STRATUM: Corporate Case Study

Sulfur Modelling at a Mixed Oxide-Sulfide Gold Deposit

January, 2023

STRATUM AI

STUDY CASE
GOLD DEPOSIT

LARGE EPITHERMAL GOLD COMPLEX IN PAPUA NEW GUINEA

THE DEPOSIT

- Large epithermal gold complex in Papua New Guinea.
- Set of complex mixed-sulfidation deposits consisting of oxides, transitionary, and sulfide ore.
- Has over ~250k meters of drillholes assayed for 10 elements, ~510k grade control, ~15k meters drillholes reserved for reconciliation.

STUDY CASE
GOLD DEPOSIT

LARGE EPITHERMAL GOLD COMPLEX IN PAPUA NEW GUINEA

PROBLEM

The mine has oxide, trans, sulfide material with spatial complex material type distribution and only a carbon-in-leach mill (oxide-only mill).

OBJECTIVE

Create a more accurate sulfur model to distinguish between oxide, trans, sulfide material types.

OUTCOME

More accurate material type model increases mill throughput and recovery by finding missing oxides and keeping sulfides out of mill & mine plan.

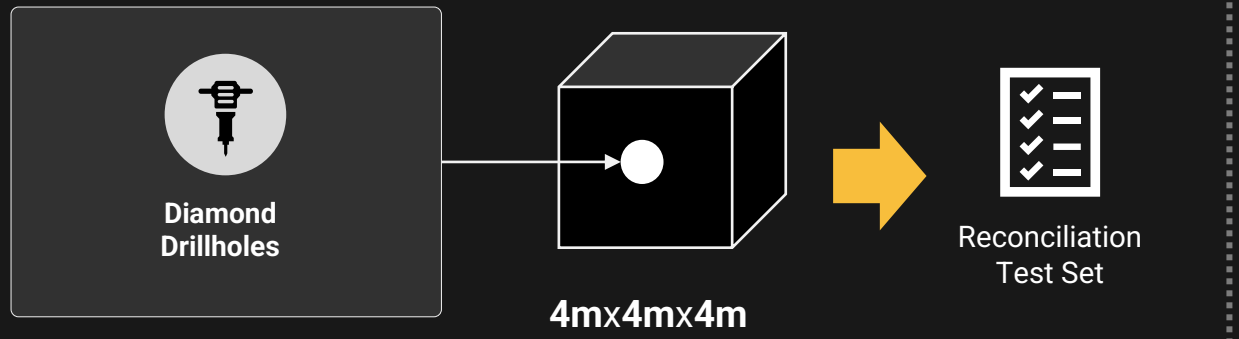
SOLUTION

AI outperforms Kriging by learning geological patterns from historical drillholes (250k 10-elements), GC drillholes (510k Au + visual) to **determine which blocks are oxide, suflide**

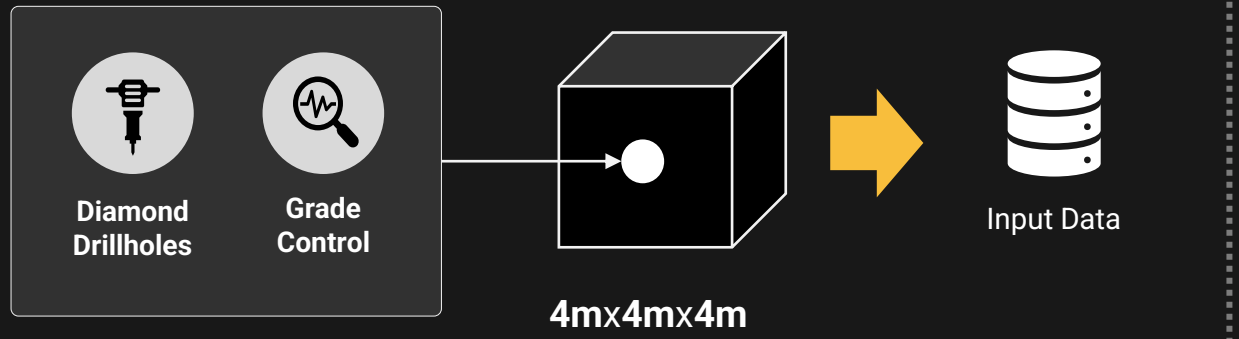
SULFUR MODELLING
INPUT DATA

RECONCILIATION TEST SET

2020 – 2021 Data



Pre-2020 Data



METRICS

CLASS PRECISION:

Where: A= (O/T/S)

$$\frac{A \text{ predicted } A}{(S \text{ predicted } A) + (T \text{ predicted } A) + (O \text{ predicted } A)}$$

Precision is the probability if you predict an oxide/transitory/sufide it will actually be one. Higher precision increases recovery by keeping sulfides out of oxide mill.

CLASS RECALL:

Where: A= (O/T/S)

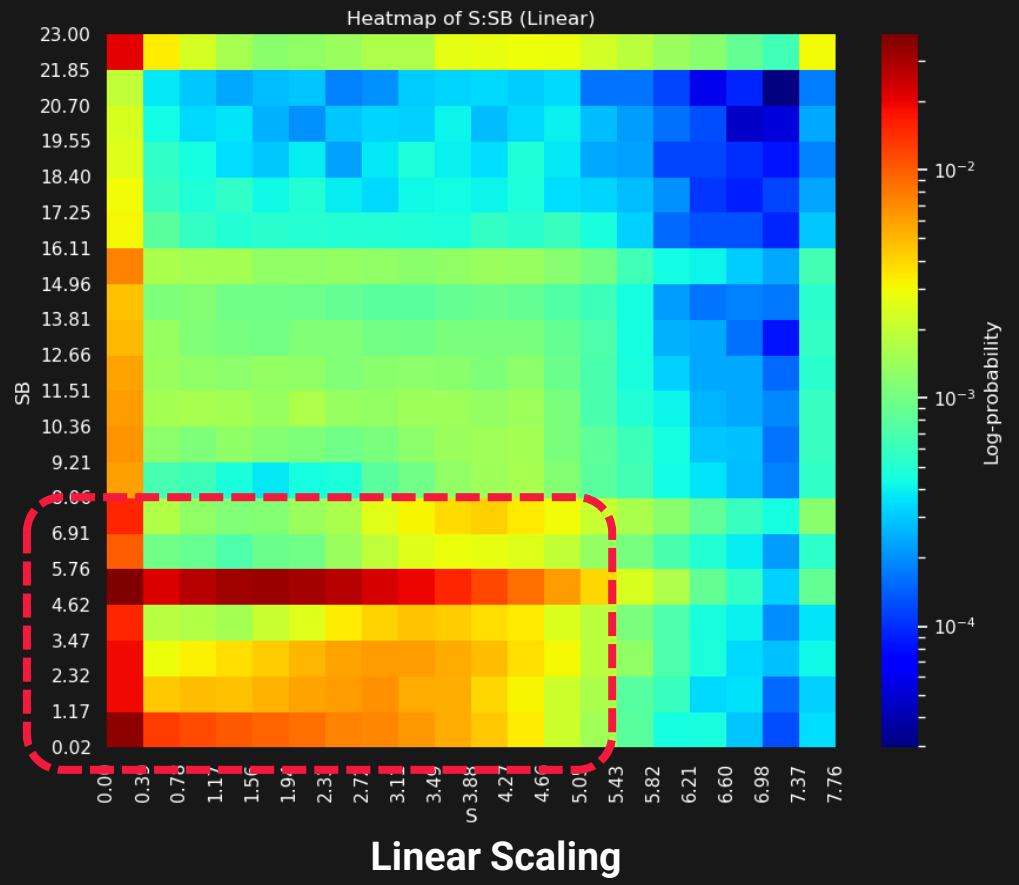
$$\frac{A \text{ predicted } A}{(A \text{ predicted } S) + (A \text{ predicted } T) + (A \text{ predicted } O)}$$

Recall is what percentage of oxides/transitory/sulfides that exist do you predict as such. Higher recall reduces missed oxides thereby increasing oxide mill throughput.

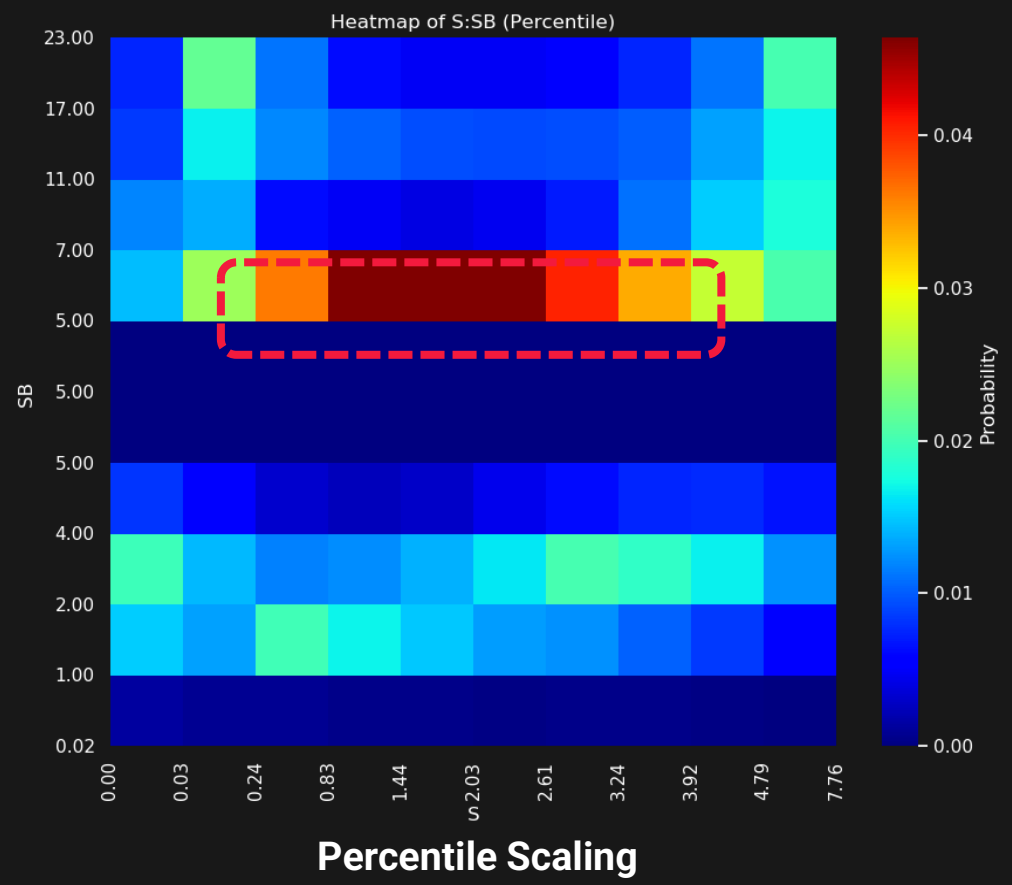
SULFUR MODELLING
CORRELATION INSPECTION

SULFUR & ANTIMONY (SB)

Non-linear correlations in transitory sulfur region:



