

Earth observation perspective in Mineral Exploration & mining

Dr. K. Vinod Kumar

Group Head

Geosciences Group, Remote Sensing Application area

National Remote Sensing Centre

Indian Space Research Organization

Balanagar

Vinodkumar_k@nrsc.gov.in



Thrust area

- Exploration
 - Regional geological survey
 - Specific anomaly detection
- Geo environment
 - Impact assessment
 - Change detection and monitoring
 - Subsidence
- Monitoring of mining activity
 - Large scale open cast mining activity

Major categories of earth observation data

- **Multispectral data**: For mapping regional geology , geomorphology and structure
- **Very high resolution data** : Monitoring
- **DEM** : Change detection and impact assessment
- **Hyperspectral data**: Mapping alteration zones, oxidation zone etc
- **Thermal data** : Change detection and monitoring of environmental hazards
- **Microwave Data**: Spatially supplementary data for regional geological mapping, buried structure(L band microwave remote sensing) & subsidence (interferometric data)

Major scope in exploration

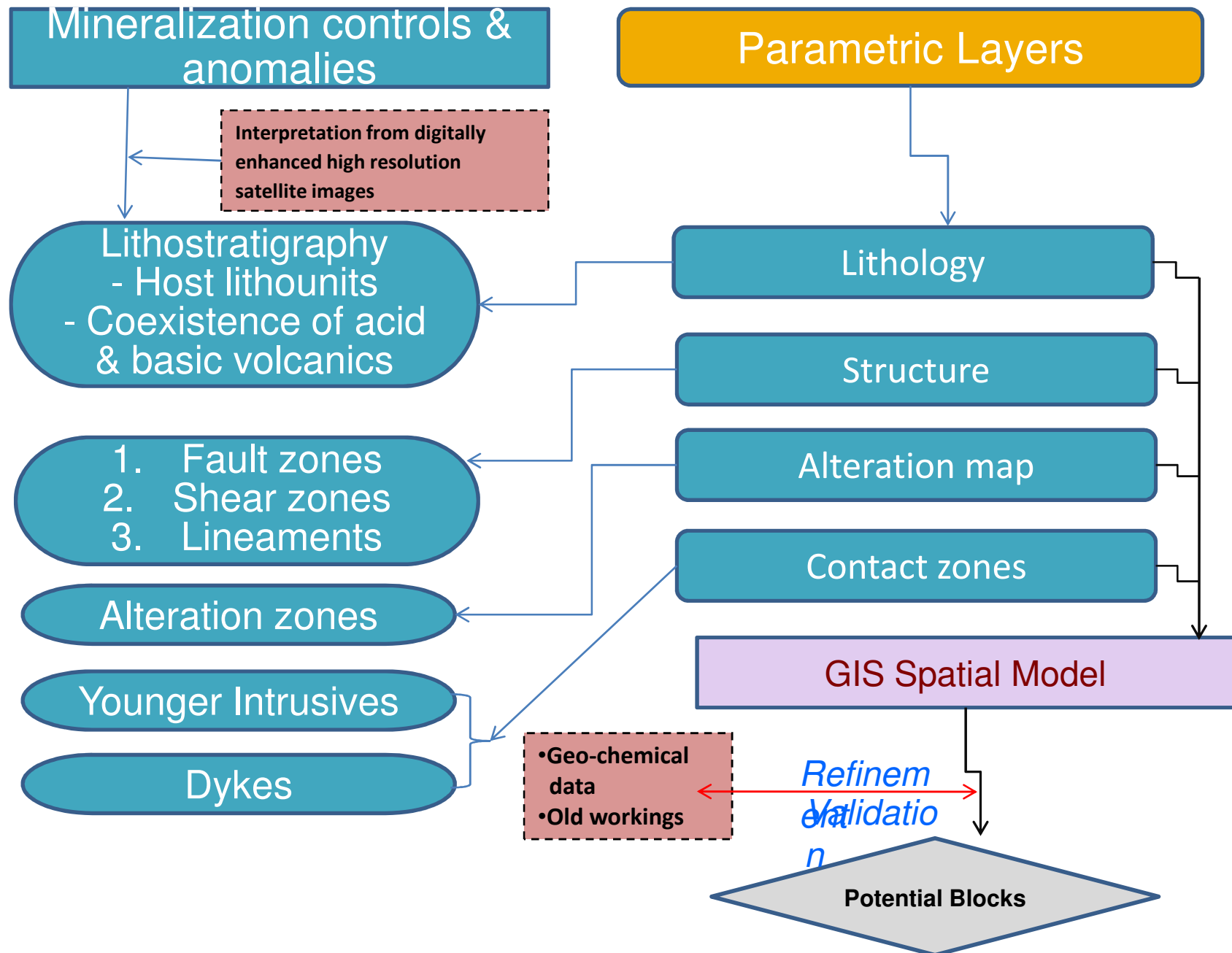
- Regional mapping of lineaments or deformed zones along which minerals are concentrated
- Detailed mapping of fractures and host rocks controlling individual load
- indication on actual extent of deposit by delineating hydrothermally altered rocks,oil seepage associated with ore deposits & petroleum resp etc.

•**Science of exploration**

- Surface signatures of brittle-ductile deformation is often prominent in imageries.
- Reflectance spectra of terrain elements have absorption features(insensitive to sensor-target distance) sensitive to mineralogy recorded able from space-borne sensors.
- Mineralogical of proxies like drainage pattern, land use-land cover sensitive host rock of mineralization and associated geological structures are mappable.
- Space-borne digital elevation data can be used in demarc topographic control of ore forming processes.

