MINERVA
INTELLIGENCE

TERRA MINING AI

BY MINERVA INTELLIGENCE

PRODUCT SUITE

OVERVIEW

MINERVA
INTELLIGENCE

ALLINNO

The mining industry is beset by myriad issues, but some of the biggest of these are related to data.

Mining and exploration companies have mountains of data… the problems come in when that data needs to be reckoned with.

Also, with the advent of AI, much of the industry's data is functionally useless – it's unstructured and non-standardized, and as such is unreadable by machines.

Minerva's TERRA Mining AI suite deploys a suite of tools to help the mining industry with systemic problems such as:

1. *Unorganized and unstructured data*
2. *Non-standardized data*
3. *Data without interpretation*
4. *Data not "analytics ready" for AI systems*

Types of AI

Machine Learning	→ Deep Learning → Predictive Analytics
NLP	→ Translation → Classification, Clustering → Information Extraction
Speech	→ Speech to Text → Text to Speech
Cognitive	→ **Inference Engine** → **Knowledge Base**
Optimization	→ Reduction → Classical → Probabilistic, Temporal
Robotics	→ Reactive Machines → Limited Memory → Theory of Mind, Self-Aware
Vision	→ Image Recognition → Machine Vision

Modified from: cloud-NQB.com

Cognitive AI – Getting a computer to think (and reason) like a human

- We create conceptual models, using ontologies, that describe a specific concept in words, not numbers.
- These models are carefully designed and structured for later use (e.g. a VMS deposit model).
- We then take cohesive datasets that cover a population of data and compare the conceptual models to the datasets where we can make explainable predictions.

