

# Applications of Hyperspectral Imagery and Spectroscopy on ImpactMin and beyond

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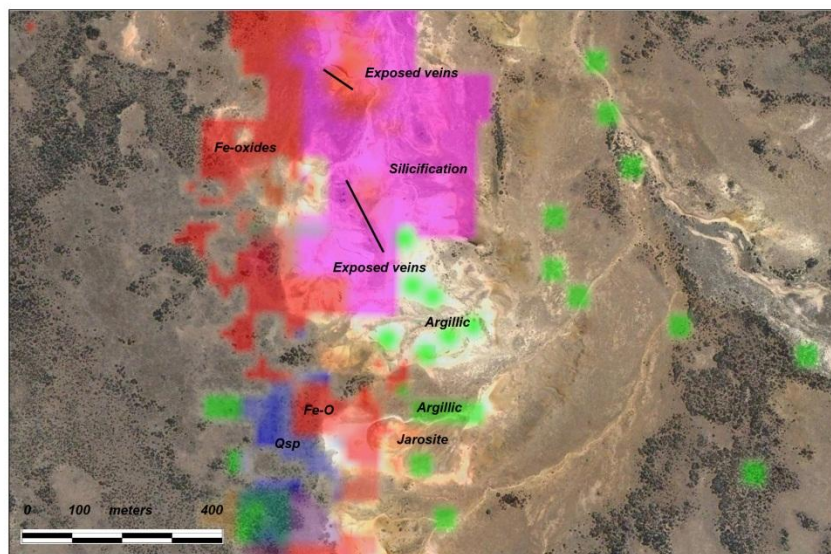
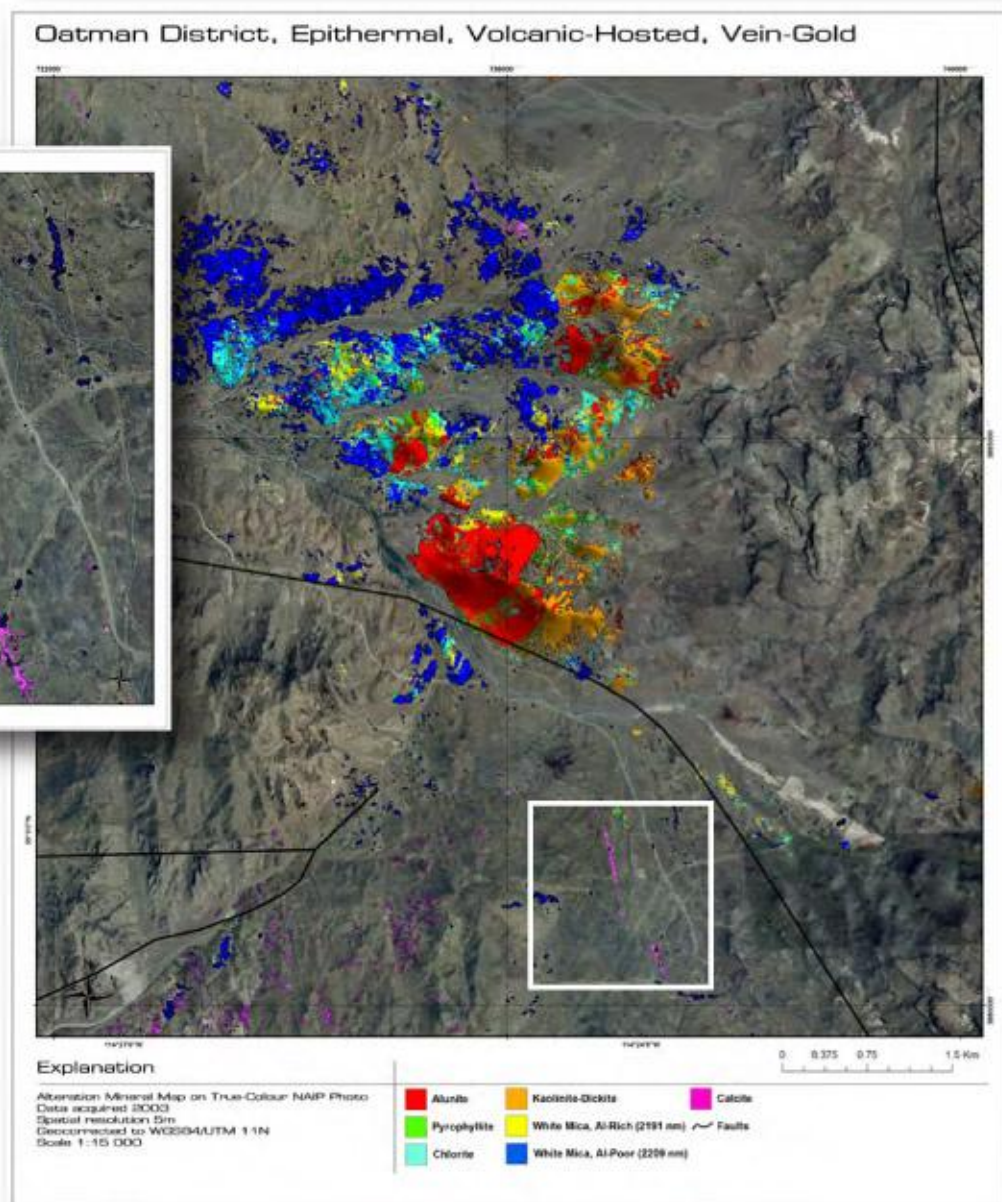
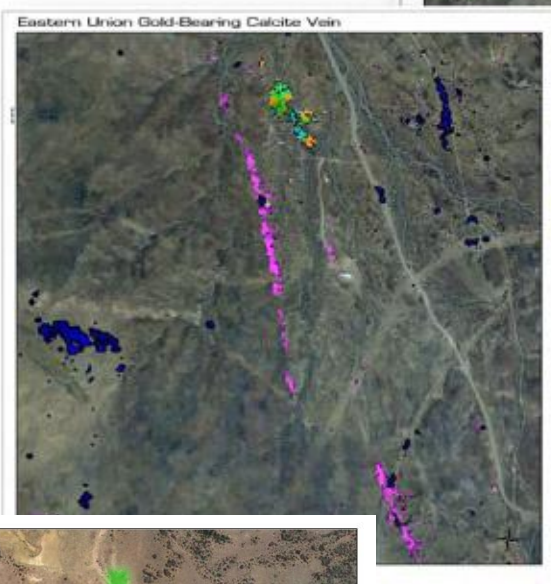


# Airborne Hyperspectral

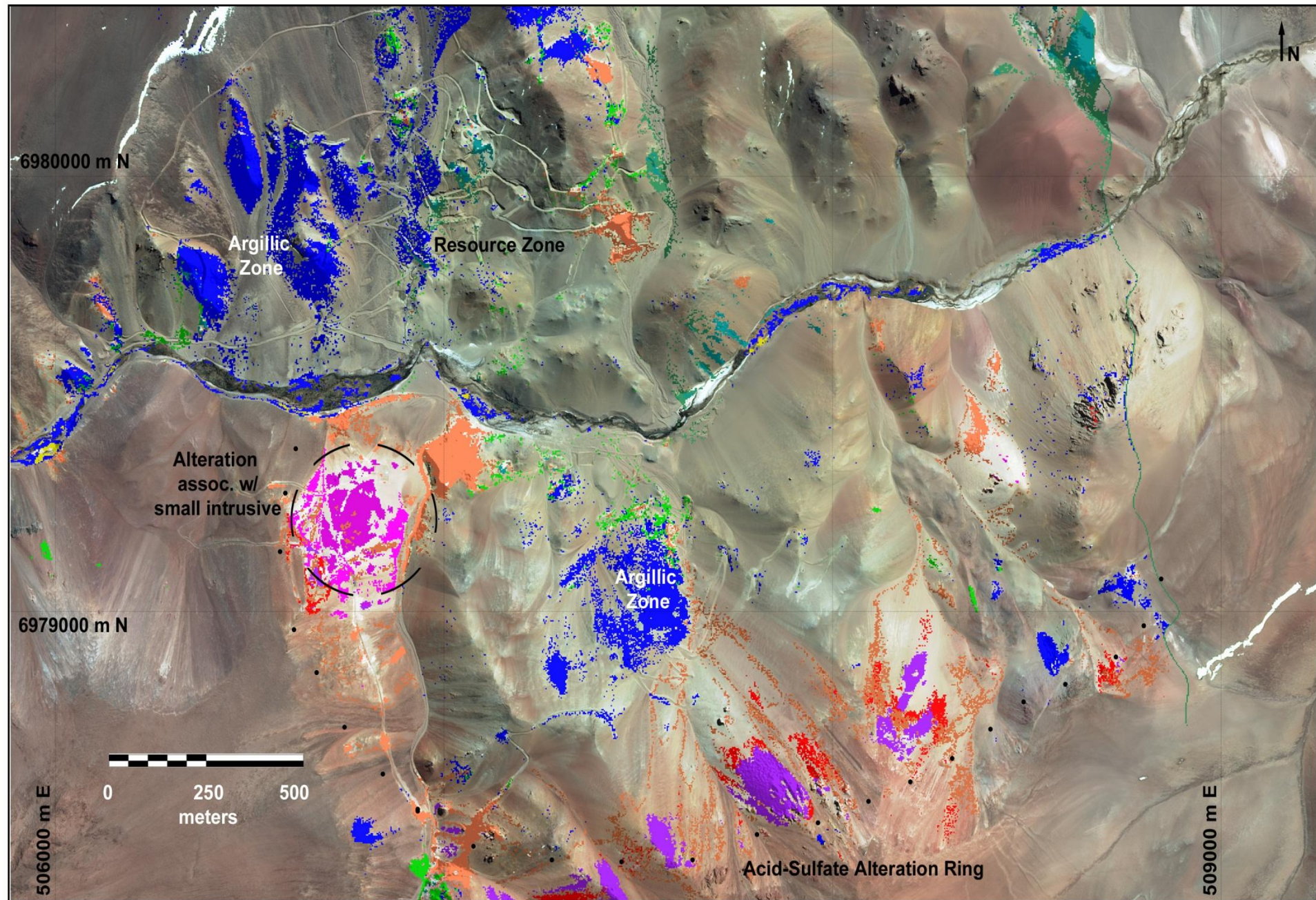
- Excellent way to identify surface clues and elements on a wider area, or inaccessible area
- Improvement on portability, technology and ease of use make it more acceptable and in-line with other geophysical methods (e.g. airborne magnetics)
- ImpactMin had used hyperspectral imagery over certain European regions for the first time

# Prospecting

Hyperspectral imaging is commonly used in prospecting for new mineral deposits with considerable success