Linear Scaling

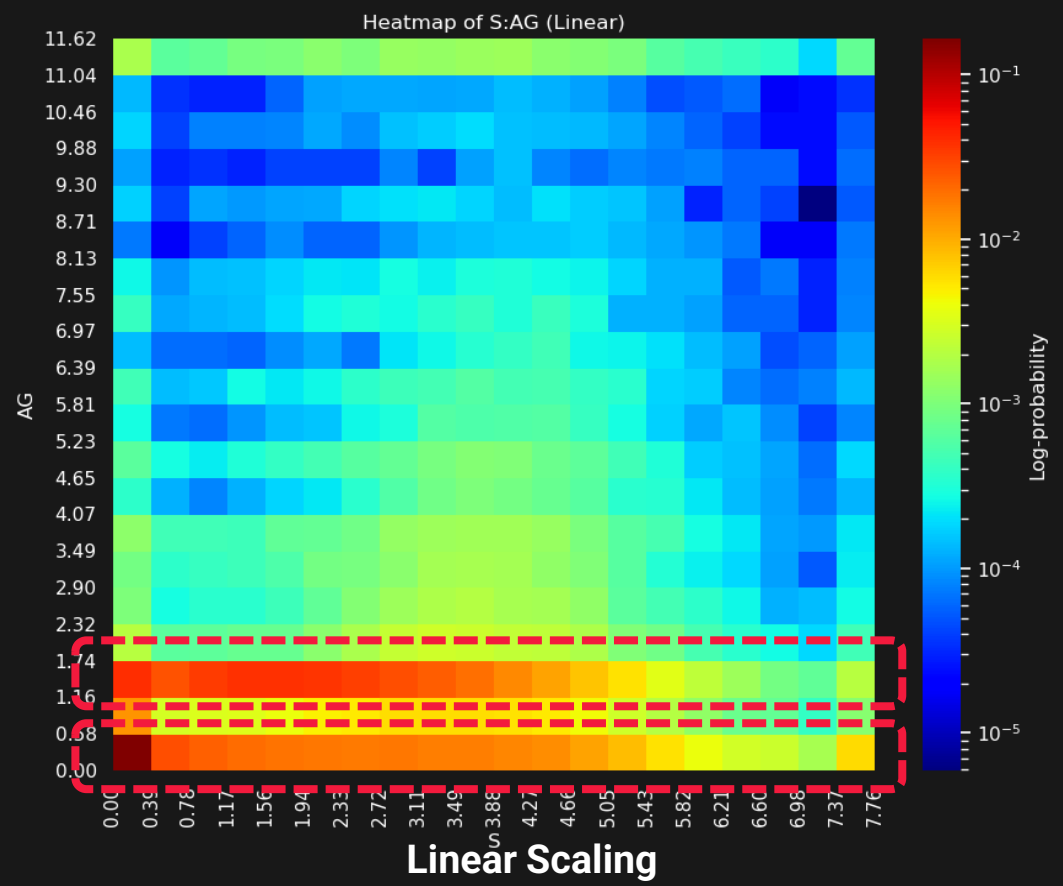


Percentile Scaling

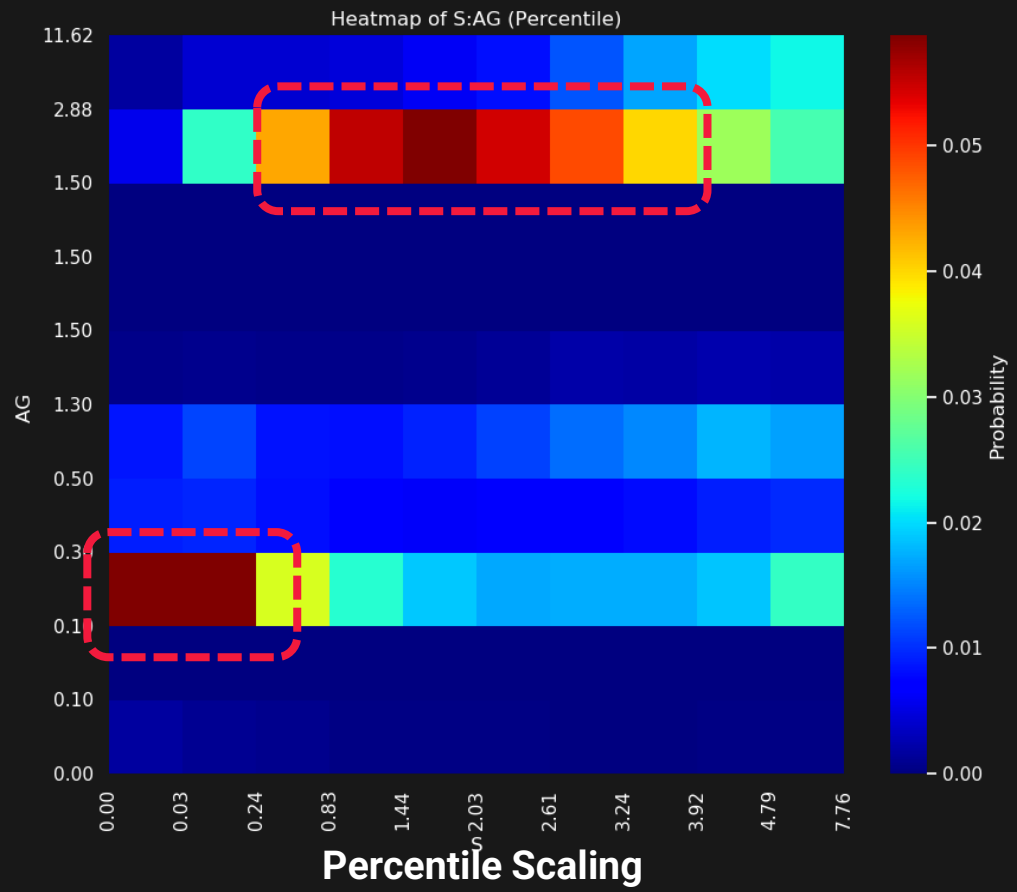
SULFUR MODELLING
CORRELATION INSPECTION

SULFUR & SILVER (AG)

Complex non-linear correlation:



Linear Scaling



Percentile Scaling

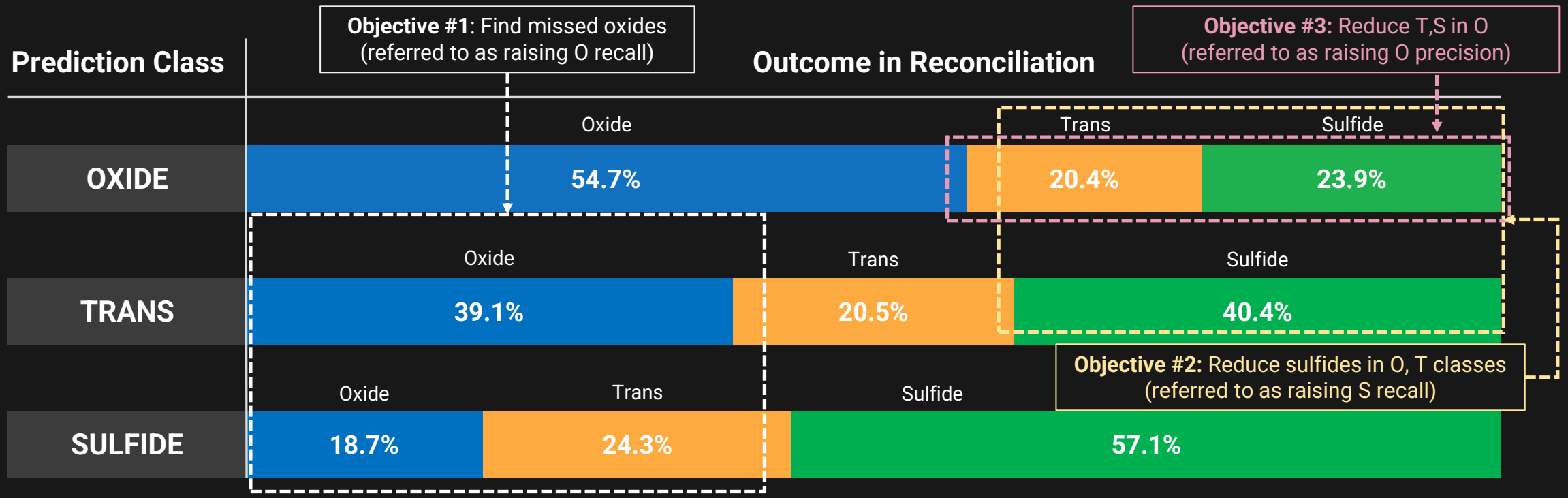
OXIDE MODEL
RESULTS

KRIGING

Prediction Class	Outcome in Reconciliation		
	Oxide	Trans	Sulfide
OXIDE	54.7%	20.4%	23.9%
	Oxide	Trans	Sulfide
TRANS	39.1%	20.5%	40.4%
	Oxide	Trans	Sulfide
SULFIDE	18.7%	24.3%	57.1%

OXIDE MODEL
RESULTS

KRIGING



Value Proposition

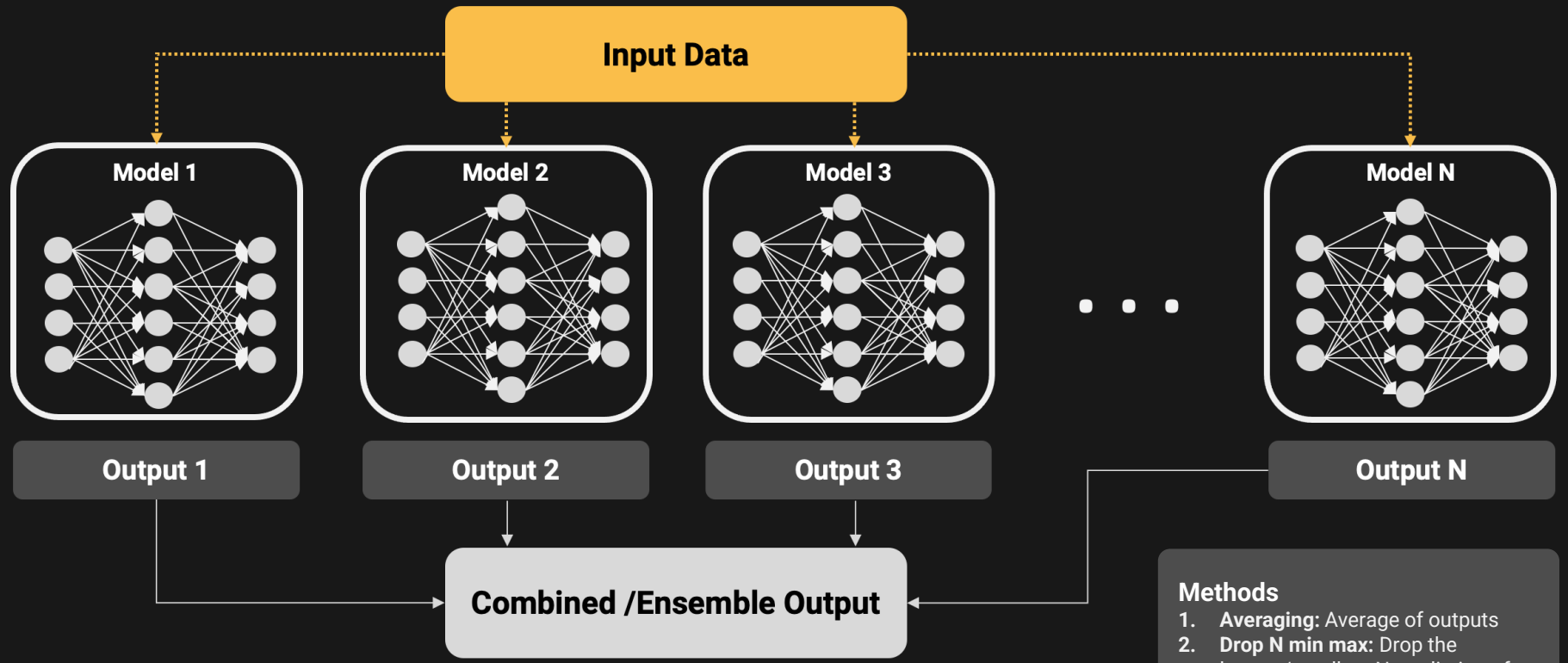
Objective #1: increases oxide mill throughput
Objective #2: increases recovery & mill throughput (*)
Objective #3: increases recovery & mill throughput (*)

(*) When misclassified ore is correctly identified in grade control, objectives #2,#3 will increase mill throughput as less ore will have to be reclassified in grade control
(*) When misclassified ore is sent to the mill, objectives #2, #3 will increase recovery as less S and unintentional T will be sent to the mill

STRATUM MODELS
AI MODEL STRUCTURE

ENSEMBLE NETWORKS

Ensemble Networks:
Combining the outputs of multiple learning models together usually creates more accurate models. We create separate models from different assays (Au, Sb, Ag etc.) and then combine them through an ensemble network.



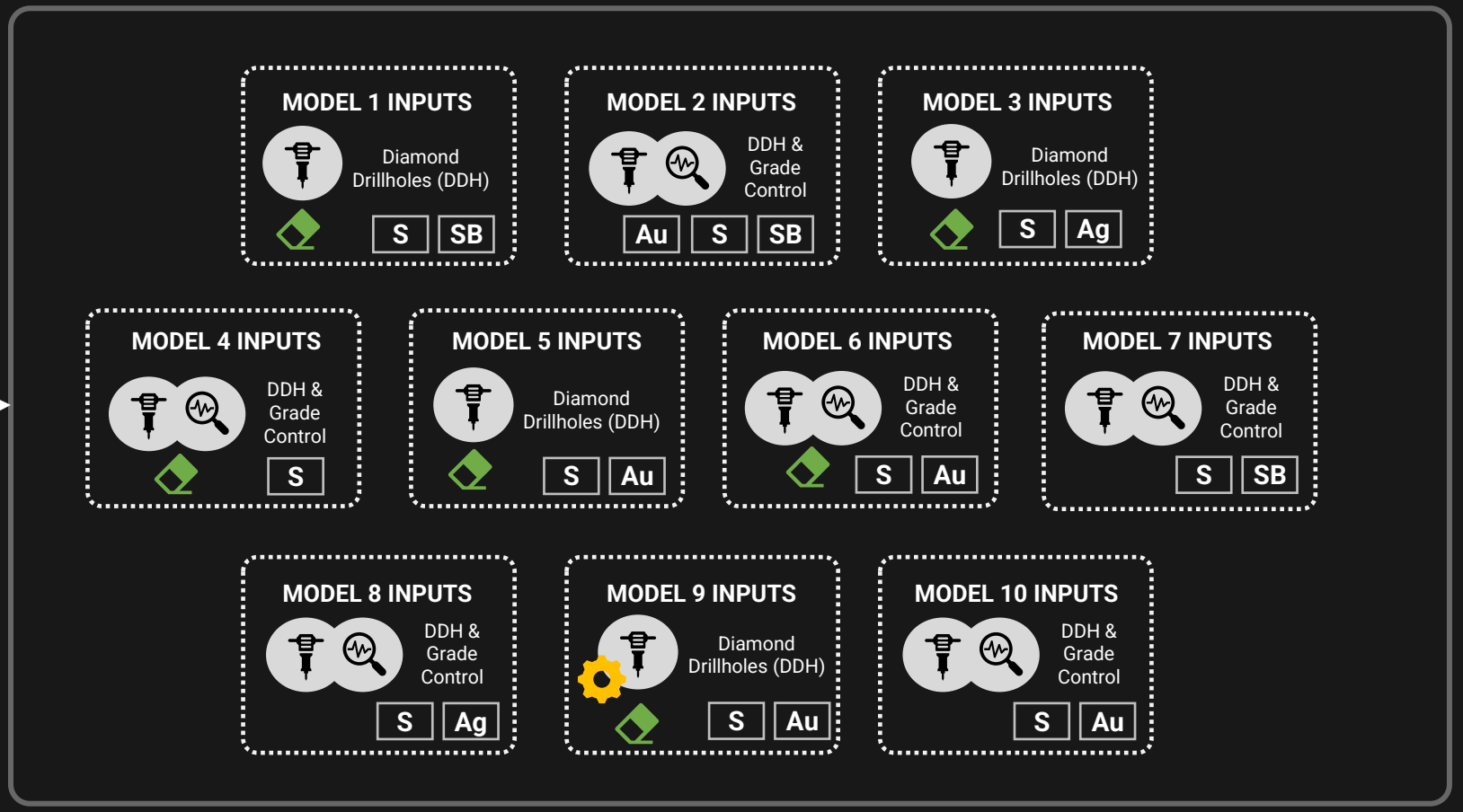
Methods
1. **Averaging:** Average of outputs
2. **Drop N min max:** Drop the largest/smallest N predictions for each block and average the middle predictions

