AI IN MINING

GeoExpOre Pvt.Ltd
Minerals can't be grown & are finite™
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NEURONS AI
WE TEACH MACHINES

About Us

Neurons AI Pvt Ltd

- Neurons AI is one of the fast growing AI services companies in India
- We house some of the finest AI talent with vast experience from the reputed institutes viz IISc, IIT, IIT (ISM) Danbad, IIIT
- We work on diverse complicated data to provide effective and costeffective predictive and learning modeles to our clients.
- We specilize in predictive analytics using ML,DL, NLP and CV.
- Few clients include Toyota, ITC, TCS, Century group, Cadmaxx , Government of Karnataka, Government of India companies.

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GeoExpOre Pvt Ltd

- One of the top 14 companies in India empaneled by Government of India, Ministry of Mines as a Private exploration company.
- One of the top companies in India accredited by QCI-NABET , India.
- Mineral Discoveries is our what we deliver to our clients.
- We are a tech driven company who use drones, airborne geophysical studies and AI powered NeuronsAI Products to discover Minerals.
- GeoExpOre house an experienced talent pool from the top campuses for earthscience in India from Nandihalli, IIT (ISM) Danbad, IIT Mumbai and IIT Karagpur.

AI IN MINERAL EXPLORATION:EVOLUTION

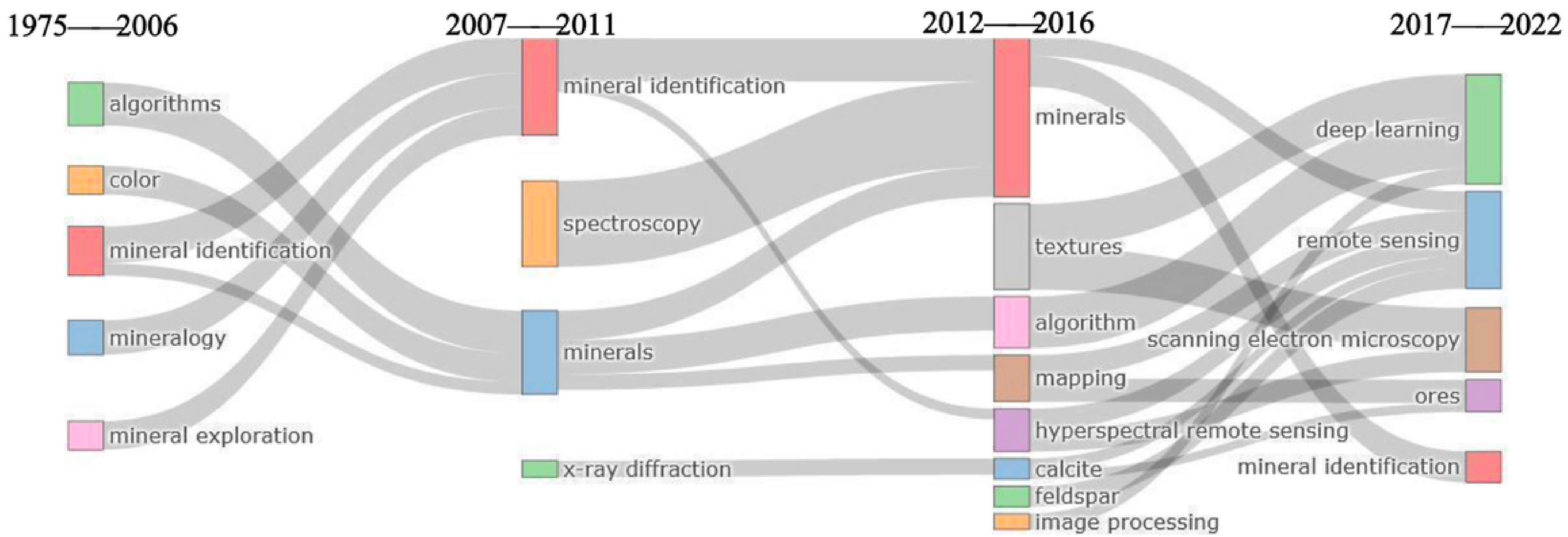


Figure . Thematic evolution diagram for the field of intelligent mineral identification.

- The evolution of intelligent mineral identification has seen initial work on using known mineral powders for calibration.
- Before 2006, the focus was on efficient algorithms and color characteristics in basic mineral identification. After 2006, there was a shift towards utilizing X-ray diffraction for precise identification.
- Post-2012, research explored mineral image processing and hyperspectral remote sensing, emphasizing textures.
- From 2017, deep learning gained prominence, with active exploration of various identification methods, including remote sensing and scanning electron microscopy, broadening the scope to include a diverse range of ore types.

What Is Mineral Exploration?

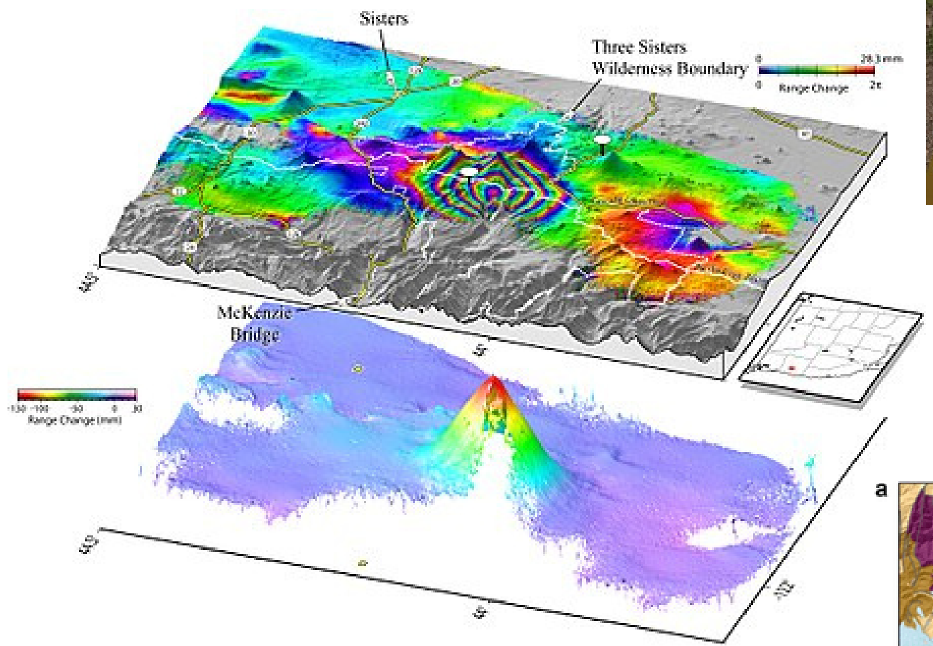
- Exploration is the initial process in the mining value chain.

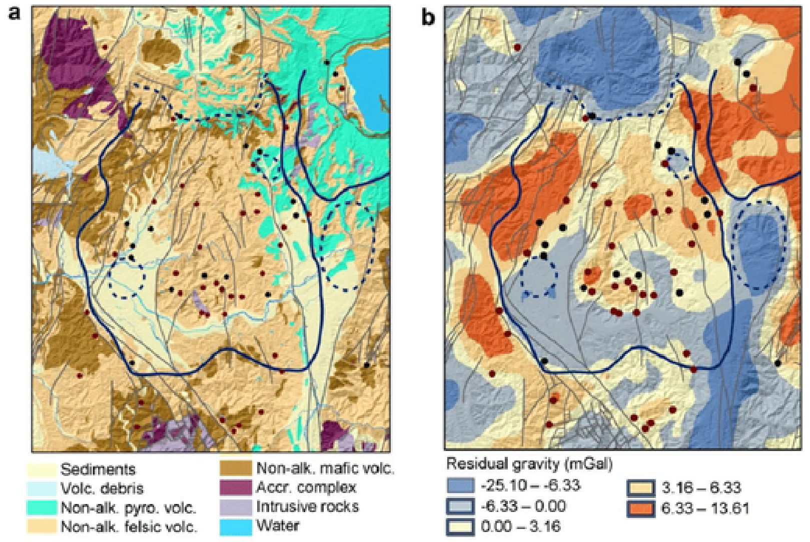
- During exploration, activities such as mapping, and mineral analysis and prospecting are carried out to estimate the mineral location and reserve size.