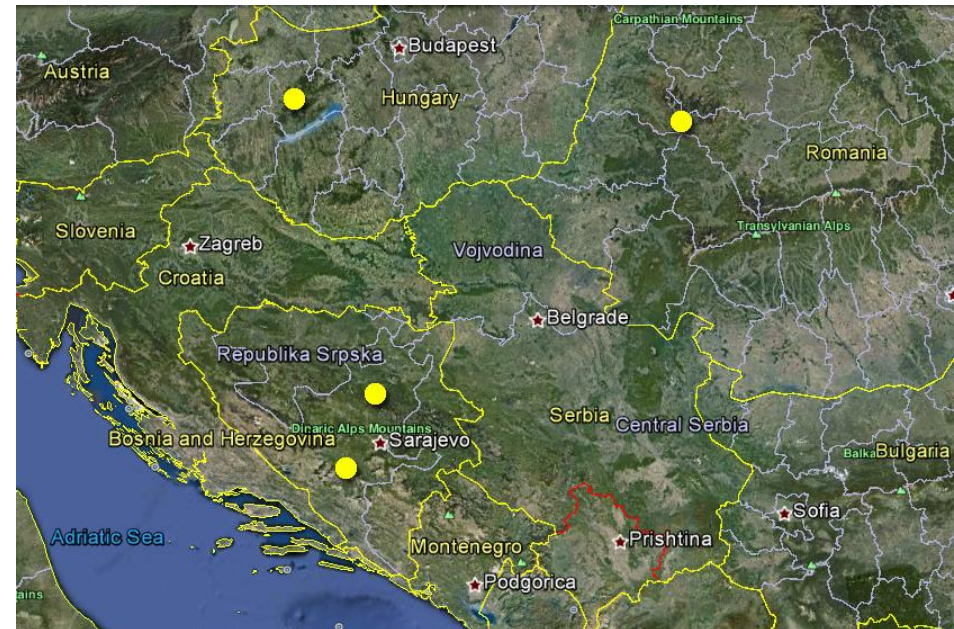






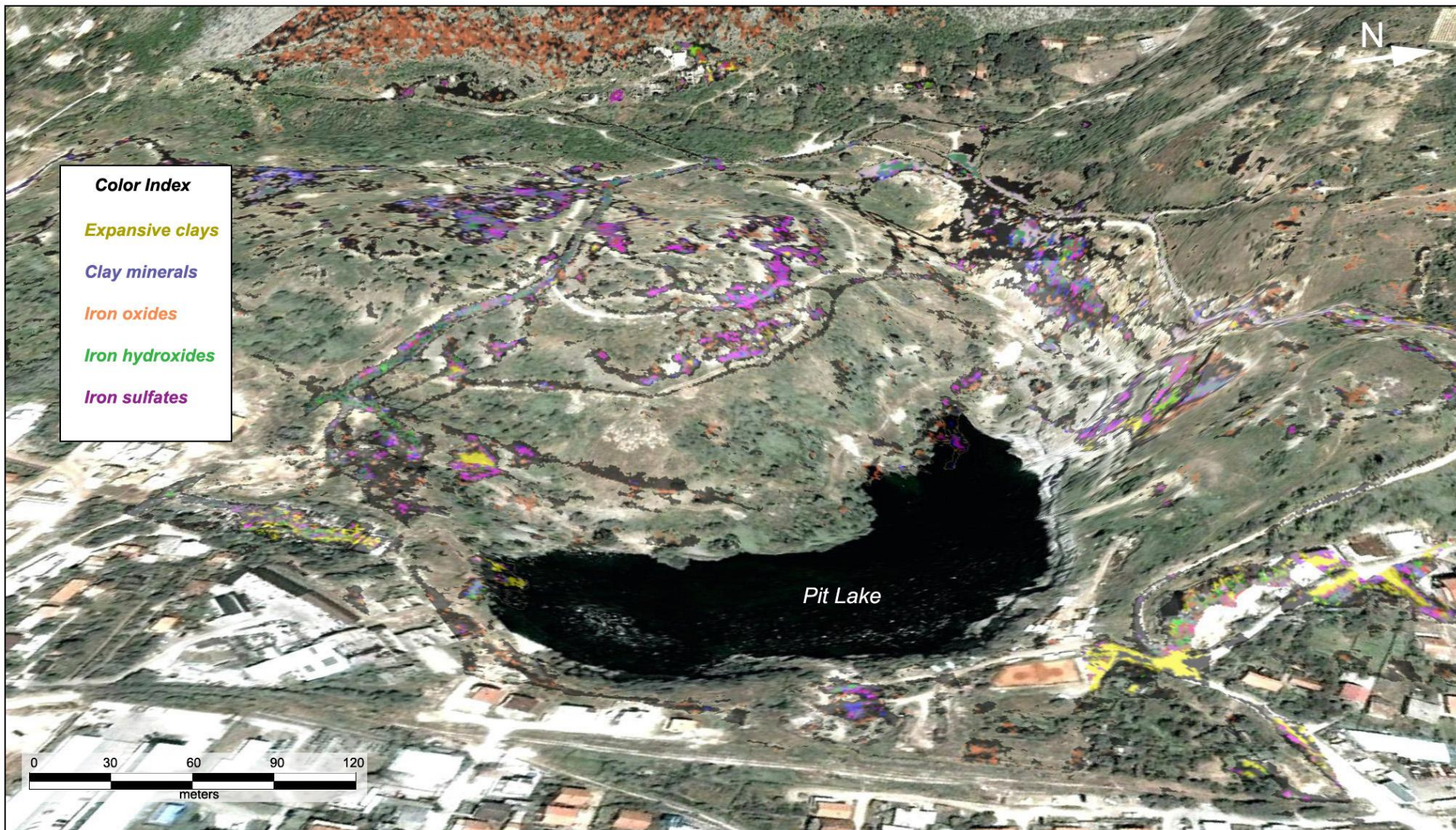
# Sites Described

- Mostar (revisited), BH
- Red Muds: Mostar, BH and Ajka, Hungary
- Zenica Steel Works, BH
- Rosia Montana, Romania  
(pseudo hyperspectral)





# Mostar

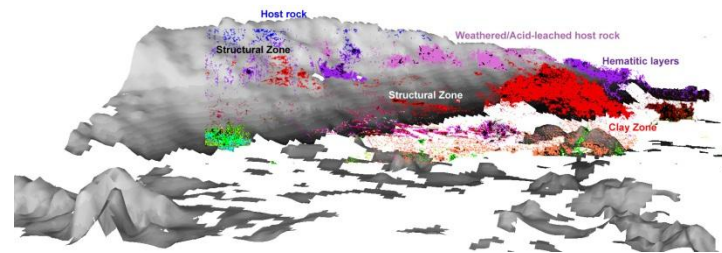
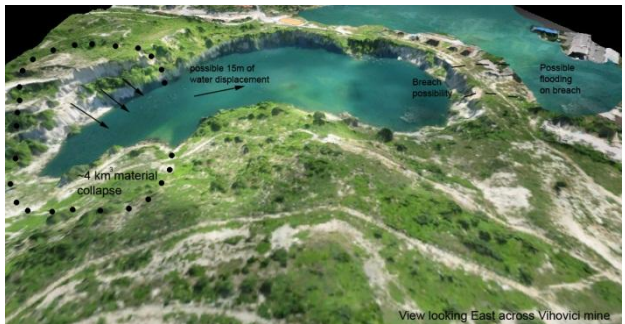
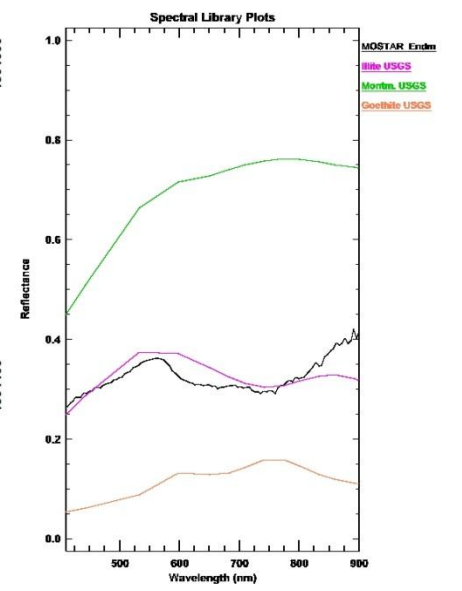
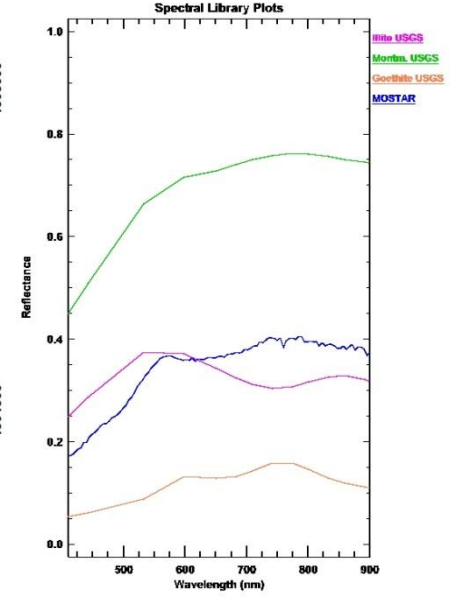
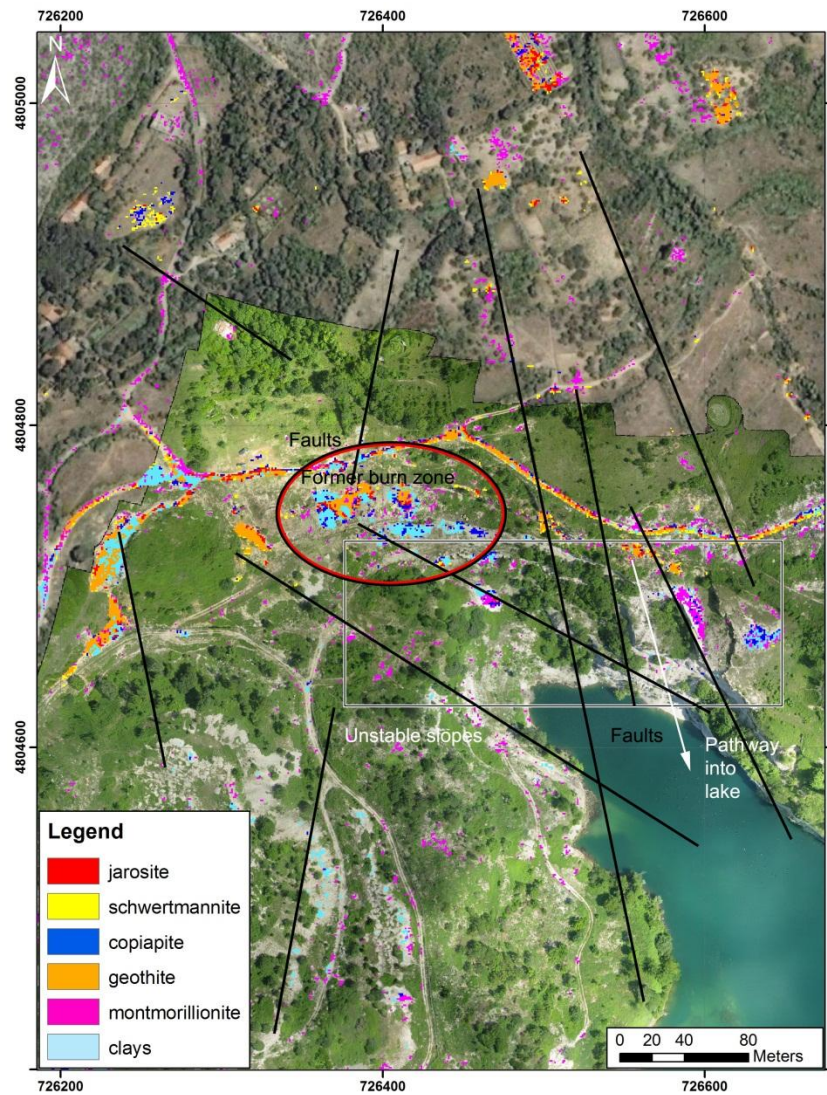
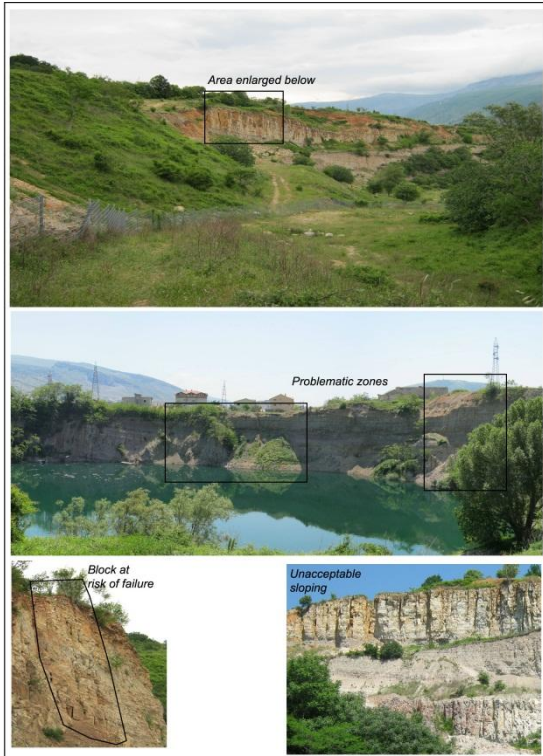