STRATUM MODELS
AI MODEL STRUCTURE

MODELS IN ENSEMBLE

Ensemble Mix

Top 10 models that are include in the Ensemble



Legend:

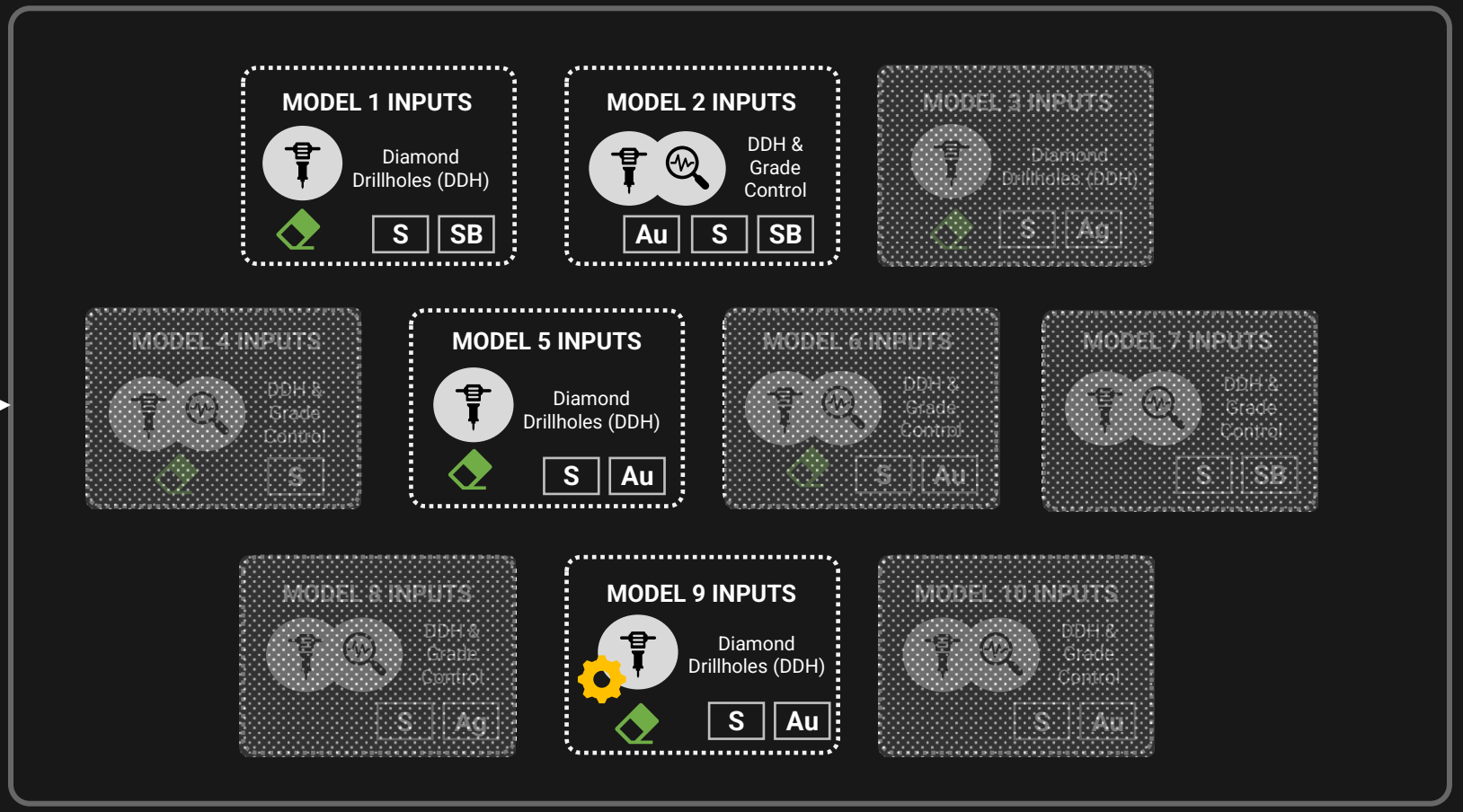
- special sampling method in training
- Metals channels
- Both metals as Input & output channels

STRATUM MODELS
AI MODEL STRUCTURE

MODELS IN OPTIMAL ENSEMBLE

Ensemble Selection

We remove models from the 10 model ensemble that do not contribute to increased performance on target metrics



Legend:

- special sampling method in training
- S — Metals channels
- Both metals as input & output channels

STRATUM MODELS
RESULTS

ENSEMBLE VS KRIGING

Model Names	Oxide Pre. (%)	Trans Pre. (%)	Sulfide Pre. (%)	Oxide Rec. (%)	Trans Rec. (%)	Sulfide Rec. (%)
Kriging	54.7%	20.5%	57.1%	60.3%	10.2%	67.7%
Stratum Ensemble	**61.2%**	**32.0%**	**66.4%**	**66.6%**	**16.2%**	**79.2%**

Resources

Stratum Ensemble

OXIDE MODEL
RESOURCES

KRIGING

Prediction Class	Predicted Outcome in Reconciliation Based on 2020-2021 Reconciliation		
	Oxide	Trans	Sulfide
OXIDE {X}MT ({X}koz	54.7%	20.4%	23.9%
	Oxide	Trans	Sulfide
TRANS {X}MT ({X}koz	39.1%	20.5%	40.4%
	Oxide	Trans	Sulfide
SULFIDE {X}MT ({X}koz	18.7%	24.3%	57.1%

Total predicted model resources (MT, koz) is under NDA with customer.

OXIDE MODEL
RESOURCES

AI ENSEMBLE

Prediction Class	Predicted Outcome in Reconciliation Based on 2020-2021 Reconciliation		
	Oxide	Trans	Sulfide
OXIDE {X}MT ({X}koz	**61.2%**	**24.4%**	**14.4%**
	Oxide	Trans	Sulfide
TRANS {X}MT ({X}koz	**39.1%**	**32.0%**	**28.9%**
	Oxide	Trans	Sulfide
SULFIDE {X}MT ({X}koz	**13.9%**	**19.7%**	**66.4%**

Outcome:

3.9MT, 194koz (+36%) more oxides in total when mining areas predicted as O, T
1.9MT (-41%) less sulfides when mining areas predicted as O

Total predicted model resources (MT, koz) is under NDA with customer.

STRATUM MODELS
RESULTS

UNIQUE OXIDE RESOURCE
BY DEPOSIT

Model Names	DEPOSIT A	DEPOSIT B	DEPOSIT C	DEPOSIT D	DEPOSIT E	DEPOSIT F
Stratum Ensemble	17% / 41% / 42%	8% / 72% / 20%	**32%** / 18% / 50%	31% / 44% / 31%	**54%** / 20% / 26%	**54%** / 18% / 29%

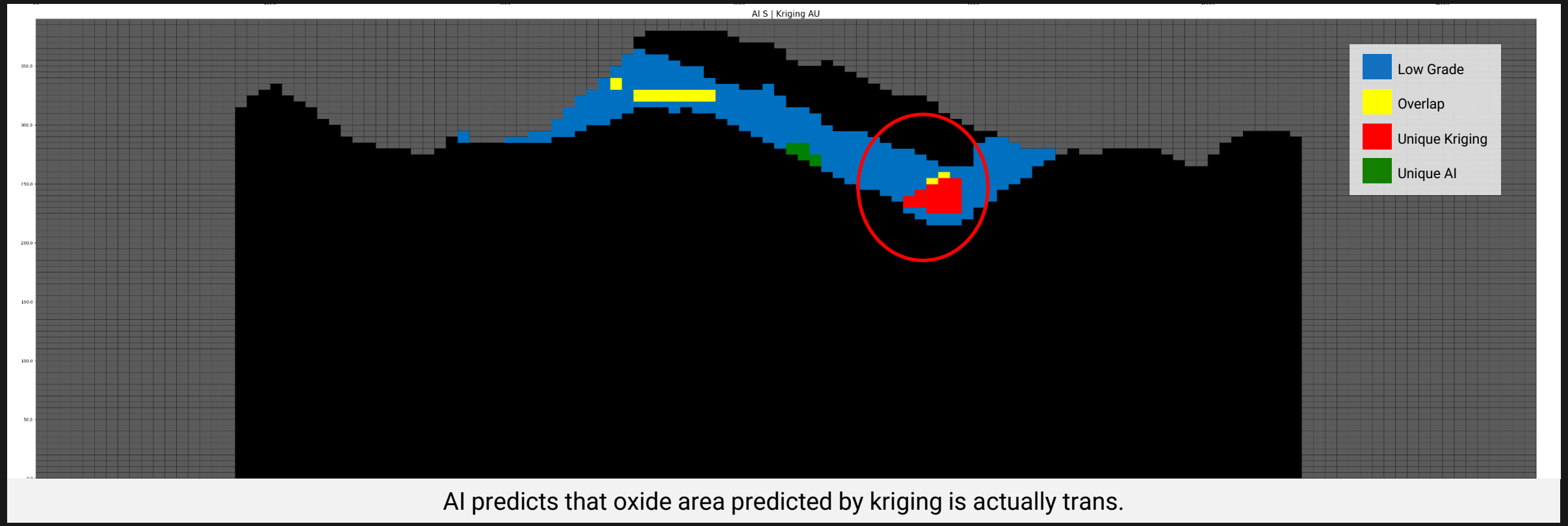
A% / B% / C%
A: Percentage of total oxide area where exclusively AI predicts economic oxides
B: Percentage of total oxide area where AI reclassifies kriging economic oxide as T/S
C: Percentage of total oxide area where both agree on zone being an economic oxide
Total oxide area: Area where AI or Kriging predicts economic oxides

Cross Sections

Deposits C-F

SULFUR MODELLING
DEPOSIT C

ECONOMIC OXIDES

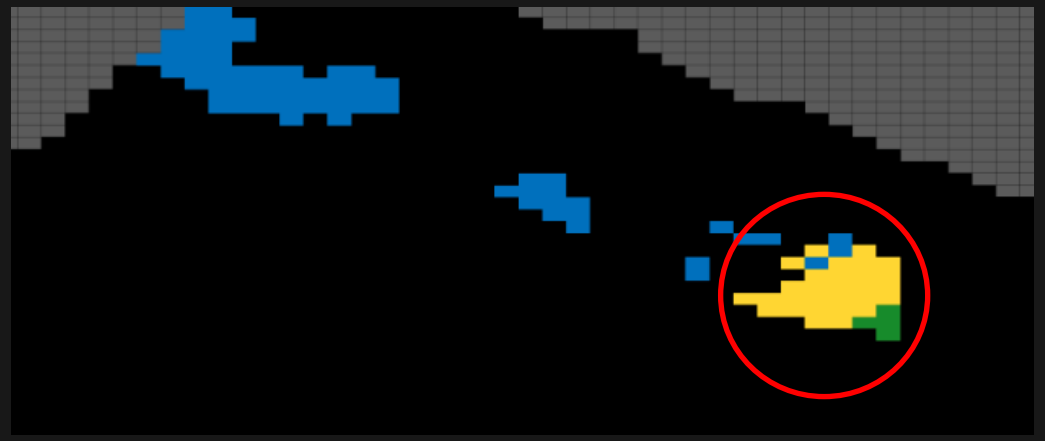


AI predicts that oxide area predicted by kriging is actually trans.

