

Project Development in Argentina

For Wind Energy and Minerals Using Spatial Data Modelling



Introduction

- **Development of New Business Opportunities in Argentina Key Project for Kenex Since Mining 2010.**
- **Based on Business Relationship with Buenos Aires Based Company Emprendimientos Energéticos y Desarrollos S.A (EEDSA).**
- **Started in 2010 with Wind and Then Minerals in 2011.**
- **MoU between EEDSA and Kenex Signed in March 2011.**
- **Kenex Incorporate Argentinean Company May 2012.**
- **Continuing Defining Targets for Modelling and Project Development in Wind Energy and Minerals.**

Kenex : www.kenex.co.nz

- **Kenex Operating Profitably for Ten Years.**
- **Knowledge Based Company, Focussing on Using Spatial Data, Modelling and Knowledge of Process to Allow Prediction.**
- **Initially Out of NZ and Now Working Globally.**
- **Focus on New Computer Modelling Techniques and Digital Spatial Data for Project Development in Mineral Exploration and Other Spatially Based Industries.**
- **Our Main Focus is to Develop New Business Opportunities and Help Manage Businesses Using Spatial Data Modelling in a GIS Environment.**

EEDSA :www.eedsa.com

- **EESDA are an Argentinian Company Based in Buenos Aires.**
- **EEDSA Involved in Renewable Energy Sector in Latin America Since 1992.**
- **Helped Develop Numerous Projects Through Wind Engineering Experience and Sector Investment Contacts.**
- **Projects Developed in Chile, Argentina, Uruguay, Mexico, Brazil, Costa Rica and the Caribbean.**
- **Looking to Expand in South America and Globally.**

Business Strategy

- **Use New Modelling Technologies and In House Spatial Databases to Identify Projects in Wind and Minerals.**
- **Use Predictive Models to Create Target Databases for Identifying Business Investment Opportunities.**
- **Self Fund Early Development of Projects then Sell.**
- **Also have Contacts in Australia and Europe to Attract Funding and List New Companies to Manage Projects.**
- **We Like to Retain Equity in Those Projects.**
- **Offer Management Services to Add Value to Projects in Which Equity is Held.**
- **Aim of Speeding up and Adding Value to Equity Projects.**

Markets

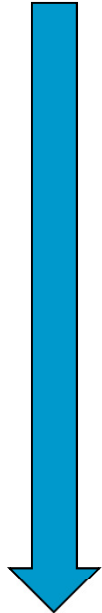
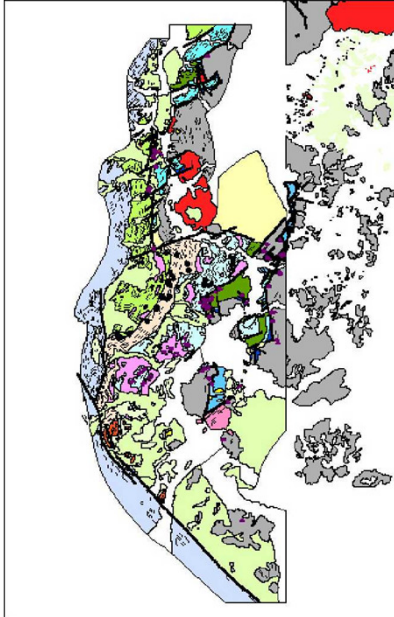
- Mineral Exploration
- Energy
- Renewable Energy
- Agriculture
- Climate
- Forestry
- Land Management
- Environmental
- Aquaculture