Brief overview of previous discussion on Vihovici

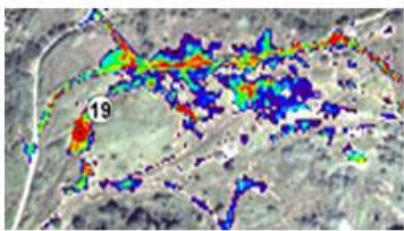
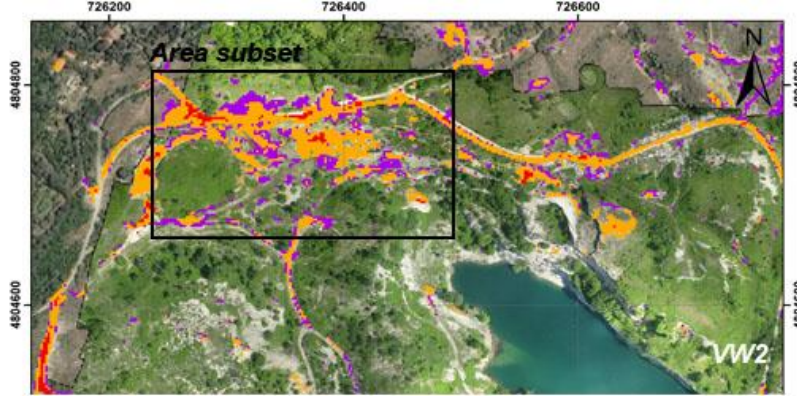


# Mostar

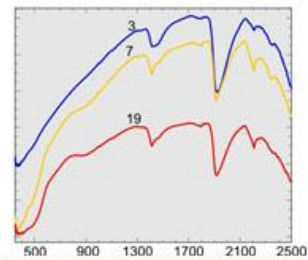
(Geotechnical Hazards)



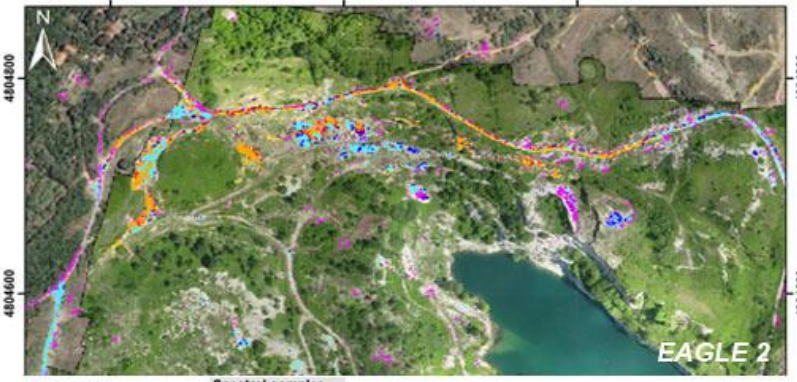




Fe-mineral intensity scale



Good degree of correlation between different datasets in addressing complex problems



**Legend**

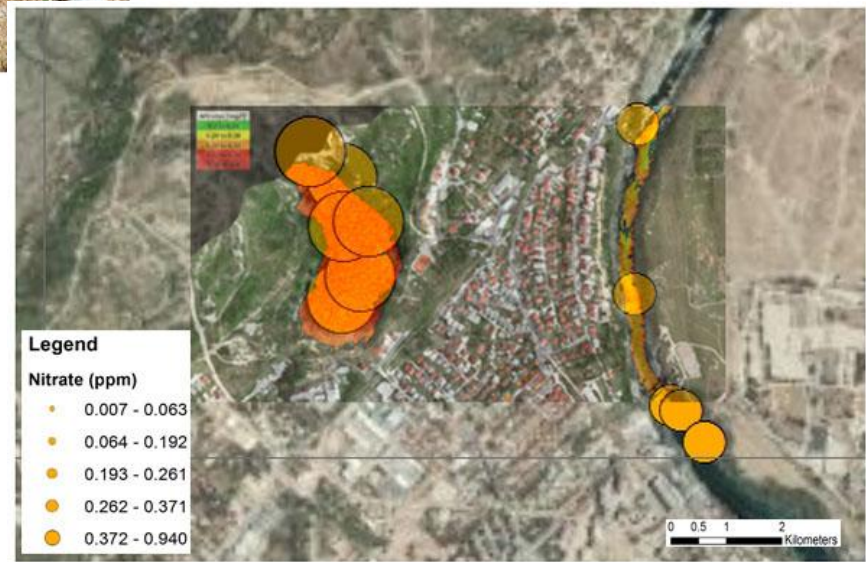
- jarosite
- goethite
- hematite

**Spectral-samples**

Slope r800/r880

- 0.982189 - 1.003160
- 0.964042 - 0.982188
- 0.953705 - 0.964041
- 0.945653 - 0.953704
- 0.938725 - 0.945652

Image base: Smartplanes UAV



**Legend**

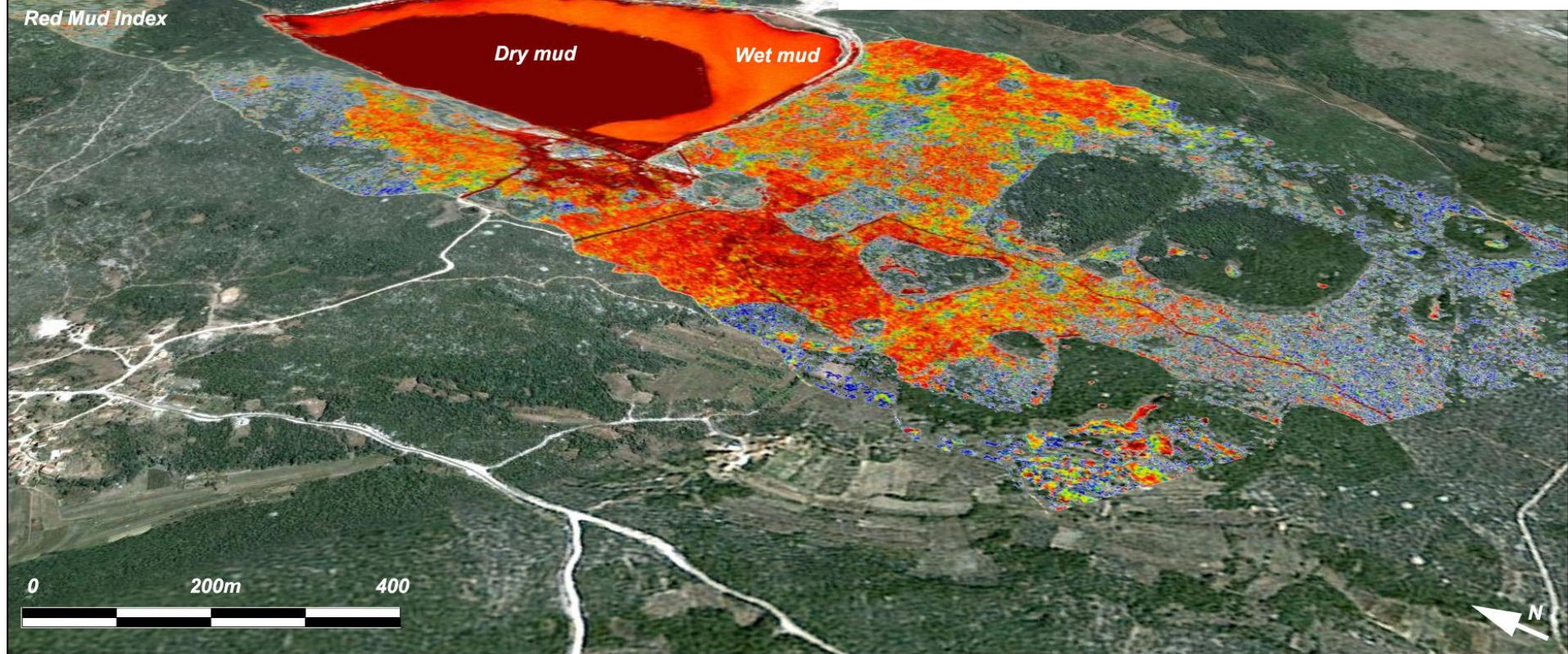
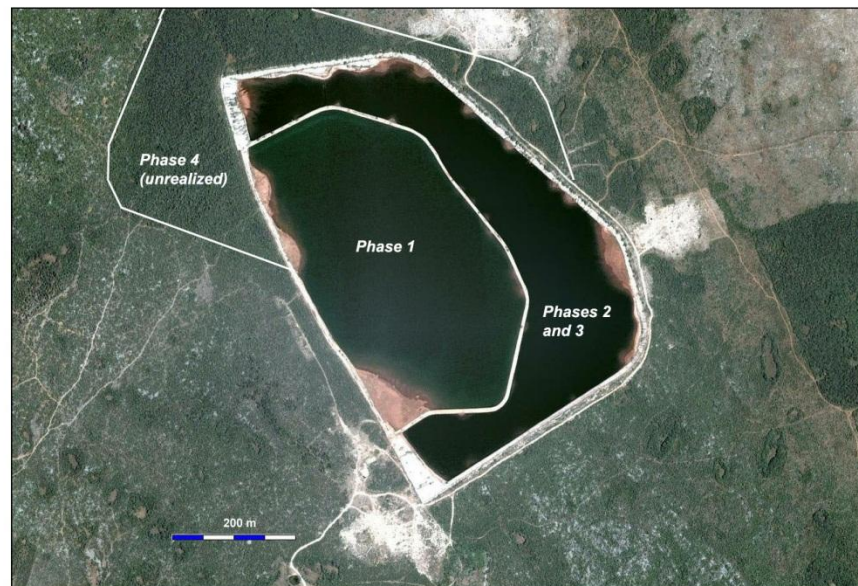
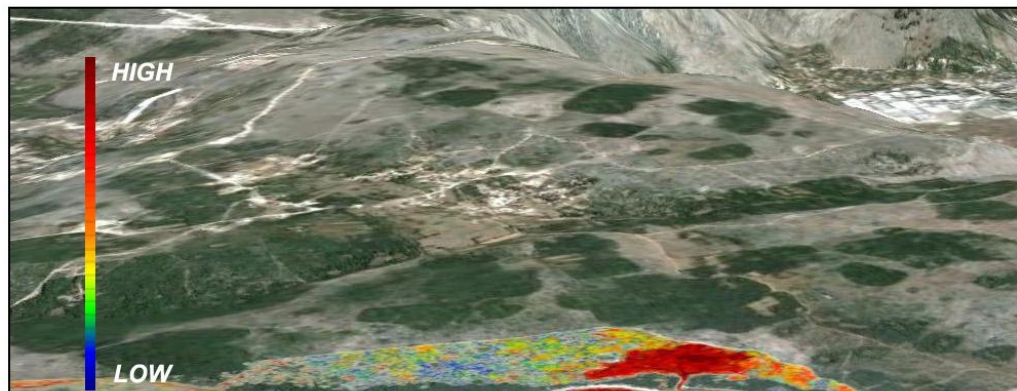
Nitrate (ppm)