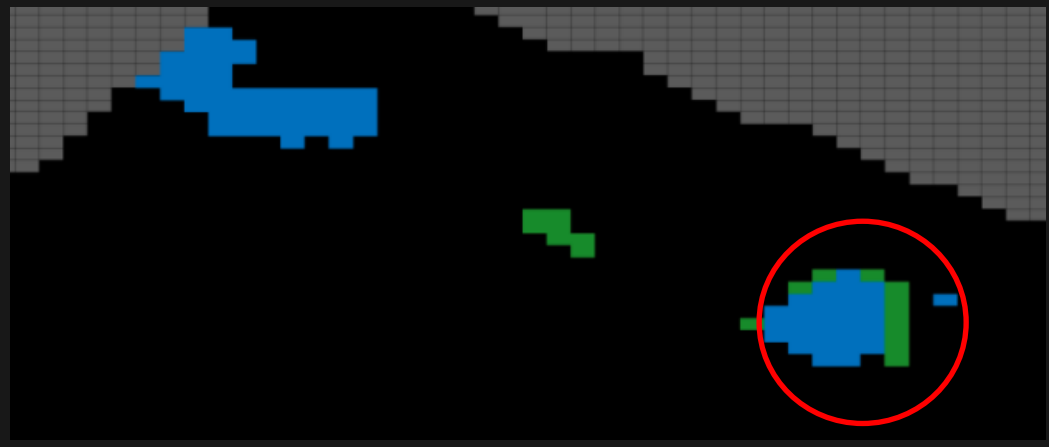
SULFUR MODELLING
DEPOSIT C

3- CLASS

STRATUM ENSEMBLE



KRIGING



Oxide
Transitory
Sulfide

AI predicts that oxide area predicted by kriging is actually trans.

SULFUR MODELLING
DEPOSIT C

ECONOMIC OXIDES

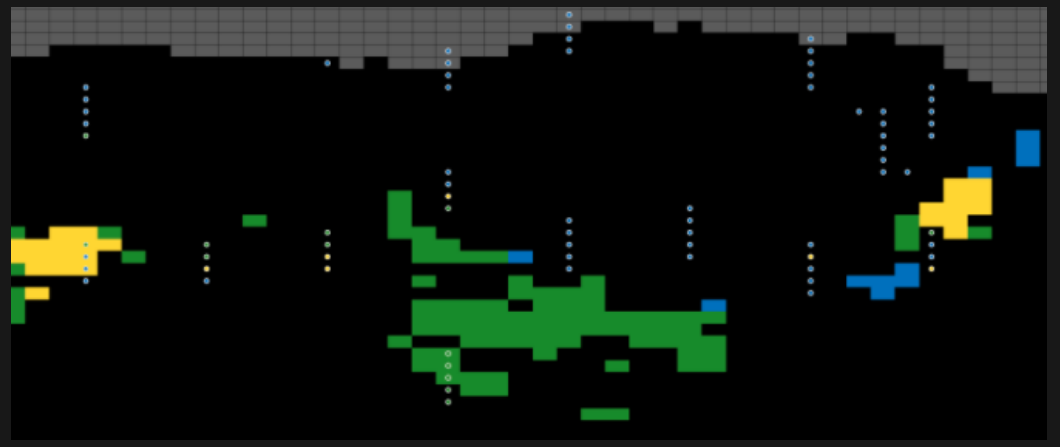
AI predicts easily accessible continuous economic oxide area near the surface.

SULFUR MODELLING
DEPOSIT C

3- CLASS

STRATUM ENSEMBLE

KRIGING



Oxide
Transitory
Sulfide

AI predicts easily accessible continuous economic oxide area near the surface.

SULFUR MODELLING
DEPOSIT D

ECONOMIC OXIDES

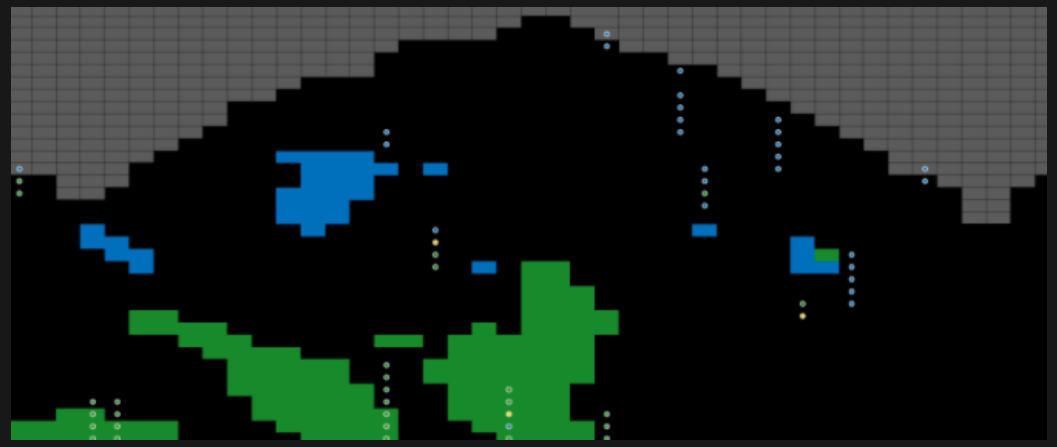
AI predicts economic oxide near surface.

SULFUR MODELLING
DEPOSIT D

3- CLASS

STRATUM ENSEMBLE

KRIGING

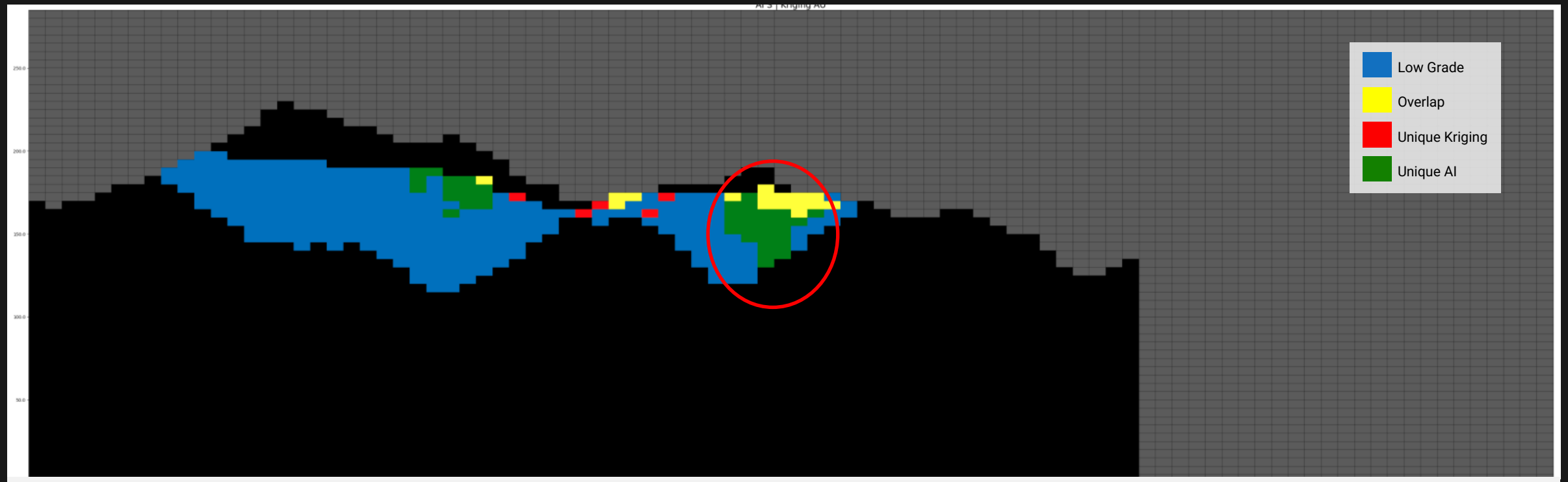


Oxide
Transitory
Sulfide

AI predicts economic oxide near surface.

SULFUR MODELLING
DEPOSIT E

ECONOMIC OXIDES

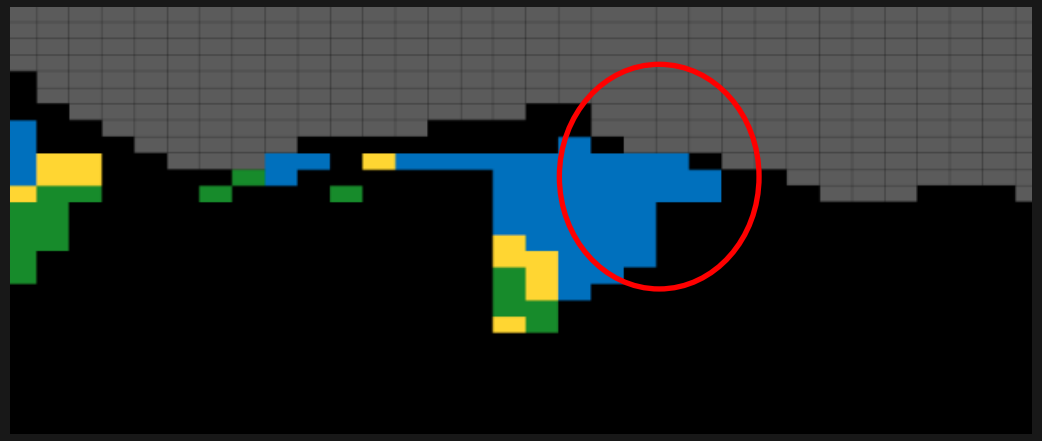


AI extends economic oxide area below known oxide mineralization.

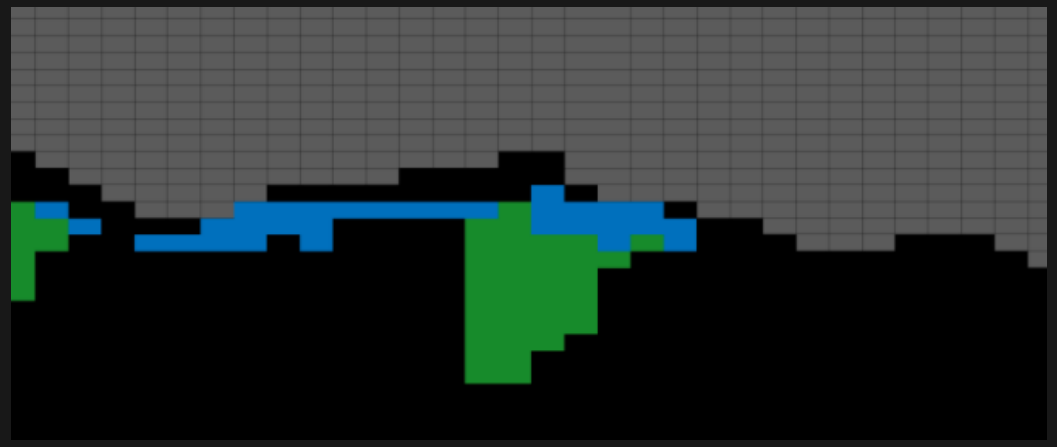
SULFUR MODELLING
DEPOSIT E

3- CLASS

STRATUM ENSEMBLE



KRIGING



Oxide
Transitory
Sulfide

AI extends economic oxide area below known oxide mineralization.

SULFUR MODELLING
DEPOSIT E

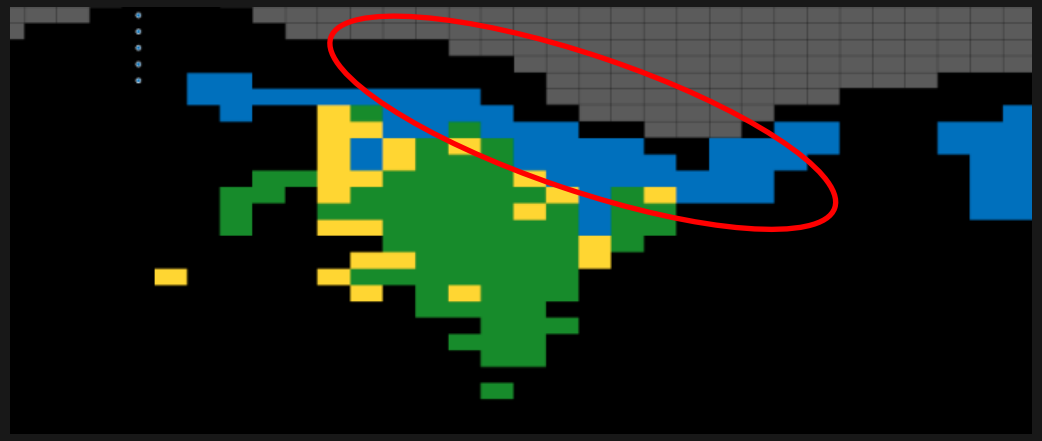
ECONOMIC OXIDES

AI predicts narrow band of unique oxide mineralization.