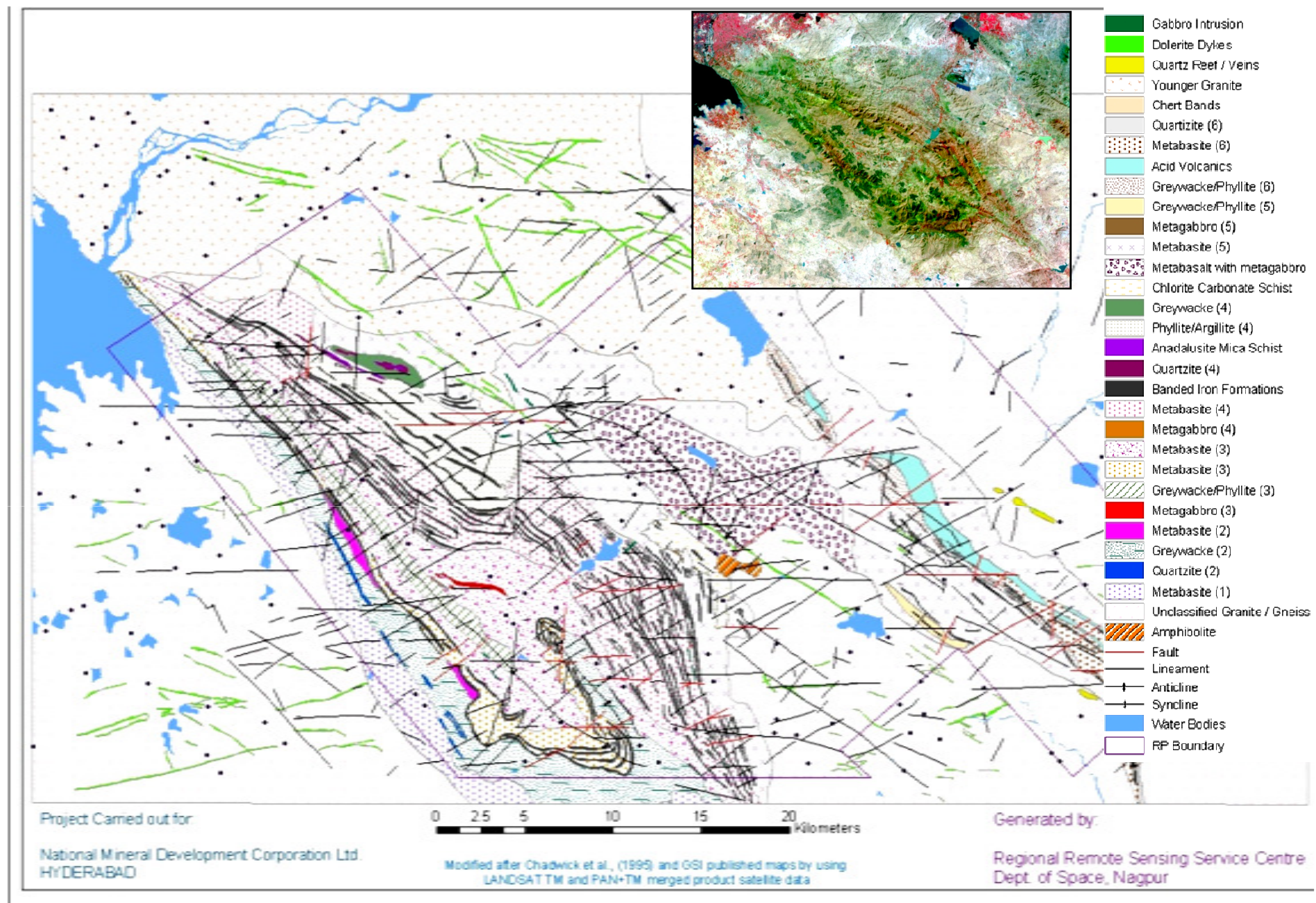


Exploration flow chart using remote sensing data

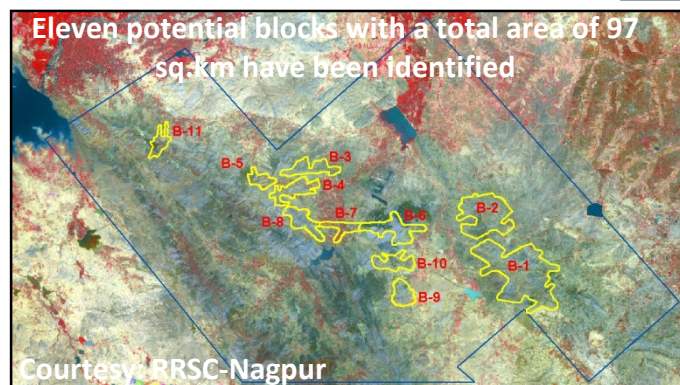
