Unearthed

GOLD MINE EXPLORATION

Presented by Mark Subra

Outline

TOPICS

- Background
- Data Analysis
- Models
- Results
- Conclusions
- Next Steps

Explorer Challenge

PREDICT MINERALIZATION LOCATIONS

Many different mineral types present, but gold is most valuable

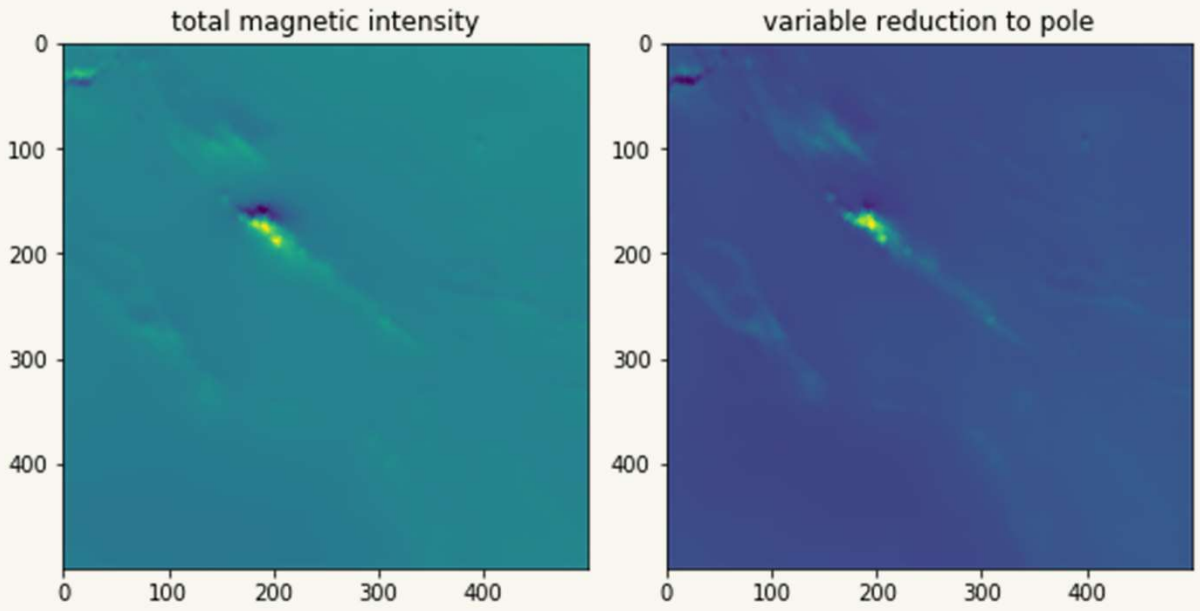