Our Business Is To Identify New Opportunities: www.kenex.com.au

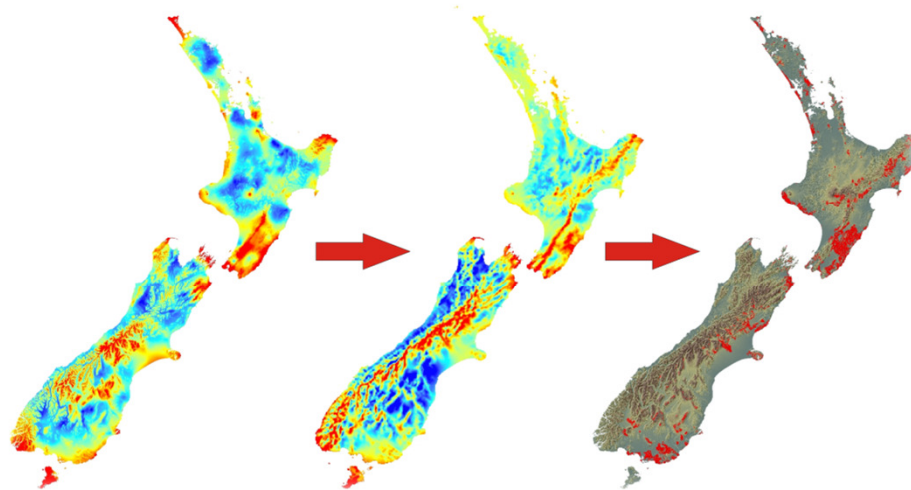


Key to Targeting



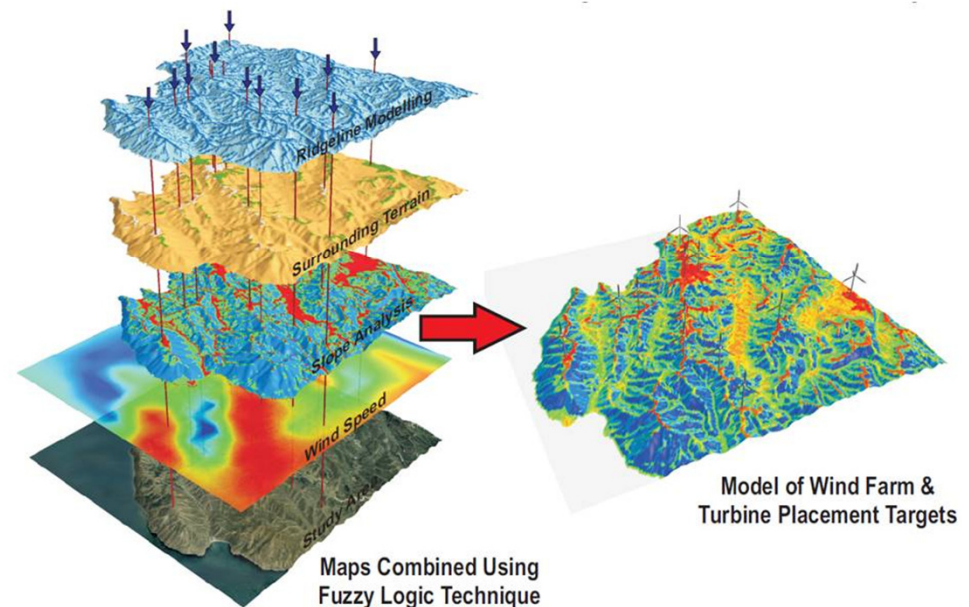
- Requirement to Get from Regional to Prospect Scale Quickly and Cheaply.
- Scale Dependent.
- Mineral Exploration and Wind Energy are Similar.
- Need to Map Key Evidence for Locating Mineral Deposits or Wind Energy.
- Work from Regional 2D to 3D Local Scale

Two Stage Modelling Process



National Scale Model to Find Wind Farm Targets Followed by Wind Farm Scale Modelling for Turbine Placement.

Multi-variable Models: Fuzzy Logic, Neural Networks, and Weights of Evidence Predictive Modelling that Replicates Known Systems