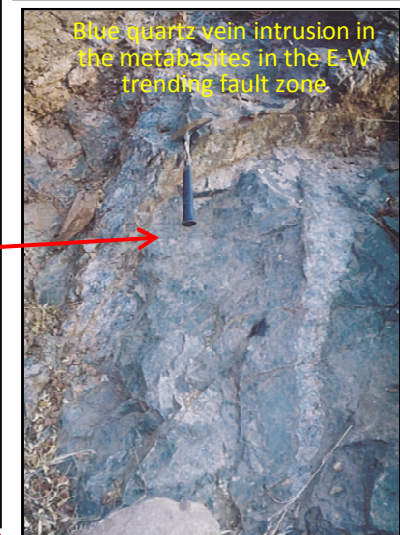
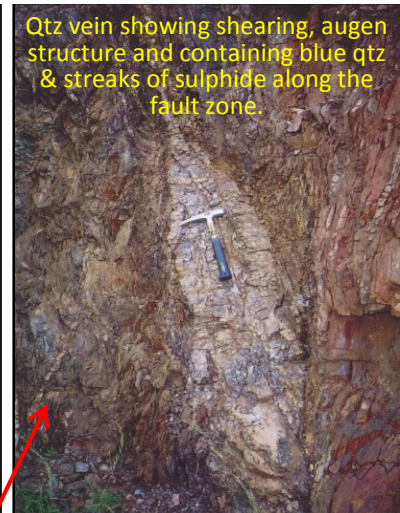
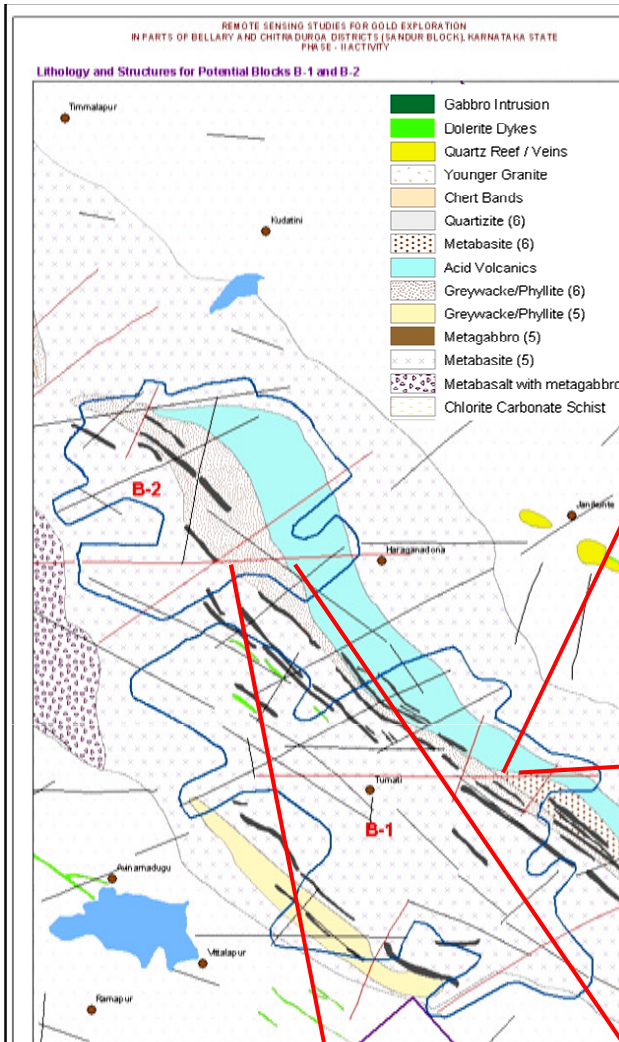
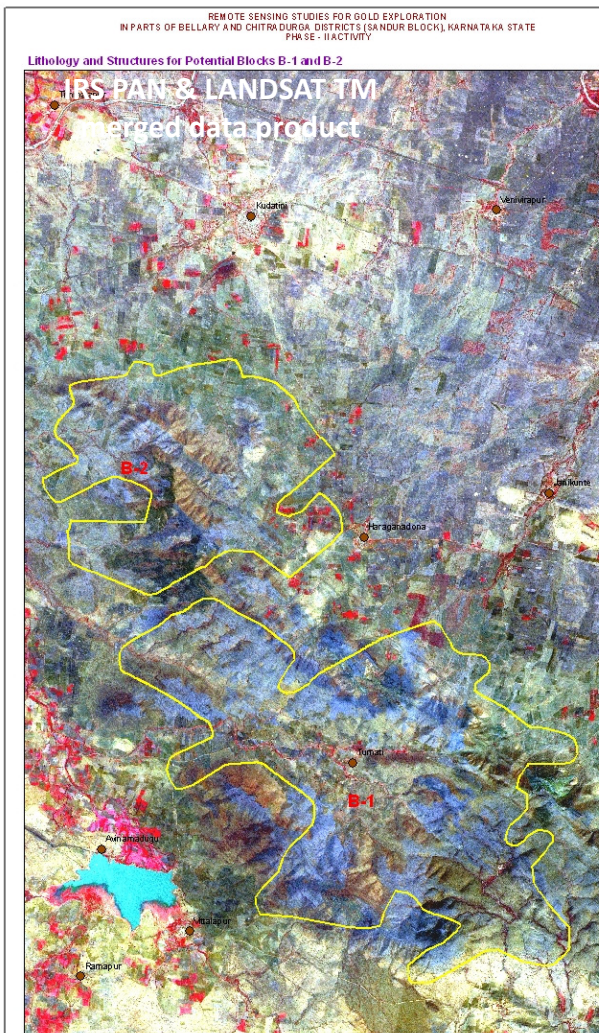