Currently Minerva is focused in the mining and natural hazards domains

TERRA MINING AI

DRIVER

OPTIMIZE UNDER-UTILIZED DRILLING DATA WITH 3D ANALYSIS OF MULTI-ELEMENT ZONES

SOLACE

HARMONIZE POORLY STRUCTURED LEGACY DATA WITH CUSTOMIZED VOCABULARIES AND RULES

LEO

FIND YOUR DOCUMENTS EFFICIENTLY WITH QUICK INDEXING, TAGGING AND SEARCHING FUNCTIONALITY

TARGET

OVERCOME LIMITED RESOURCES WITH HUNDREDS OF QUICKLY GENERATED DEPOSIT-SPECIFIC TARGETS

SOLACE
BY MINERVA INTELLIGENCE

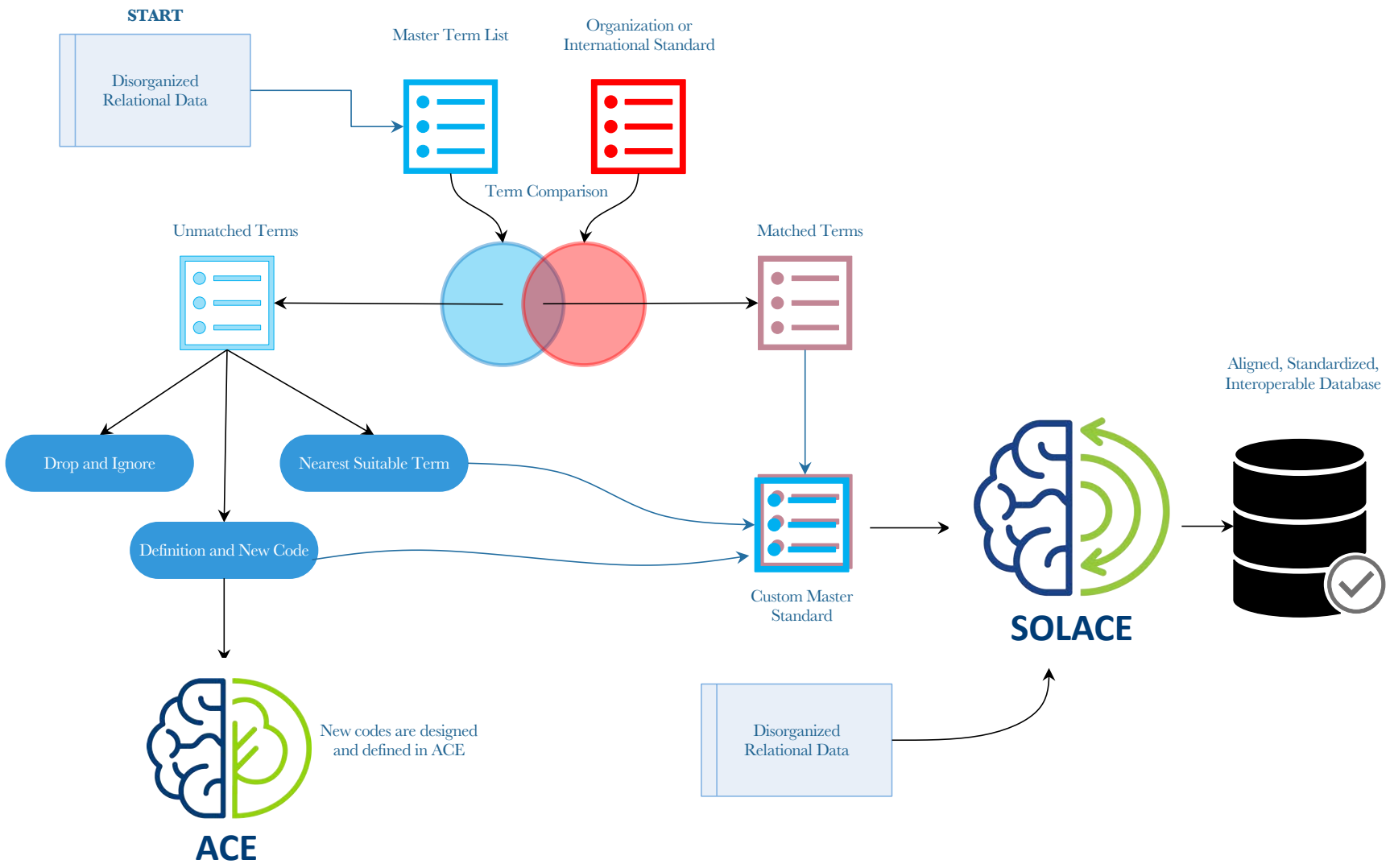
SOLACE is an integrated service that takes raw domain data and builds an infrastructure to align current and future data to chosen standards and make the data analytics-ready.

- SOLACE is meant for companies that routinely handle streams of poorly controlled data
- Traditionally this data is manually cleaned by employees to a minimum level of quality to suit the use case before being passed on to a centralized database. When data from new projects is acquired or created, this manual and subjective process is repeated, wasting time and effort.