- 0.007 - 0.063
- 0.064 - 0.192
- 0.193 - 0.261
- 0.262 - 0.371
- 0.372 - 0.940

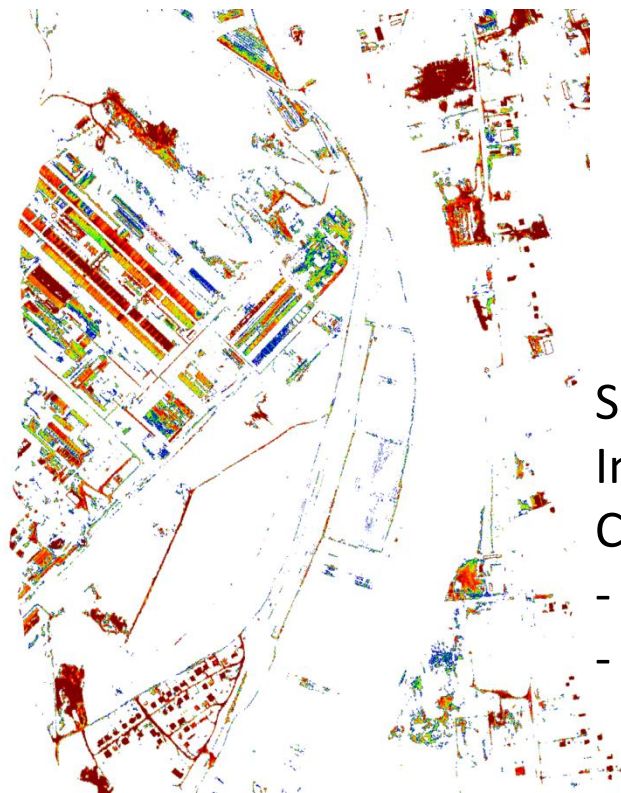
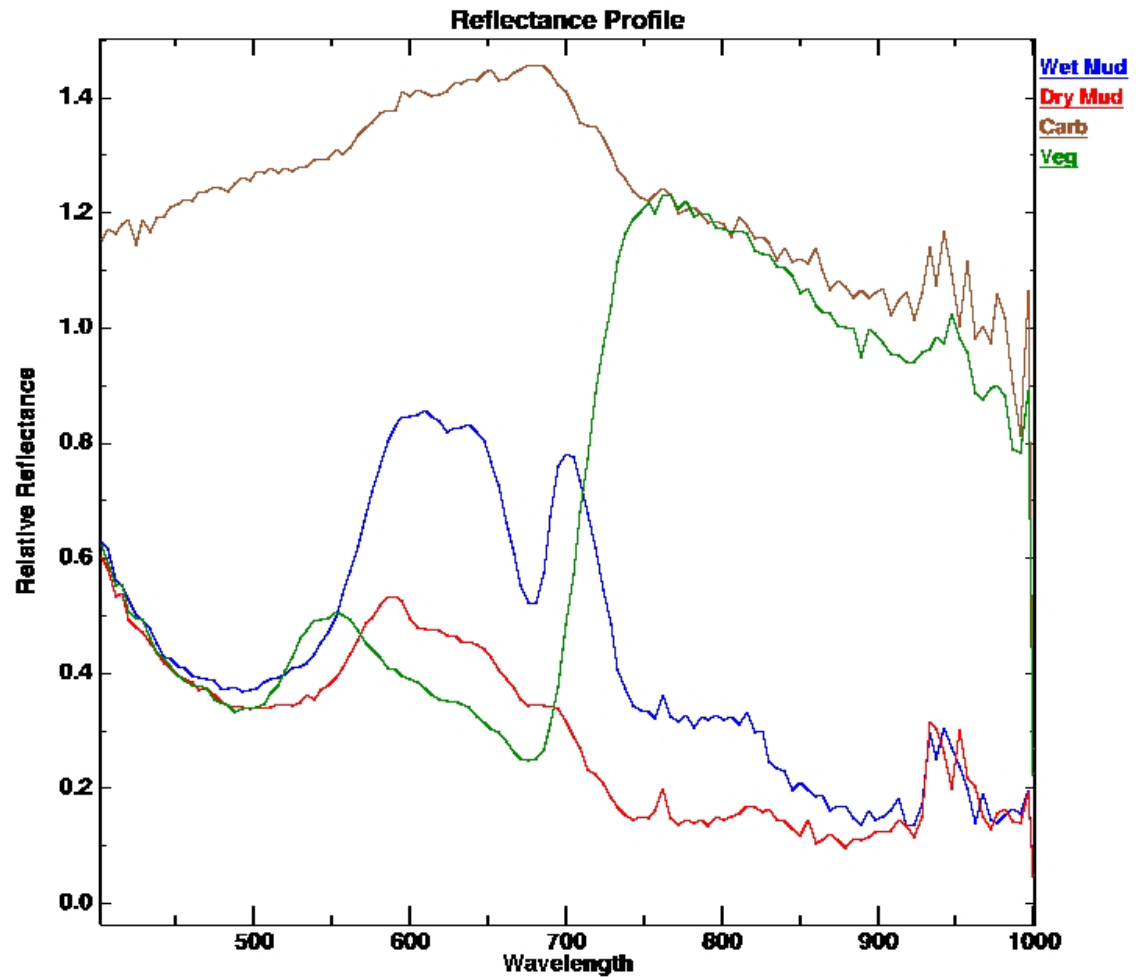
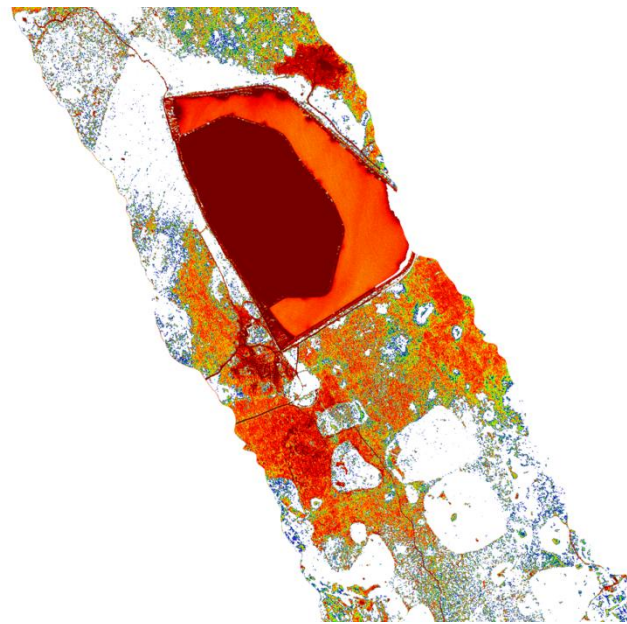
Mutually supporting data from different datasets



# Mostar







Successful implementation of Red Mud Reflectance Index

Could delineate distribution of red mud in

- Old dumps area (and dispersal beyond)
- Former alumina factory (inactivated), but effects persist