Geoenvironment impact assessment and change


- **Environmental degradation - land**
 - Changes associated with open-cast mining
 - Land subsidence in underground mining
 - Deforestation and erosion in river catchments
 - Forest fires
 - Land degradation due to natural disasters
 - Waste disposal from nuclear power plants
- **Environmental degradation - air**
 - Spread and dispersion of smoke plumes from industries and power plants
- **Environmental degradation - water**
 - Discharge and dispersion of thermal plumes from industries and power plants into rivers and lakes
 - Waste from nuclear power plants/Mines
 - Oil spill into ocean




Courtesy: RRSC-Nagpur



Ground information



AERO MAGNETIC



The map displays a complex terrain with numerous contour lines and elevation markers. A legend in the top left corner identifies various symbols used on the map, including different types of lines and points. The map is overlaid with a grid of blue squares, some of which are numbered 1, 2, and 3. A red line is drawn across the map, possibly indicating a specific path or boundary.

INDO-FRG PROJECT, PHASE IV

82-00 E. 19-10 N

81-55 E. 19-52 N

82-00 E. 19-52 N

REMOTE SENSING GEOLOGY & AIRBORNE GEOPHYSICS

BASED ON REMOTE SENSING DATA INT. WITH LIMITED GROUND CHECKS

FREE UNIVERSITY, BERLIN

RESULTS

NEW KIMBERLITE PIPE

DIAMOND EXPLORATION

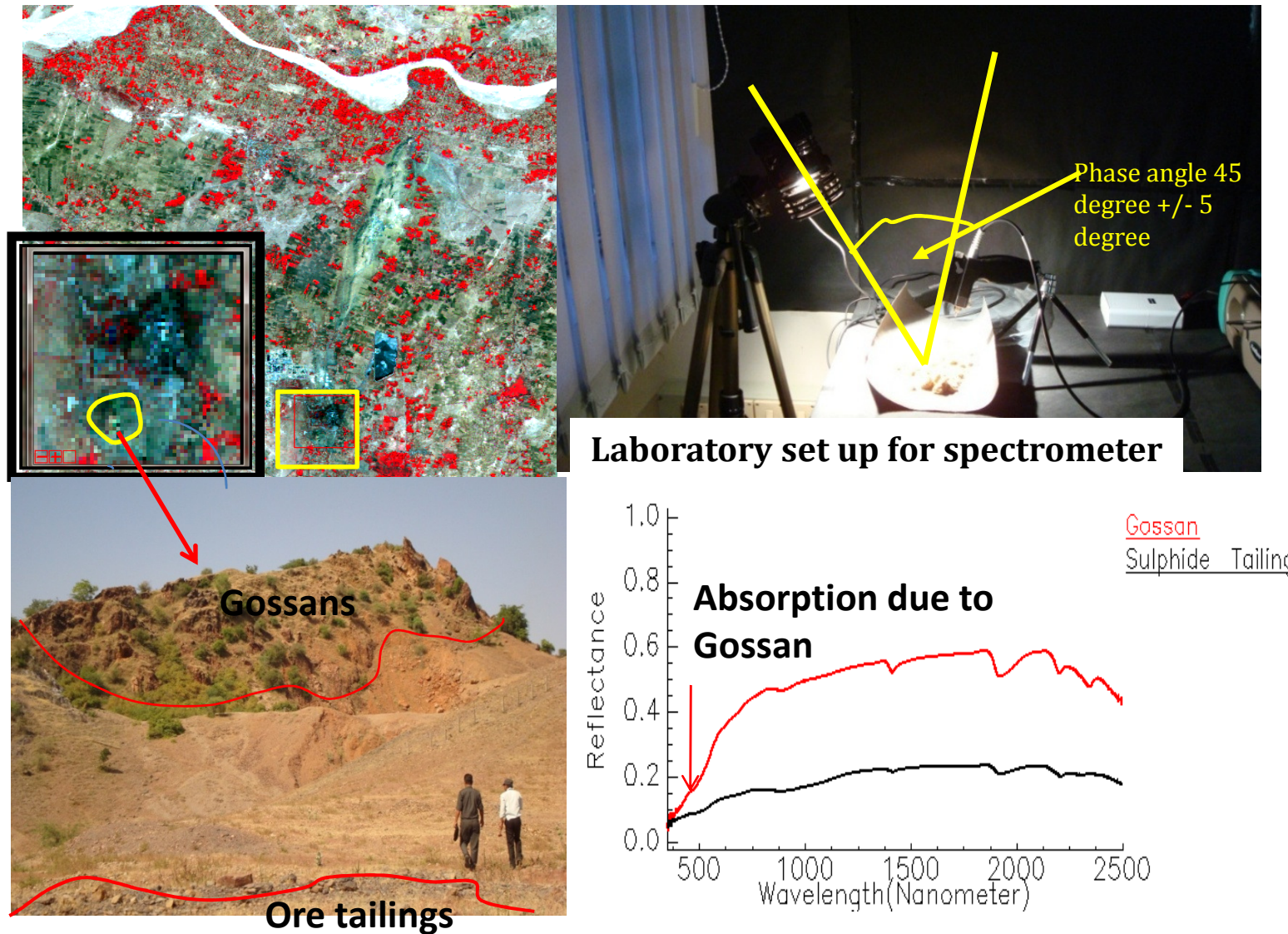
RESULTS

NEW KIMBERLITE PIPE

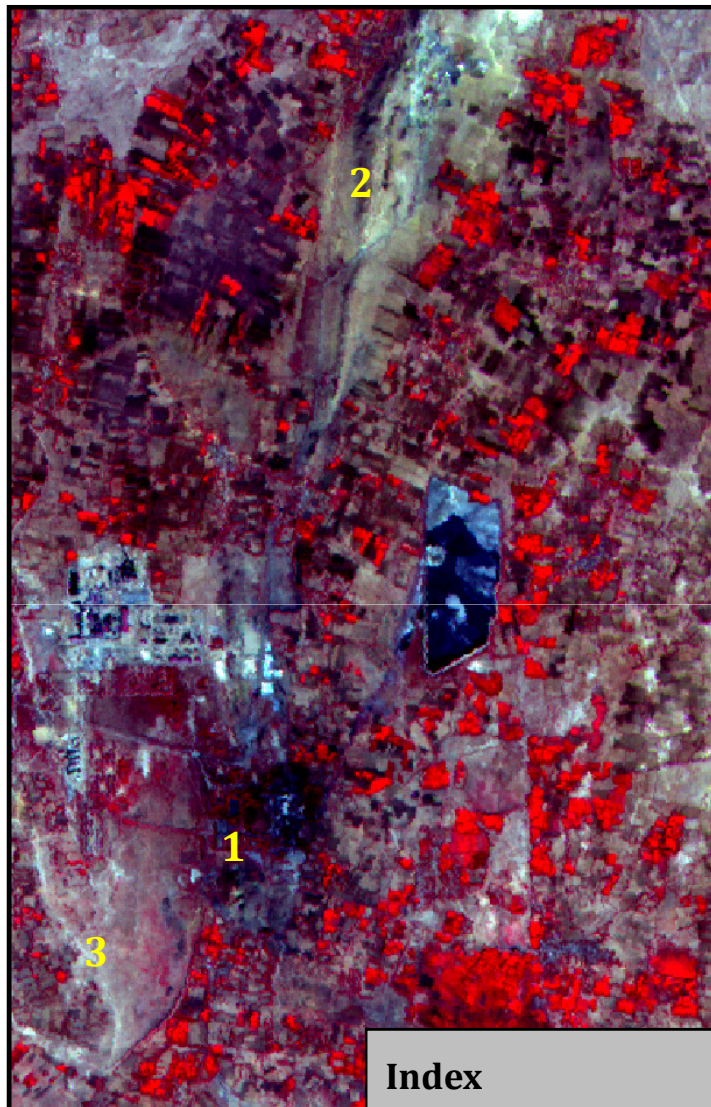
DIAMOND EXPLORATION

GIS INTEGRATION

Spectroscopic study of rocks

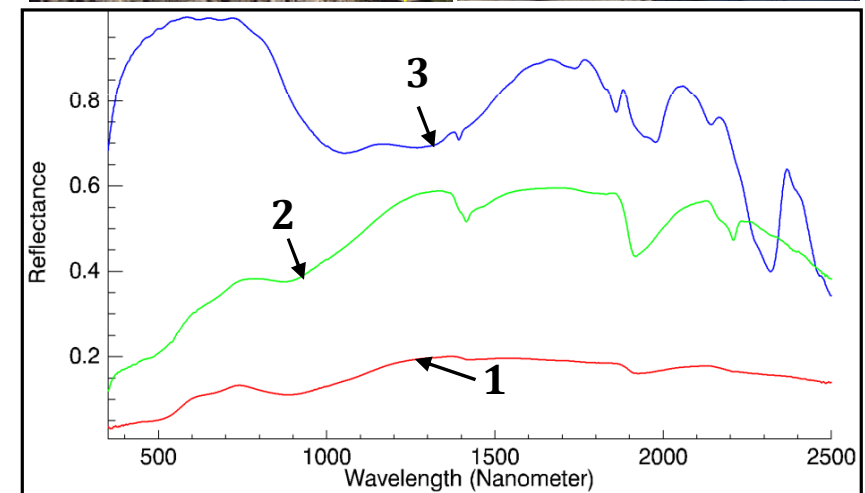


Each spectroscopic profiles are being interpreted based on semi quantitative mineralogical data (XRD/EPMA).



Index

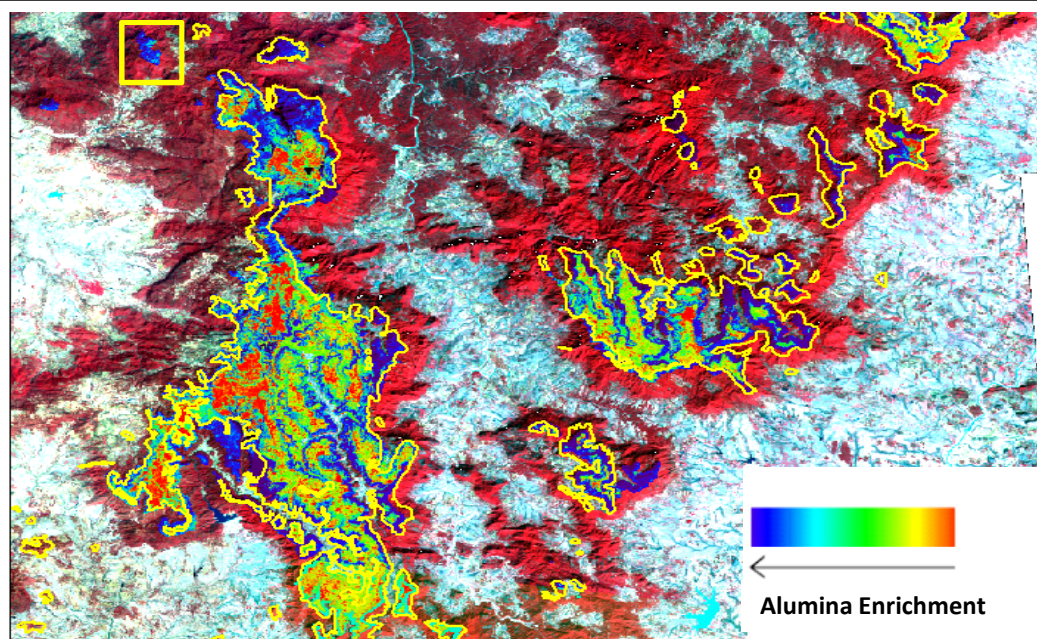
1. **Gossan**
2. Quartzite
3. Carbonate rock



