 2004



decorrelated Landsat reflectance bands utilized to model altered exposures shown in pastel colors to white

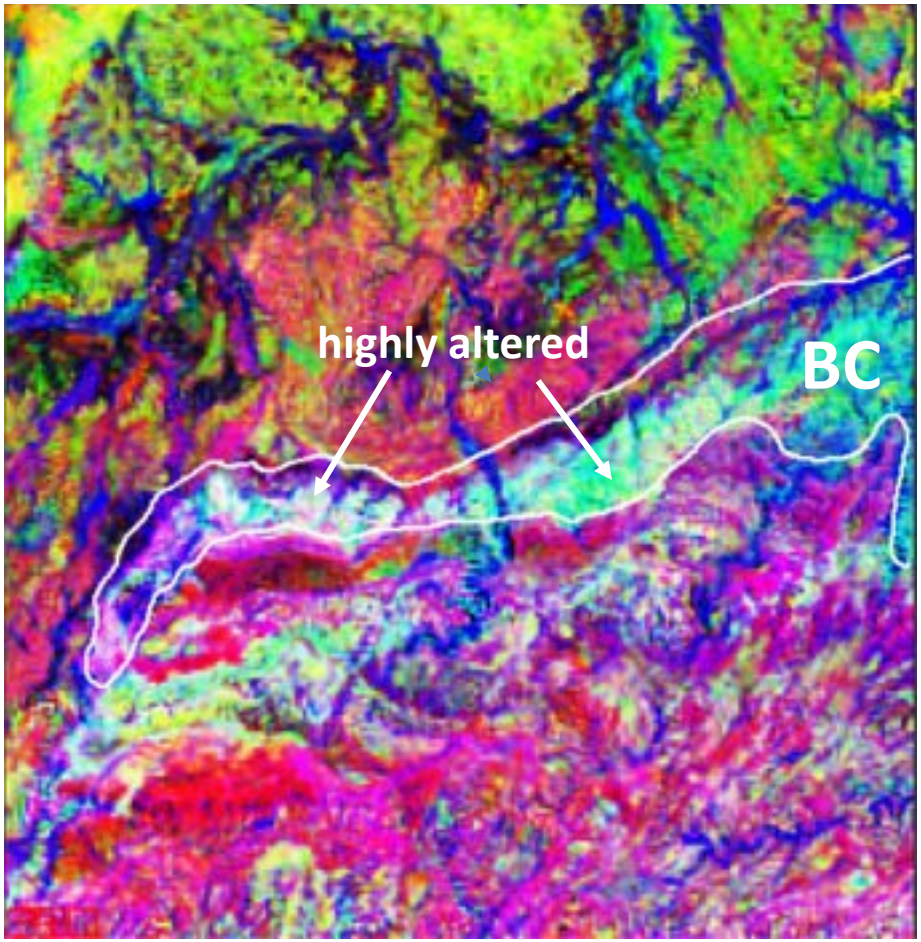


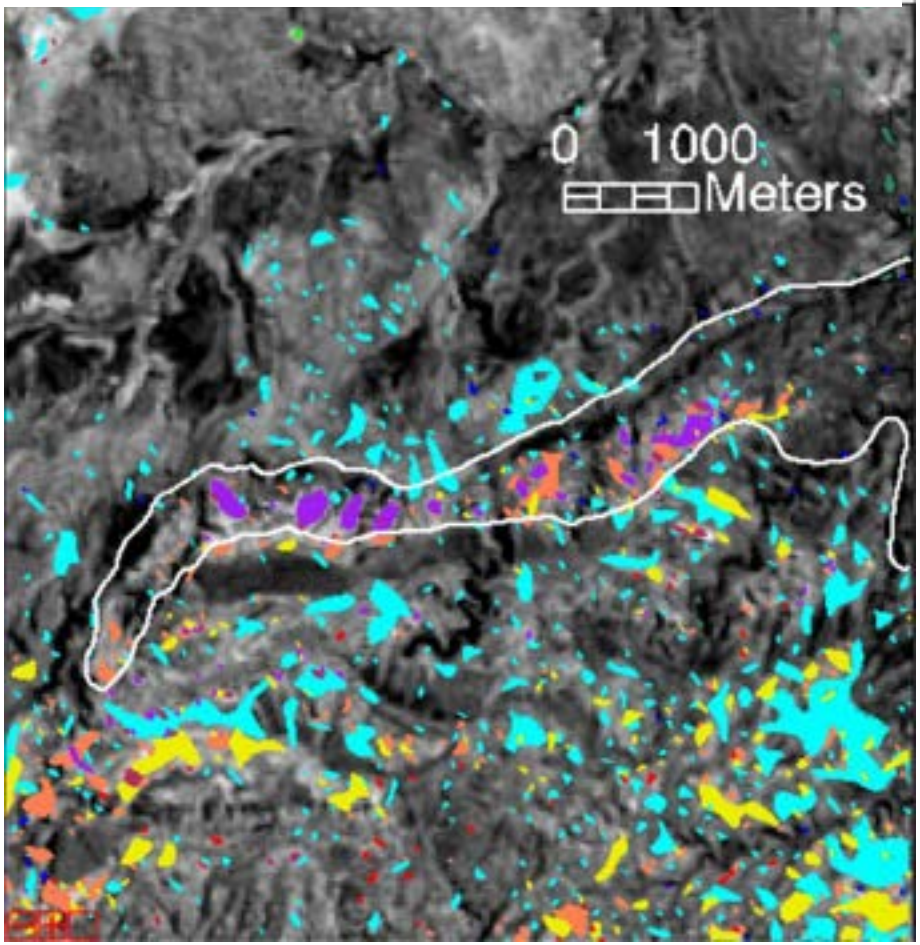
mineral identification accomplished using ASTER SWIR spectra compared to mineral spectral libraries



This is a view of the Nullagine area in 2004, before major mining disturbance. Finding alunite & kaolinite here suggests hydrothermal activity & argillically altered exposures.