- SOLACE provides organizations the means to choose a standard, define the terms they need to use, convert legacy data to the standard, and implement an alignment process to automatically convert new data.

All of these terms are similar but unique. How can humans or computers handle them?

Benefits

- Formalizes a necessary process that is often done ad-hoc
- Produces harmonized streams of data that remove the data cleaning burden from database managers
- The system remembers historic alignments and improves over time
- Individual employees and stakeholders on the data creation stage do not have to change the words they prefer, so long as they continue to use them the same way. This avoids the problem of the top-down imposition of standards, which leads to limited adoption.



LEO BY MINERVA INTELLIGENCE

LEO uses controlled vocabularies to automatically index, tag, and geotag your files, making document management and searching much faster and more effective

UNSTRUCTURED DOCUMENTS

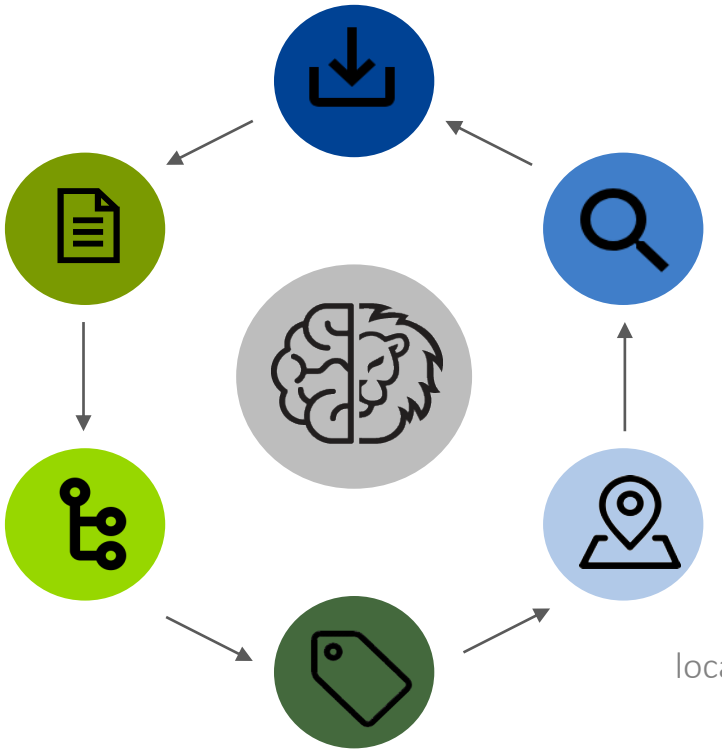
Can be a single- or multiple-document repository with any MS Office files, PDFs, images, or even non-OCR scans