1. Gossan is a patch of rusty rock /oxidized zone
2. Indication mineral and guide for sulphide ore search
3. Minerologically composed of Goethite, Hydrogoethite and other iron oxide minerals etc
4. Dariba gossan named as ***national gossan monument***
5. Dariba is *Type Area* for oxidized zones.

Delineation of Lateritic Bauxite in Jharkhand state

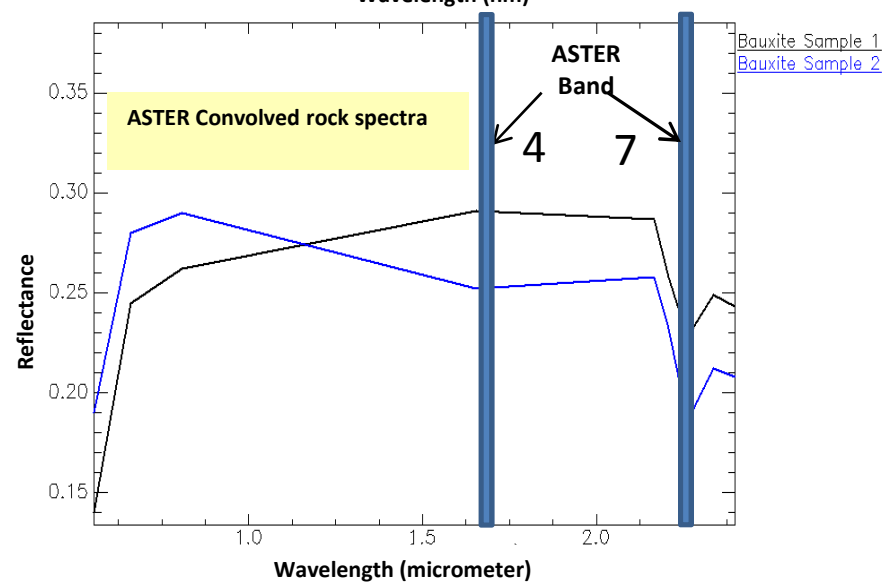
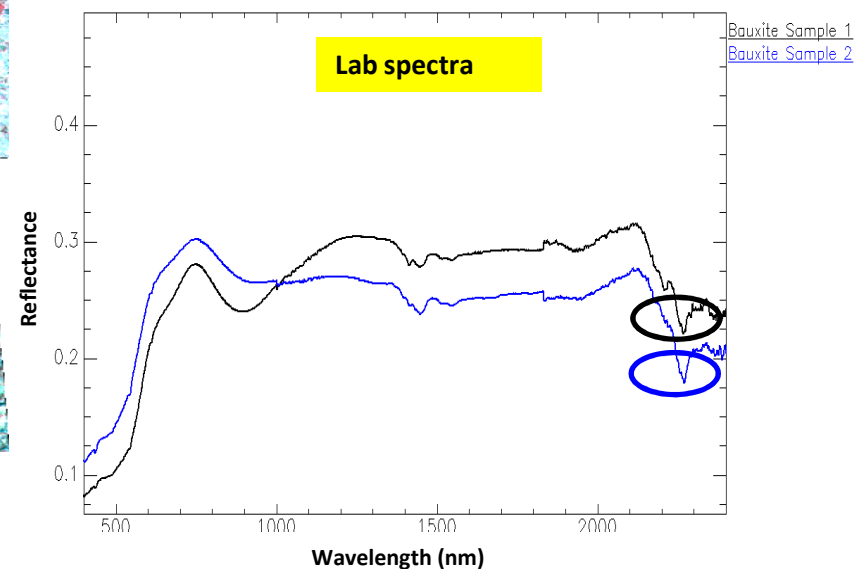
Highlight: Update the extent of lateritic bauxite



R=3rd Channel; G= 2ND Channel; B=1st Channel(Date: 18.05.2003)