Close-Up of Highly Altered Western Flank *of updated BC mapping*





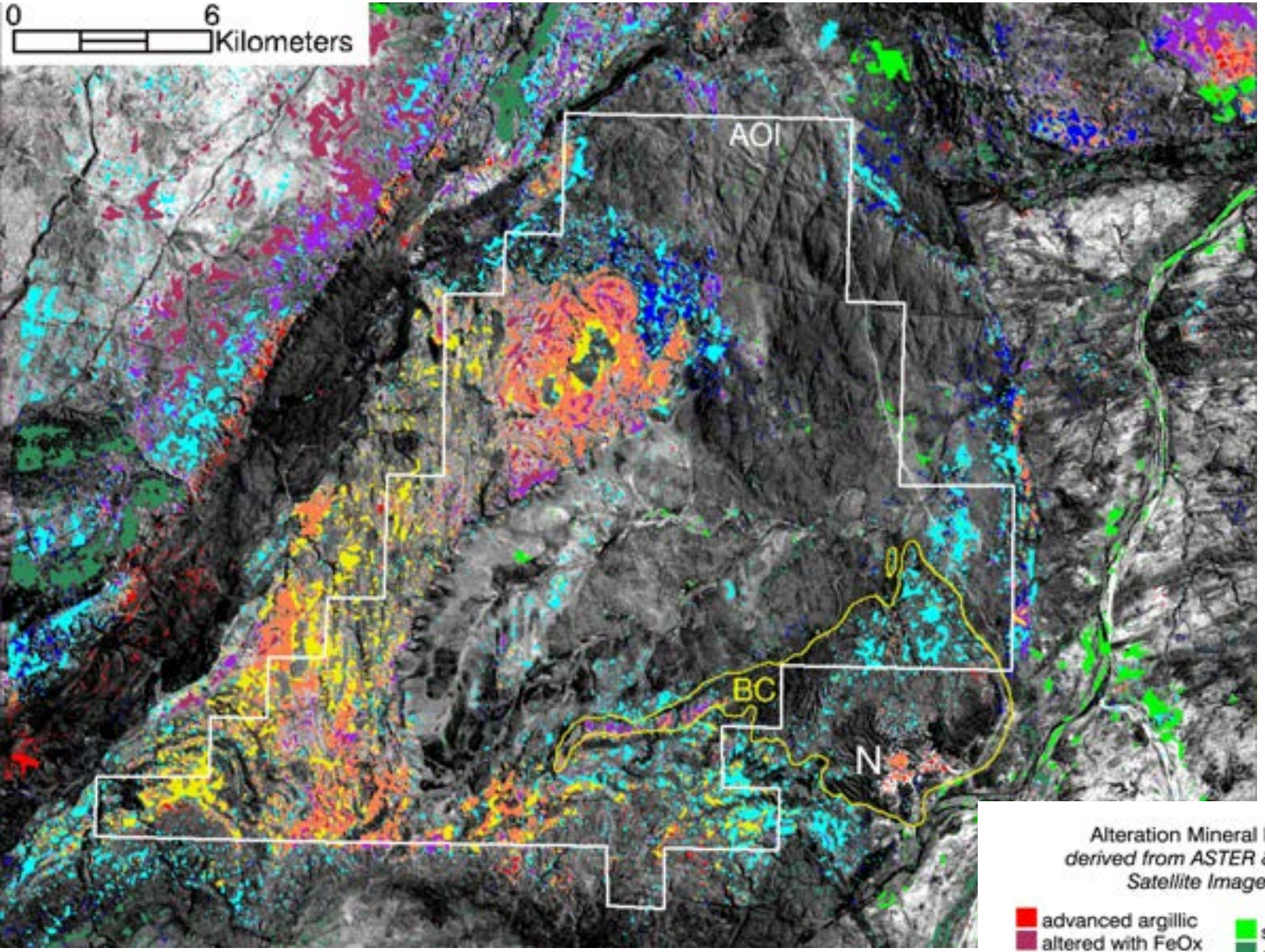
decorrelated Landsat reflectance bands utilized to model altered exposures shown in pastel colors to white