Approach to Wind and Minerals Exploration Targeting

Mineral Systems

Critical processes

Measure Prospectivity

Geological risk

Assess Cultural Issues

Geopolitical risk

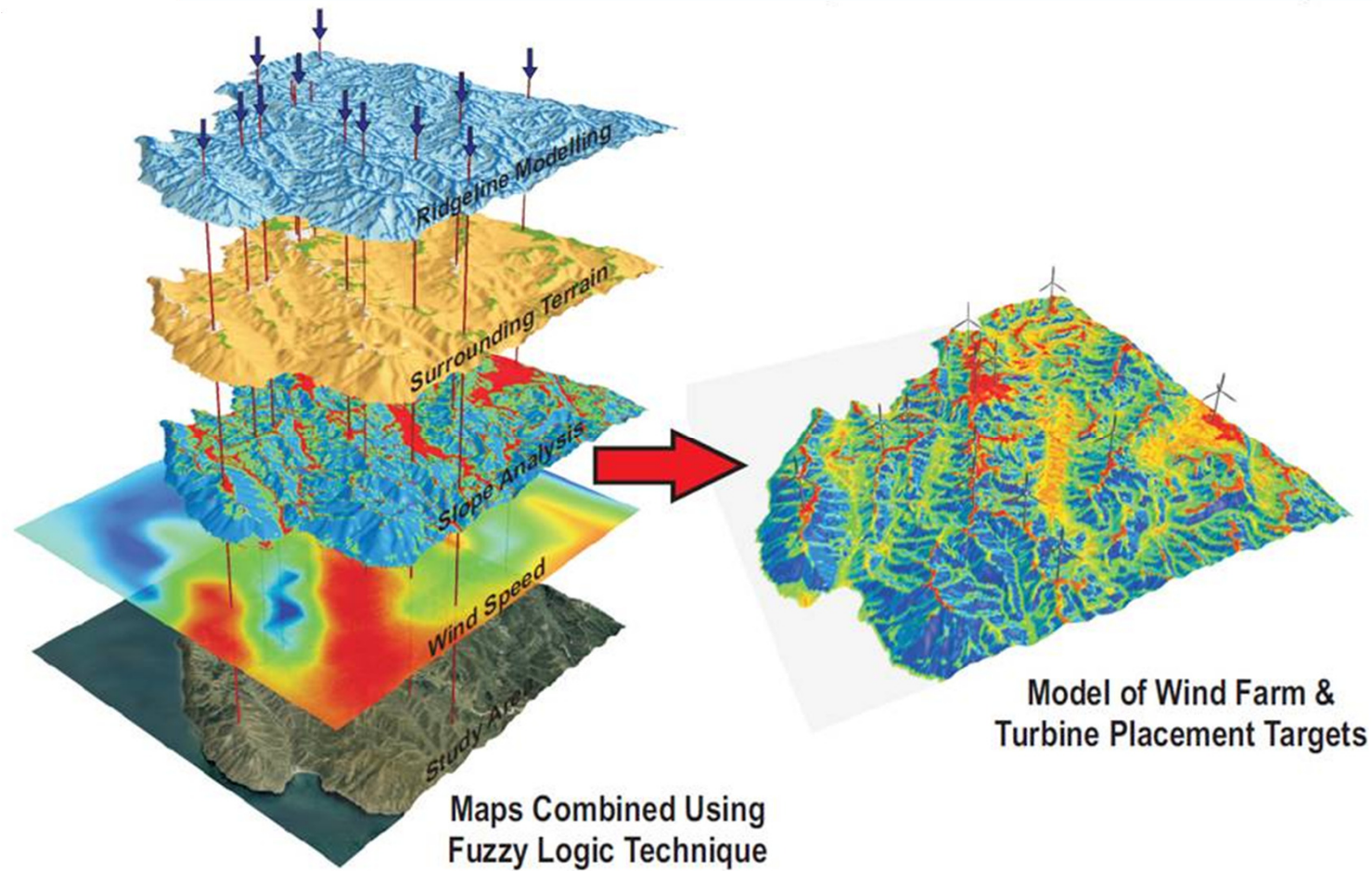
Simulate Economic Value

Financial risk

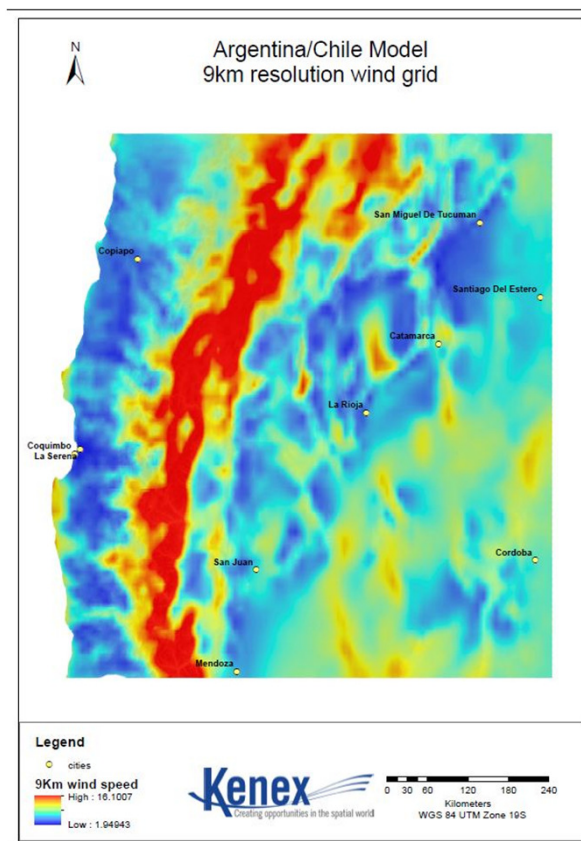
Prospectivity Matrix

Rank targets

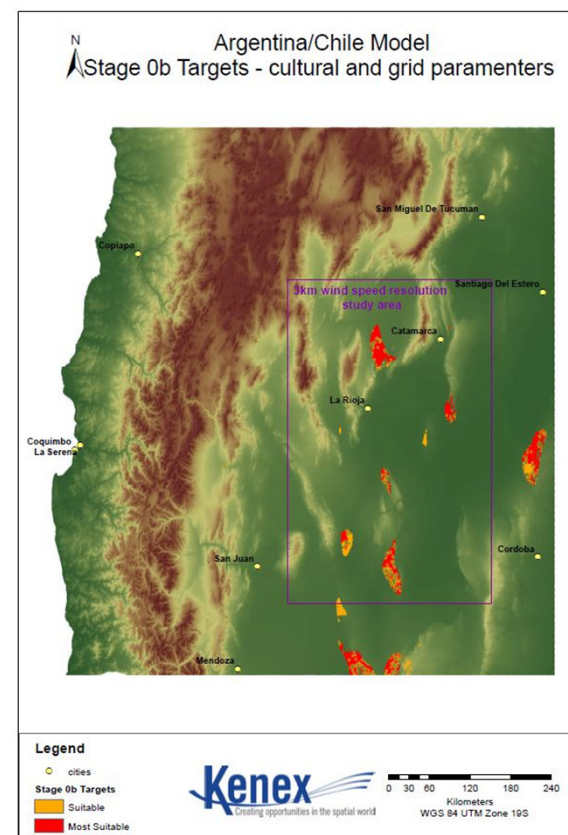
More Than Wind



More to Wind Targeting



=



Understand and Improve Your Chances of Success?