- This information is then used for mine planning and cost estimation to identify a feasible operating approach to gain investment to proceed with setting up the facilities to extract the economically feasible minerals

- Remote Sensing
- Geological Mapping
- Geophysical Surveys
- Geochemical Surveys
- Bulk Sampling
- Drilling (core or destructive)

Exploration Methods





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Remote Sensing and Machine Learning Methods

- **Machine learning can process various remote sensing data:**
  - **Satellite data:** Identify lithological units, alteration zones, and indicator minerals using spectral analysis.
  - **Airborne data:** Extract detailed structural information with LiDAR and hyperspectral data for precise targeting.
  - **Ground-based data:** Combine with other data sources for comprehensive analysis and validation.

- **Different techniques for diverse tasks:**
  - **Supervised learning:** Train models to classify specific features like lithology or alteration zones based on labeled data.
  - **Unsupervised learning:** Discover hidden patterns and anomalies in unlabeled data, potentially leading to new exploration targets.
  - **Deep learning:** Analyze complex relationships within large datasets, particularly useful for hyperspectral imagery.

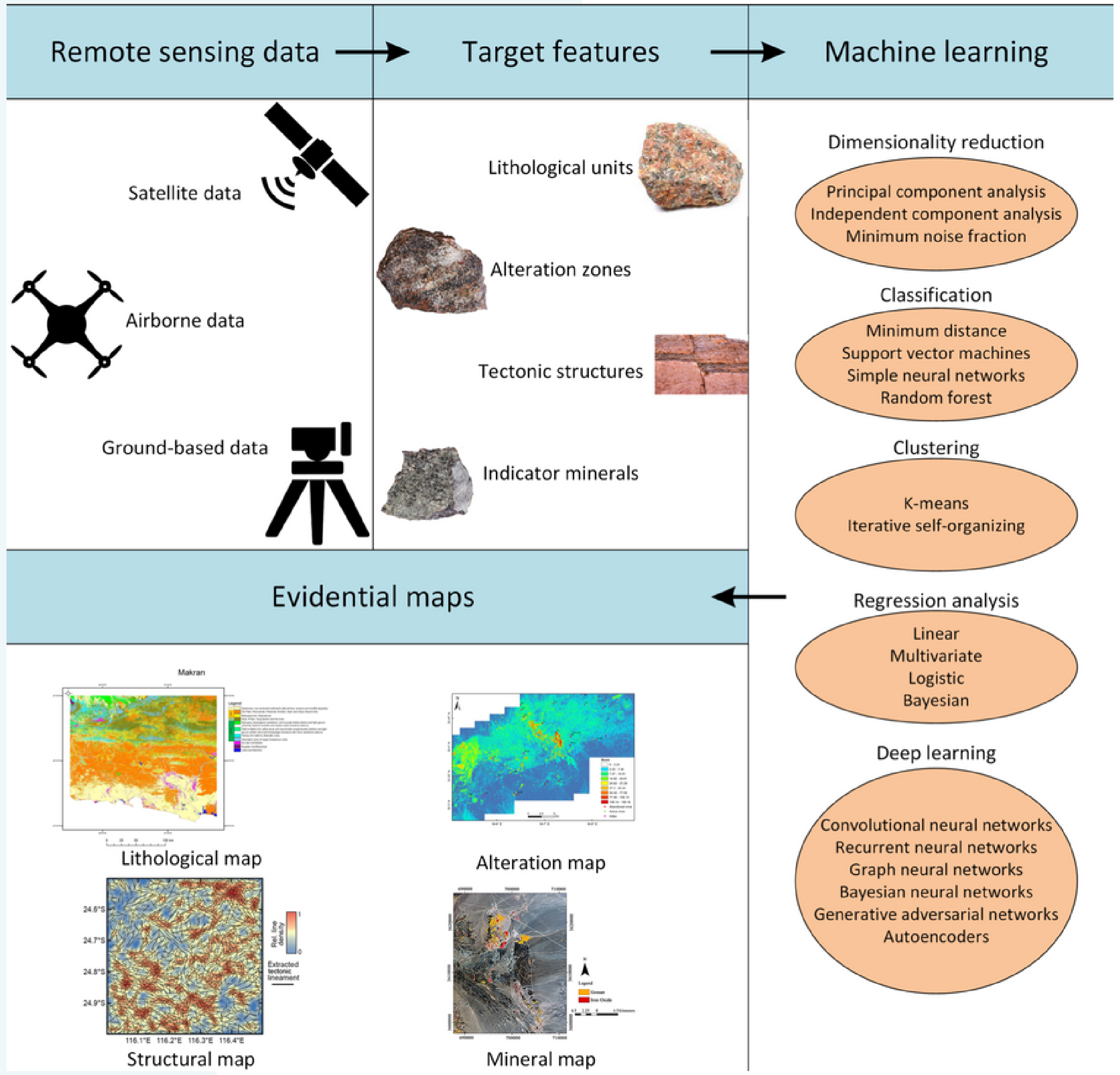


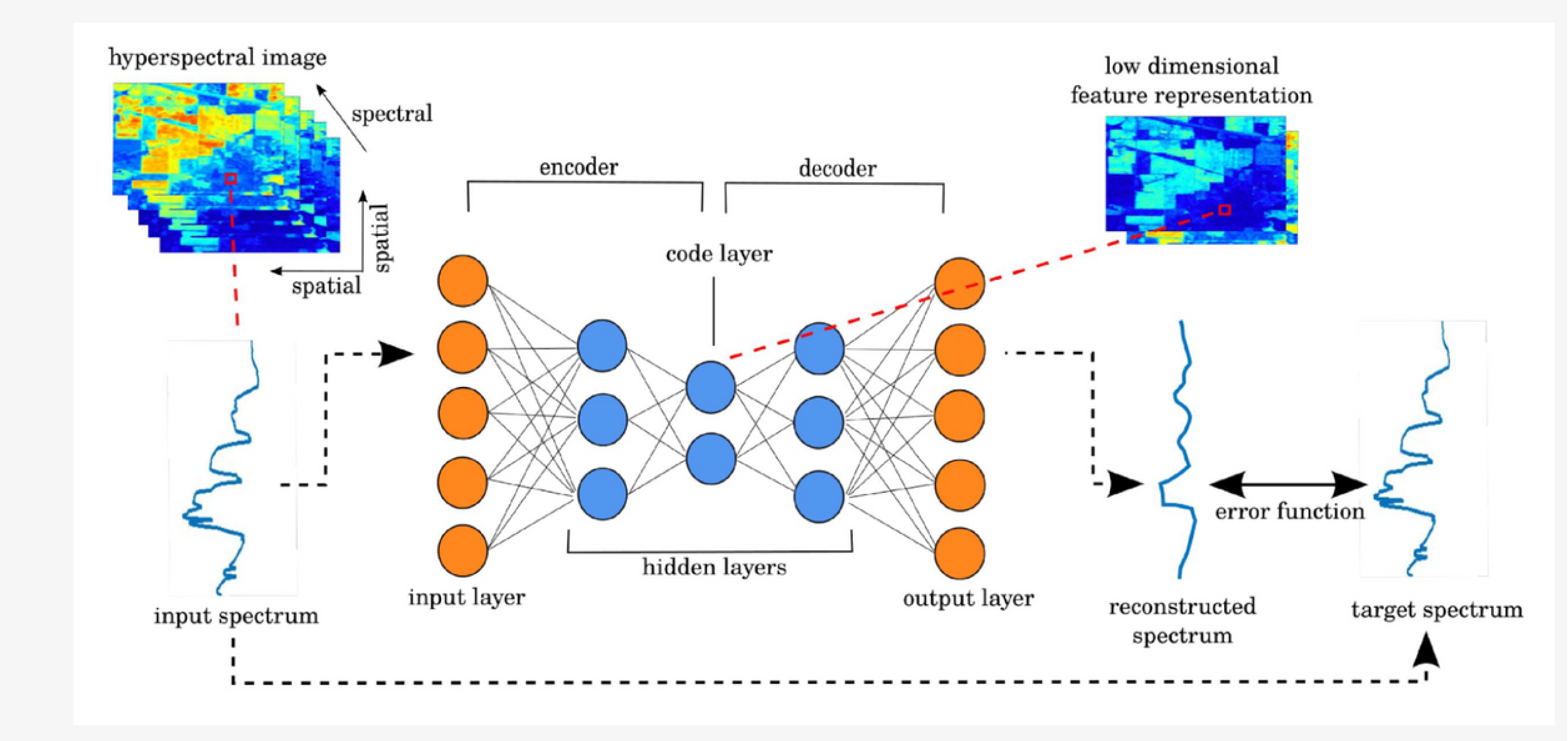
Figure : Workflow of using the combination of remote sensing data and machine learning methods for creating evidential maps.