Alteration Mineral Models
derived from ASTER & Landsat Satellite Imagery

- advanced argillic
- altered with FeOx
- kaolinite
- muscovite/sericite
- highly altered seds
- siliceous
- chloritic
- illite
- montmorillonite/smectite

alteration mineral identification and resulting spectral classification

Resulting Alteration Mineral Modeling & Updated Beaton Creek (BC) Mapping



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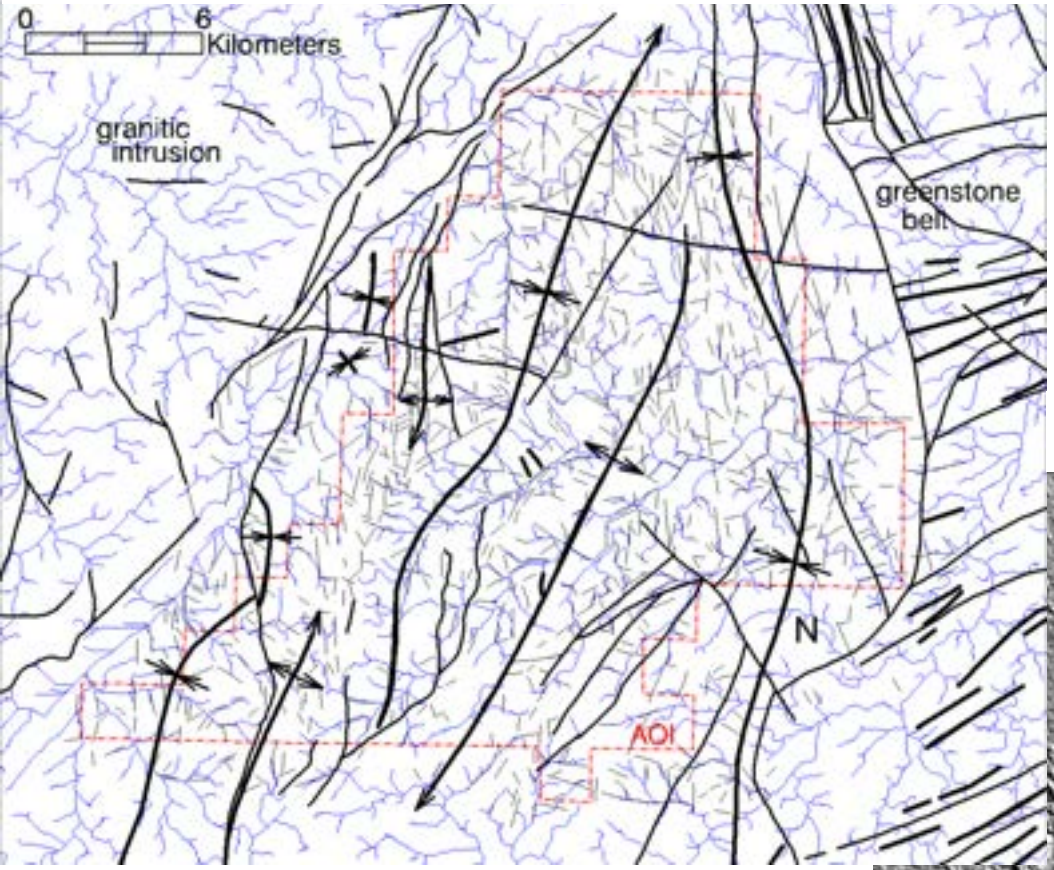
N - *Nullagine*