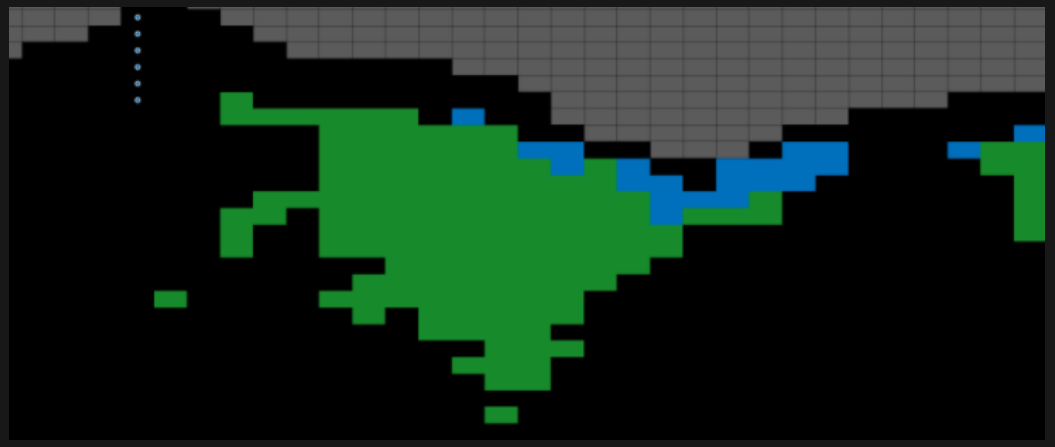
SULFUR MODELLING
DEPOSIT E

3- CLASS

STRATUM ENSEMBLE



KRIGING

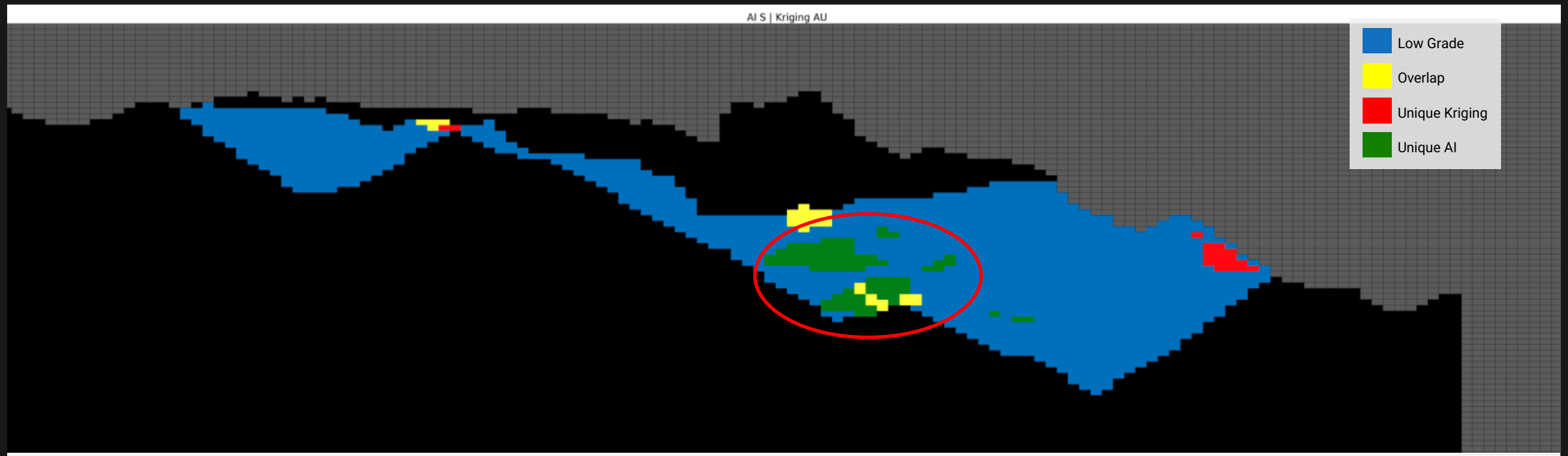


Oxide
Transitory
Sulfide

AI predicts narrow band of unique oxide mineralization.

SULFUR MODELLING
DEPOSIT F

ECONOMIC OXIDES



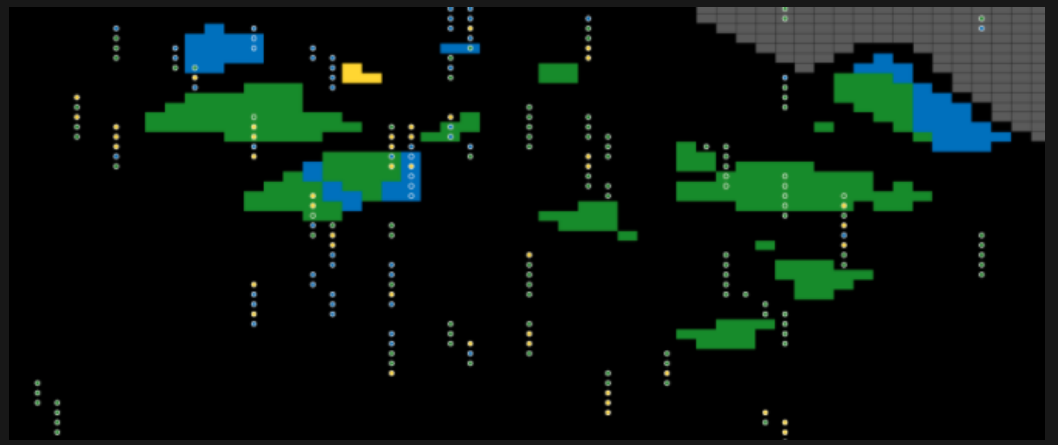
AI predicts large continuous unique oxide mineralization area at depth based on nearby Au, S, Sb grade signatures

SULFUR MODELLING
DEPOSIT F

3- CLASS

STRATUM ENSEMBLE

KRIGING

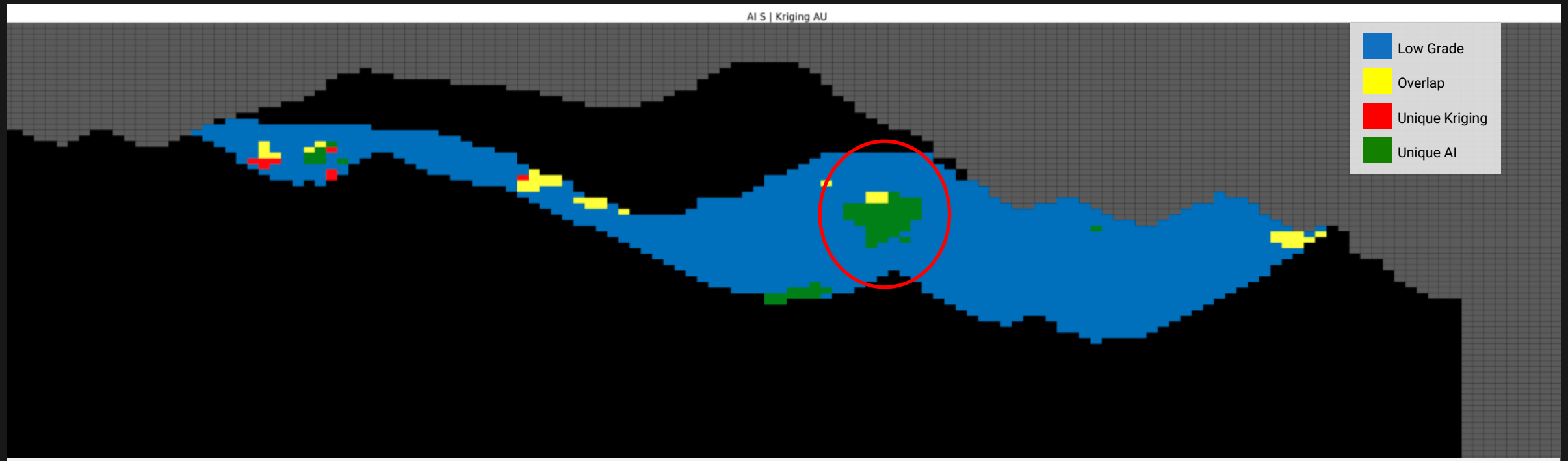


AI predicts large continuous unique oxide mineralization area at depth based on nearby Au, S, Sb grade signatures.

Oxide
Transitory
Sulfide

SULFUR MODELLING
DEPOSIT F

ECONOMIC OXIDES

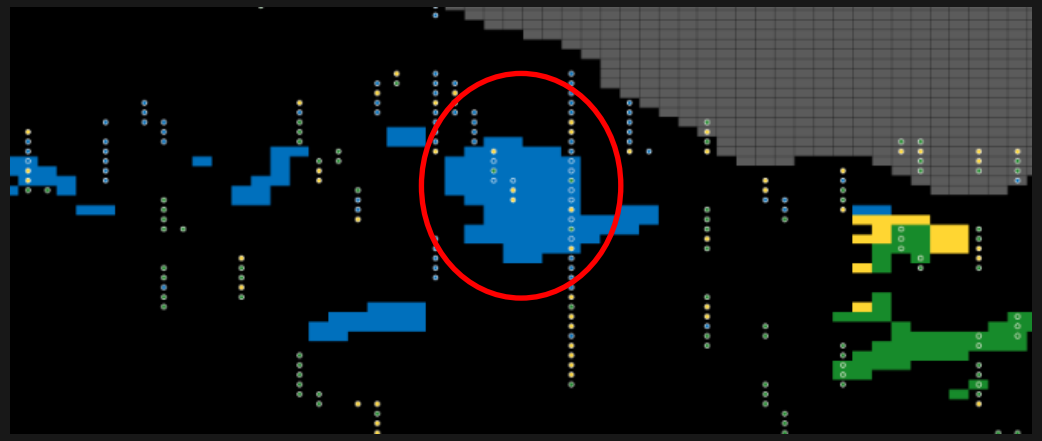


AI suggests small oxide mineralization actually forms larger continuous area.

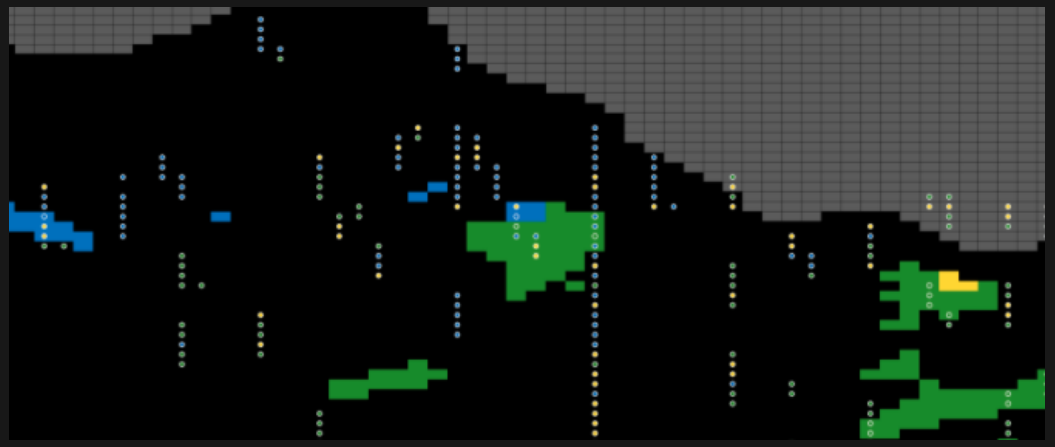
SULFUR MODELLING
DEPOSIT F

3- CLASS

STRATUM ENSEMBLE



KRIGING

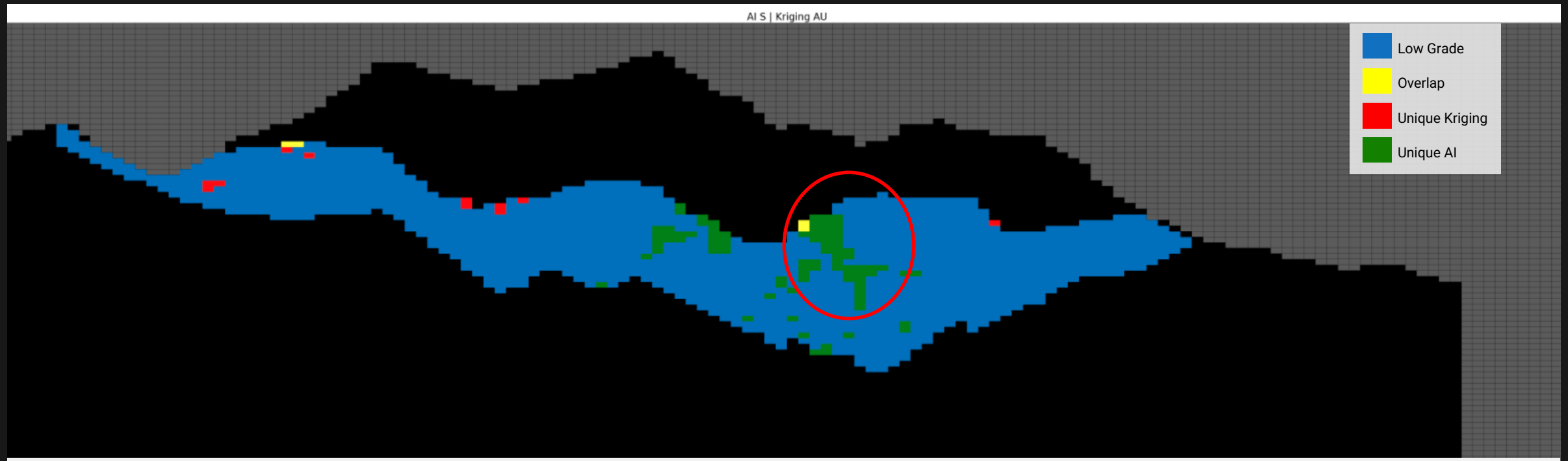


AI suggests small oxide mineralization actually forms larger continuous area.