AUTOENCODERS AND REMOTE SENSING FOR MINERAL EXPLORATION

In the context of hyperspectral data, an autoencoder is employed for unsupervised feature learning. Each individual spectrum, representing both input and reconstruction target, contributes to the training process.

The reflectance or intensity at each wavelength corresponds to input neurons, and as the network learns to reconstruct, the code layer condenses into a powerful feature representation.

Post-training, the encoder efficiently maps input spectra to a reduced-dimensional feature space, offering valuable dimensionality reduction when the code layer has fewer neurons than the input layer.



Case Study :Advanced Mineral Prospectivity Mapping for Cu/Zn Deposits through Supervised Deep Learning using Geophysical, Geological, and Geochemical Data

1 Objective

Advanced geological mapping and sampling methodologies employed to develop a detailed understanding of the geological framework, encompassing structural controls, lithological variations, magentic and gravity anomalies along with the digital elevation data that may influence the distribution of Cu/Zn anomalies.

2 Dataset

- Dataset comprises geophysical, geochemical, and geological data
- Geophysical data includes lines, faults, magnetic and gravity anomalies, focusing on subsurface characteristics.
- Geological/geochemical data involves Stream Sediment and Lithology observations, analyzing rock formations and structures.
- Aster Data, employing remote sensing techniques, contributes to geophysical data by studying surface properties.

2

Methodology

- The main challenge lies in feature engineering due to the vast and varied data presented in different file formats.
- The aim is to integrate these multidimensional datasets, forming the basis for a predictive model that predicts regions with high anomalies for the minerals.
- Using the coordinates, a boundary dataset is constructed, overlaying all other data, creating different channels for each type of data.
- Train AI/ML model and apply to all pixels, visualise results
- Evaluate performance with a randomly selected testing subset and repeat with stratified classes.
- Parameter Tuning based results obtained and desired output.

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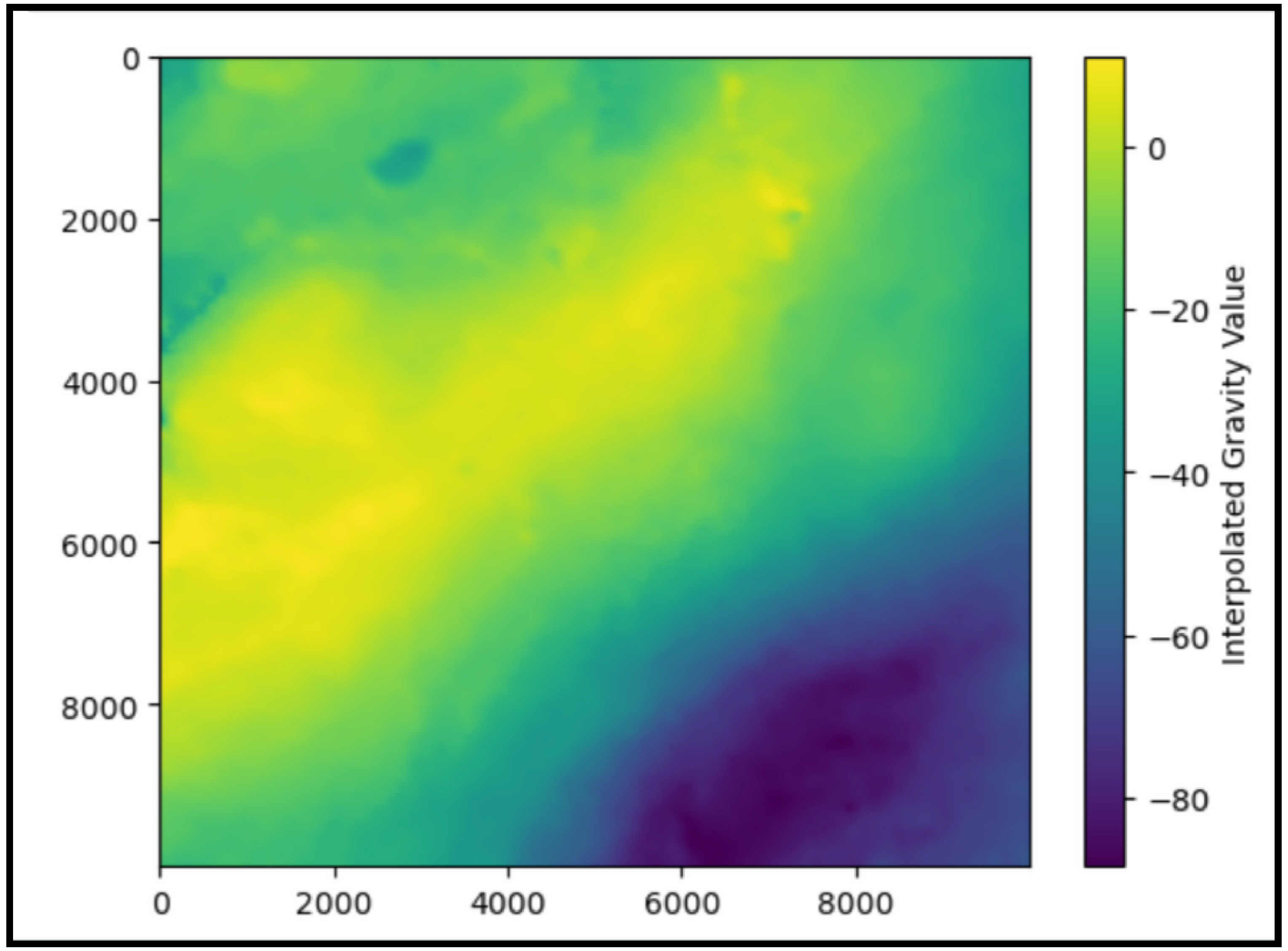
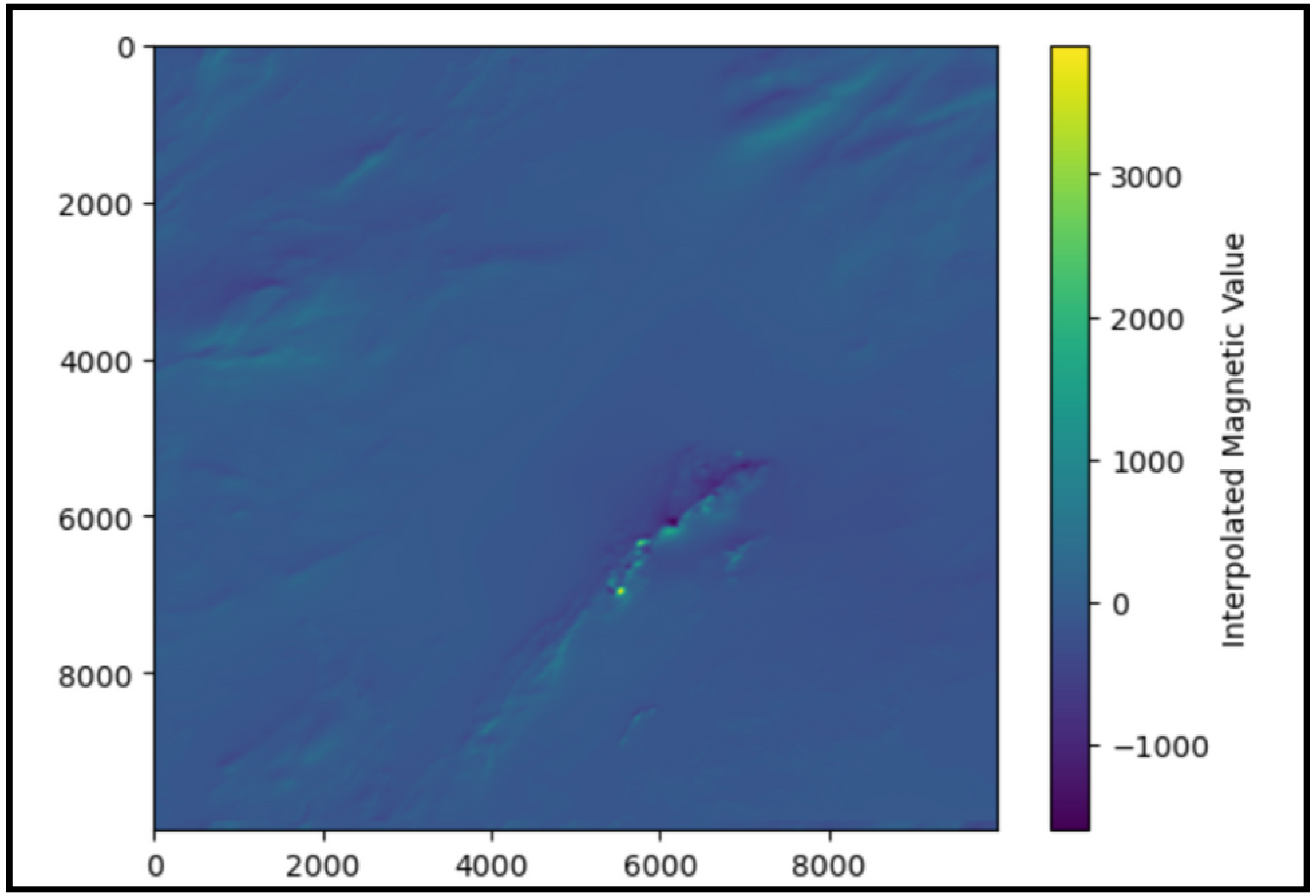
Advanced Mineral Prospectivity Mapping for Cu/Zn Deposits through Supervised Deep Learning using Geophysical, Geological, and Geochemical Data