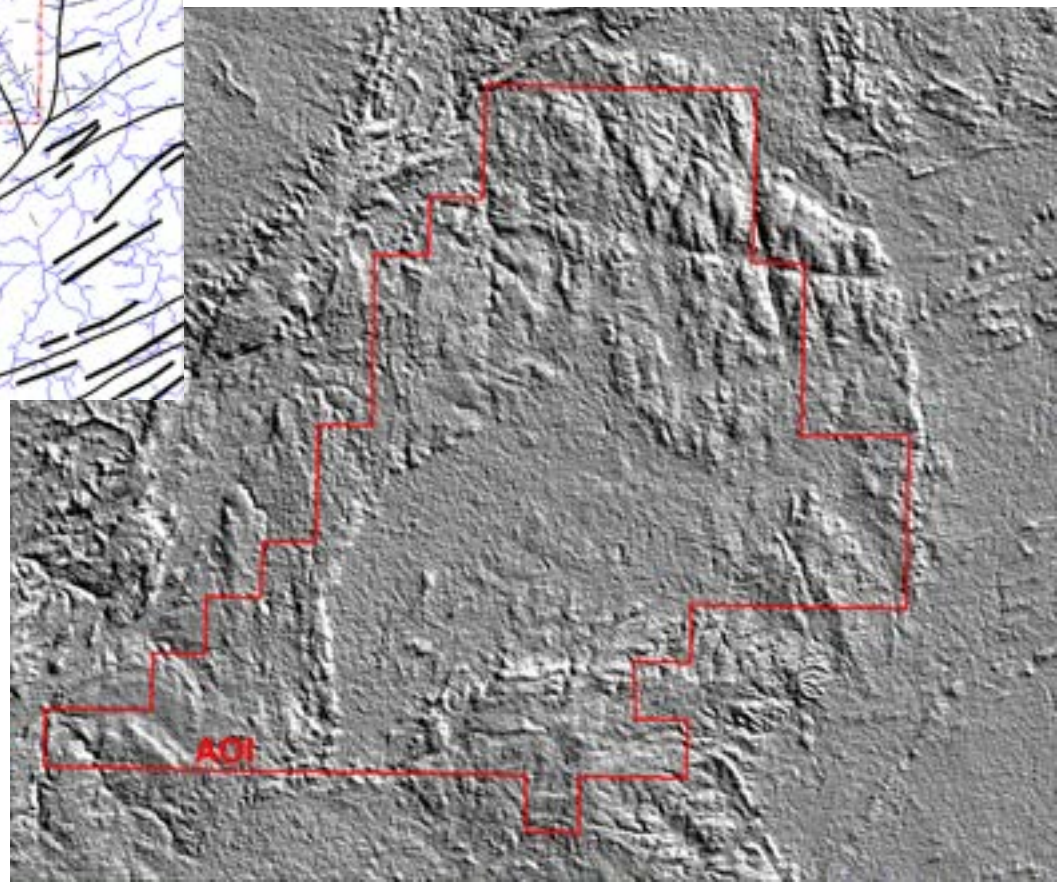
Structural Mapping & Interpretation



ASTER-Derived
Digital Elevation Model (DEM) Data

DEM data drainage modeling
& aids structural interpretation

Sun-Angle Enhanced DEM



interpreted fault/fracture zone

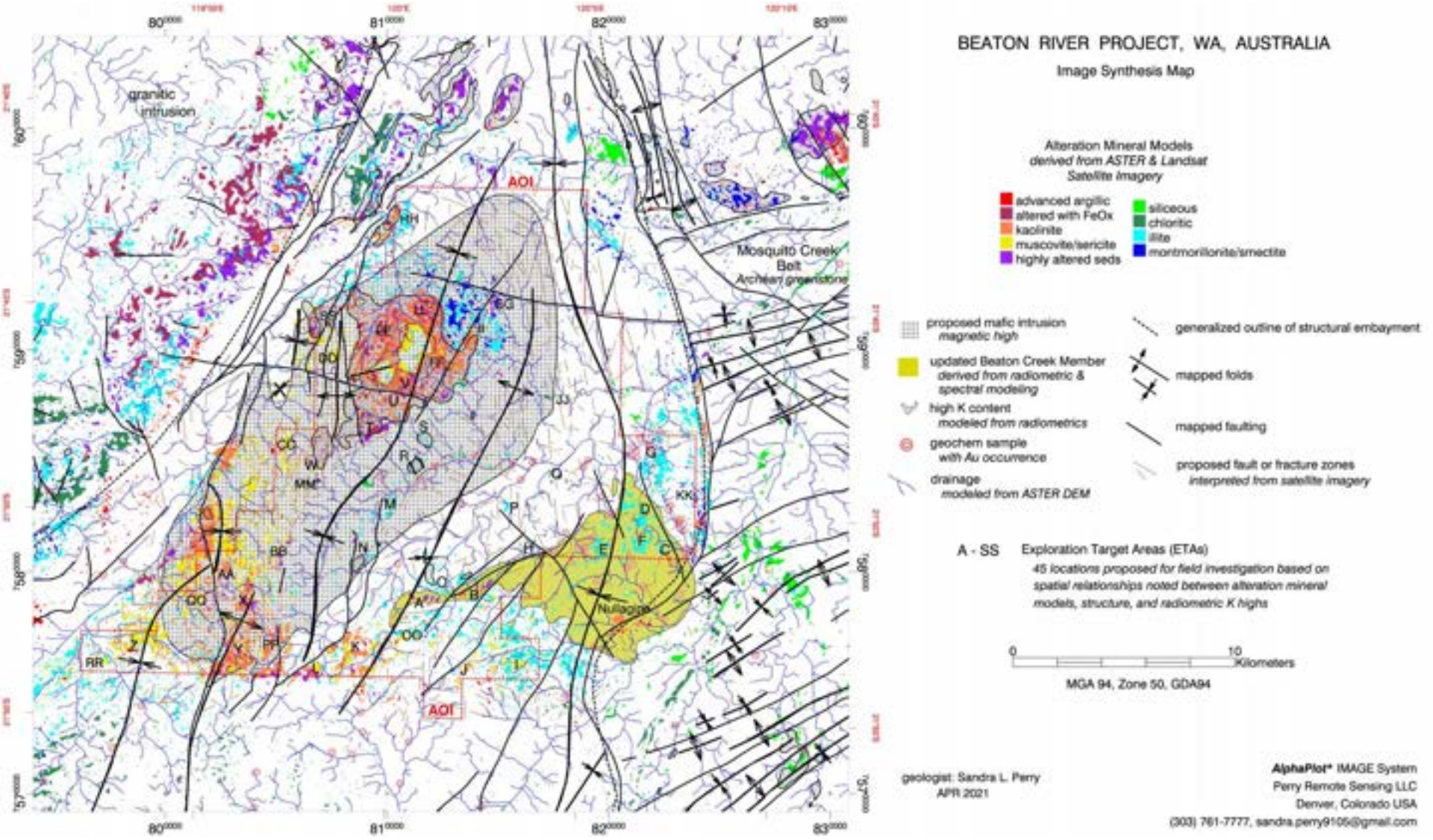
mapped fault

mapped anticlines & synclines
are annotated

modeled drainage in blue lines
N - Nullagine

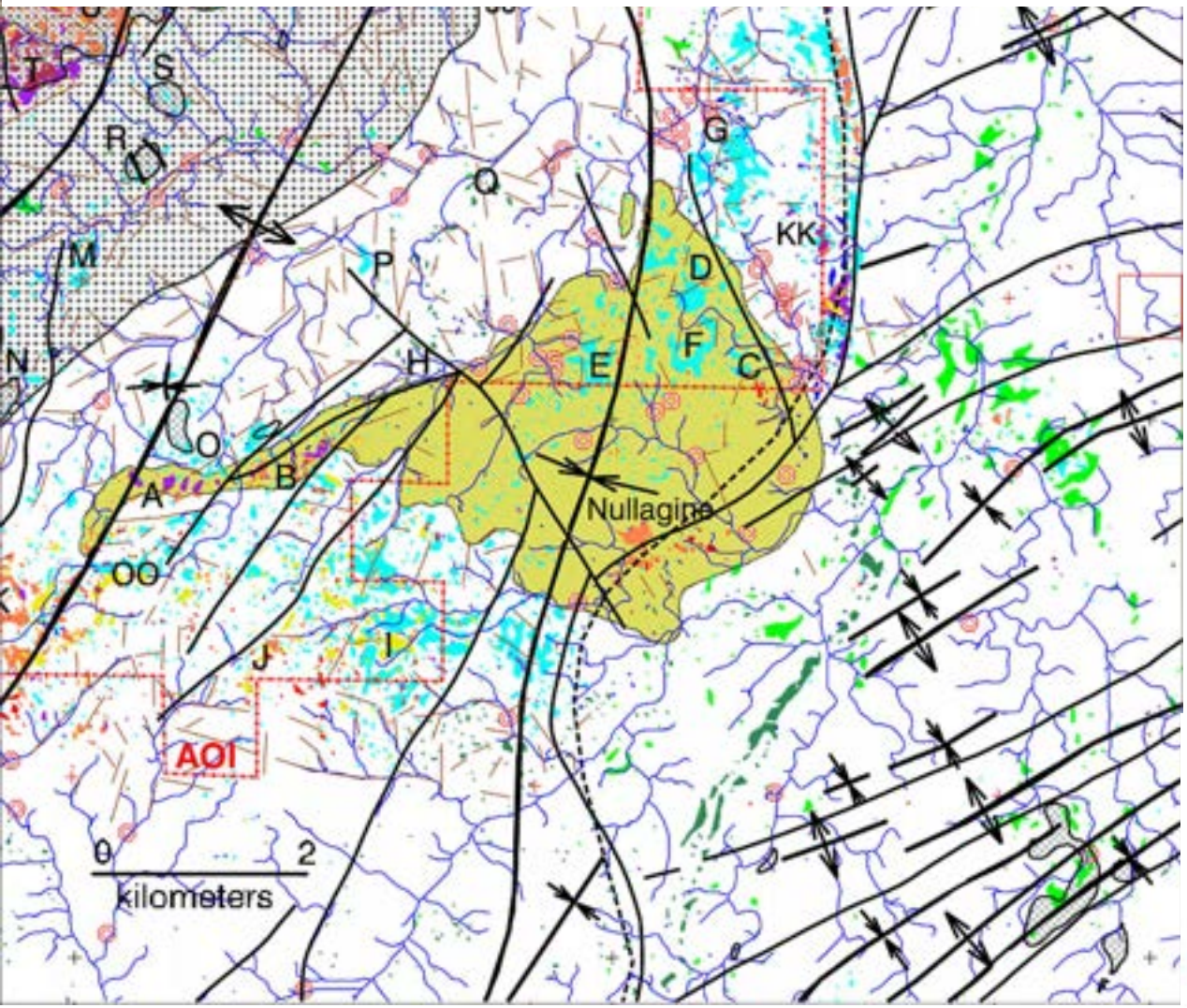
Integration of All Modeled and Interpreted Elements

Image Synthesis Map