UNCERTAINTY AND COMPLEXITY

Large-scale deposits are rare, requiring certain geological processes

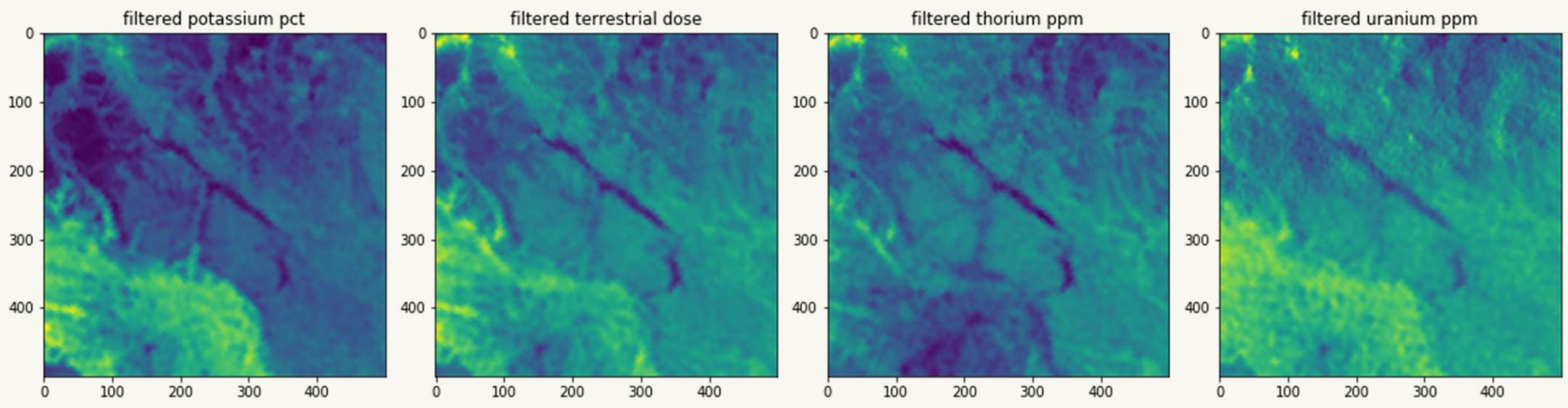
EXPLORATION

Difficult to distinguish ore-grade deposits from unmineralized rock

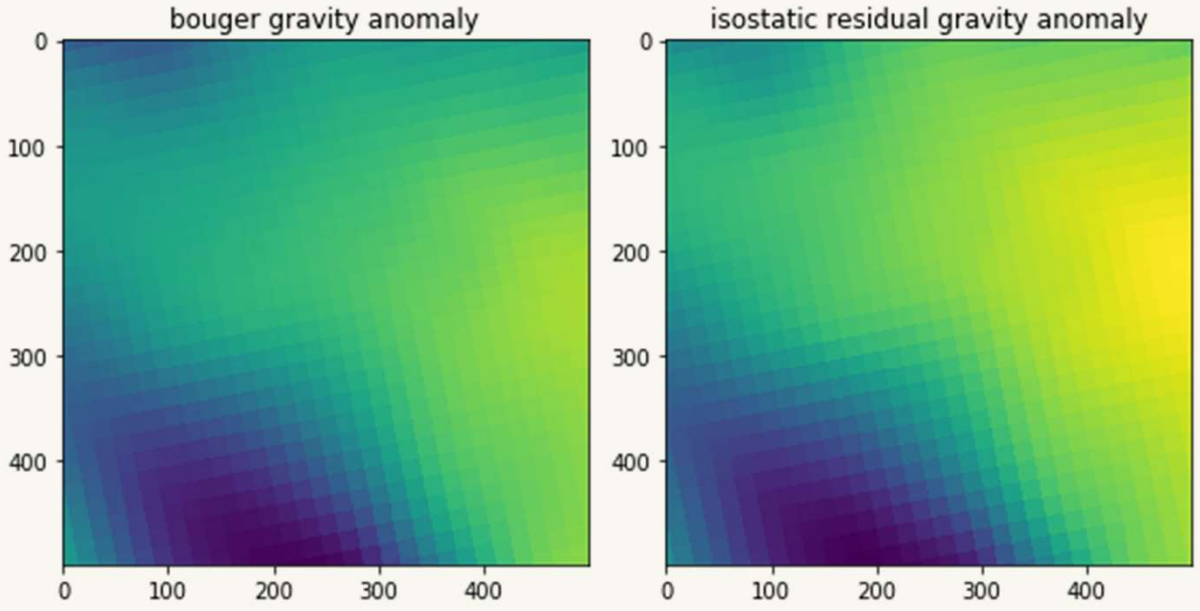
Data Exploration - Magnetics