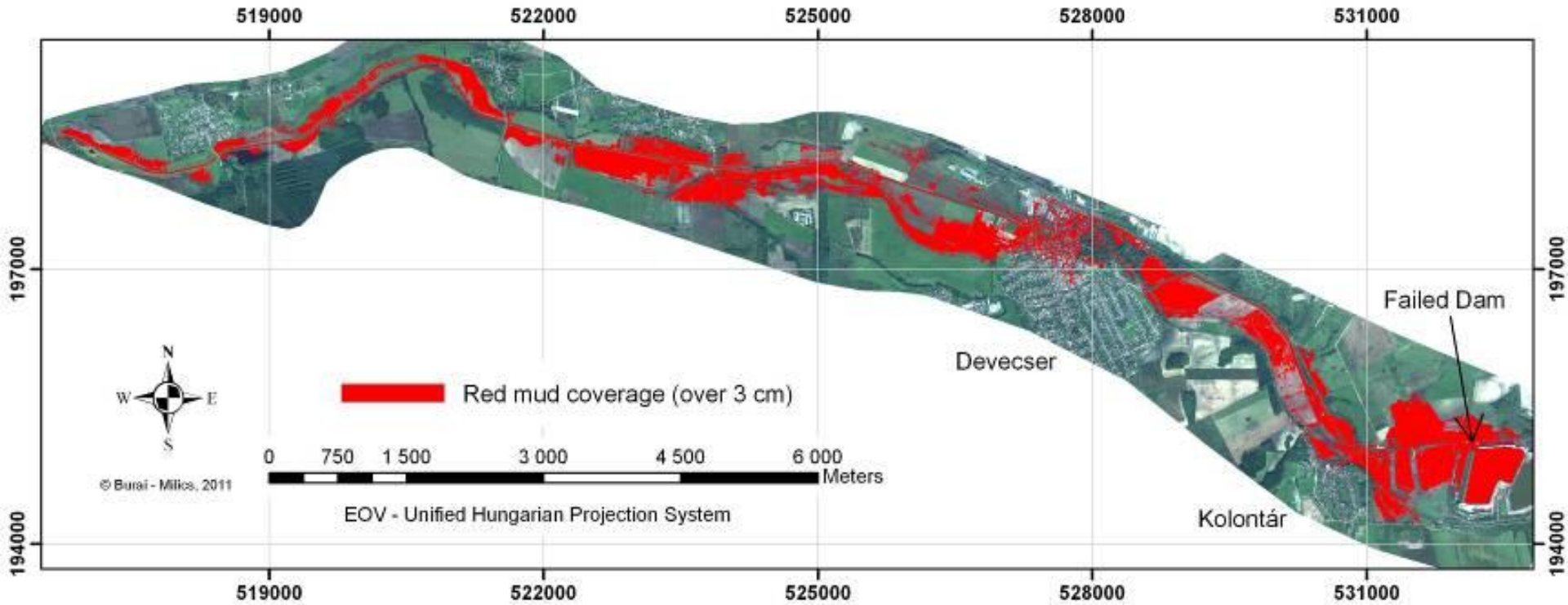


# Devecser, Hungary

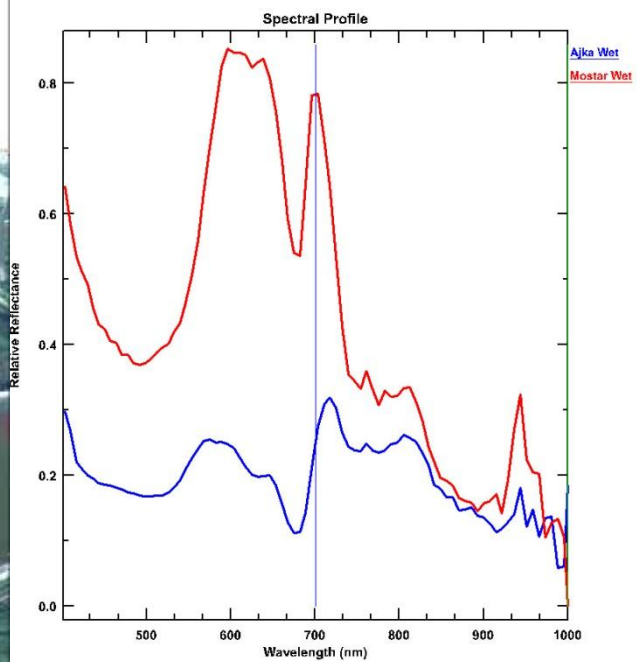




# Devecser, Hungary

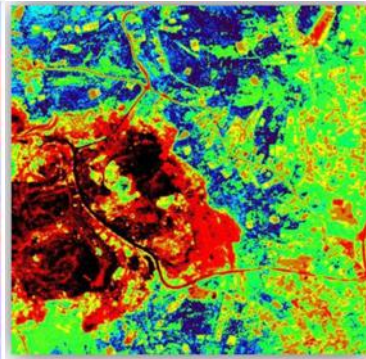
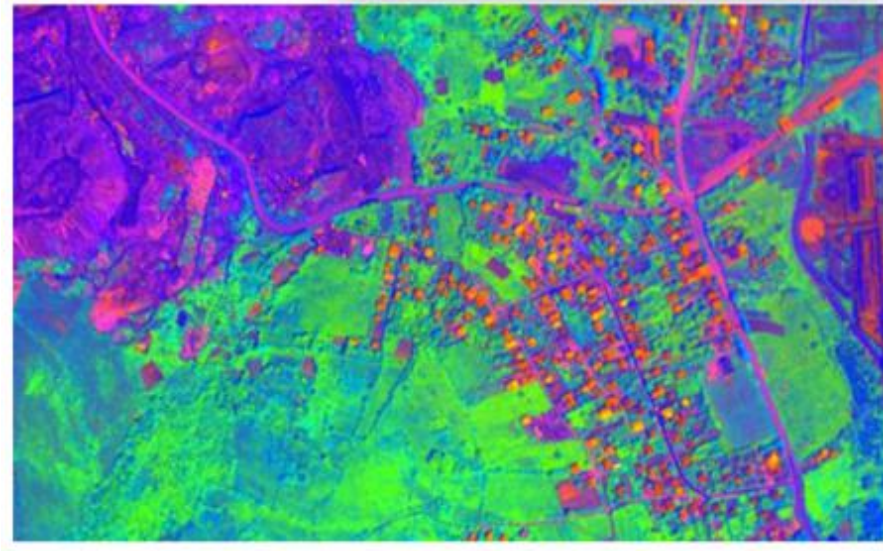








# Zenica, Bosnia and Herzegovina



- Steelworks by Acelor-Mittal (no filters)
- Main deposition area for slag and other waste at Raca – considerable problem
- Over 300% increase in cancer rates since 2006





Increased radioactivity measured



About 4 times the normal





Truly a life and death issue...







# Rosia Montana, Romania





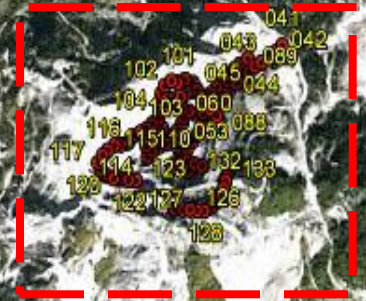
# Sampling for pseudo-HSI in Rosia Montana

Ignătești

Adit

Celiste Pit – 134 stations

Blidești



Abrud tailings dam – 50 stations



Abrud-Sat

Corna

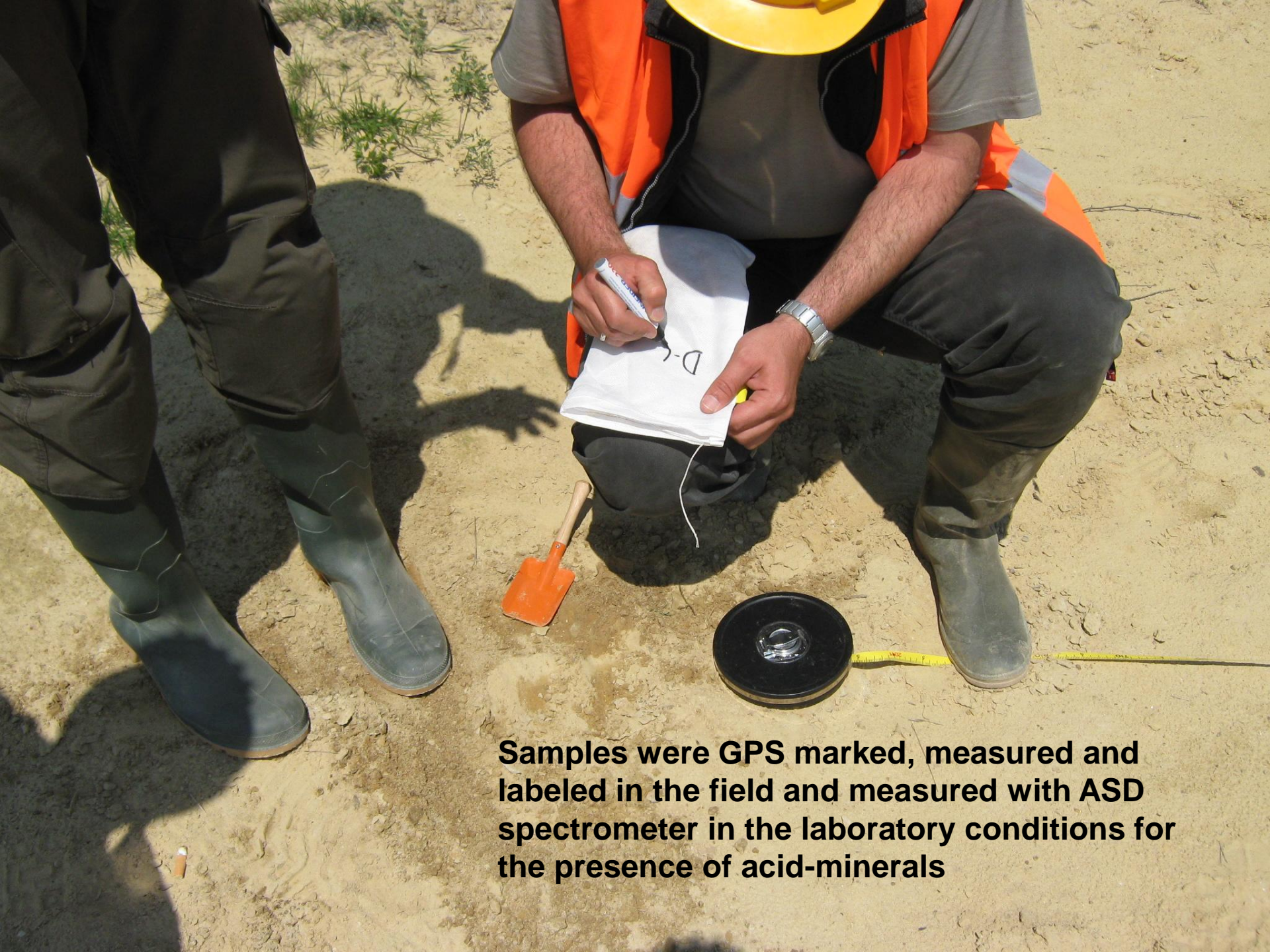
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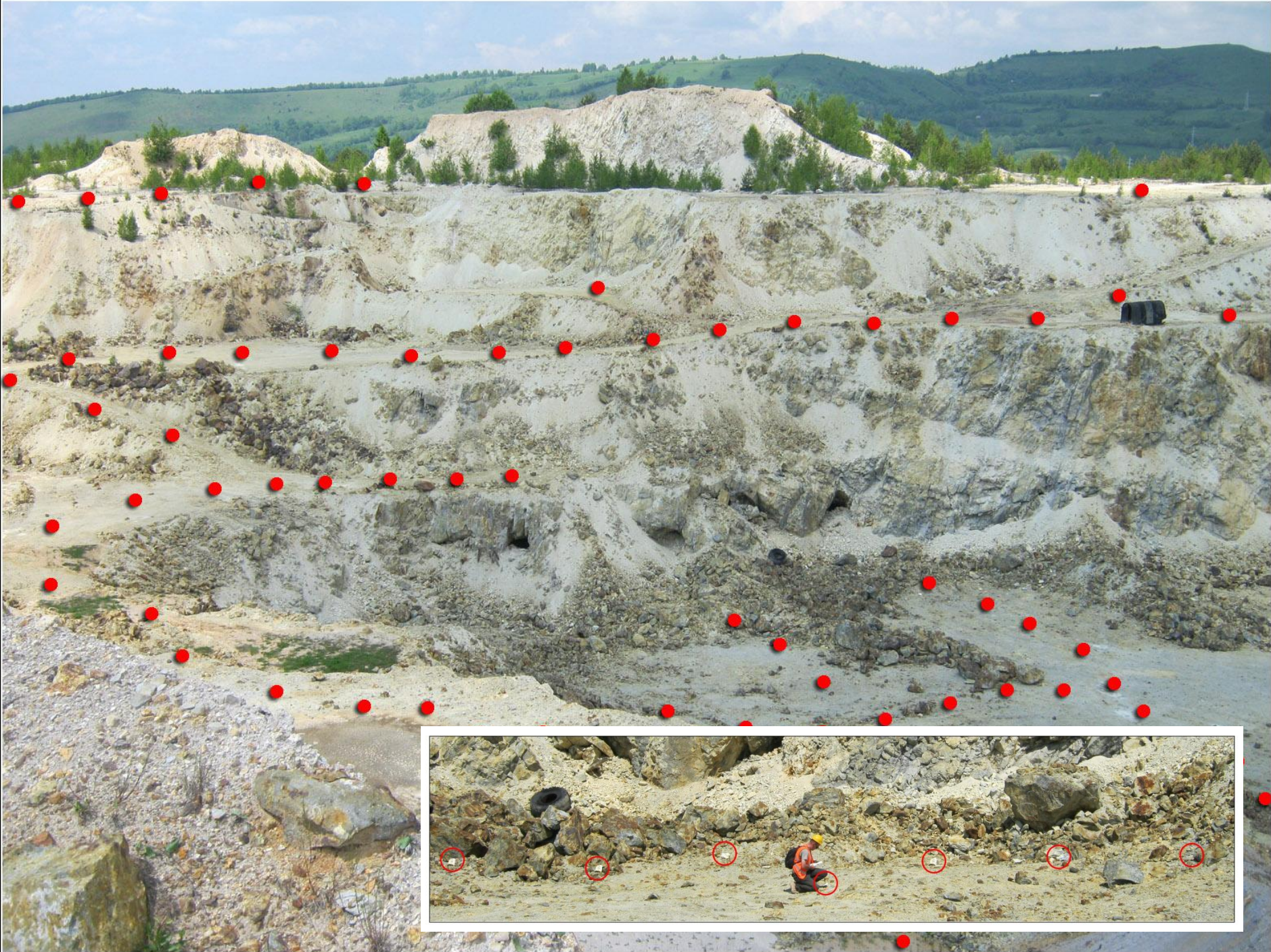