Exploration target areas (ETAs) are proposed for field investigation based on spatial coincidence & relationships noted between alteration models, structure, & radiometric high K content

Image Synthesis Map Close-Up *Nullagine Area*

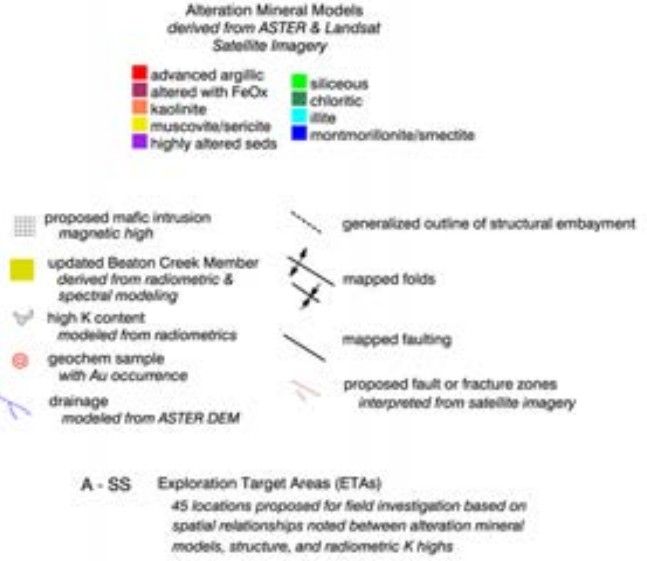


ETAs C through G reflect illite content in a younger facies a top the BC unit that appears to extend north; illite here may or may not represent alteration; ETAs OO, J, & I are proposed as sericitically altered exposures; KK appears highly altered.