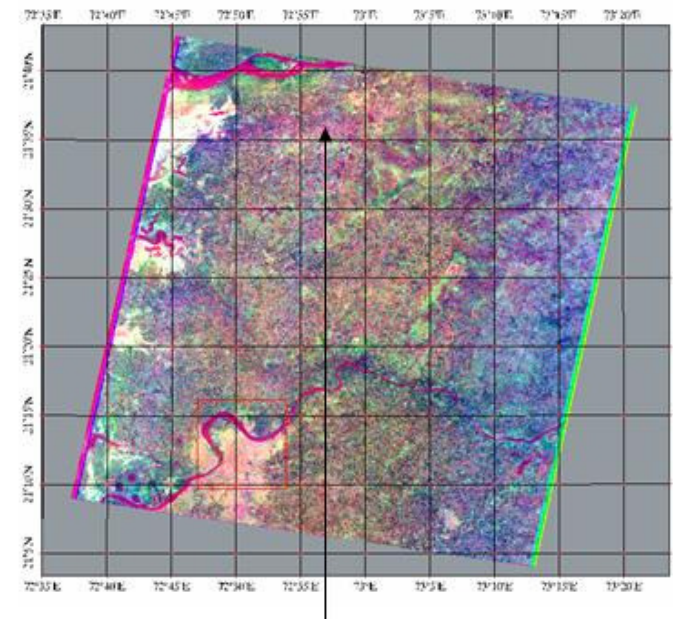
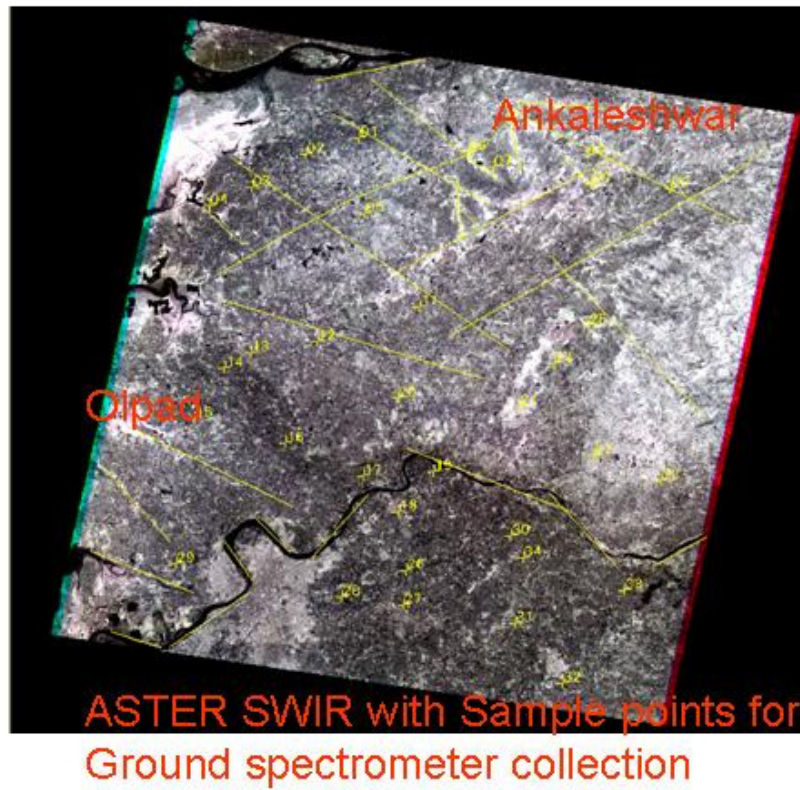


Bauxite occurrences in the field

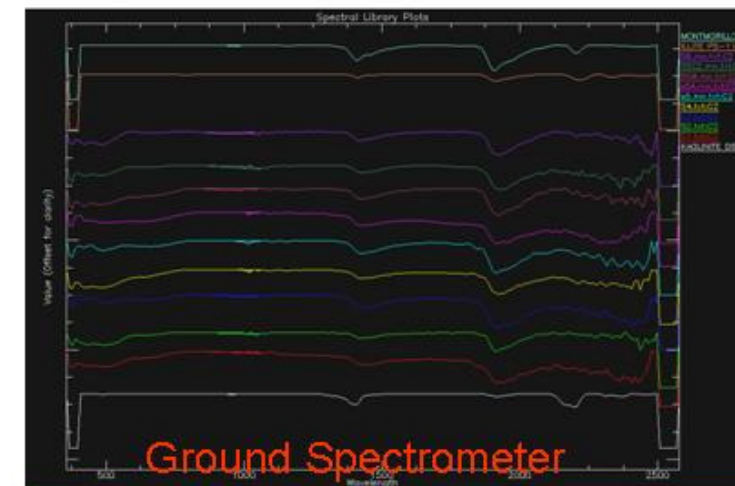


THANK YOU

Onshore shallow gas seepages around Ankaleshwar, Olpad and Kosambai main field using ASTER (SWIR) data