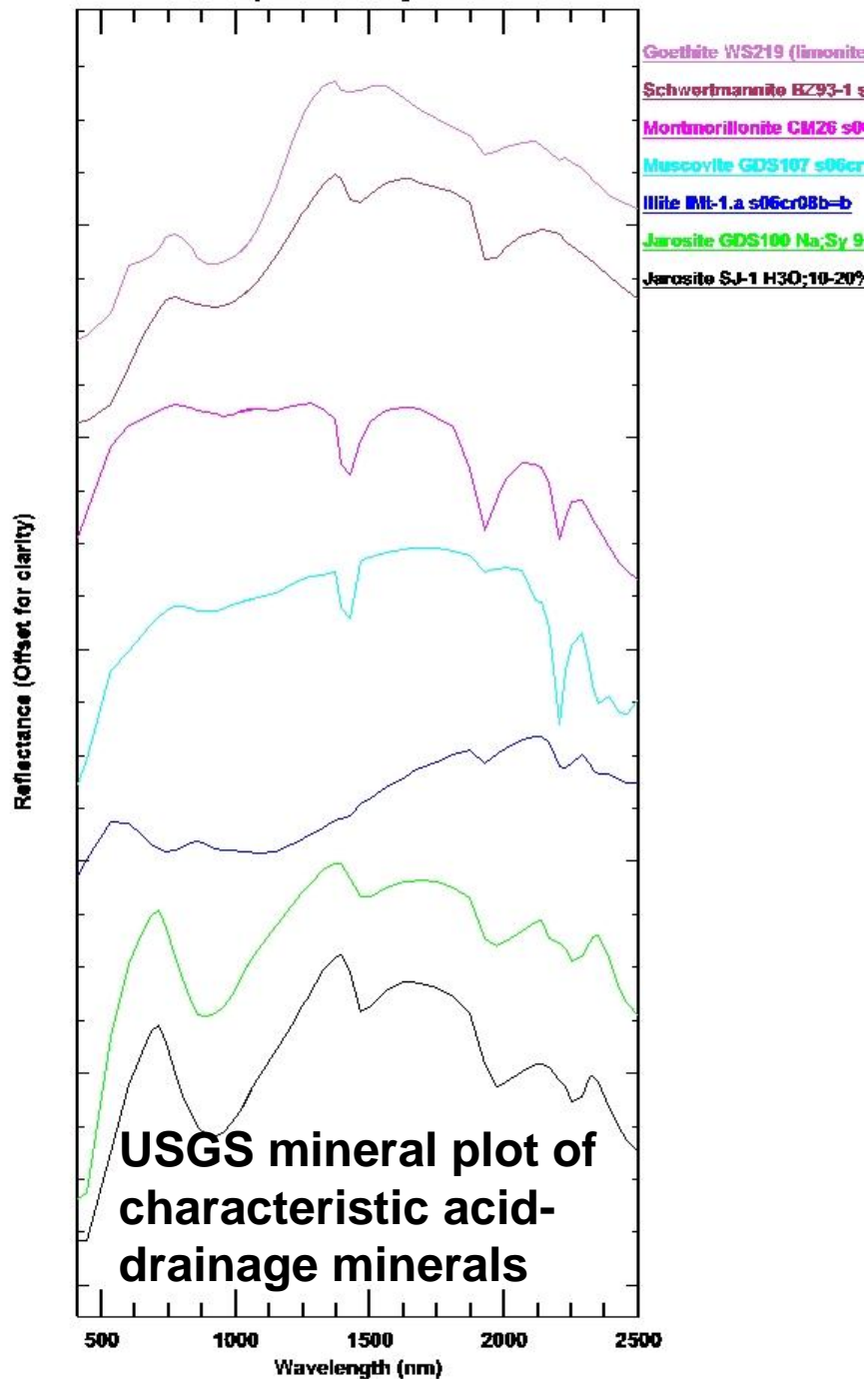
**Samples were GPS marked, measured and labeled in the field and measured with ASD spectrometer in the laboratory conditions for the presence of acid-minerals**