Gravity



Magnetic

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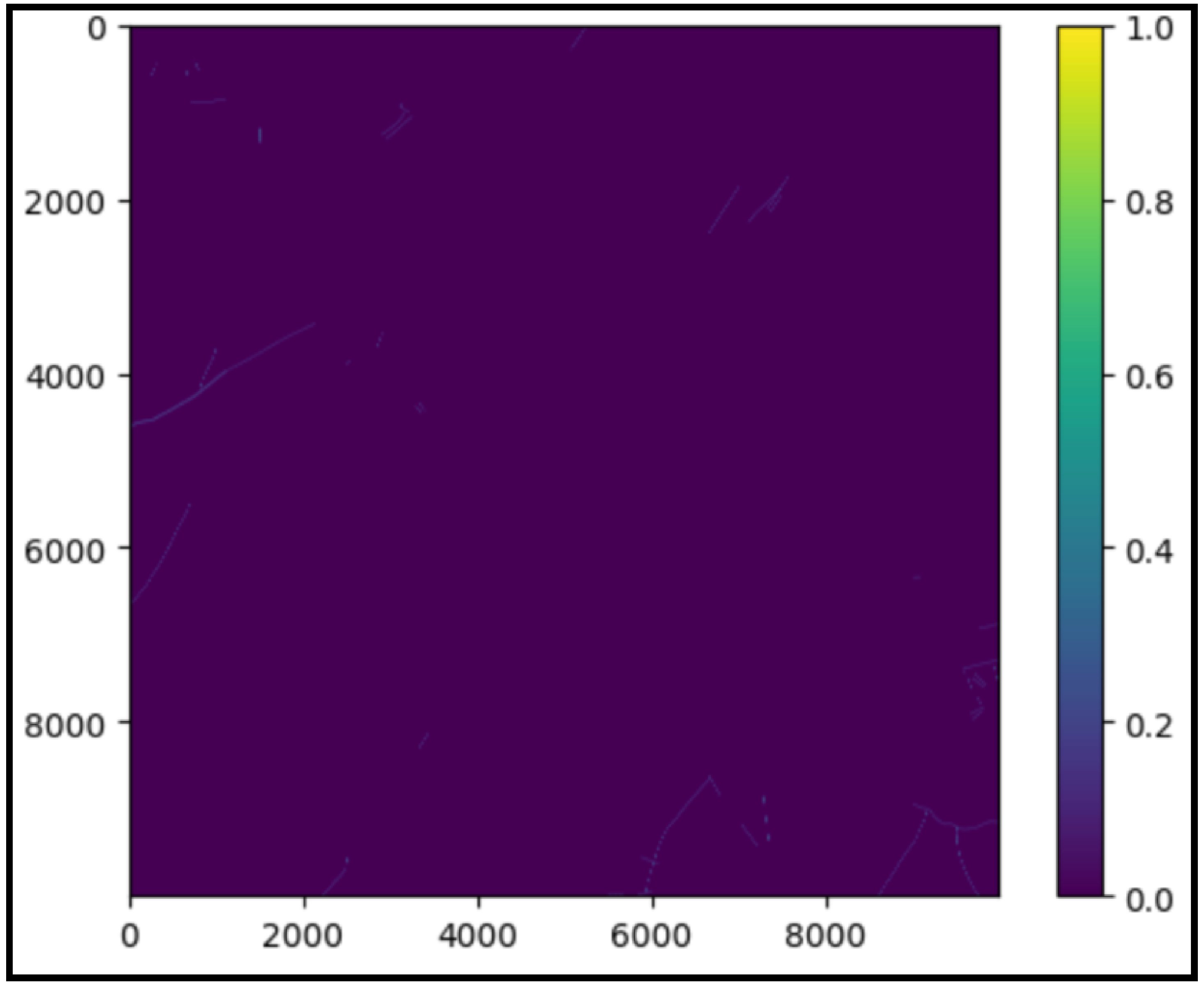
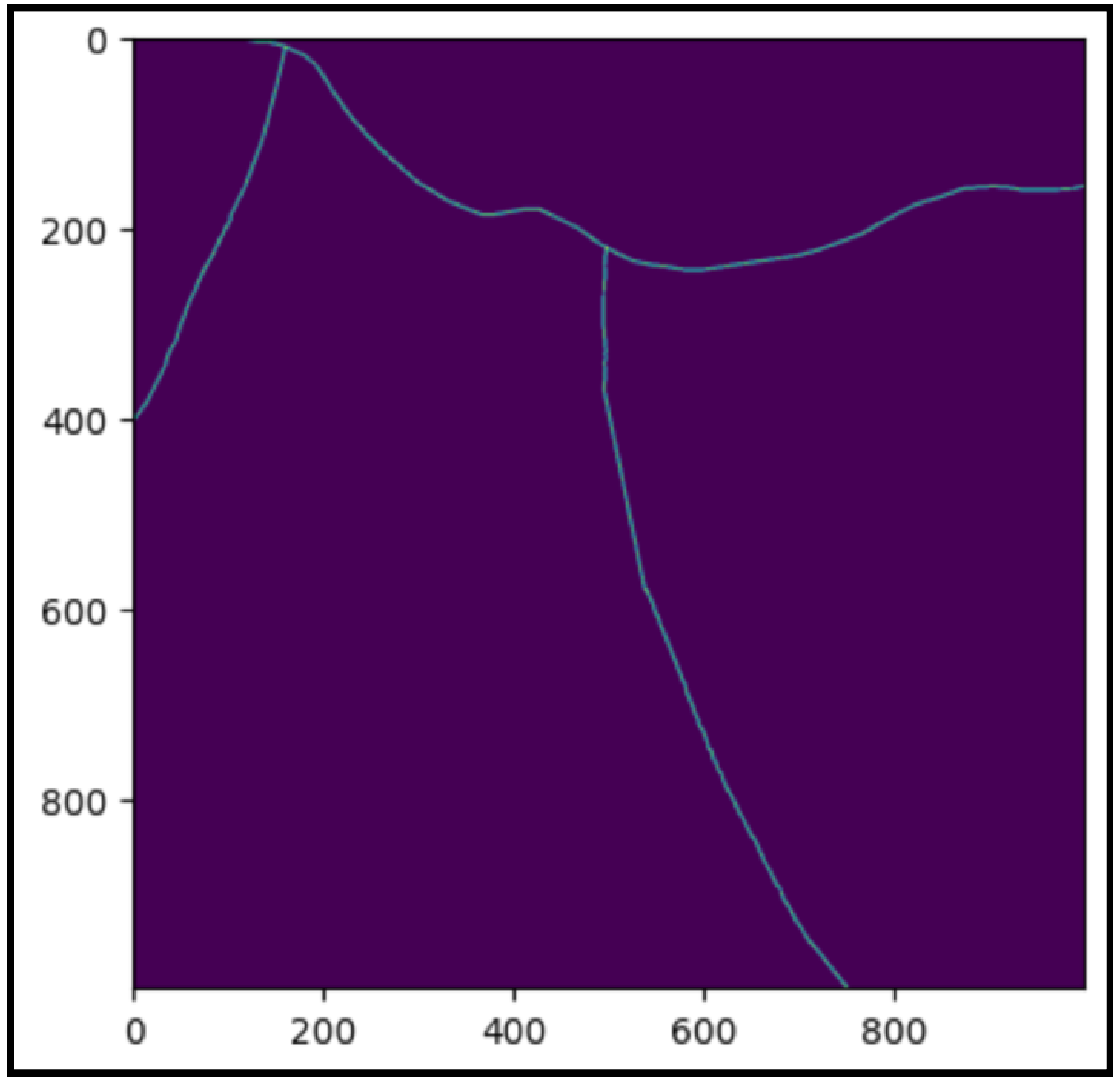
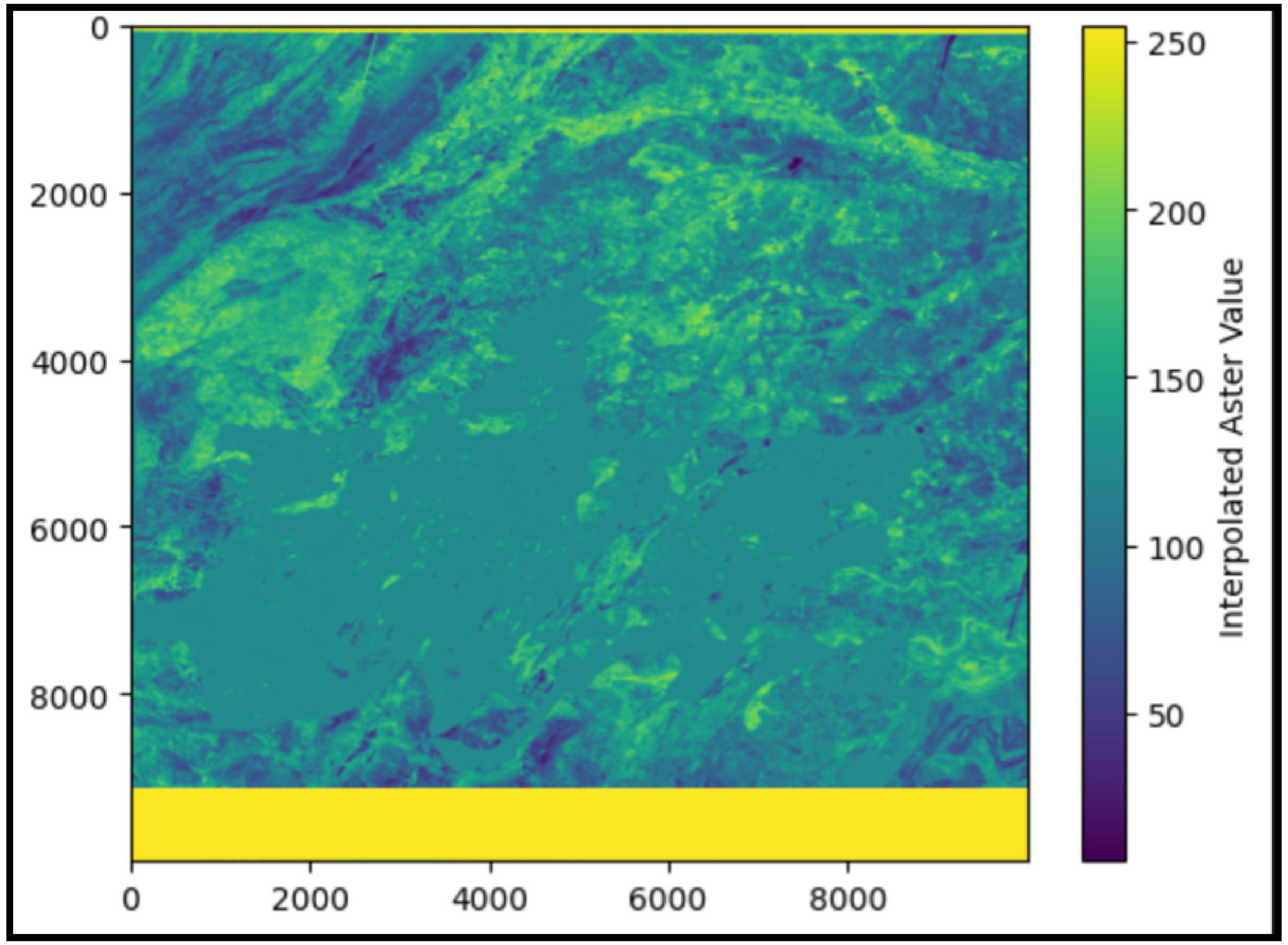