Magenta colour indicates probable seepage zones



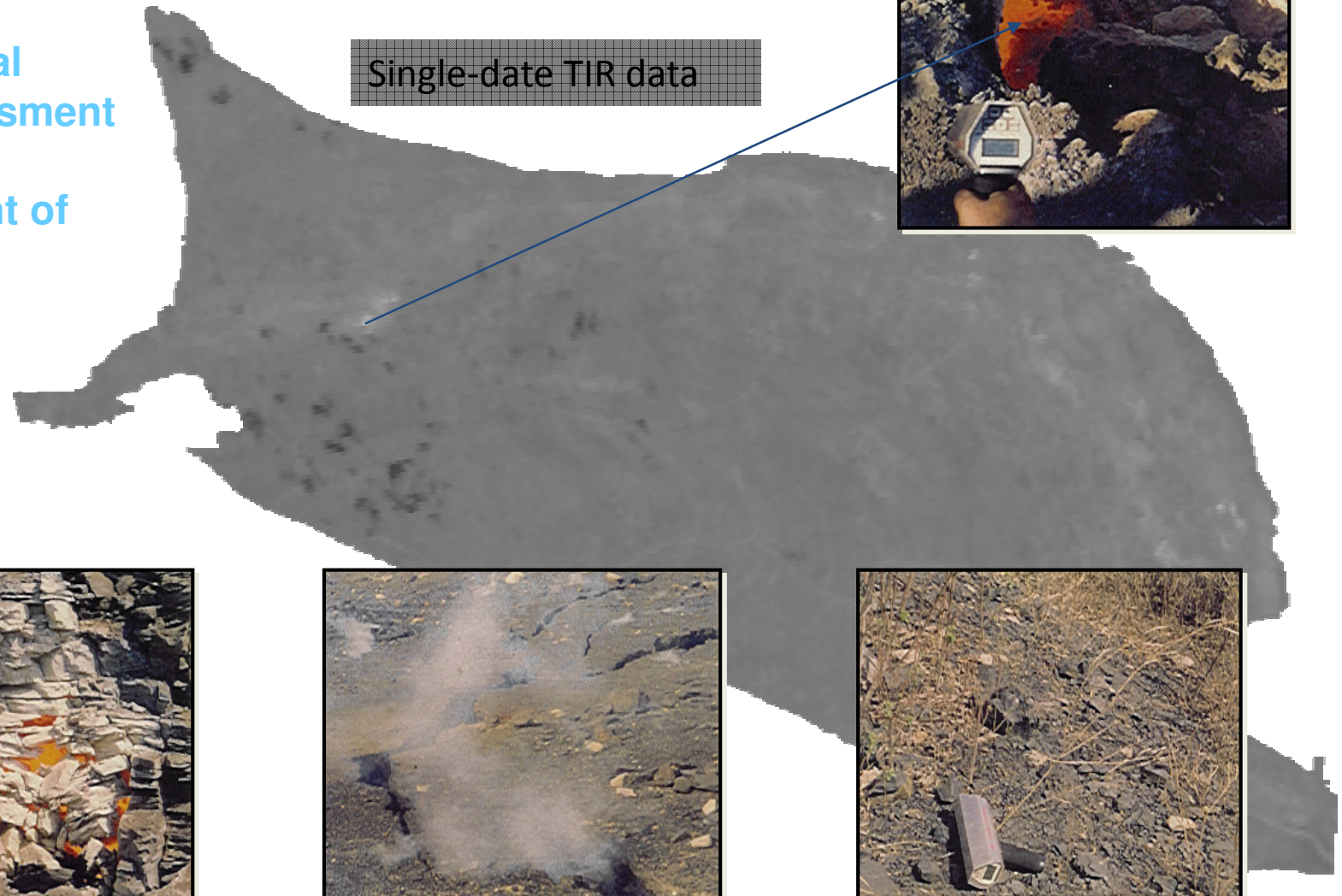
Geoenvironment

JHARIA COALFIELDS

Coal fire mapping
using ASTER data
(TIR)

Environmental
impact assessment

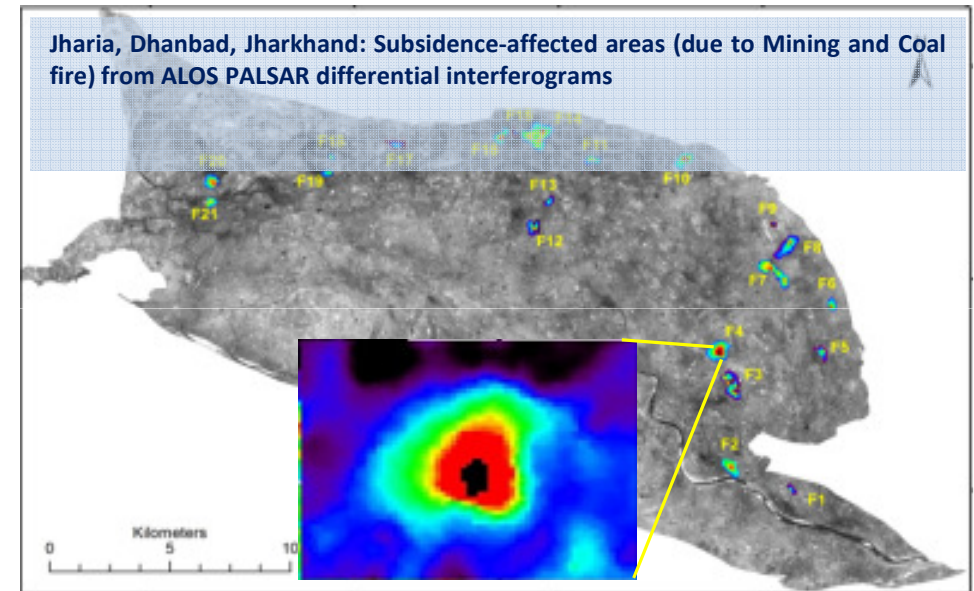
Establishment of
industry



Deformation :

Land Subsidence: Potential Applications

1. Mining / Coal fire related Land subsidence in Jharia coal field (Jharkhand)
2. Ground water related land subsidence in Indo-Gangetic Plains
3. Oil /Ground water exploitation related subsidence in Delta regions (Krishna-Godavari Delta)



THANK YOU