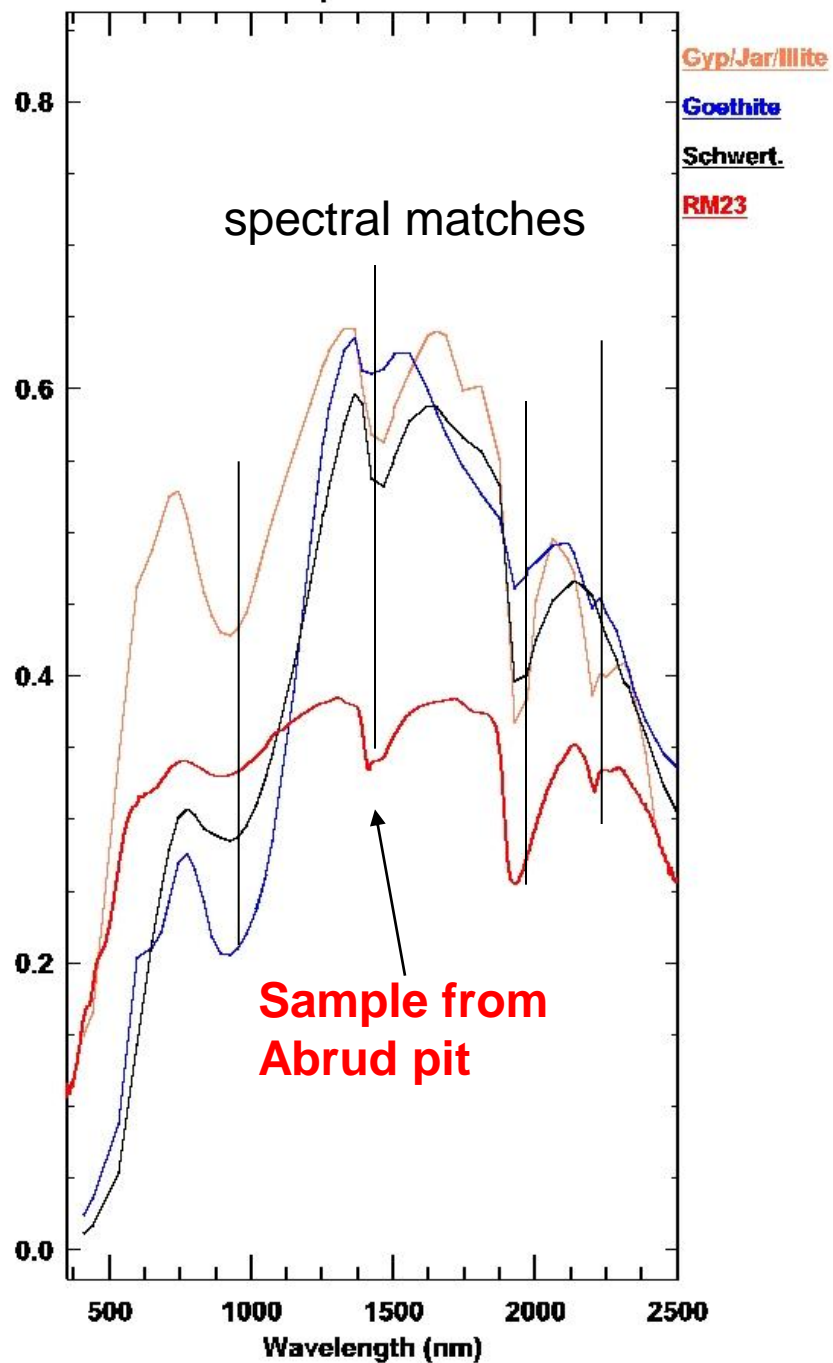




Spectral Library Plots

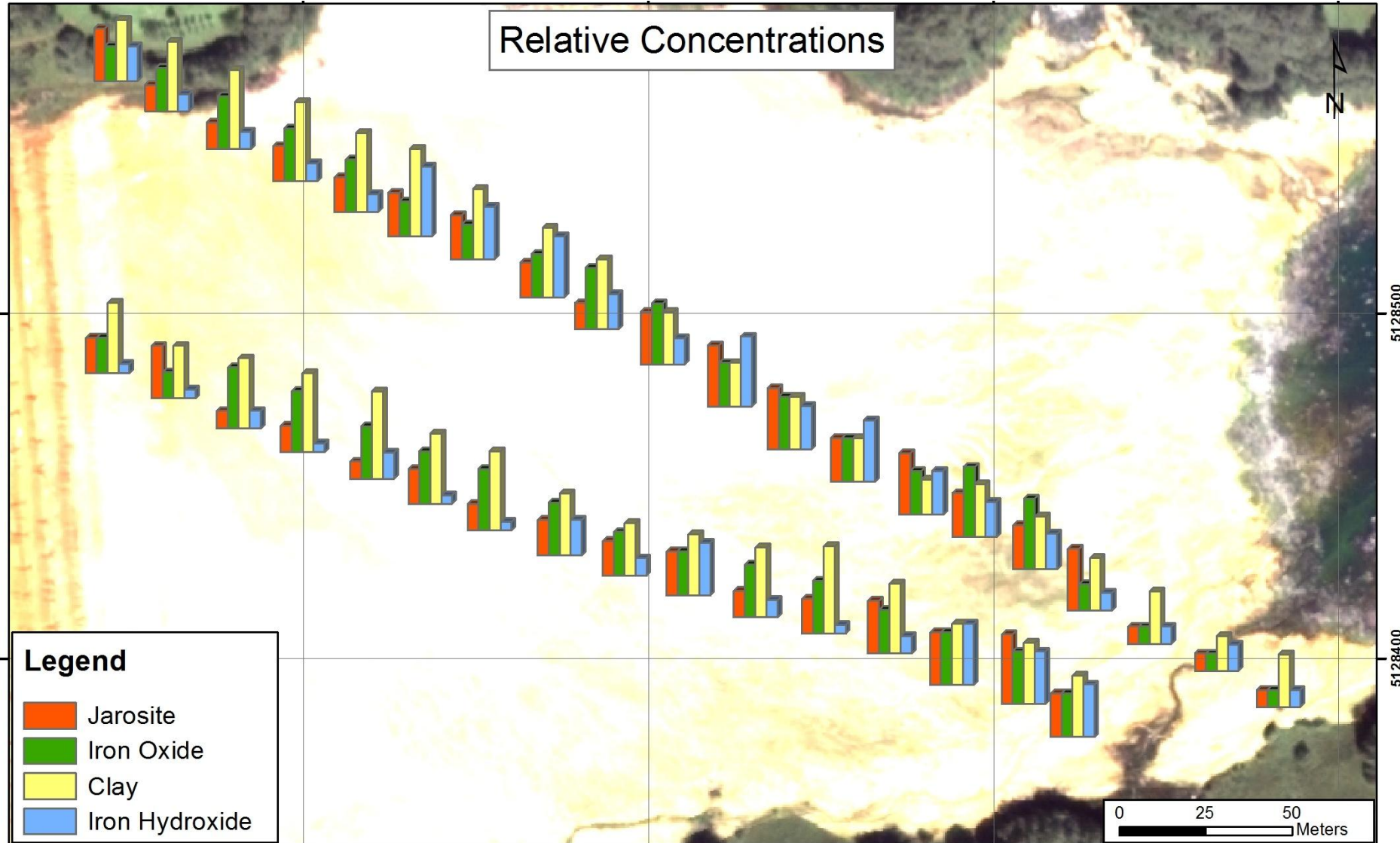


RM Spectral Plots

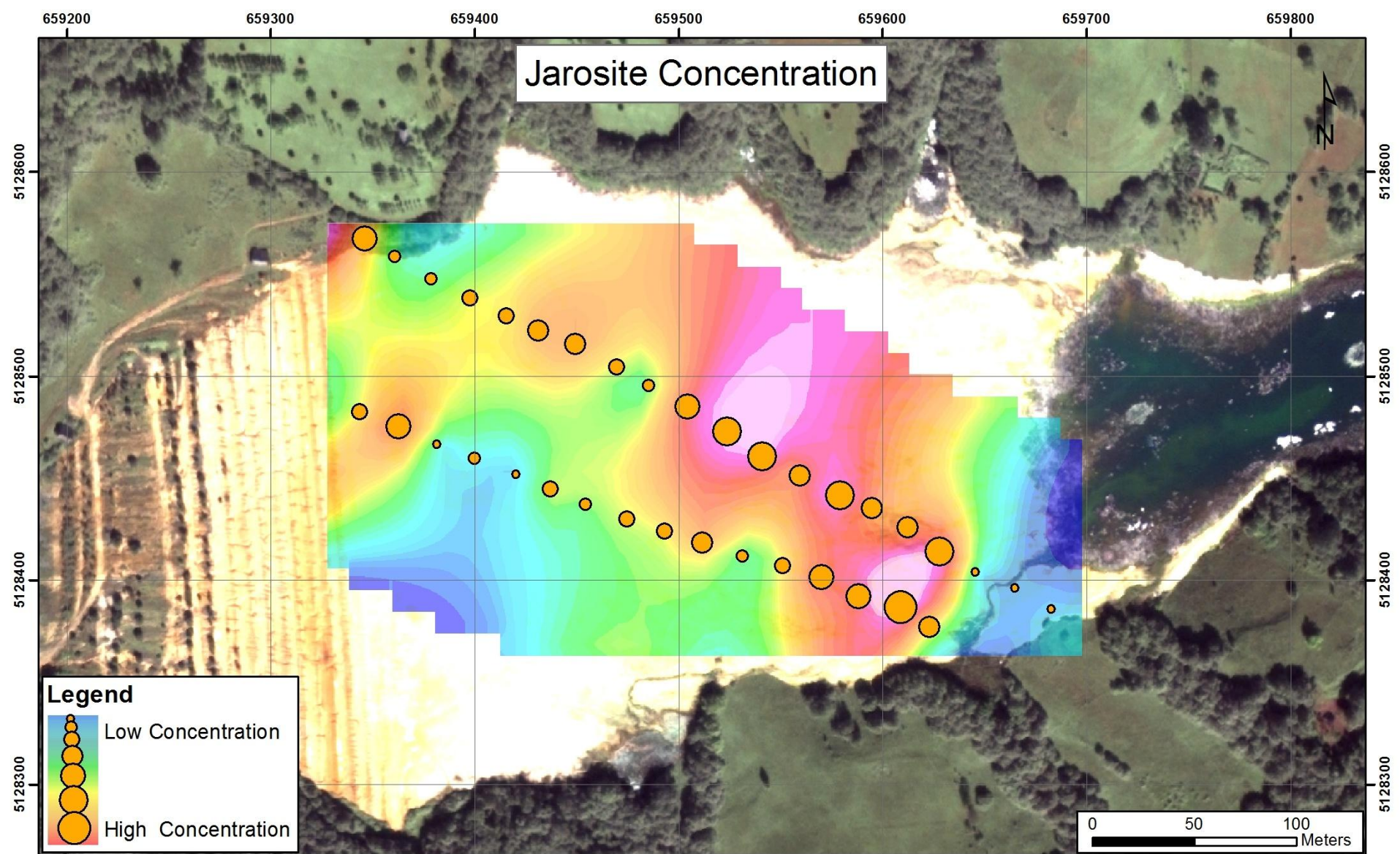




# Abrud tailings dam



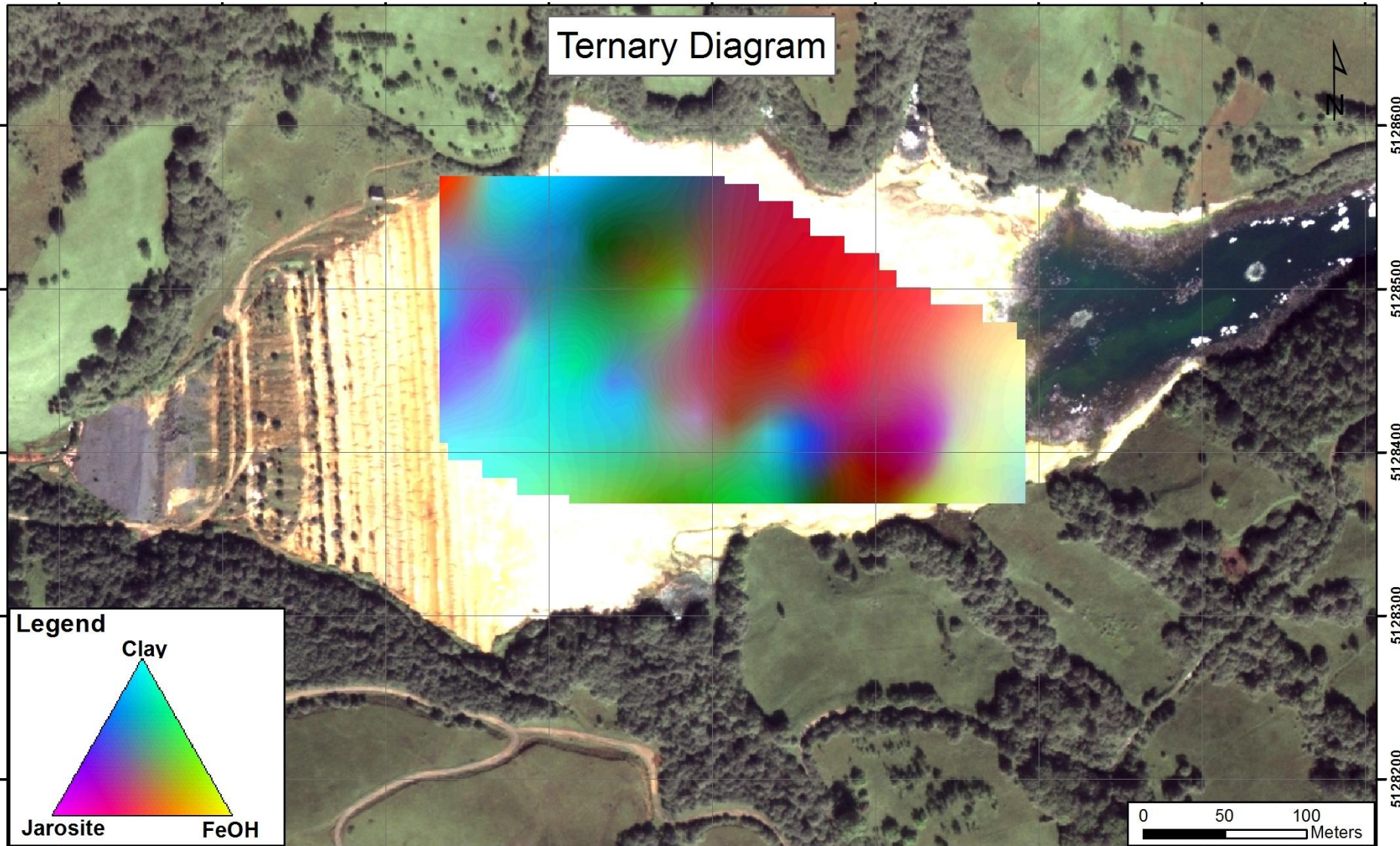




Concentration of sulfate minerals (jarosite), presents those problematic areas where active weathering of sulfide minerals is taking place in reducing conditions and possibility of leaching and remobilization of heavy metals