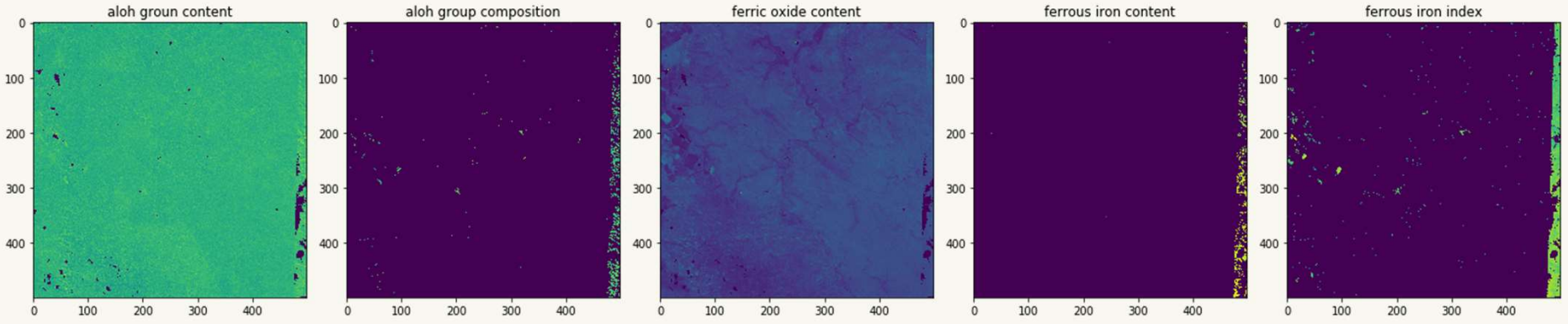
Data Exploration - Radiometrics



Data Exploration - Gravity



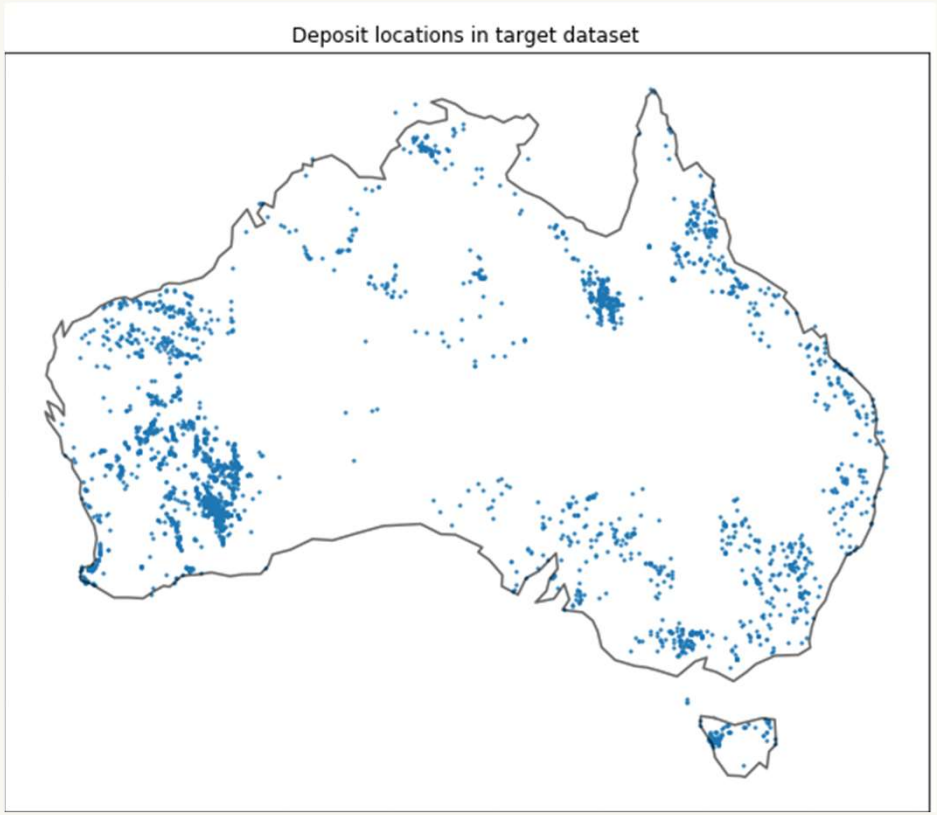
Data Exploration - ASTER



Data Exploration

DATASET

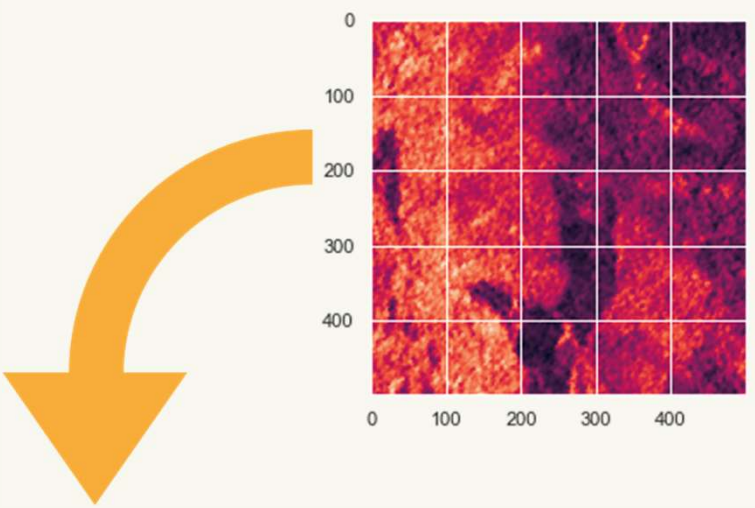
- 1863 sites by ID numbers
- Known types of minerals