Fault

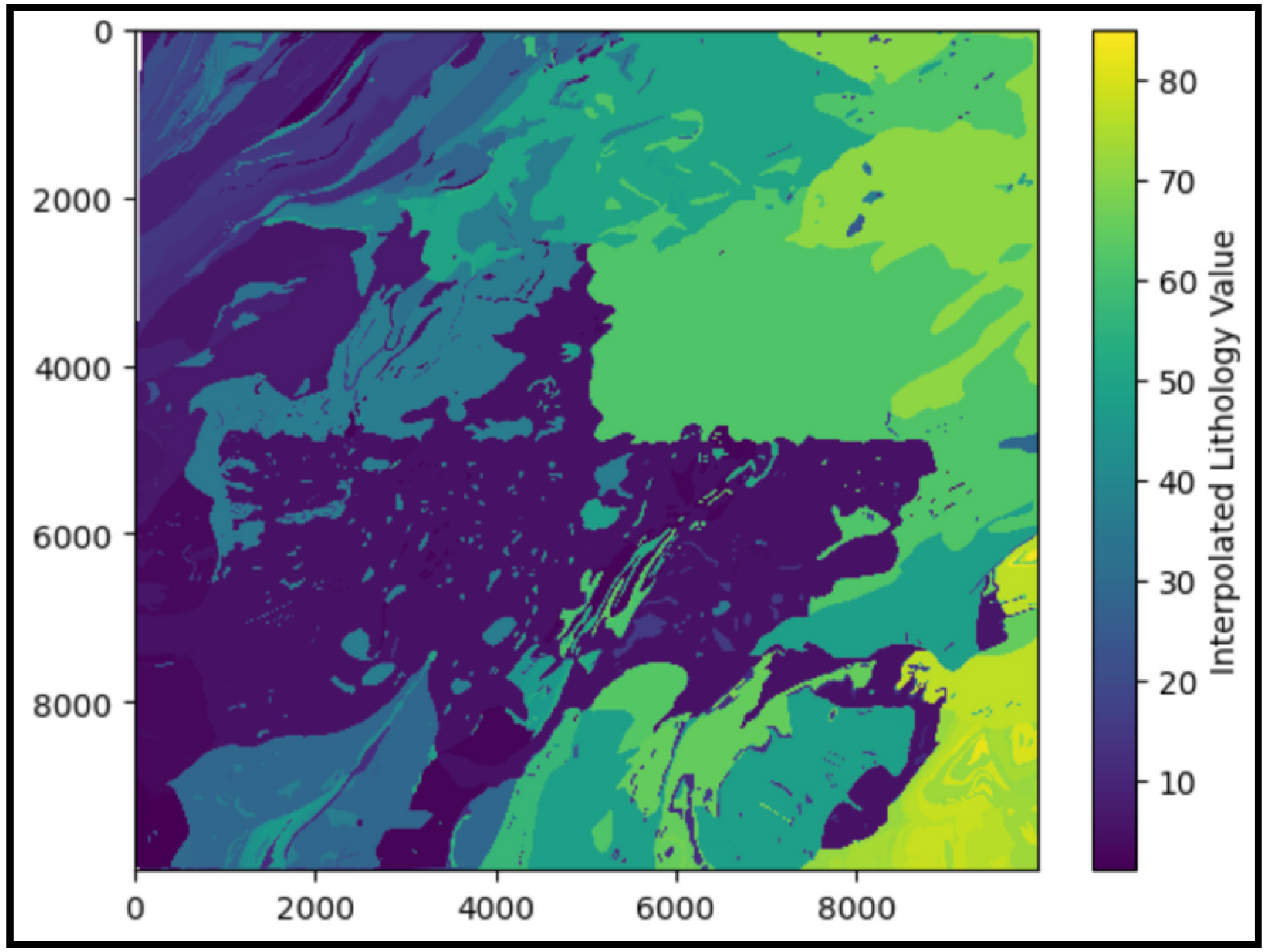


Fault(Higher Resolution)