CONTROLLED VOCABULARIES

LEO uses taxonomies that are built into the system but can be further customized for each client's needs

AUTO-TAGGING

LEO automatically tags documents with relevant words from the taxonomy



DOWNLOAD DOCUMENTS

Once the documents have been found the user can download them

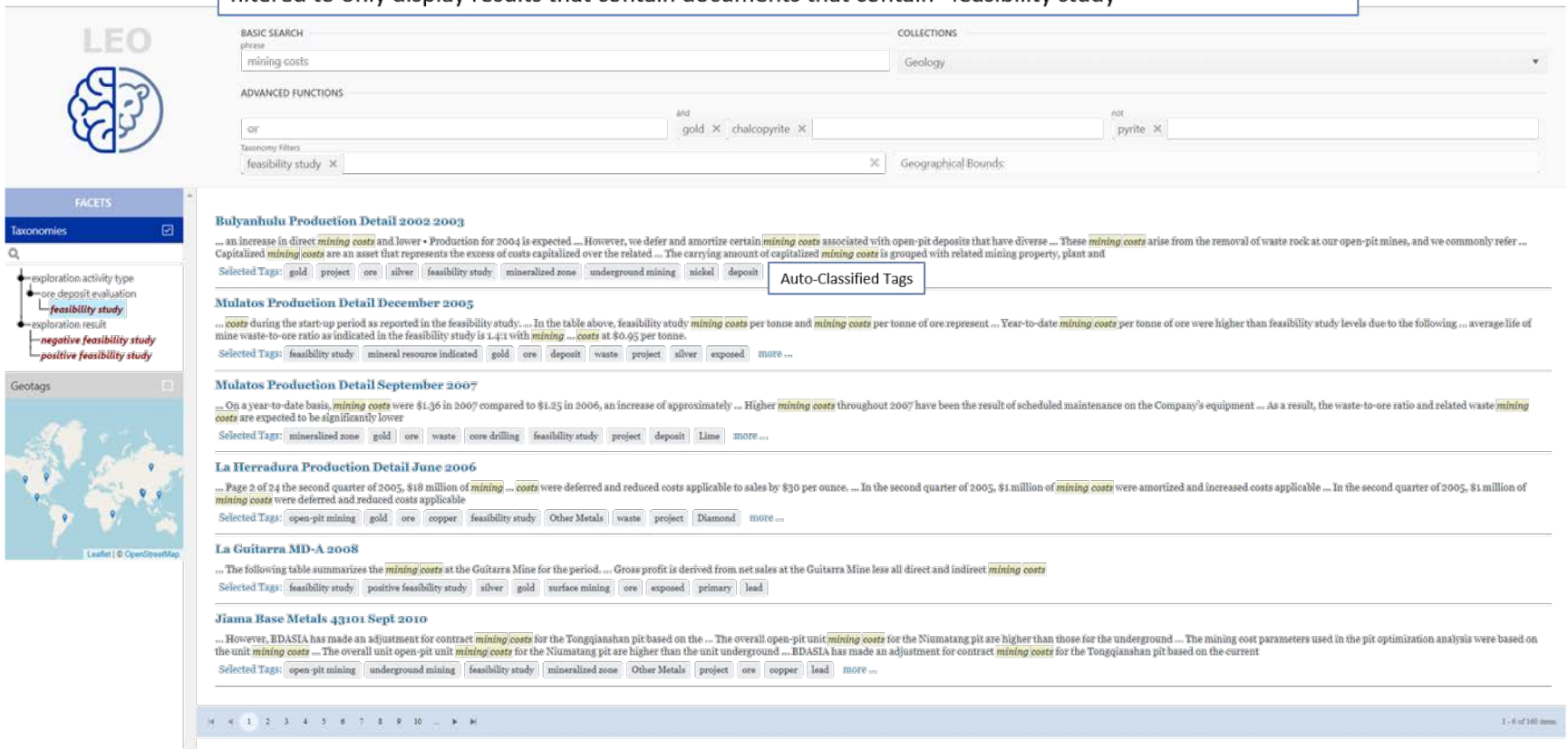
SEARCH FUNCTIONALITY

Basic and advanced search functions in an easy-to-use interface

GEO-TAGGING

LEO automatically tags documents with location data and displays the results on a map

Free text search for “mining costs”, with the tags “gold and chalcopyrite, not pyrite”. Results are then filtered to only display results that contain documents that contain “feasibility study”



Link to LEO Live Demo Site

LEO Benefits

- Increase interoperability of unstructured documents
- Increase communication between different operations or groups within operations (Geo-Mine-Met)
- Control over data management setup and workflow (auditable)
- Automatic tagging of documents with user input, controlled approvals of tags, ability to add and customize tags
- Can OCR scan and tag old legacy documents
- On-premise or cloud-based
- Front-end search capabilities using controlled language
- Front end document search capabilities for handing alternative spellings, short forms and misspelled words