Data Processing

RASTERIO LIBRARY

- Process images to give numerical values for data
- Create dataframe for predictive models



id	bougergravity_mean	isostaticresidual_mean	totalmagnetic_mean	variablereduction_mean
8888	-466.406891	-6.900751	-109.427673	85.052681
14292	-503.673187	-120.126038	-31.623005	-80.718369
132399	-27.807846	103.177826	-63.601978	141.103851
183374	-576.454712	-121.468323	-35.086399	-60.554379
222338	337.696960	449.877472	126.945335	460.823090

Model - Binary Classification

Accuracy:

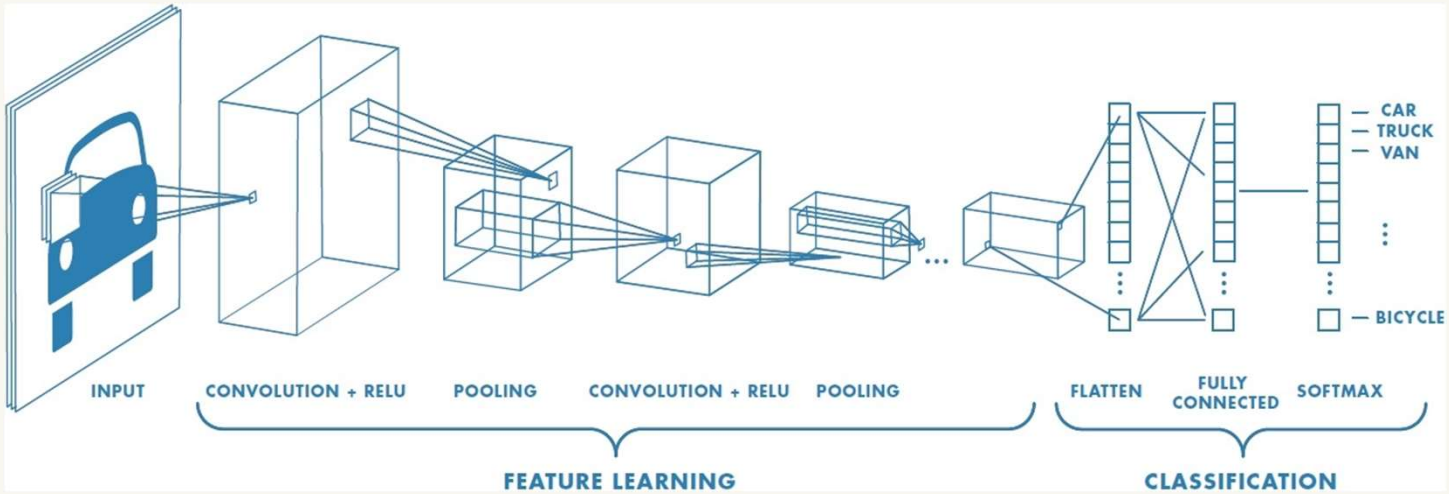
- 331 locations contain no gold
  - Model predicted 326
- 92 locations contain gold
  - Model predicted 23
- 28 predicted gold locations
  - Model predicted 5 false positives
    - Good for exploration purposes

		Prediction	
		Not Gold	Gold
Actual	Not Gold	326	5
	Gold	69	23

VGG16 Convolutional Neural Network

TRANSFER LEARNING

- No need to train deep network, use existing model and adjust
- Use a small portion of data



VGG16 Convolutional Neural Network

RESULTS

- Initial model accuracy:
  - 67.1%

- Second version accuracy:
  - 74.6%

Conclusions

BINARY CLASSIFICATION MODEL

Pros:

- Low rate of false positives: vast majority of predicted gold locations turned out to contain gold
- Save on exploration costs

Cons:

- Some gold deposits were missed: lose out on potential sites

NEURAL NETWORK MODEL

Pros:

- More accurate overall than classification model
- Use small datasets to make accurate predictions for large datasets

Cons:

- Data processing time
- Higher computing power required

Next Steps

- Integrate with other types of data
- Fine-tune neural network model
- Try other classification models

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