Advanced Mineral Prospectivity Mapping for Cu/Zn Deposits through Supervised Deep Learning using Geophysical, Geological, and Geochemical Data

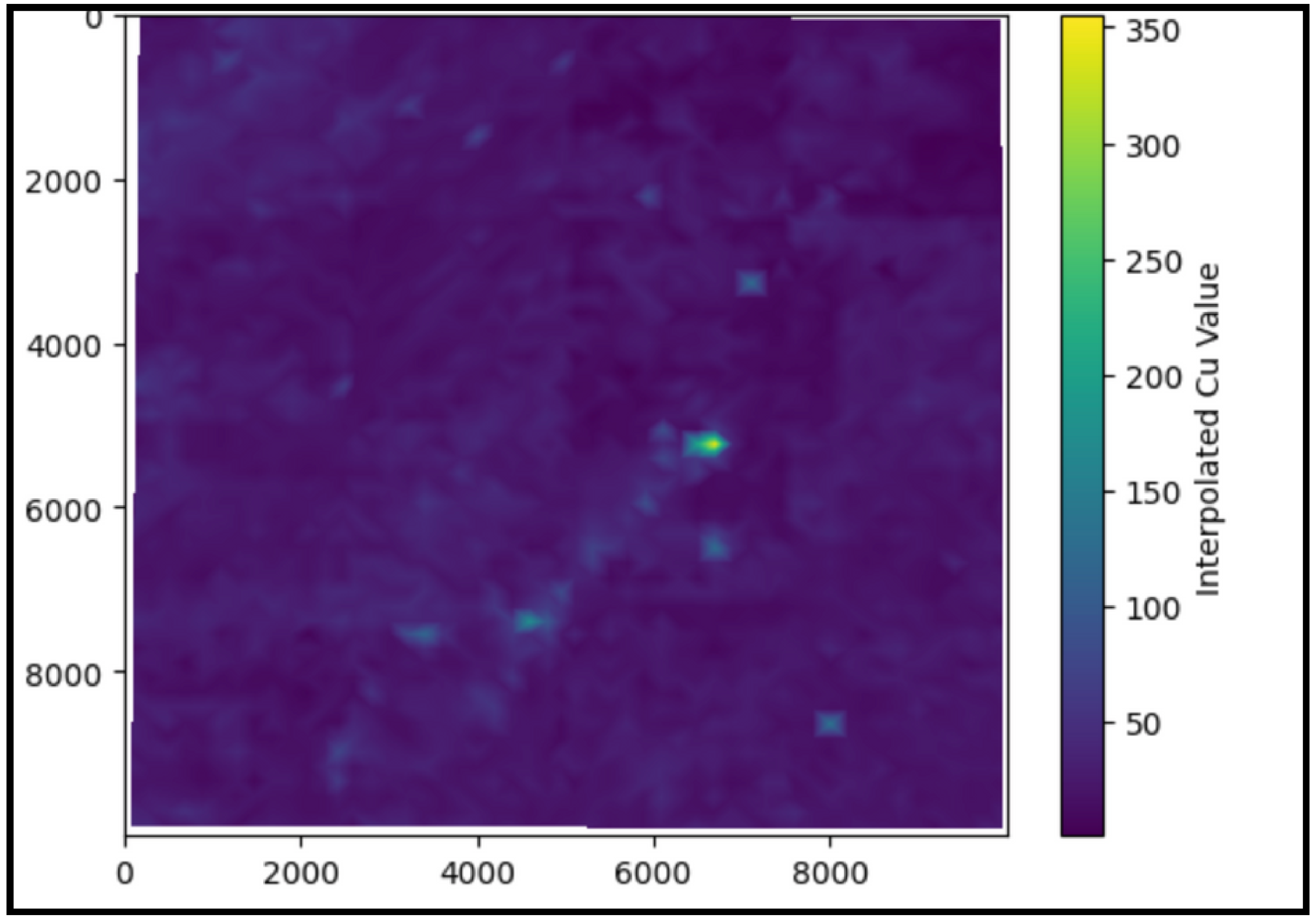


Aster

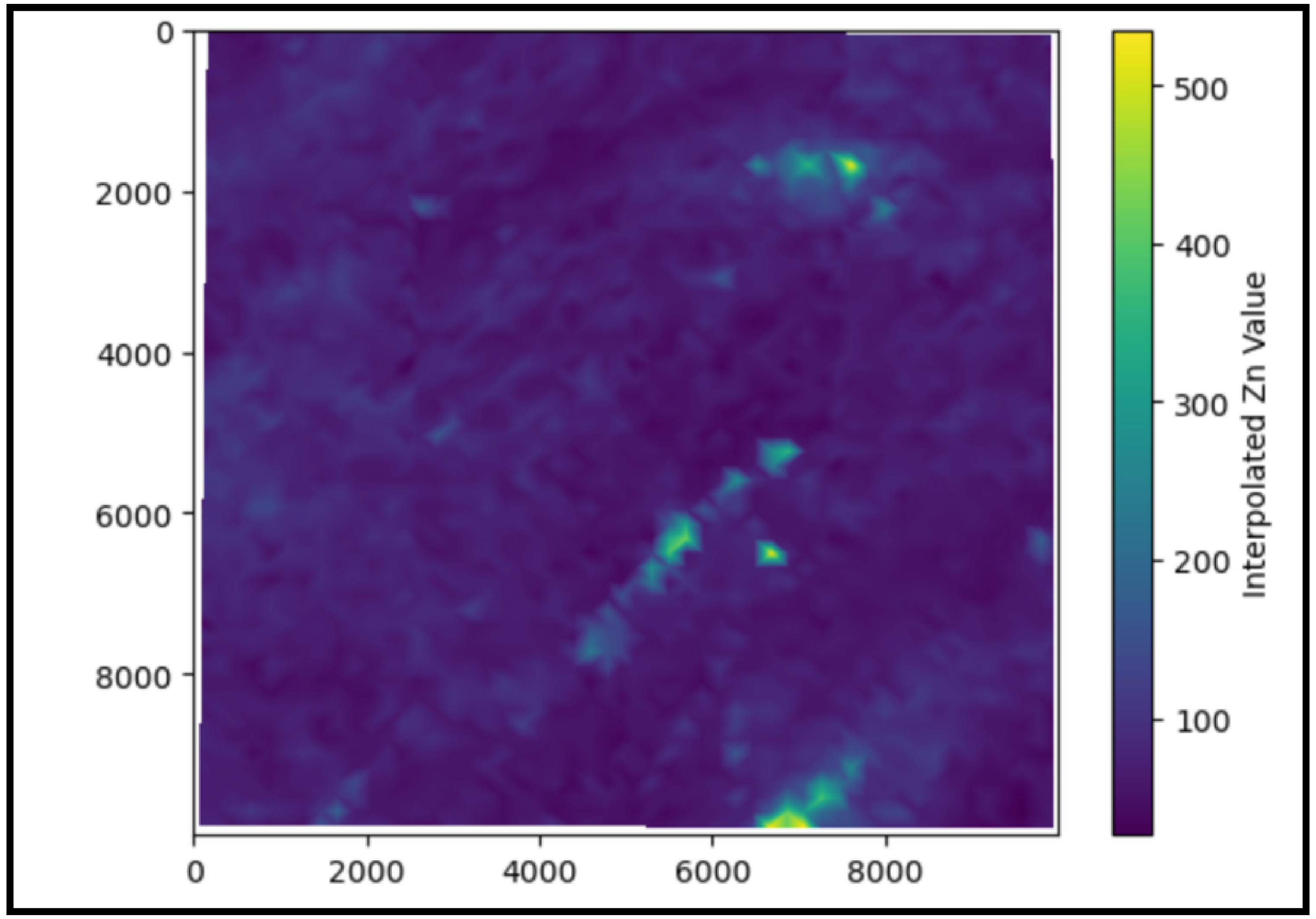


Lithology

Advanced Mineral Prospectivity Mapping for Cu/Zn Deposits through Supervised Deep Learning using Geophysical, Geological, and Geochemical Data