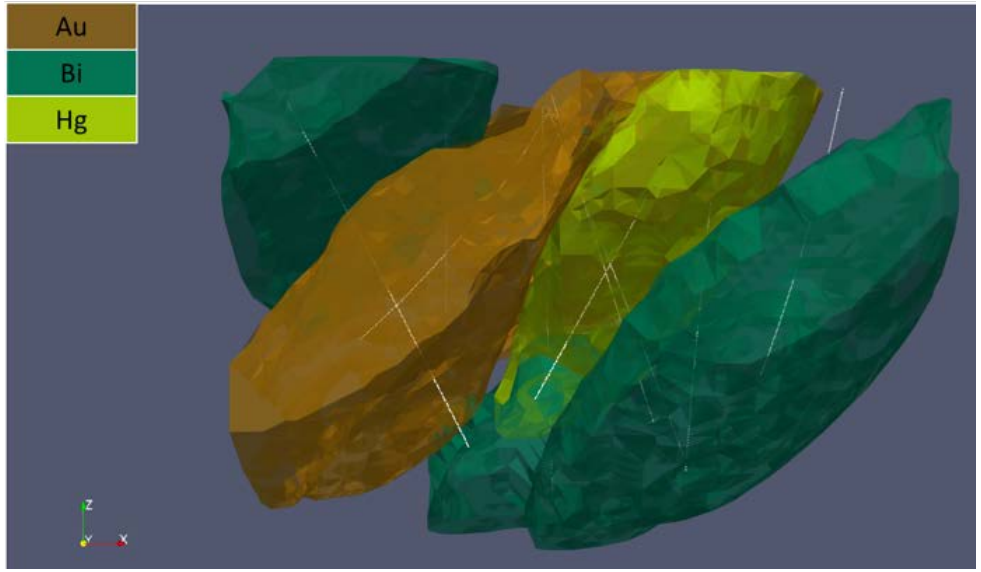
DRIVER
BY MINERVA INTELLIGENCE

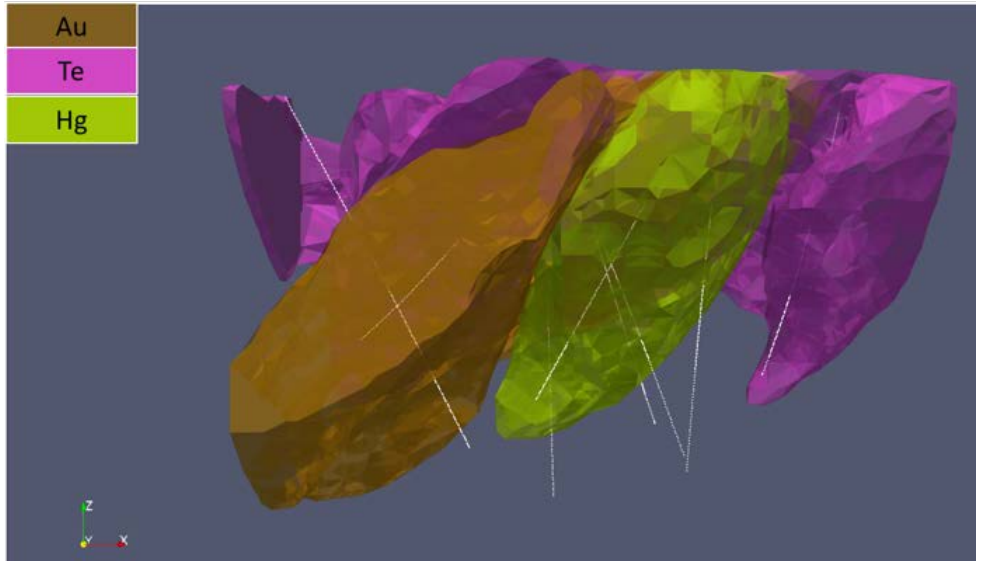
Limited Time, Limited Expertise

- Exploration drilling campaigns spend millions of dollars collecting data, but often focus on only a few key elements
- Resource evaluations spend hundreds of thousands of dollars quantifying the shape and extents of ore bodies for the primary commodities, but rarely apply the same workflow to other elements available in the assays.

3D Analysis Of Multi-Element Zones

- DRIVER takes multi-element drilling data and applies spatial and geostatistical analysis to produce hundreds of 3D volumes for the full suite of elements
- Used to identify spatial distribution of different element groups for exploration and geometallurgy purposes
- Identifies and indexes key zones and compares DRIVER results to mineral deposit knowledge, explanations and advice (Minerva's core AI system)

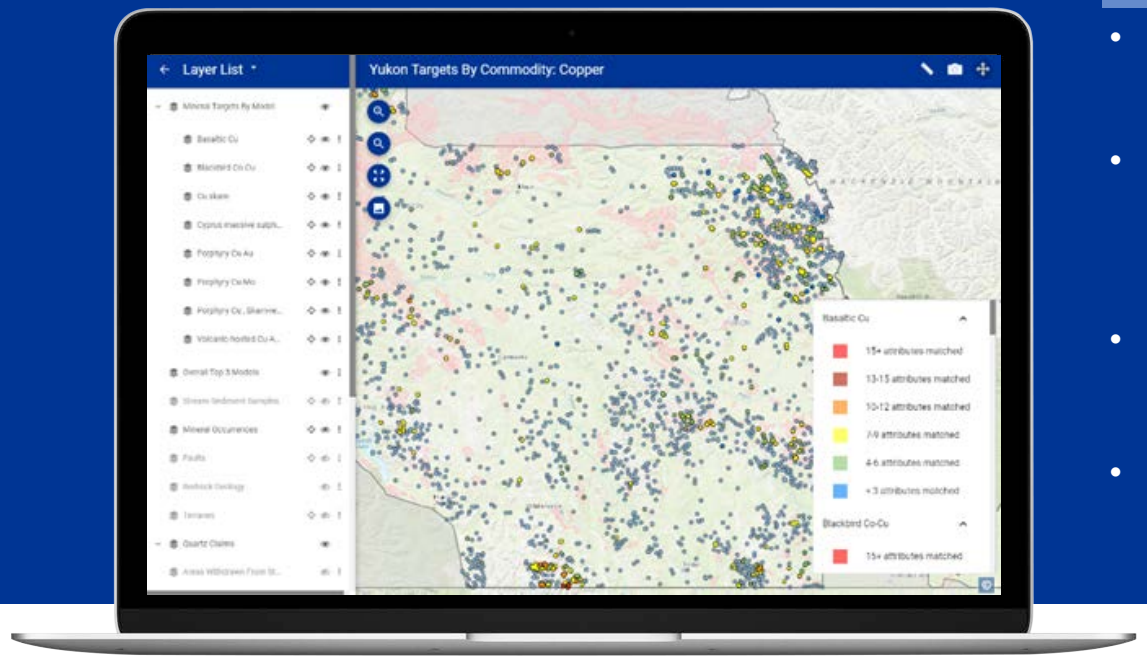




TARGET

BY MINERVA INTELLIGENCE

A cognitive AI system that produces explainable exploration targets by mimicking the traditional process of geological data evaluation