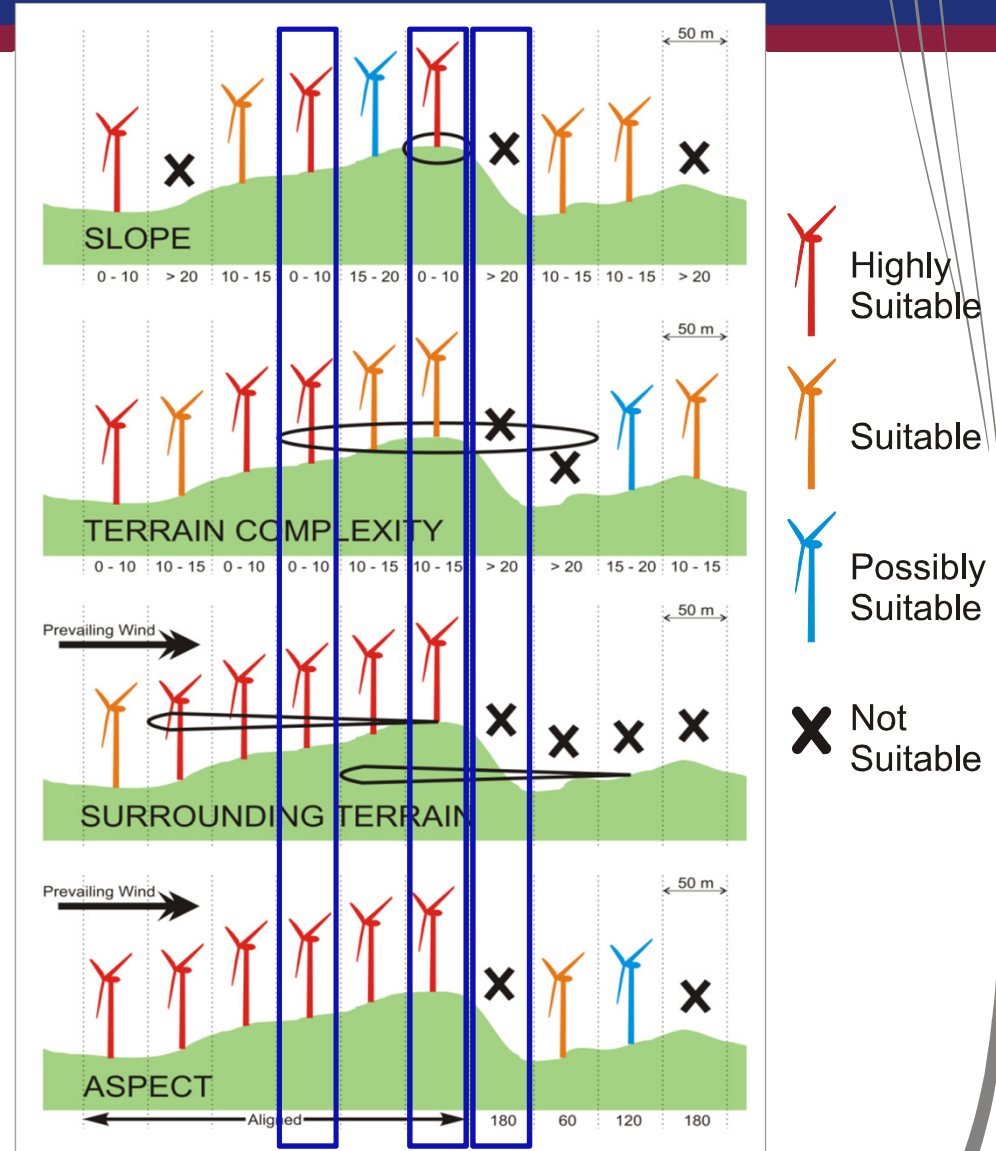


The Practical Implication Of High Discovery Risk For Strategic Planning & Exploration Budgeting Is A Large Difference Between The Average Cost Of Exploration Success And The Level Of Funding Required To Ensure Success (e.g. - “World Class” Deposits)

Discoveries Are Typically Made By The 5th-7th Person/Company Covering The Ground

Factors Affecting Turbine Placement

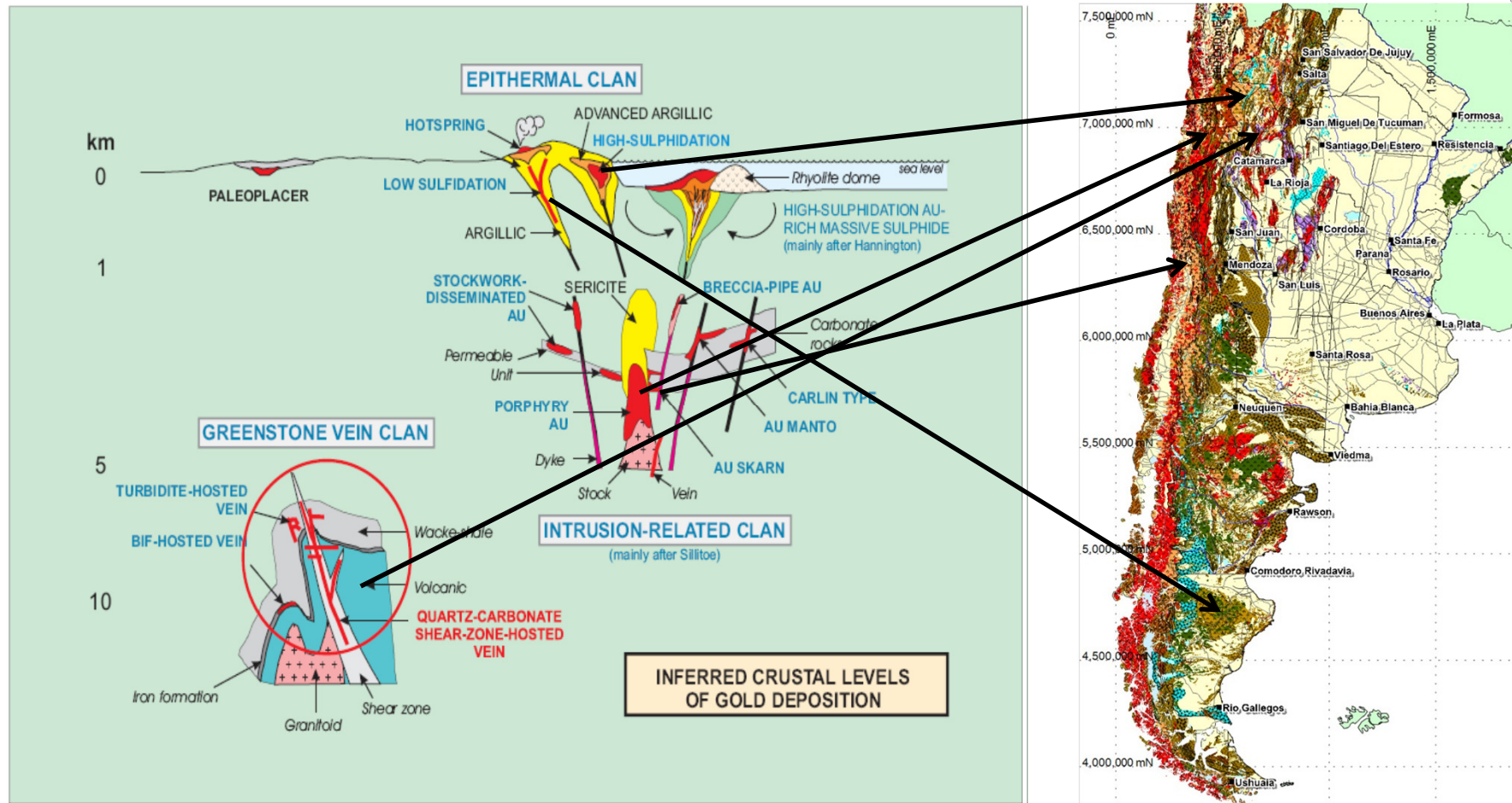
- Key Parameters for Energy Capture and Turbine Loads:
 - Wind Speed Distribution
 - Turbulence
 - Inflow Angle
- Turbulence and Inflow Angle Influenced by Local and Surrounding Terrain.
- Mesoscale Modelling and Topographic Modelling Provides these Data.
- Logistical Factors Including Existing Infrastructure and Power Connections.
- Social and Land Access.
- Consenting Issues.