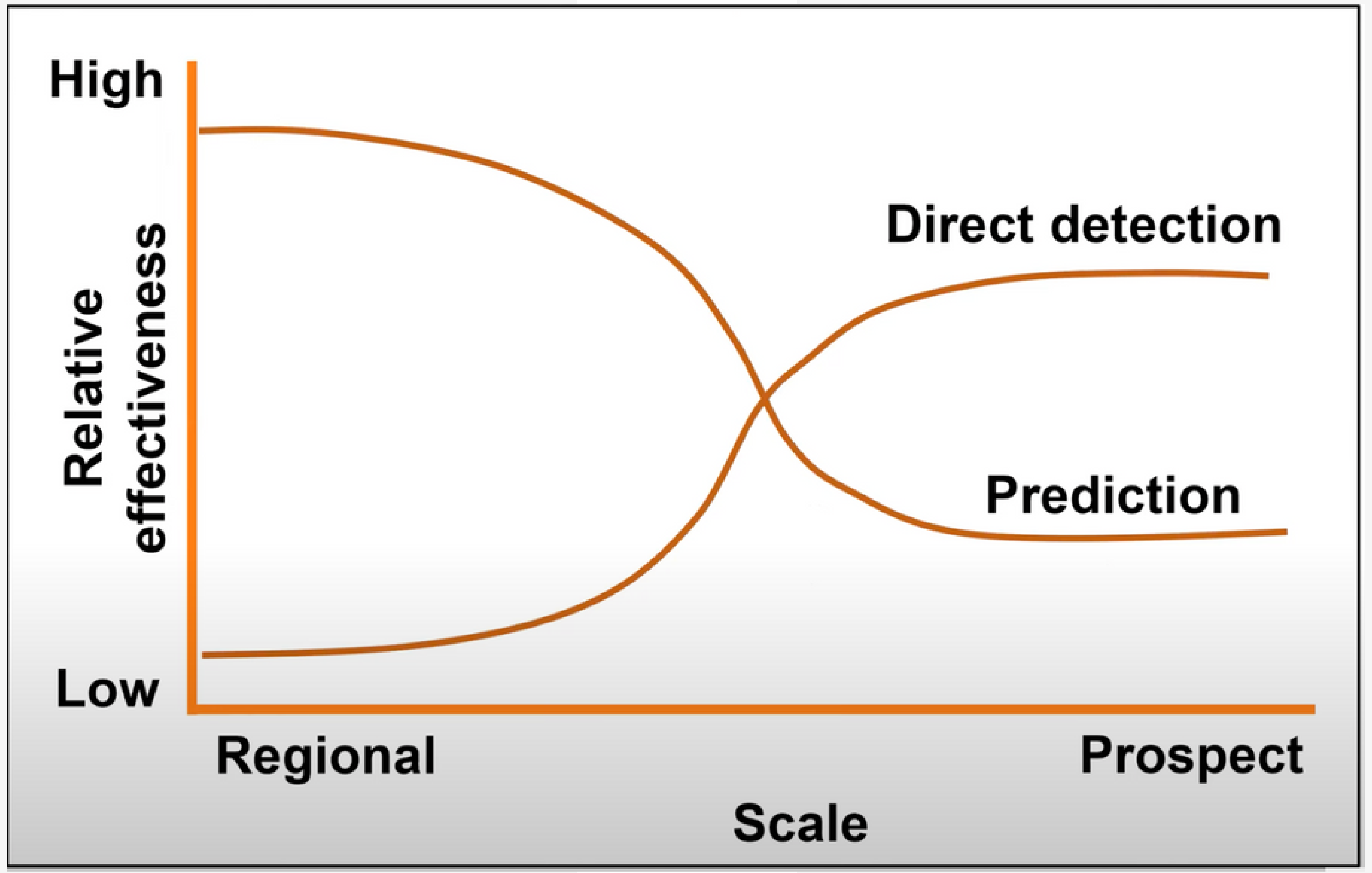
Stream Sediment
(Cu Concentration)



Stream Sediment
(Zn Concentration)

WHY MINERAL PROSPECTIVITY MAPPING?

- Prospectivity mapping is a predictive method used at large scale and in greenfield areas to reduce the exploration ground, and when direct detection methods are not available.
- Narrowing down and ranking prospective ground.
- Applied at all scales (province to deposit) but more effective on large areas.
- Exploration companies: targeting the ground to conduct more focused exploration, claim selection.
- Geological surveys: land management, jurisdictional promotion, inventory of strategic resources.



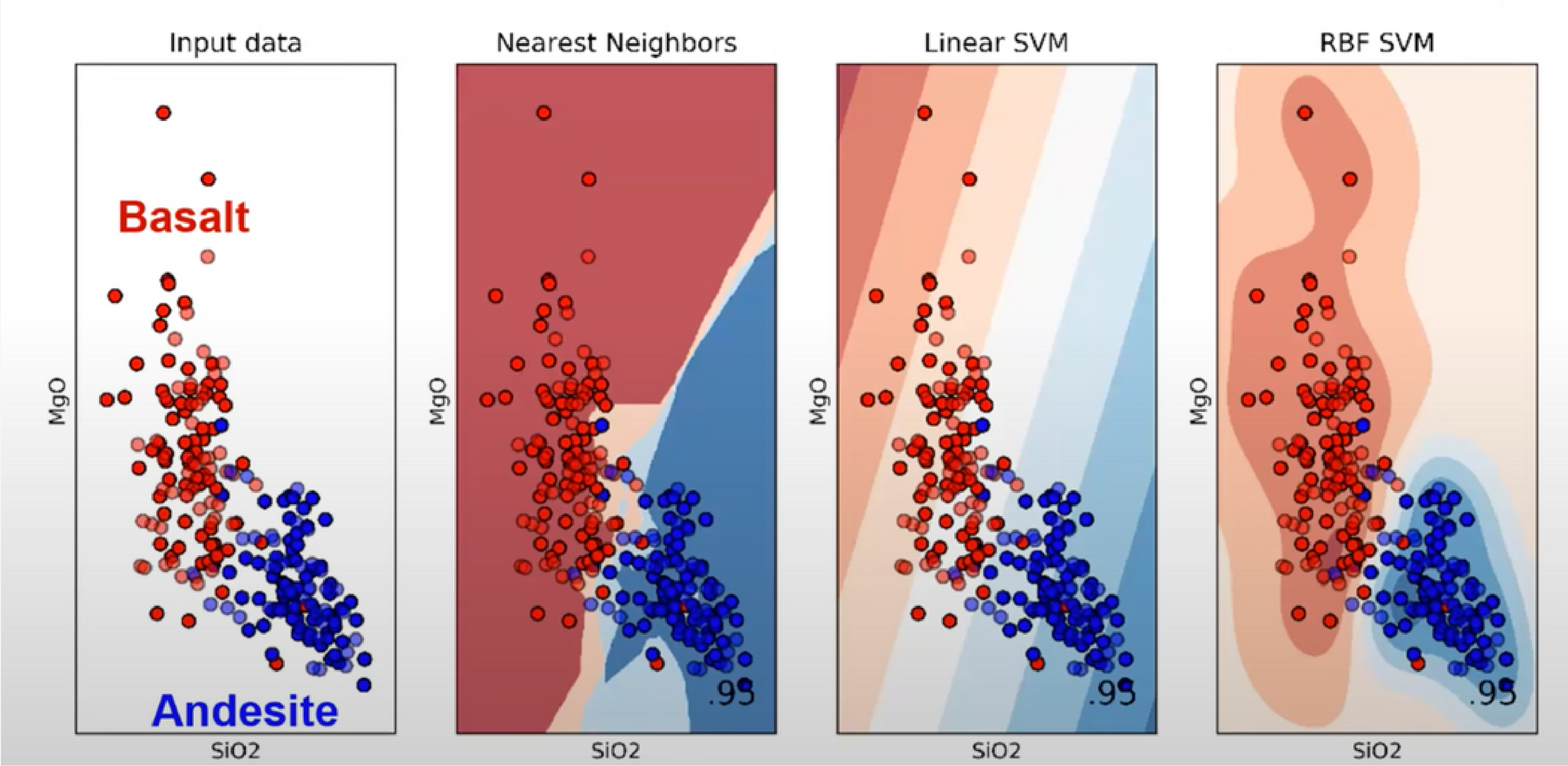
MACHINE LEARNING FOR PROSPECTIVITY

• Machine learning is a data-driven approach based on the supervised training of the model using existing deposits and barren locations

.