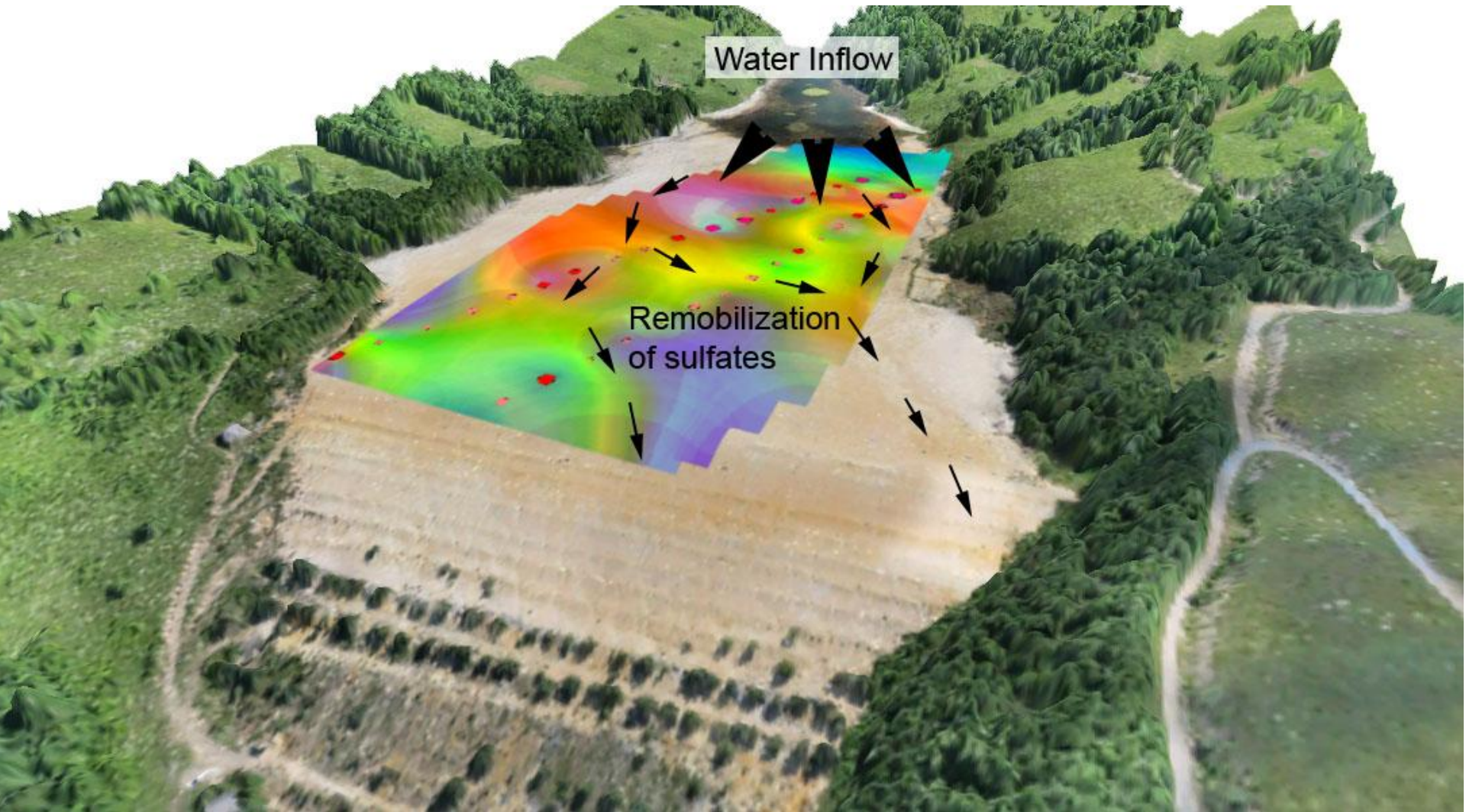


# Ternary Diagram





# Merging Data

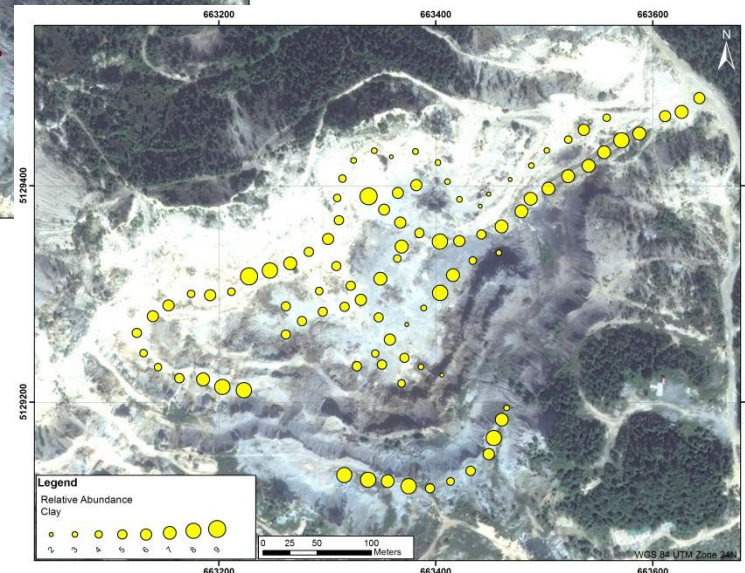
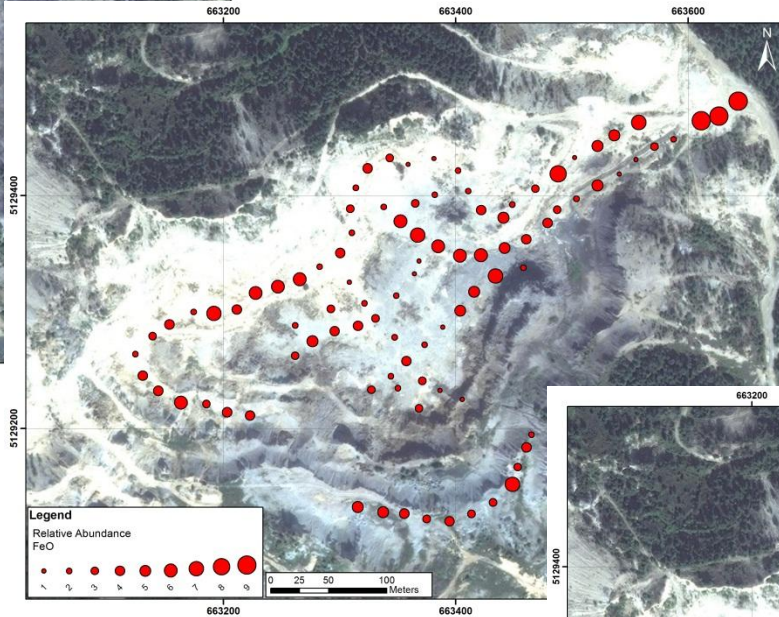
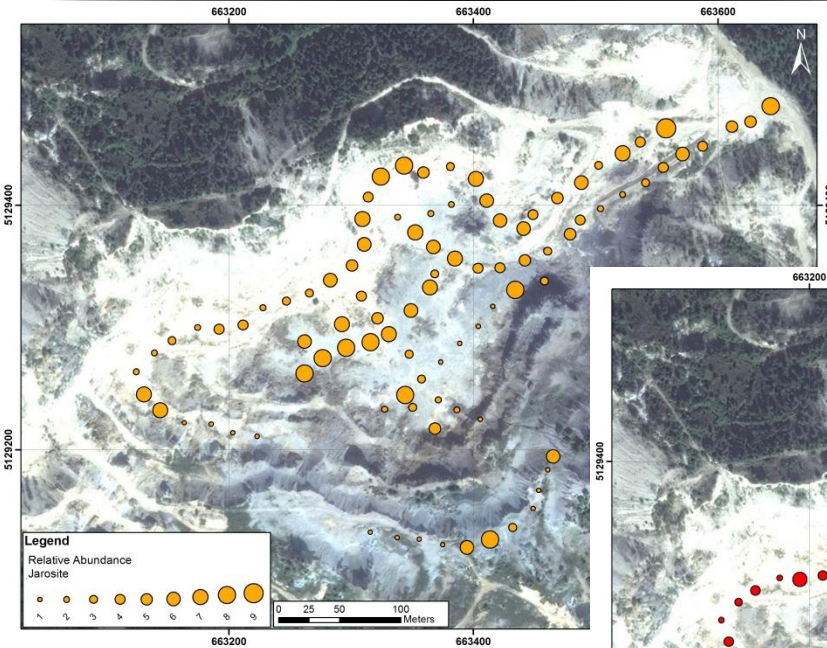


Combining pseudo-hyperspectral data with UAV imagery and derived DEM



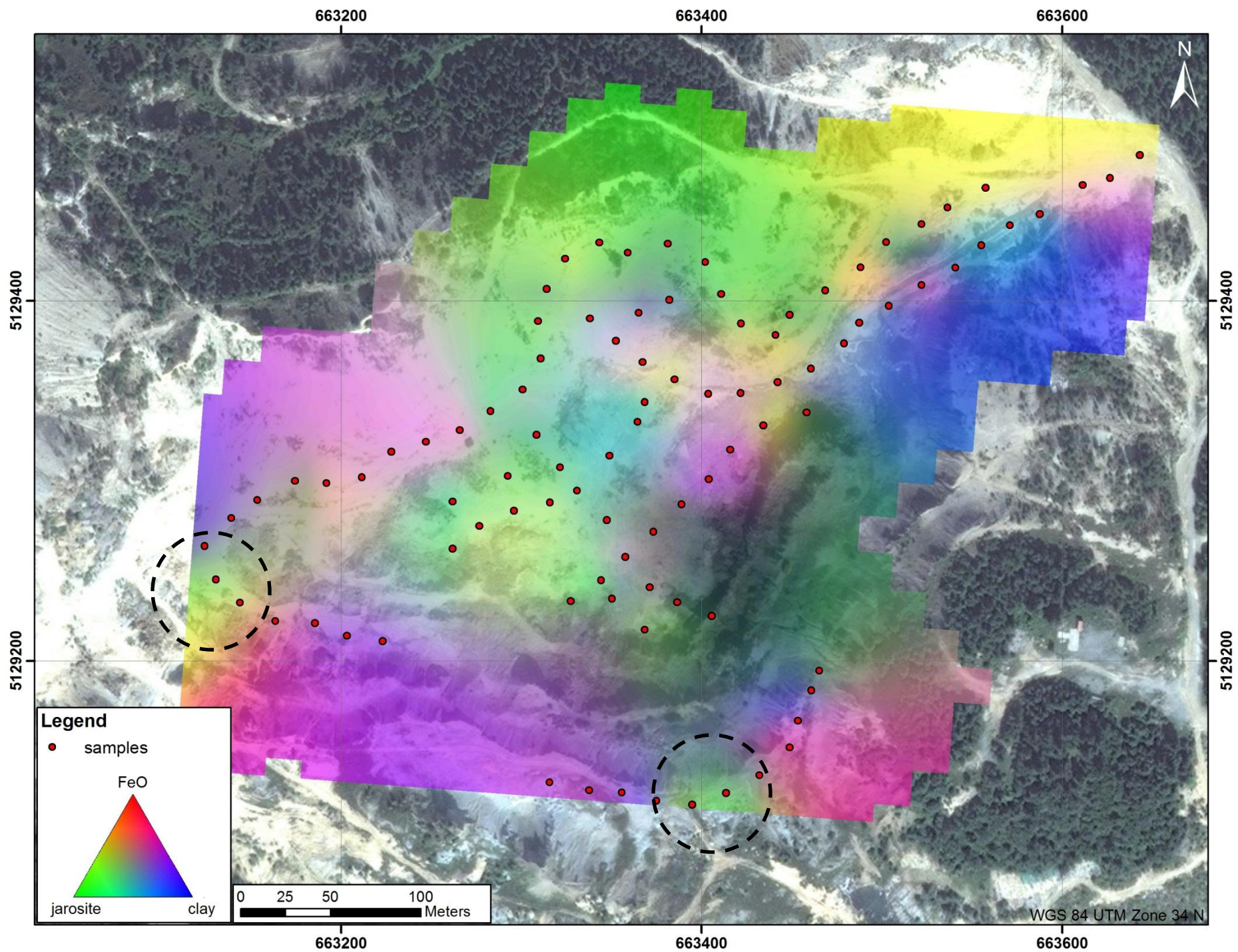
# Celiste Pit

127 samples were collected throughout the Celiste pit



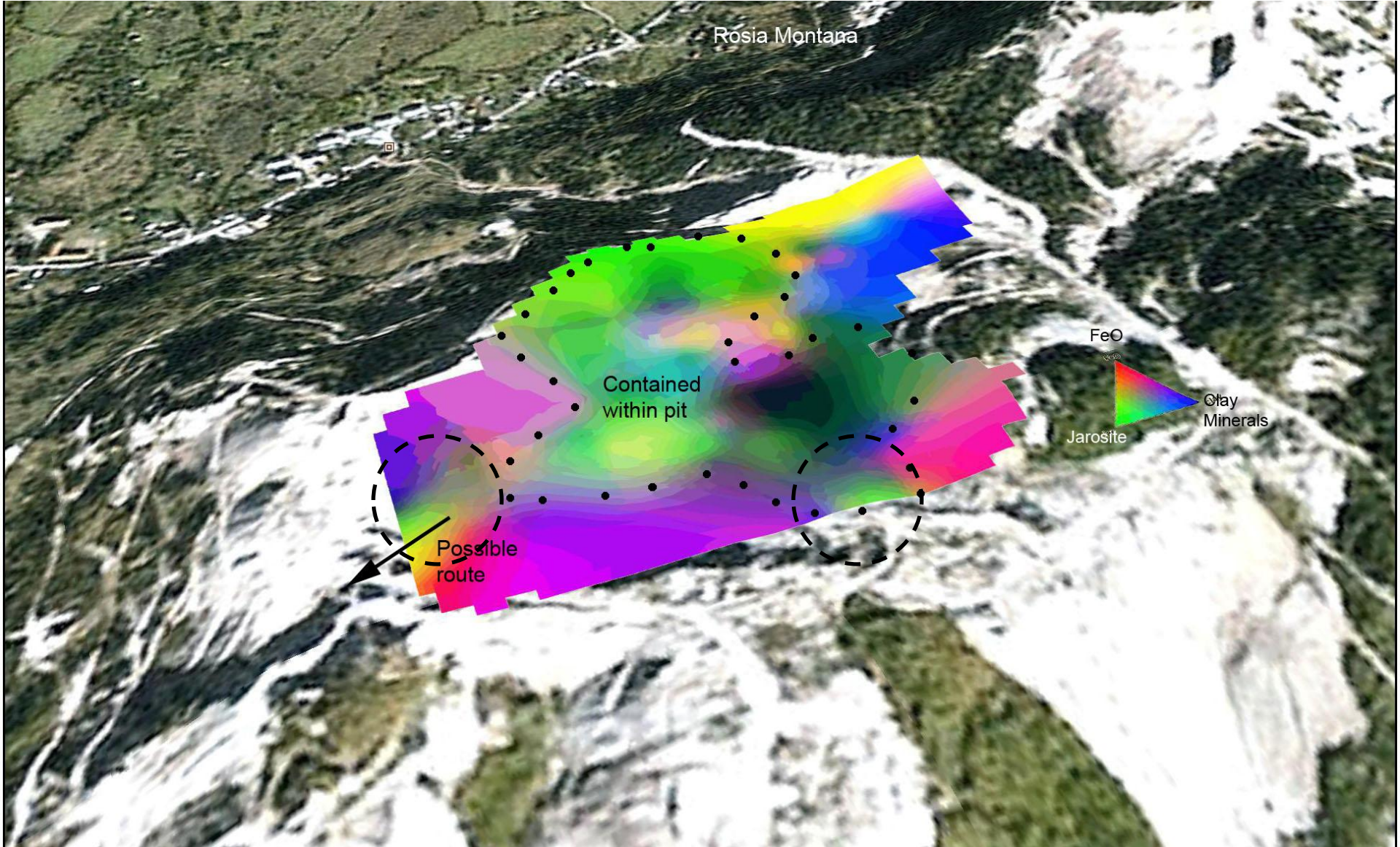
The results suggest that majority of the alteration is contained within the pit itself, but there are couple of areas on the fringe worth investigating







# Ternary Diagram





# Concluding Remarks

- ImpactMin's lessons learned and data acquisition have opened up new ways for investigating sites of interest in the Western Balkans
- Hyperspectral imaging is a valuable tool in indicating surface mineral occurrences, but also pollutants in soil, water, air as well as vegetation stress
- Created useful baselines for other follow-up projects, long-term monitoring and elements for possible future interdisciplinary programs (e.g. Horizon 2020)
- In process of submitting articles on Mostar/Hungary red muds, Zenica pollution and Rosia Montana investigation – contribution to science and input to GEOS.