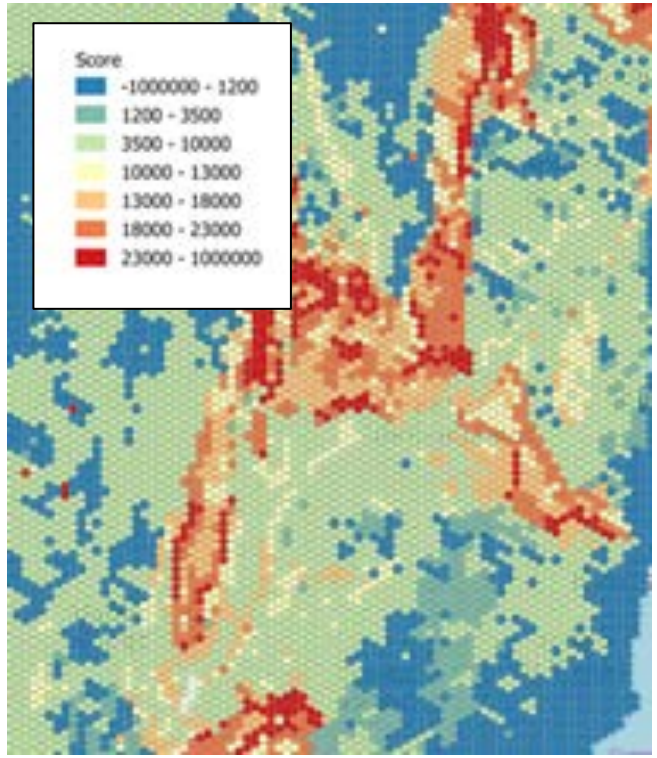


Benefits

- Able to use and interpret large data sets with multiple generations of data
- Combines machine intelligence with human intelligence to reach conclusions faster than geologist
- Provides explanations for individual target points
- Processed datasets reside as a standardized dataset for future AI-applications

Mineral Targets

- Focused on provincial- or state- to country-scale Mineral Target prospectivity maps for mineral exploration but can be applied to smaller claim areas for junior mining companies
- End product is an interactive target map layer that is auditable and provides explanations and advice to users
- Interactive Demo: https://yukonmineraltargets.com/



	PorphyryCu-Mo: Property, Value, Freq			YMT2397: Property, Value, Freq		Match Type	Node Score
Deposit	deposit	present	Deposit	deposit	present		
Has Age	Danian-Piacenzian	sometimes	Has Age Numeric	57-64	present	equivalent pdts - sub_range	100
Has Rock Host	tonalite	sometimes				unmatched	-10
Has Rock Host	granitoid	usually	Has Rock Host	granodiorite	present	exact_exact_pot - exact_AKD_val	9000
Has Rock Host	monzogranite	sometimes				unmatched	-10
Has Rock Host	sedimentary rock	sometimes				unmatched	-10
Has Rock Host	granodiorite	sometimes				unmatched	-10
Has Rock Host	pyroclastic rock	sometimes				unmatched	-10
Has Element Mzn Enhanced	Ag	sometimes				unmatched	-10
			Has Setting Genetic	pluton	present	unmatched	
Has Setting Genetic	arc systems	sometimes	Has Setting Genetic	arc	present	exact_exact_pot - exact_AKD_val	1000
			Has Rock Host	porphyry	present	unmatched	
			Has Rock Host	diorite	present	unmatched	
			Has Rock Host	quartz diorite	present	unmatched	
Has Element Mzn Enhanced	Zn	sometimes				unmatched	-10
			Has Rock Host	quartz monzonite	present	unmatched	
Has Element Mzn Enhanced	Pb	sometimes				unmatched	-10
Has Element Mzn Enhanced	S	always	Has Element Enhanced	S	present	equivalent pdts - exact_exact_val	10000
Has Element Enhanced To Ore	Mo	usually	Has Element Enhanced	Mo	present	subpdt_exact - exact_exact_val	6750
Has Element Enhanced To Ore	Cu	usually				unmatched	-10
Has Element Mzn Enhanced	B	sometimes				unmatched	-10
Has Element Mzn Enhanced	Sr	sometimes				unmatched	-10
Has Element Mzn Enhanced	W	sometimes				unmatched	-10
Has Mineral Enhanced To Ore	Molybdenite	usually				unmatched	-10