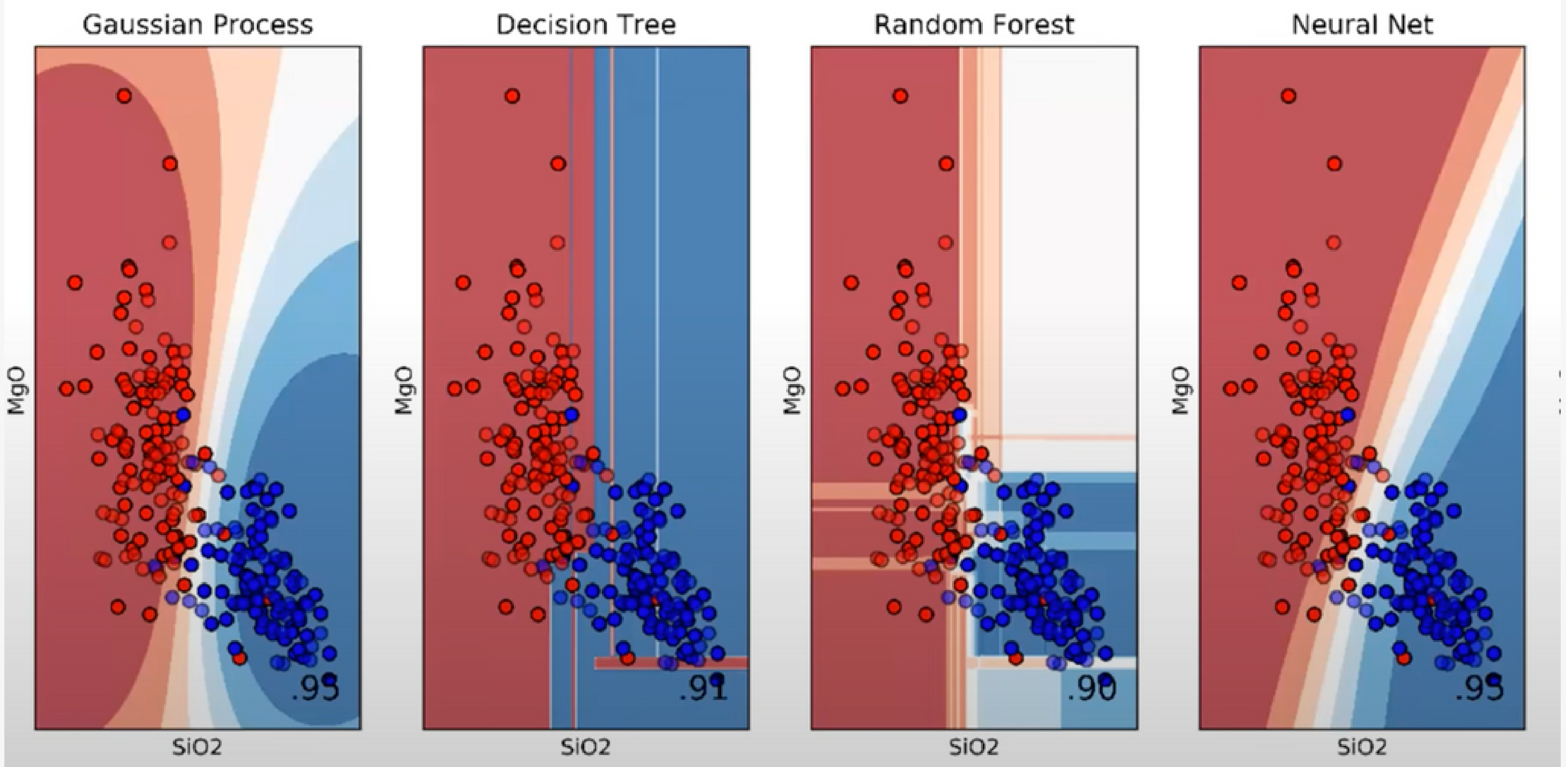
• It is adapted to regions with complex deposit models, large available data and existing known deposits.

• Machine learning does not assume variable dependence and can model complex relationships between datasets.



Algorithms use training data to establish the relationship between variables .

Y = f(X1,X2,...., Xn)



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HOW DOES COMPUTER LEARN?

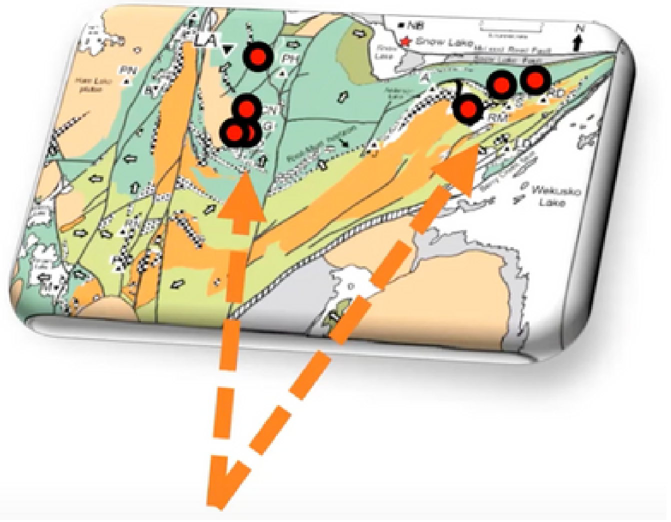
TRAINING DATA

LEARNING ALGORITHM

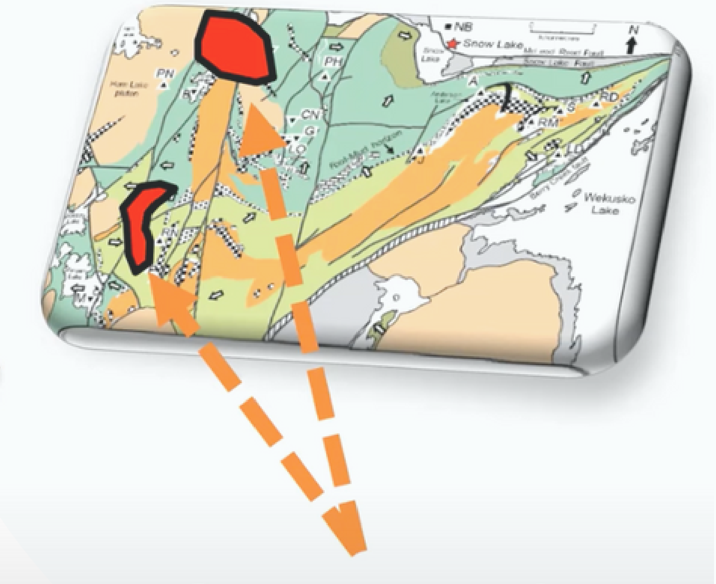
(DATA DRIVEN)

TRAINED MACHINES

TRAINED MACHINES



KNOWN DEPOSIT



The algorithm is not biased by a deposit model. It is data-driven. However, the user choose the input data and interpret the results

QUERY

(WHAT ARE THE DEPOSITS IN THIS CAMP)

GENERATION OF TARGETS

THANK YOU

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