Several Exploration Target Areas (ETAs) are proposed within the two tenements in the vicinity of Nullagine

ETAs A & B exhibit highly altered exposures of Beaton Creek (BC) conglomerate that extends west into the AOI

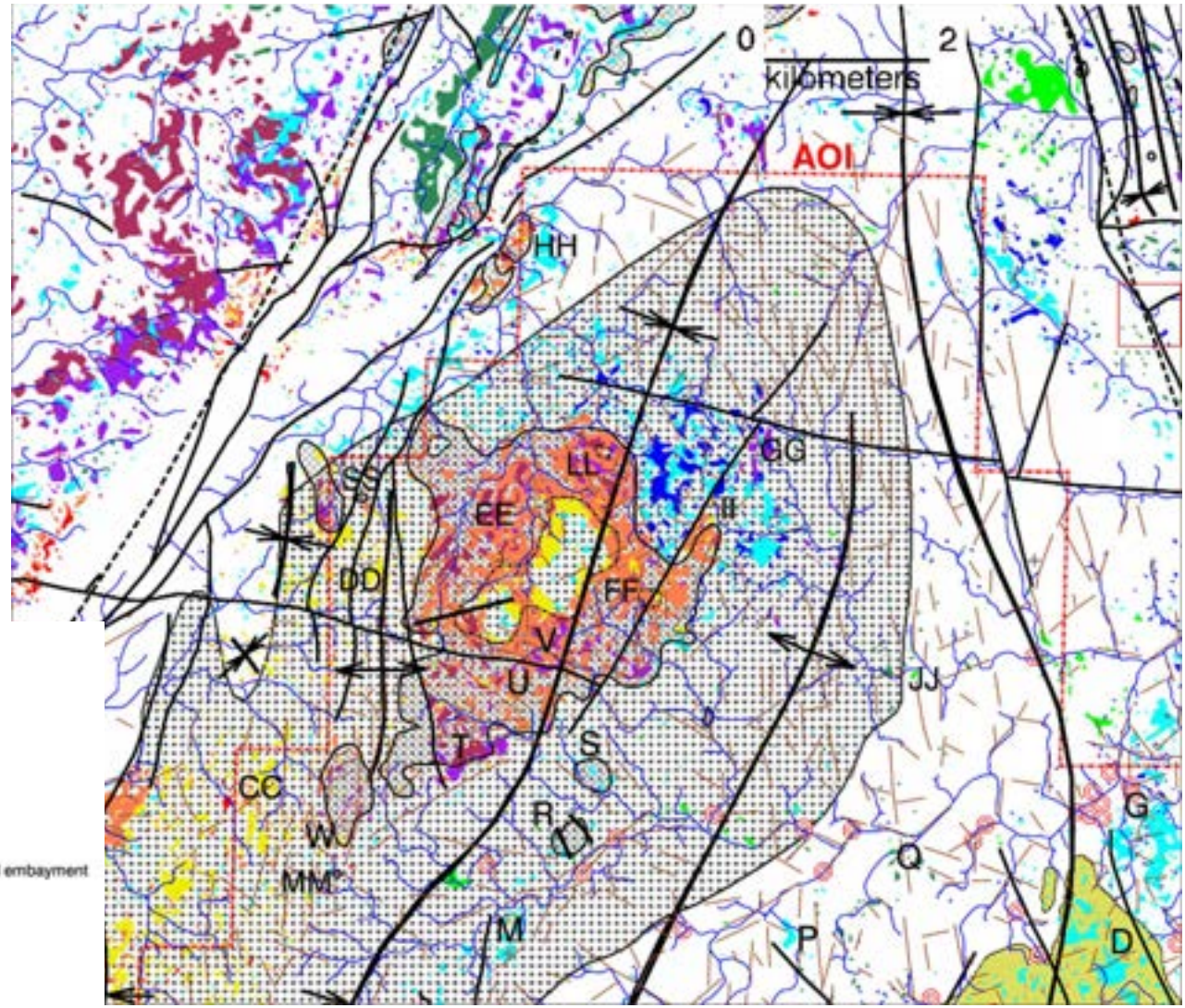
Nullagine shows argillic alteration on the east side of the syncline; ETAs A & B may represent similar alteration on the west flank of the fold