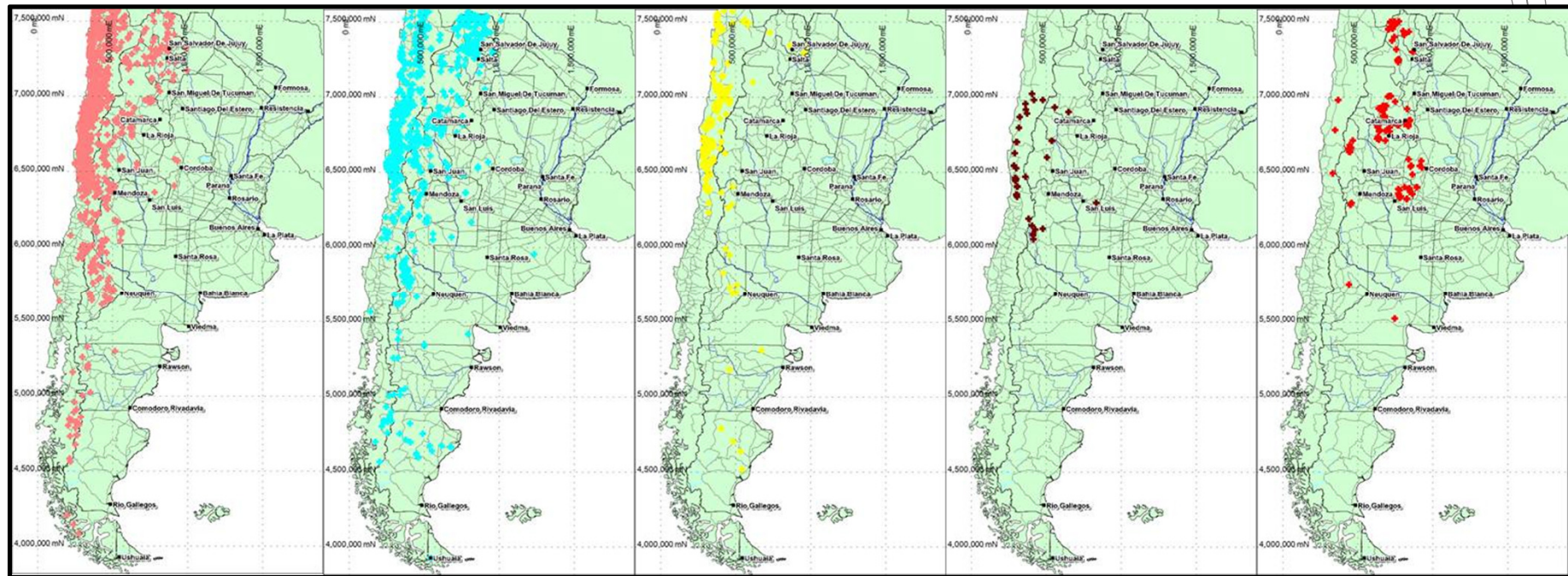
Mineral System

- **Mineral Systems Approach Adaptation of Petroleum Modelling, Allows Probabilistic Assessment.**
- **Requires Critical Parameters of Ore Formation to be Identified Related to :**
 - **Controls on generation and preservation of Ore**
 - **Processes that Cause Metals to be Mobilised from Source, Transport and Deposition into Traps.**
- **This Approach Allows for Multiple Ore Deposit Styles to be Realised in Single Mineral System.**
- **Need to Map Evidence for These Processes.**

Modelling for Minerals in Argentina



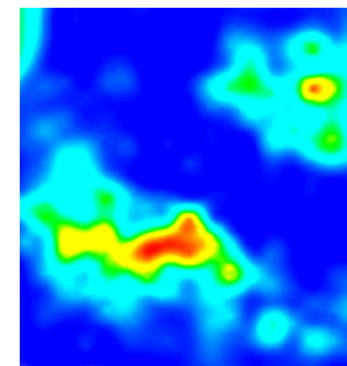
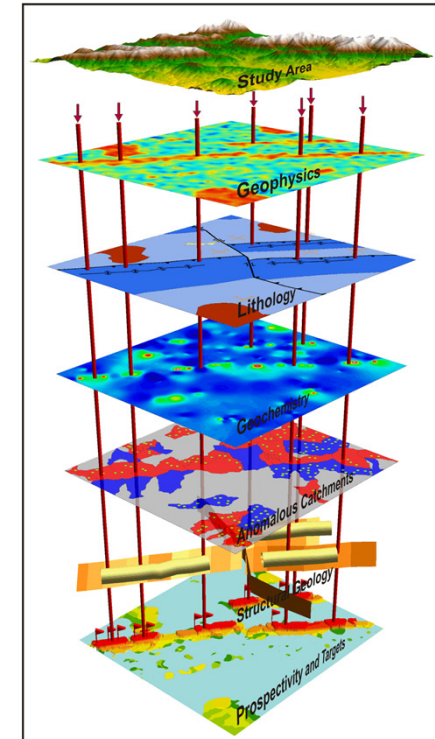
Mineral Systems of Argentina and Chile