Oxide
Transitory
Sulfide

SULFUR MODELLING
DEPOSIT F

ECONOMIC OXIDES



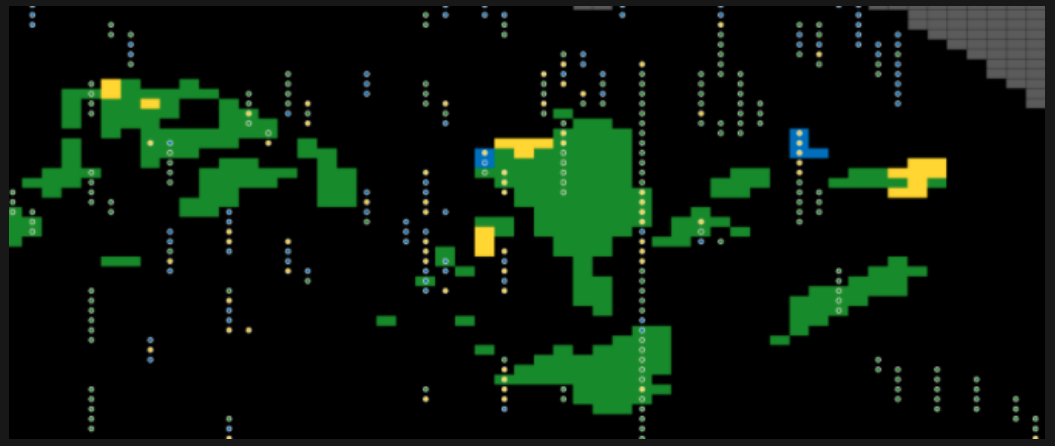
AI predicts unique oxide mineralization area that extends down from recent mined areas.

SULFUR MODELLING
DEPOSIT F

3- CLASS

STRATUM ENSEMBLE

KRIGING

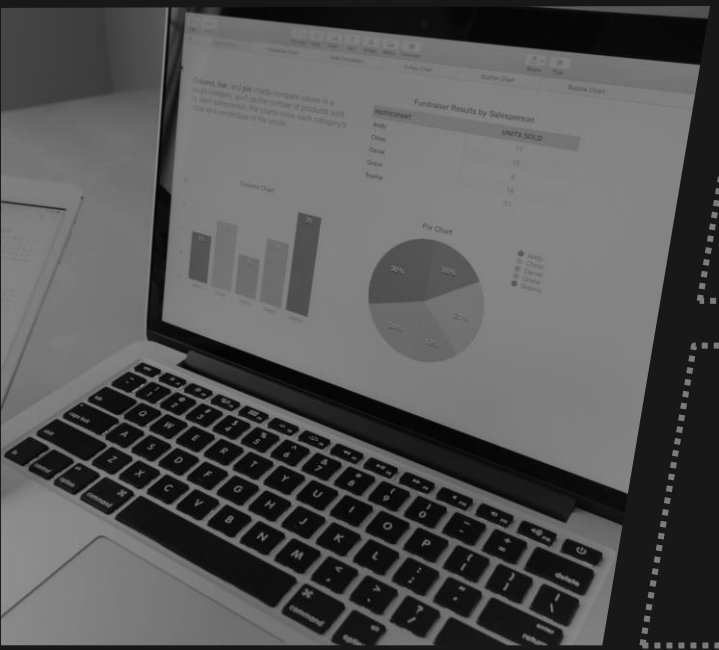


AI predicts unique oxide mineralization area that extends down from recent mined areas.

Oxide
Transitory
Sulfide

SULFUR MODELLING
MODEL SUMMARY

RESULTS



Increase mill-throughput by identifying missed oxide ore.

Mining oxide, trans areas expected to yield **3.9MT (194koz)*** more oxide ore.

Increase recovery by keeping sulfides and unwanted transitory ore out of mill.

41% less sulfides in oxide class,
28% less sulfides in trans class.

* 109koz of gold translated to approximately ~$350M topline revenue, ~$115M gross profit over 3 years.

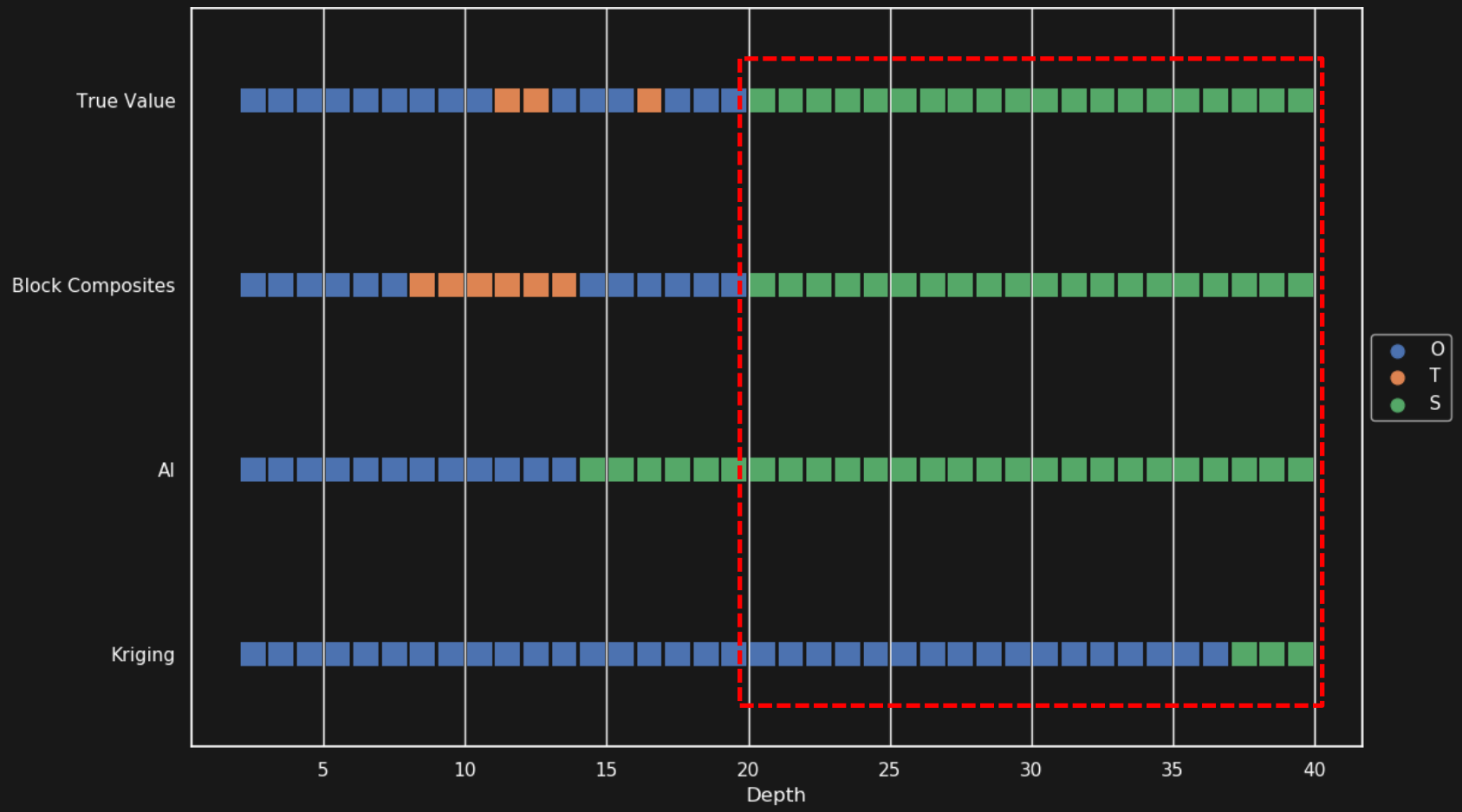
Appendix

Drillhole Reconciliation Sections

DRILLHOLES PLOT

DDH040

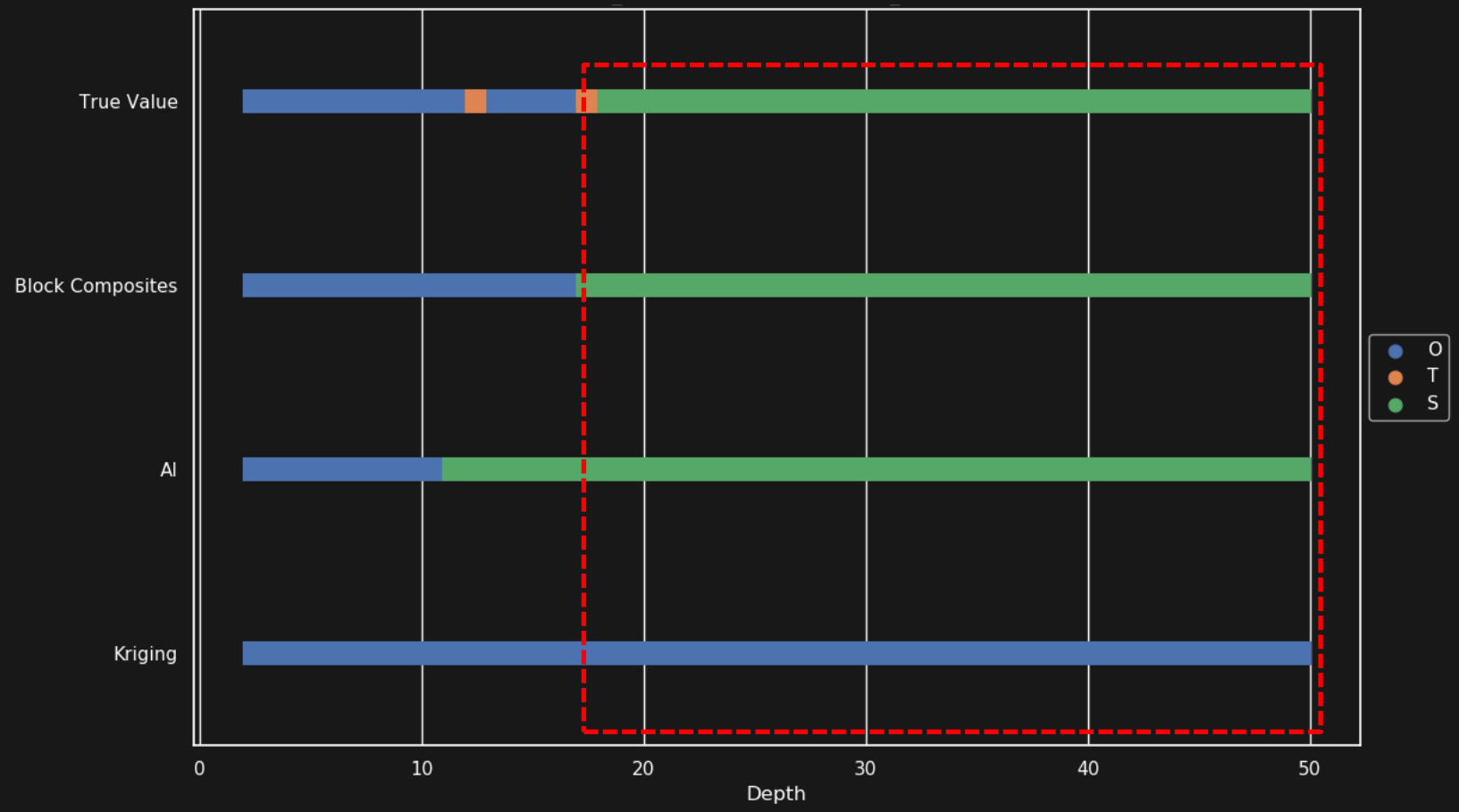
AI correctly classifies sulfide area missed by kriging as oxide.