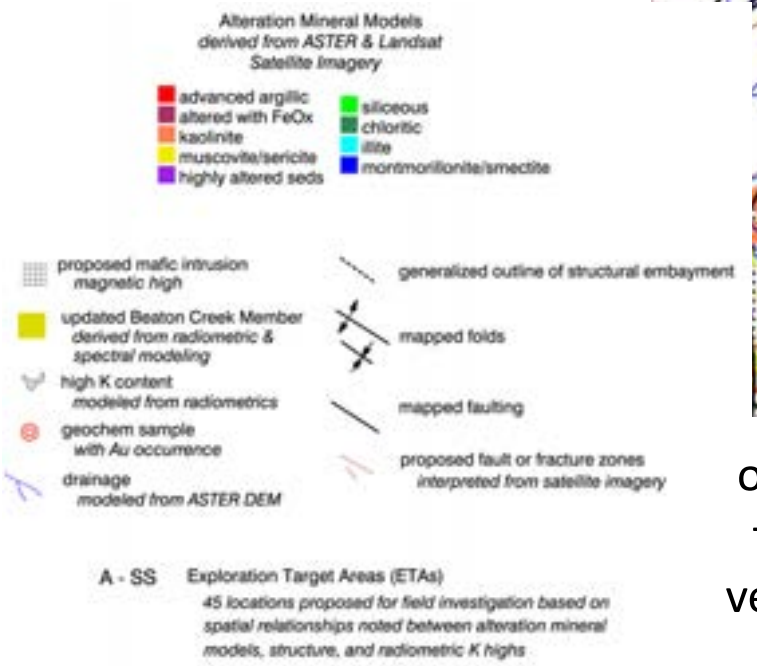


the pattern of highly altered argillic exposures (T, U, V, EE, FF LL) follow the outline of high K, confirming alteration and suggesting a connection with the interpreted intrusion;

GG represents a highly altered exposure at a significant fault intersection;

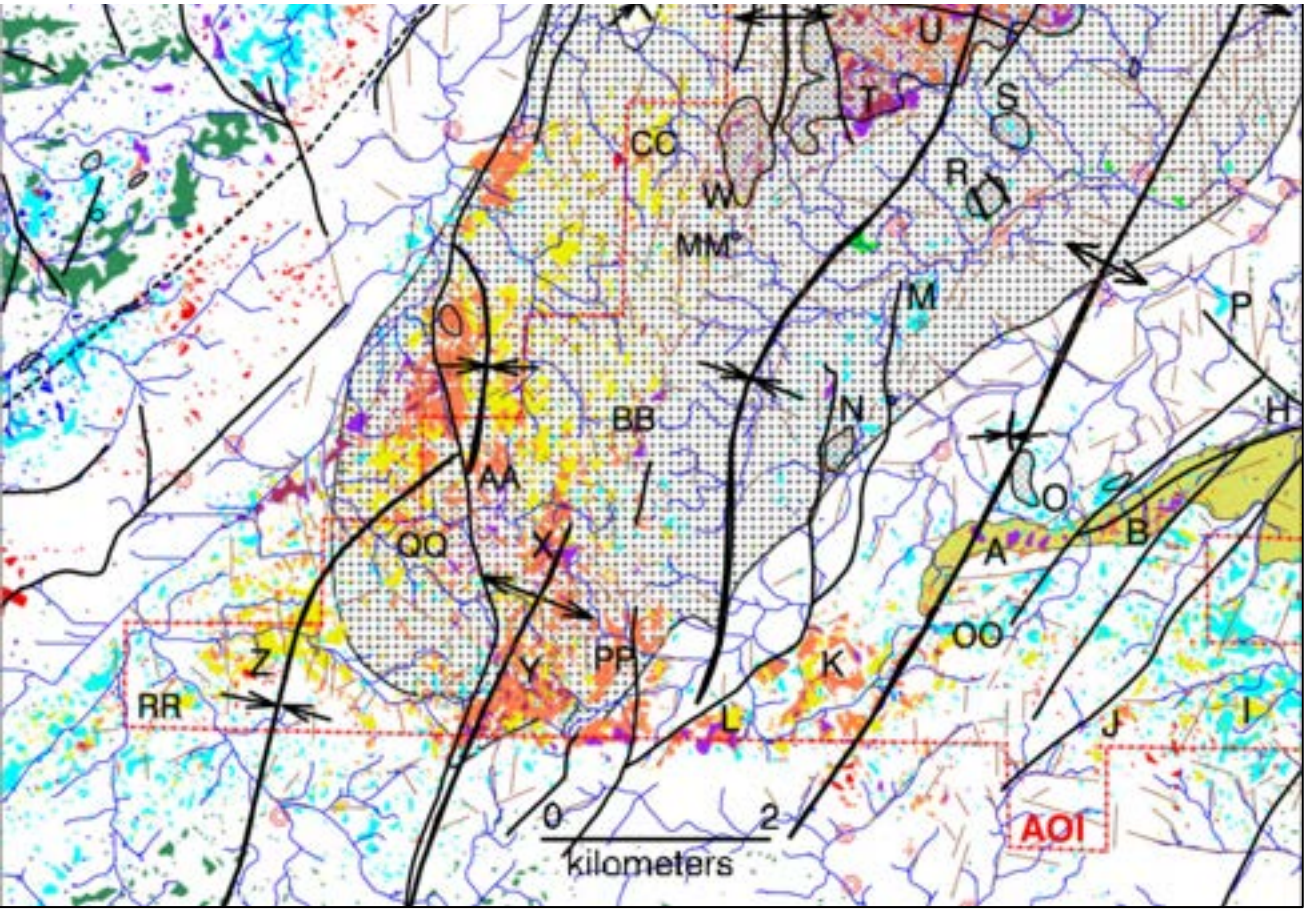
Image Synthesis Map Close-Up *North Intrusion Area*





other ETAs here should be field investigated & sampled to test the hypothesis that this could be a mineralized vent above the shallowest portion of the mafic intrusion