Porphyry **LS Epithermal** **HS Epithermal** **Skarn** **Granite**

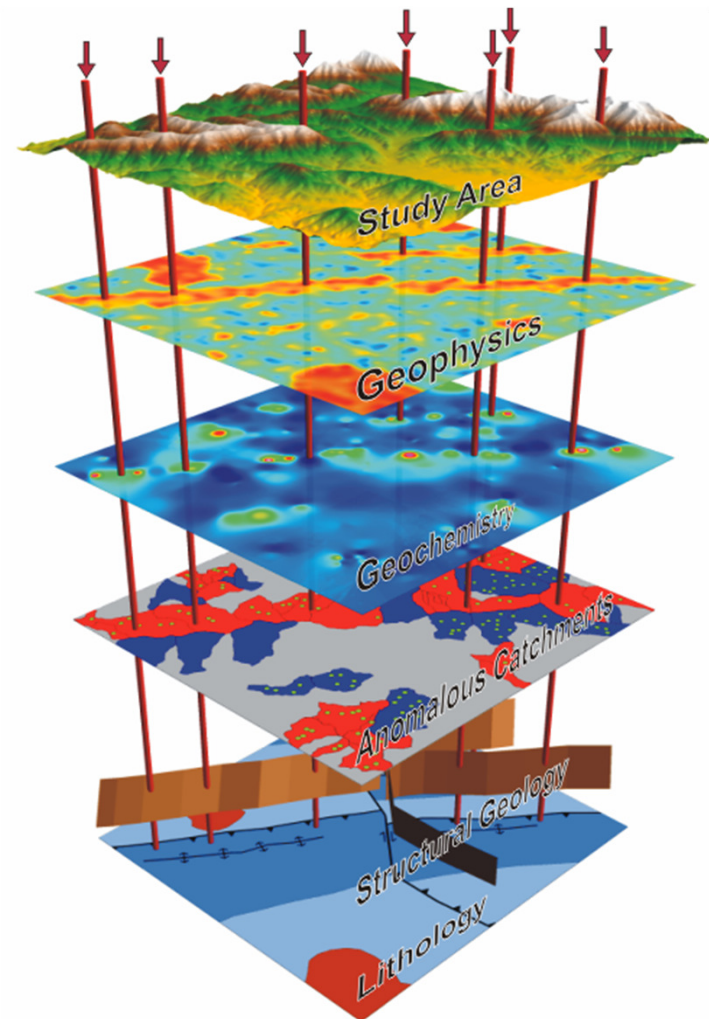
Spatial Data Modelling Approach

- Use All Digital Data Available
- Predictive Maps from Geological, Geochemical and Geophysical Data Based on Mineral System Model
- Use Known Deposits to Test Spatial Correlation of Maps or Develop Expert Weights Based on Known Systems.
- Combine Maps Using Weights from Spatial Correlation or Experts
- Use Computer to Calculate Probability of an Occurrence for Each Grid Cell



Spatial Data Modelling

**Multi-variable Models:
GIS Map Queries and
Map Addition, Fuzzy
Logic, Neural
Networks, and Weights
of Evidence Predictive
Modelling Replicating
Known Systems**



Fuzzy Logic: Expert Analysis

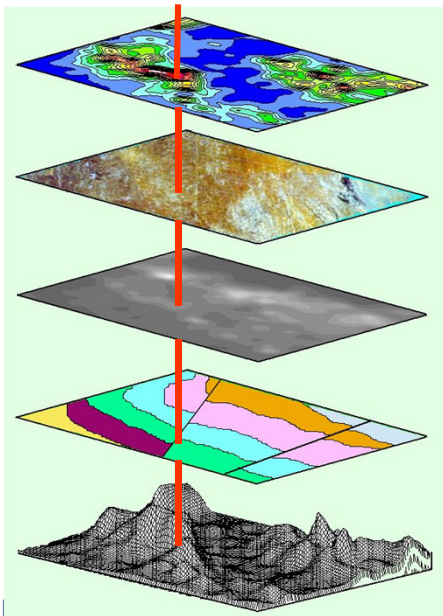
Using Expert Estimates of Weights (f)

Assuming Fuzzy Set Membership e.g., As Anomalies 1=Anomalous $f=0.7$,
0=Not Anomalous $f=0.001$,

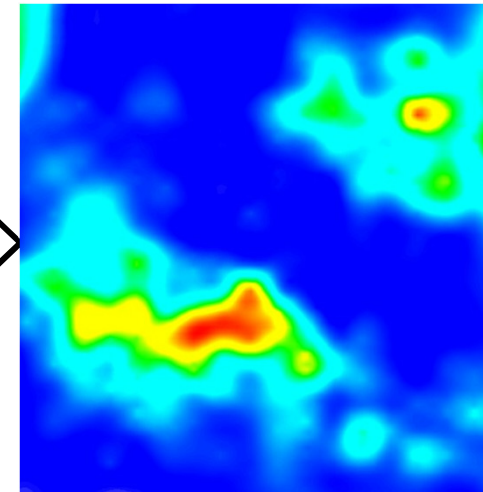
Maps Combined Using Combinations of And, Or, Sum, Product and Gamma

Good for Poorly Explored Areas, Depends on Experts!