DRILLHOLES PLOT

DDH044

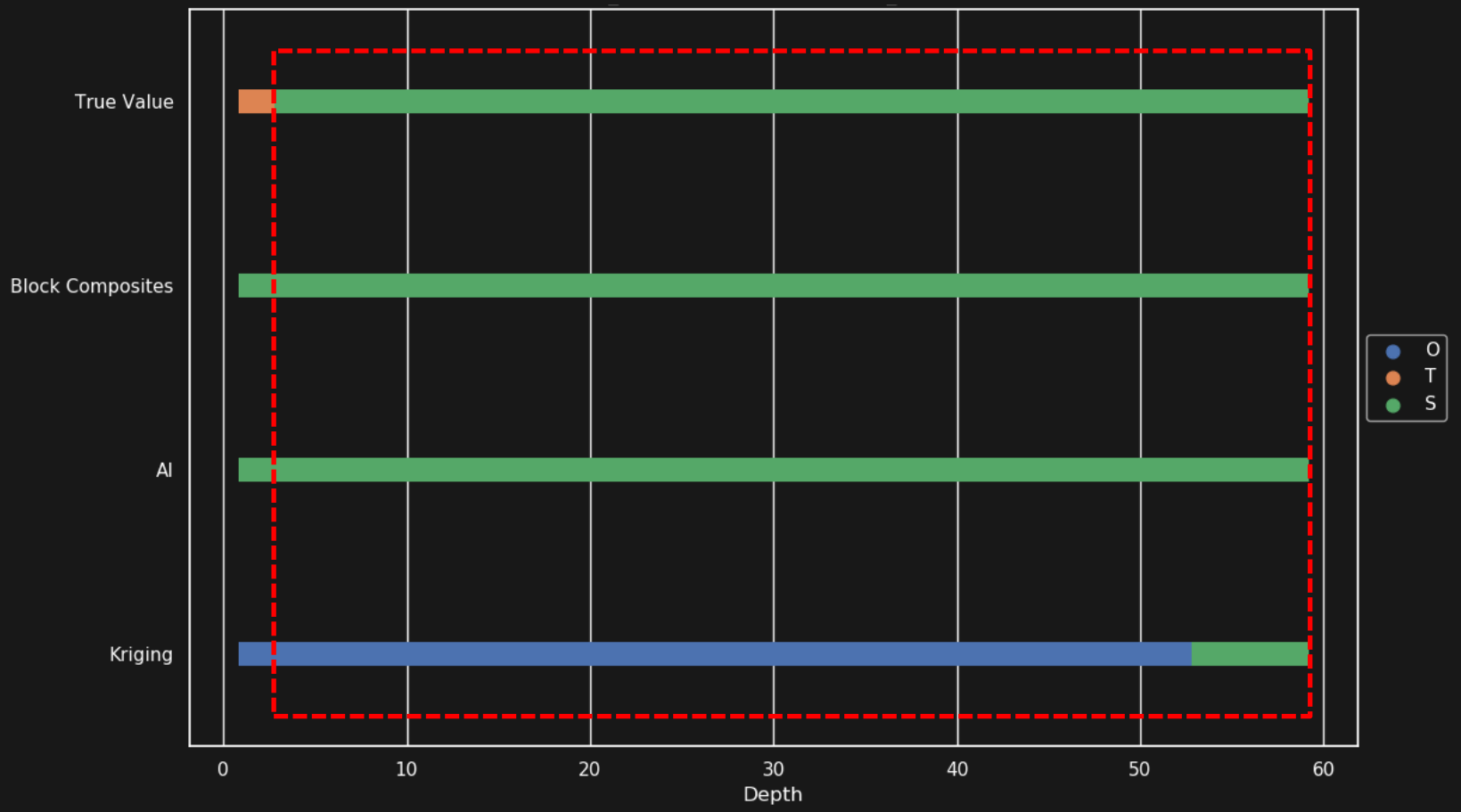
AI correctly classifies sulfide area missed by kriging as oxide



DRILLHOLES PLOT

SRCH048

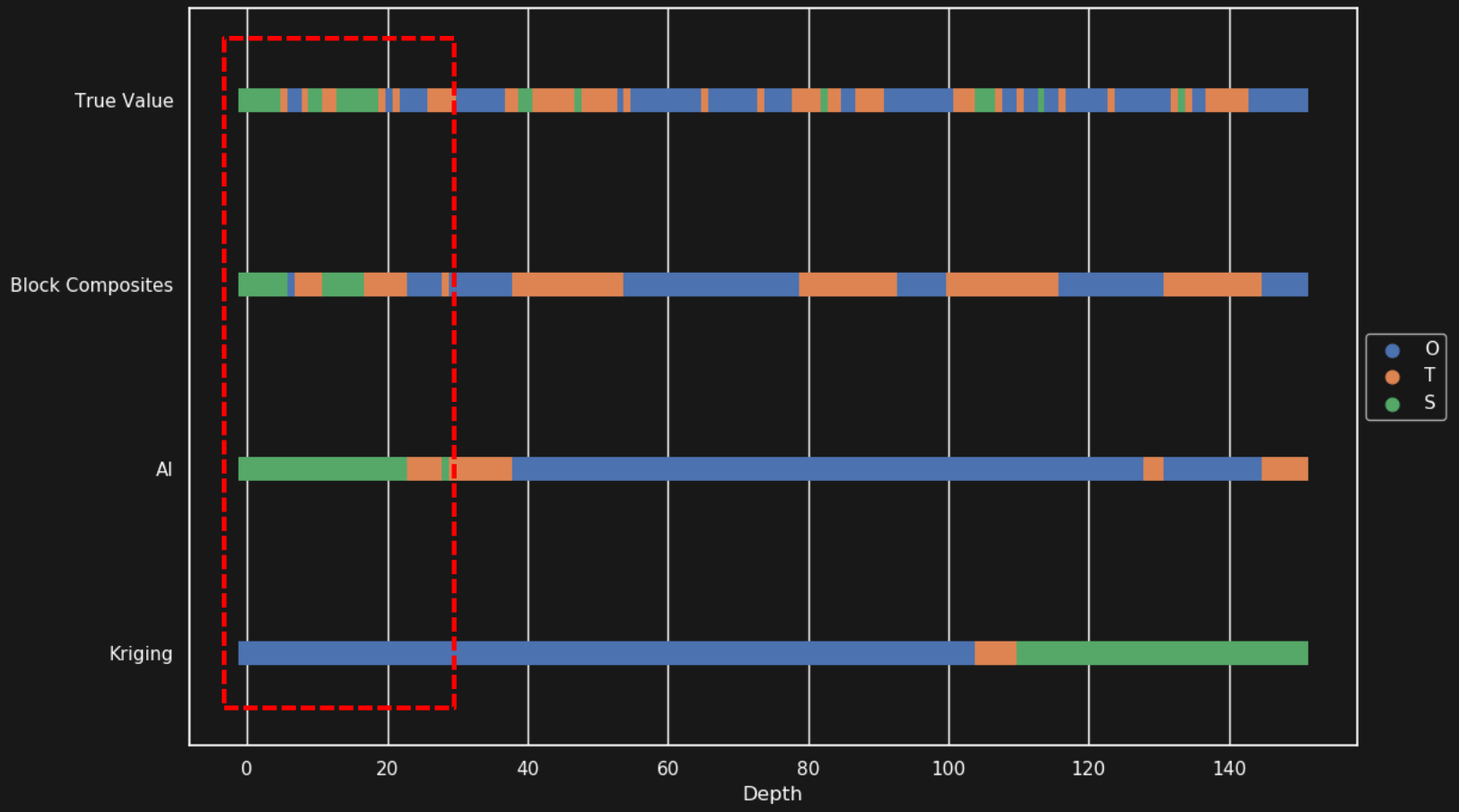
AI correctly classifies majority sulfide area as sulfide



DRILLHOLES PLOT

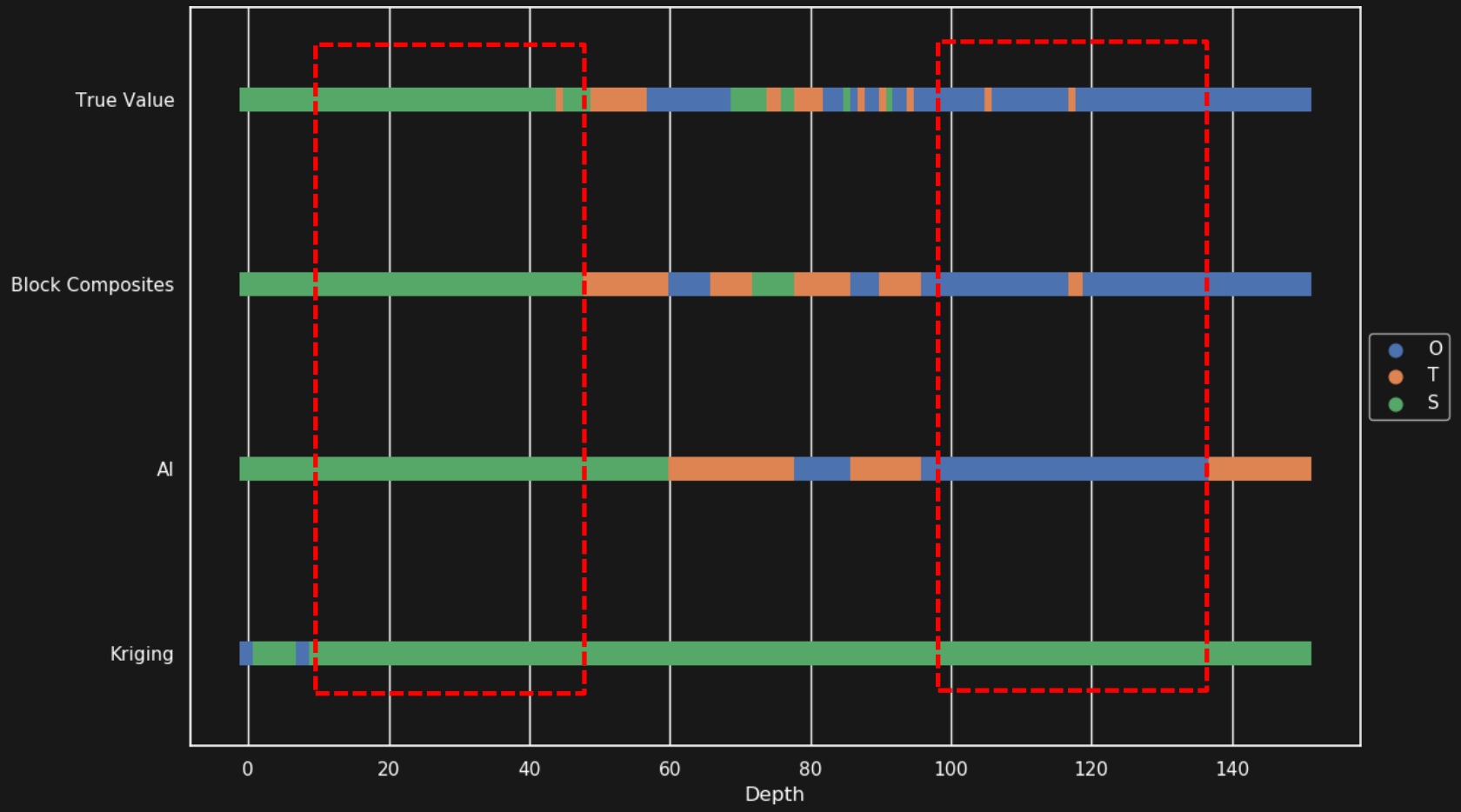
SRCH079

AI correctly classifies majority sulfide area as sulfide



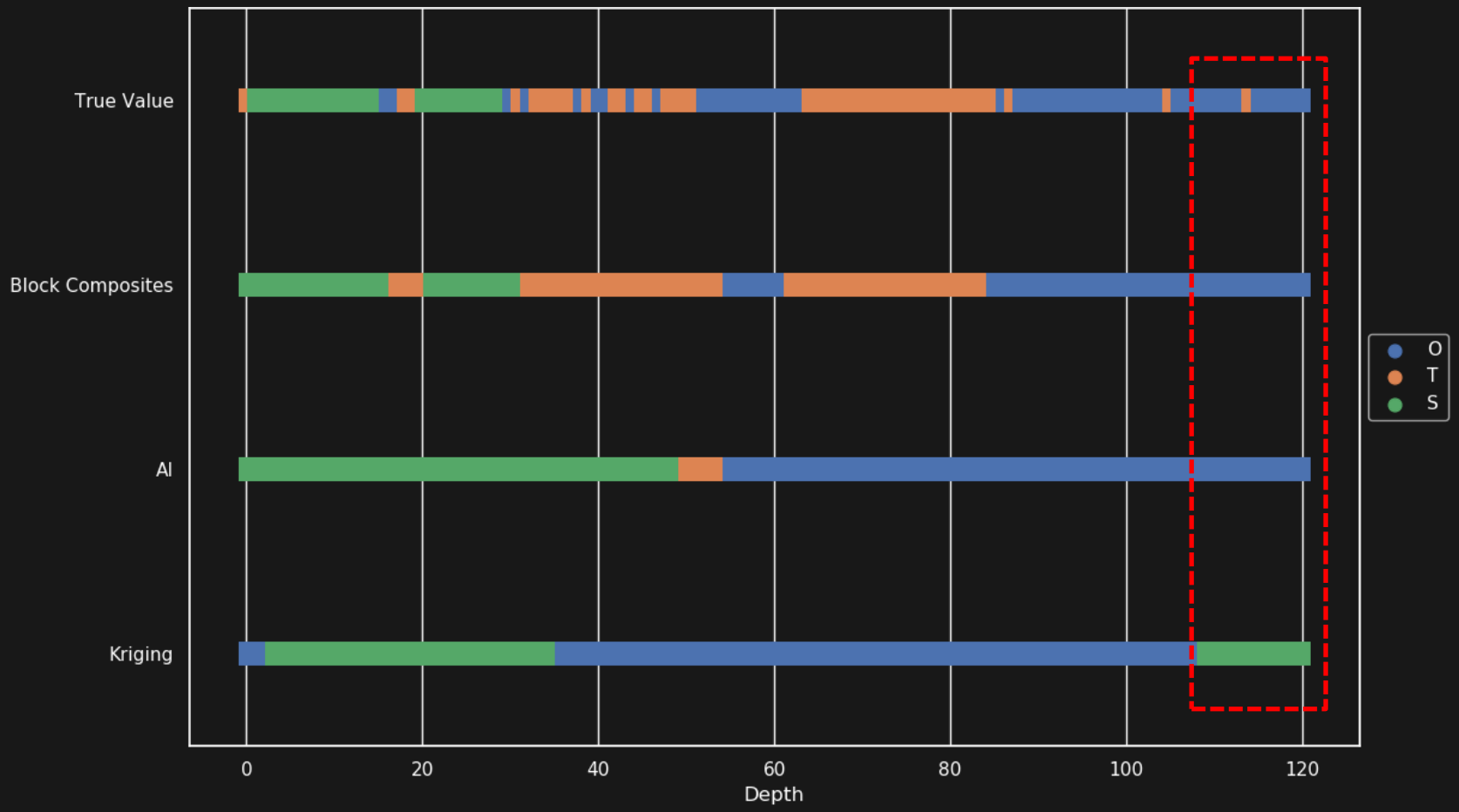
DRILLHOLES PLOT
SRCH080

AI correctly classifies sulfide area as sulfide and correctly identified oxide areas classified by kriging as sulfide.