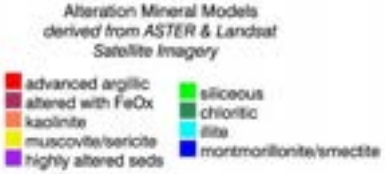
Image Synthesis Map Close-Up *South Intrusion Area*



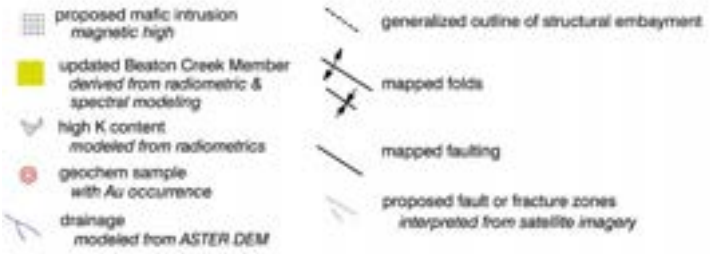
the southern part of the interpreted mafic intrusion reveals many modeled argillic & sericitic exposures worth field investigation

many are associated with faulting & fold hinges

ETAs R, S, & W coincide with high K locations as well



modeled alteration here too may be related to hydrothermal fluids migrating upward from the intrusion at depth, traveling along fault conduits and possibly focused and/or trapped within anticlinal hinges or synclinal flanks



A - SS Exploration Target Areas (ETAs)

45 locations proposed for field investigation based on spatial relationships noted between alteration mineral models, structure, and radiometric K highs

PROJECT RESULTS

- Digital analyses of satellite imagery and airborne radiometric data have characterized & provided updated mapping of a Proterozoic-age pebble conglomerate, hosting Au nugget production in the Nullagine District that extends into AUGF's tenements E46/1215 & E46/1280
    - *updated mapping shows that the conglomerate occupies a central part of a regional syncline with highly altered flanks; within the two tenements, the central portion is prospective for nugget Au, & the western extent is highly prospective for epithermal precious metals*
    - *further review of airborne radiometrics indicates this conglomerate unit exhibits high uranium response, suggesting a potential sedimentary U deposit*
- A pronounced magnetic high occupies the western half of the two tenements and is interpreted as SW-tilting mafic intrusion; sericitic & argillic alteration mapped from satellite imagery is situated above & peripheral to the interpreted intrusion, also confirmed by high-K radiometric responses
    - *alteration modeling from satellite imagery suggests that a variety of intrusion-related precious/base metal prospects exist within this western tenement part*
- 45 exploration target areas are recommended for field investigation, based on modeled alteration and interpreted structural spatial relationships

PROJECT RECOMMENDATIONS

- While nugget Au appears to be the resource in the Nullagine district, satellite image analysis indicates exposures characterized by argillic and advanced argillic alteration from Sept 2004, before major mining disturbance. It is proposed that there may be a hydrothermal event in this area that offers an epithermal opportunity within the Beaton Creek formation, especially as it trends into AUGF's tenements. ETAs A & B are important locations to field visit, sample, & test.
- Au sampling (*from diamond recon geochem survey*) locations that coincide with ETAs should be re-checked for Au values (ie, ETA G). Those ETAs with Au values should be prioritized for fieldwork & sampling.
- Updated mapping of the Beaton Creek conglomerate exhibits a high degree of uranium, as modeled from airborne radiometric data. It is recommended that samples collected in this area be tested for U.
- Magnetic data modeling has revealed a large, highly magnetic body that dominates the western ½ of the tenement area. Through further analysis, this mag feature is interpreted as a SW-tilting mafic intrusion. Proposed altered exposures a top & peripheral to the intrusion should be field investigated and sampled for both precious- & base metals.

PROJECT RECOMMENDATIONS

- It is proposed that the NE-trending intrusion is tilting to the SW and likely is less deep along its northern reaches. This project utilized tilt derivative methods on the magnetic data to estimate depth-to-magnetic source, which is a first-phase method for estimating depth of the intrusion. A better method uses gravity data, however current gravity data station spacing is too coarse for adequately modeling depth. Therefore, it's recommended that AUGF contract out gravity in-fill stations to at least 2-km spacing.
- If the proposed intrusion is shallower on the northern portion, then ETAs located here should be prioritized for field investigation. Since high K confirms modeled alteration here, these exposures should be sampled and tested for precious- & base-metal geochemistry.
- It's the opinion of this author that the intrusion was emplaced at the time of the initial breakup & extension of the structural embayment. This trough filled with erosional sediments from adjacent granitoids & greenstones. With recurrent pulses of compression, regional secondary folds formed. The intrusion may have pulsed and retro-boiled as well over time & likely is the primary source of hydrothermal mineralization found outside AUGF's tenements and possibly within them, expressed by alteration

  modeled by this project.

OBSERVATIONS

After modeling & interpreting satellite imagery, potential-field geophysics, airborne radiometric data, and DEM data, it is proposed that there may be four viable & economic mineral occurrences within AUGF's two tenements:

1. Au nugget play within the updated mapping for the Beaton Creek (BC) conglomerate
2. Epithermal Au found along the western extent of the BC mapped unit
3. Sedimentary U play within the updated BC mapped unit
4. Precious/base metal play above or peripheral to the mafic intrusion.

Respectfully Submitted this 3rd day of May 2021,

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PERRY REMOTE SENSING, LLC.
Geologic Exploration Using Satellite Technology