Mineralisation Potential



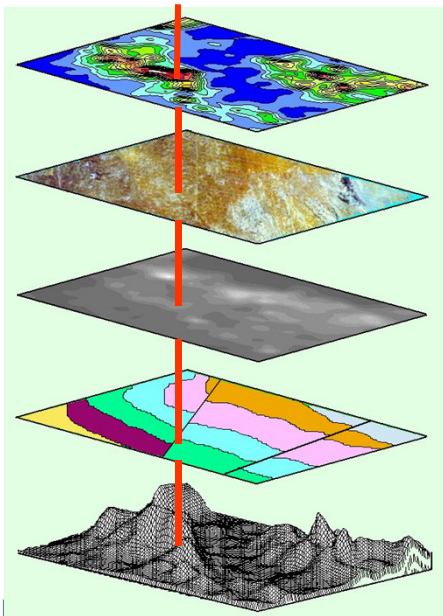
**A weighted
aggregation
process**



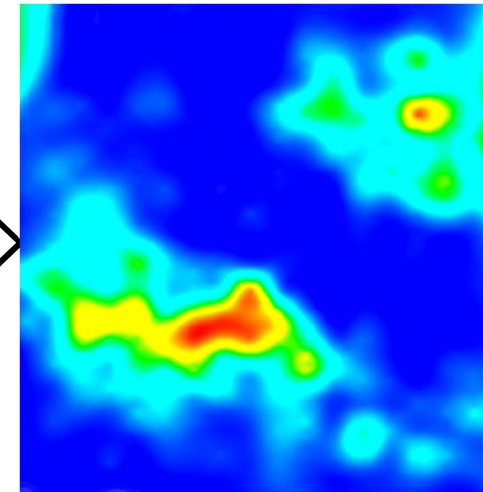
Weights of Evidence : Data Driven

Using Statistically Estimates of Weights from W- and W+
Derived from Spatial Analysis of Predictive Map Variables and Training Data,
Maps Combined Using Weights Based on Mineral System,
Accounts for Missing Data,
Good for Better Explored Areas, Requires Training Data

Mineralisation Potential

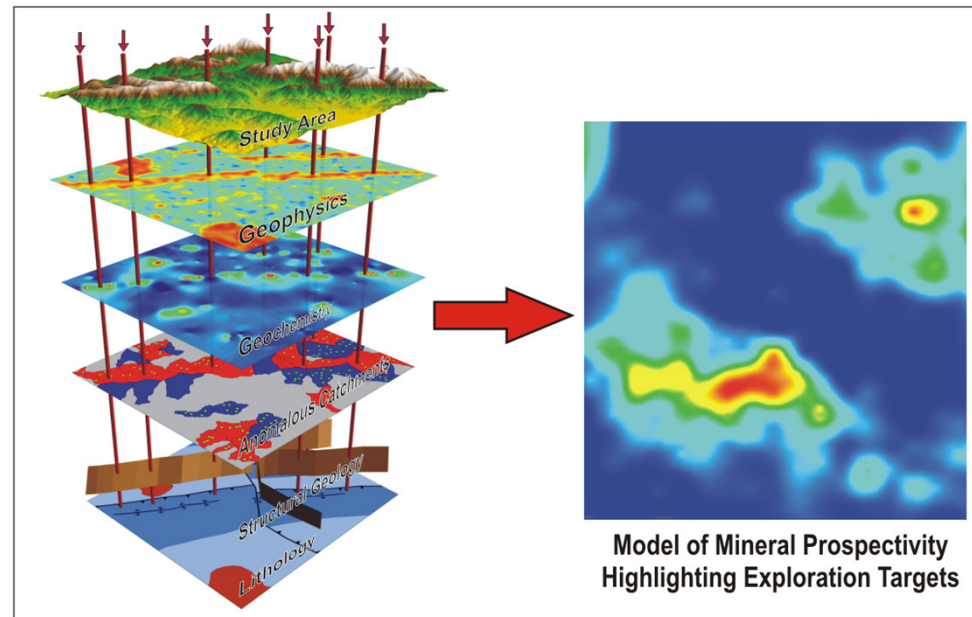


**A weighted
aggregation
process**



Model = Mineral System

Map	Variable
VMS mineral occurrence clustering.	Source
Volcanic and syn volcanic lithologies.	Source
Syn volcanic faults.	Transport
Bends along syn volcanic faults.	Transport
Gossan out crops.	Trap
Lithological contacts that map the presence of the ancient seafloor.	Trap
Alteration mapped by magnetite destruction in volcanic lithologies.	Trap
Areas with anomalous copper values.	Deposition
Areas of high magnetic contrast.	Deposition



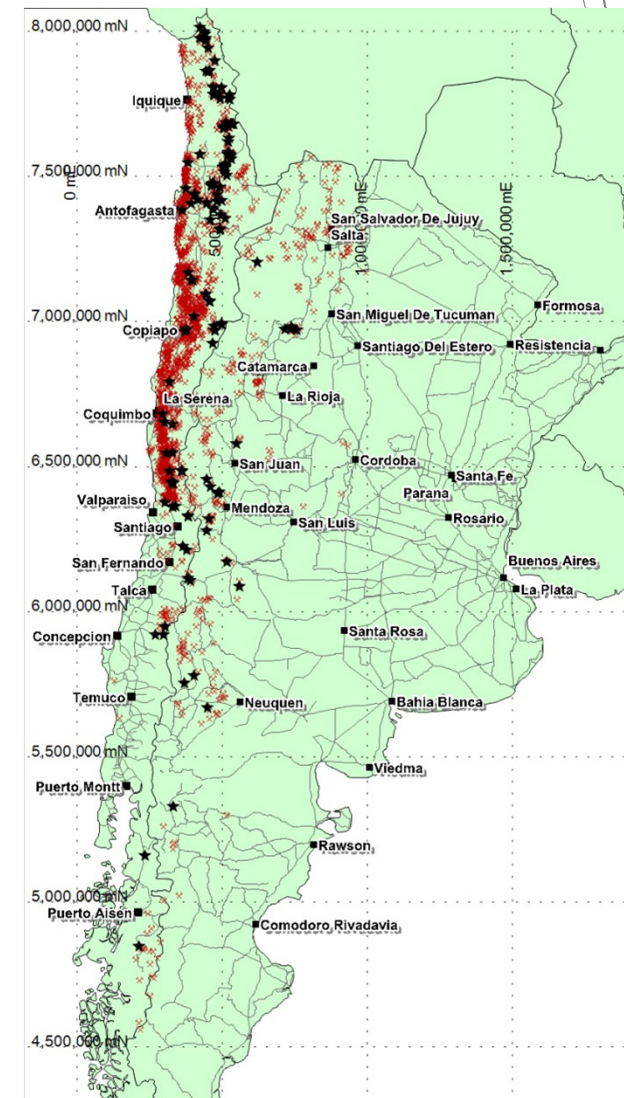
Study Area and Modelling Strategy

- **Geology Crosses International Borders.**
- **Important World Class Examples in Chile.**
- **Modelling Argentina and Chile for Stage One Targeting.**
- **Stage One Target Areas to be Modelled with More Detailed Data: Historic and New Data.**
- **3D Modelling if Data Appropriate for Drill Targets.**