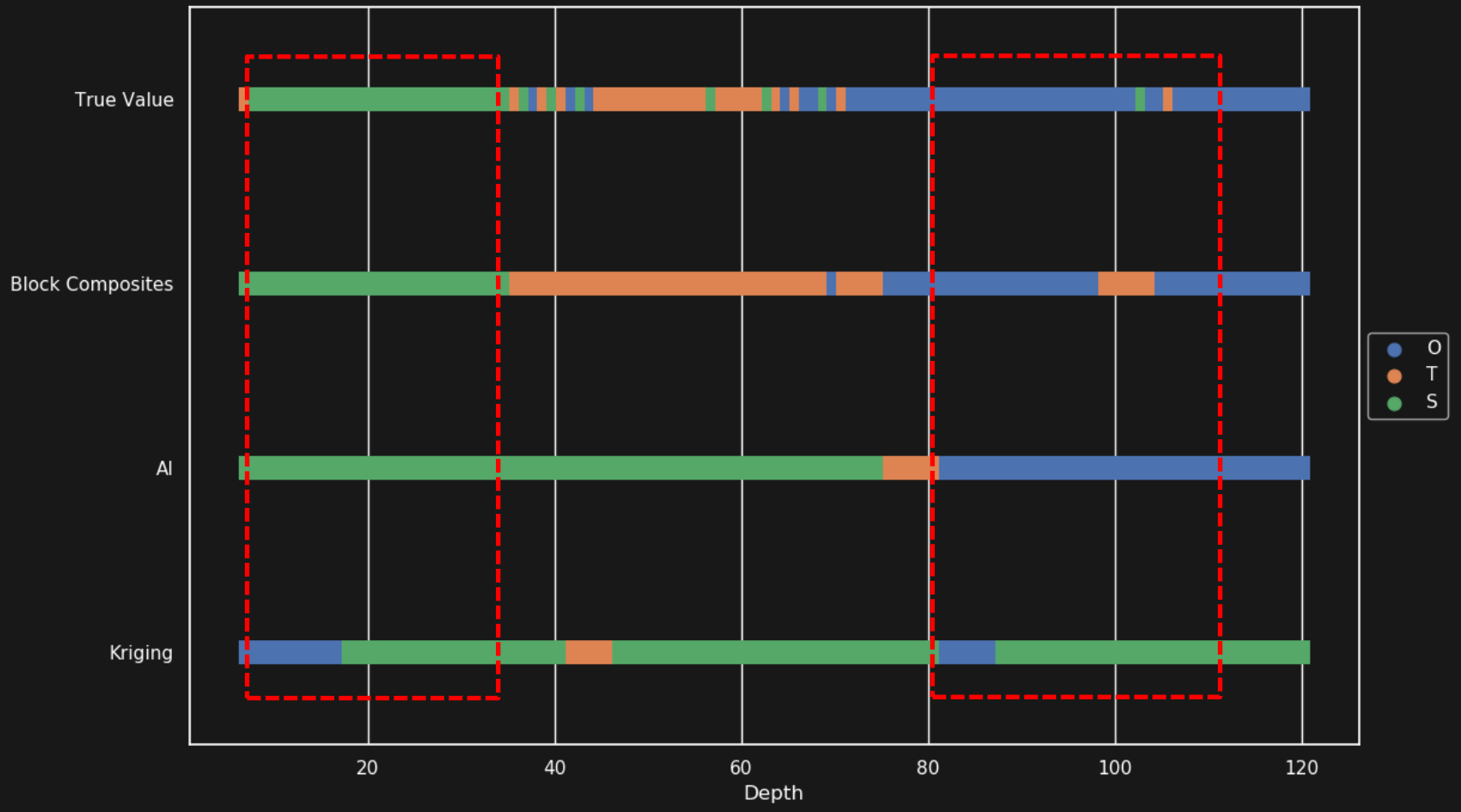
DRILLHOLES PLOT
SRCH087

AI correctly identified oxide areas classified by kriging as sulfide.



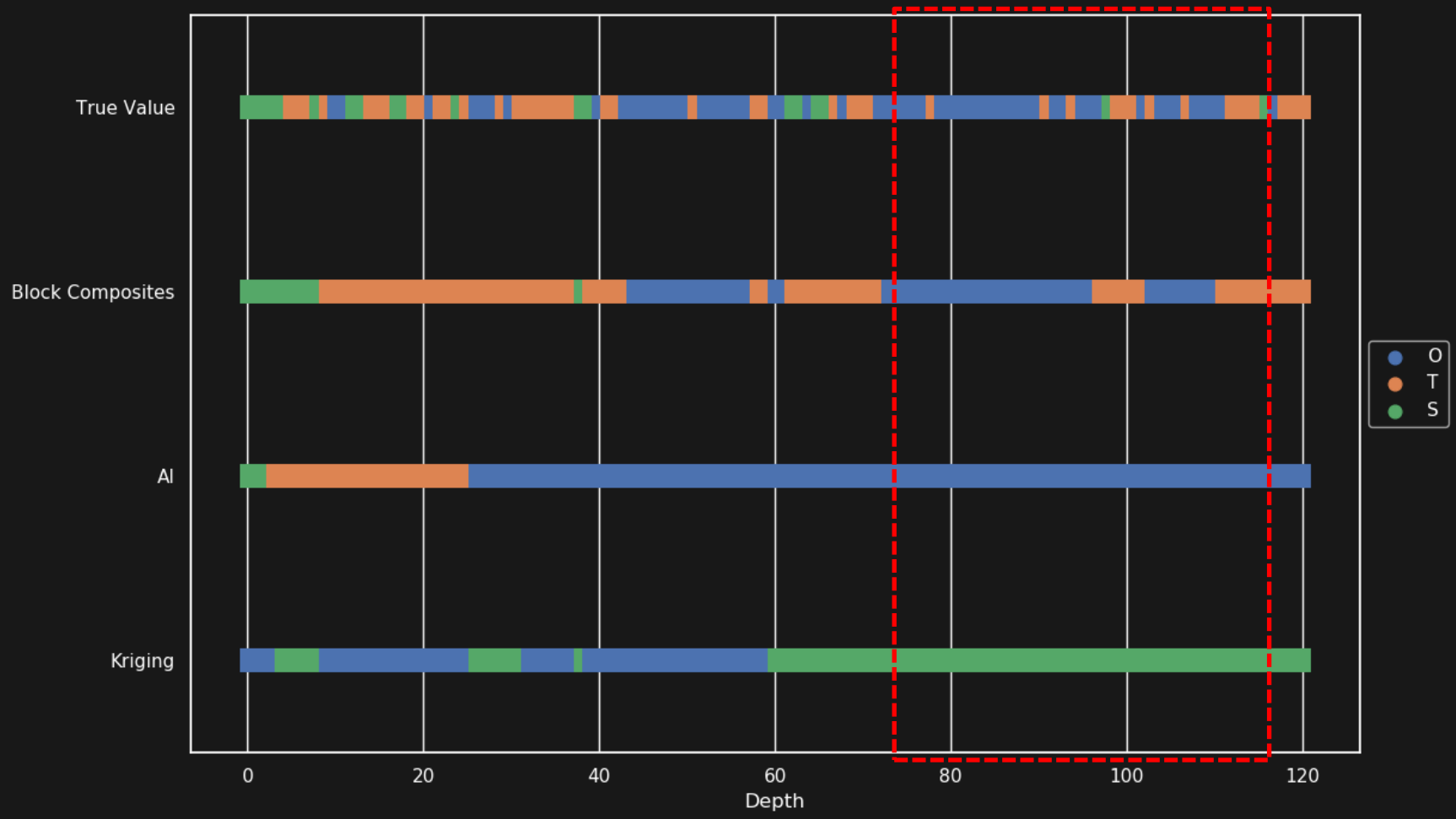
DRILLHOLES PLOT
SRCH093

AI correctly classifies sulfide area as sulfide and correctly identified oxide areas classified by kriging as sulfide.



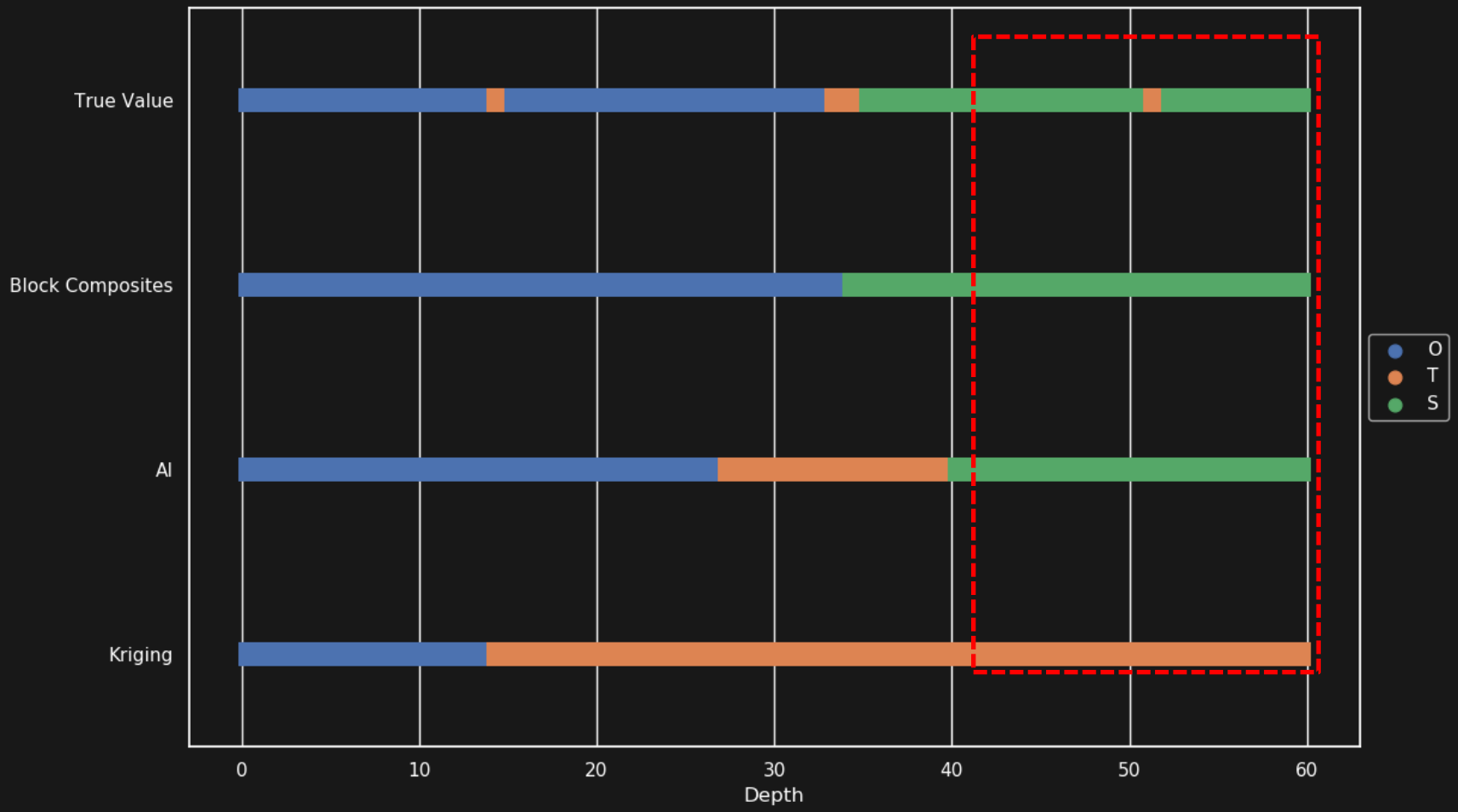
DRILLHOLES PLOT
SRCH090

The AI correctly classifies areas of oxide classified by kriging as sulfide



DRILLHOLES PLOT
SRCH099

AI correctly identified sulfide areas classified by kriging as trans.



STRATUM

LOW RISK – HIGH YIELD – AI DRIVEN