Advice

To improve the match:

Rank	Advice	Score
4	Check if Molybdenite is present.	9010
5	Check if Cu is present.	9010

To worsen the match:

Rank	Advice
4	Check if Cu is absent.
6	Check if Chalcopyrite is absent.

TERRA MINING AI

DRIVER

OPTIMIZE UNDER-UTILIZED DRILLING DATA WITH 3D ANALYSIS OF MULTI-ELEMENT ZONES

SOLACE

HARMONIZE POORLY STRUCTURED LEGACY DATA WITH CUSTOMIZED VOCABULARIES AND RULES

LEO

FIND YOUR DOCUMENTS EFFICIENTLY WITH QUICK INDEXING, TAGGING AND SEARCHING FUNCTIONALITY

TARGET

OVERCOME LIMITED RESOURCES WITH HUNDREDS OF QUICKLY GENERATED DEPOSIT-SPECIFIC TARGETS

- **Global Mining Company** – Contracted Minerva to complete a SOLACE project on their drillhole database to align terms from all mines, projects and acquisitions to one standard.
- **International Exploration Company** – Completed a TARGET project for the entirety of Brazil for 80+ different deposit models.
- **World-Renowned Canadian Exploration Company** – Geochemical evaluation of over 50,000 soil samples using technology from DRIVER.
- **Exploration company–** After merger of two companies, using LEO to index, tag and search their combined document repositories.
- **International Mining Project** – Used Minerva technology to complete a data audit, interpretation and provided new prospectivity targets to client.

THEIR PROBLEM

A **global mining company** that had multiple mines, projects and acquisition data in different formats and languages

OUR SOLUTION

Minerva's **SOLACE** consulting service and SaaS software solution

RESULTS

A **custom master standard** and an **aligned, standardized interoperable database** uniting all their data under one single, auditable standard

THEIR PROBLEM

An **international exploration company** exploring in Brazil wanted an efficient way to rank exploration targets.

OUR SOLUTION

Minerva's **TARGET** consulting service

RESULTS

An **interactive webmap** displaying **targets** of 80+ deposit models for the entire country of Brazil

THEIR PROBLEM

A **world-renowned Canadian exploration company's** collected over 50,000 soil samples and wanted additional exploration vectors

OUR SOLUTION

Minerva's **DRIVER** 3D metallurgical and geochemical analysis product

RESULTS

Geostatistical analysis resulting in shapefiles displaying **exploration vectors**

THEIR PROBLEM

Orogen Royalties had tens of thousands of unstructured documents after a merger of two companies

OUR SOLUTION

LEO Intelligent document management system built for the mining and exploration industries.

RESULTS

"With LEO, we are able to quickly search through thousands of documents using keyword searches and obtain a listing of relevant documents along with contextual reference and a listing of other key geological words in the document."

Dave Groves, P. Geo. VP Exploration
Orogen Royalties

MINERVA INTELLIGENCE

301 - 850 West Hastings Street
Vancouver, British Columbia, Canada

minervaintelligence.com
info@minervaintelligence.com

TERRA MINING AI
BY MINERVA INTELLIGENCE

ALLINNO

Greg Macpherson
Allinno - Australia/New Zealand
+61 411 280 780

www. allinno.com.au
greg.macpherson@allinno.com.au

TERRA MINING AI
BY MINERVA INTELLIGENCE

Greg Macpherson
Allinno – Australia/New Zealand
+61 411 280 780

www. allinno.com.au
greg.macpherson@allinno.com.au

301 - 850 West Hastings Street
Vancouver, British Columbia
Canada V6C 1E1

For more information:
604.620.1051
minervaintelligence.com
info@minervaintelligence.com