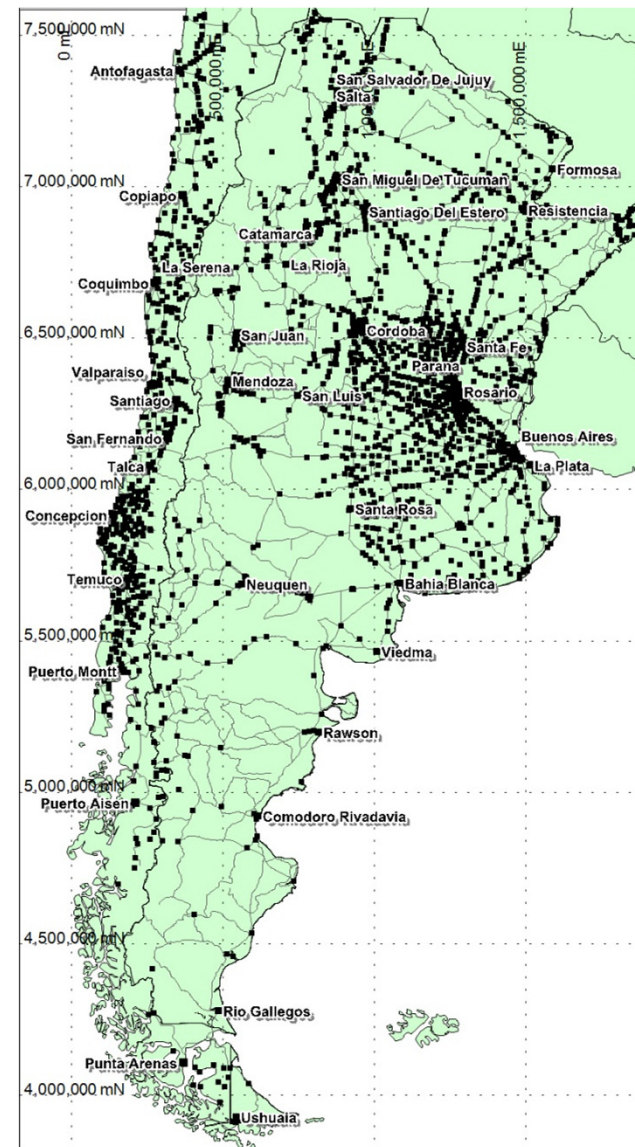
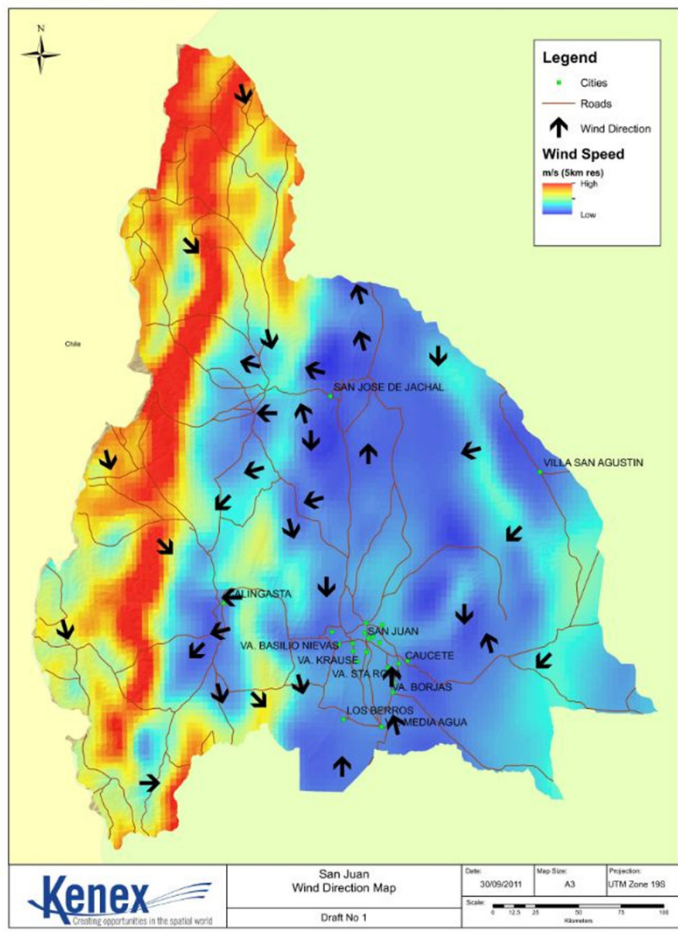


Training Data

- System Model Defines Training Data.
- Training Data from Both Chile and Argentina.
- Training Data Come from Chile and Argentina Mineral Occurrences.
- Apples and Oranges
- Based on Size and Production
- Subset of Total Database Allows Testing of Predictive Efficiency.
- Weights of Evidence Assumes One Training Site Per Unit Cell.



Wind Data



Databases That Cover Study Area

- **Integrated and Assessed in Argentina and Chile.**
- **6,347 mineral occurrences.**
- **7,717 rock data.**
- **128,902 SS data.**
- **21,016 soil data.**
- **790 drill holes.**
- **3,525,700 km² Geology, Gravity and DTM.**
- **Added New Attributes and Age Data to Geology and Faults.**



Argentina Wind Modelling Status

- **Stage One Wind Modelling Completed for 10 Provinces.**
- **Numerous Targets Under Review and Target Database Compiled.**
- **Stage Two Wind Modelling Started on Selected Target Areas.**
- **One Project Sufficiently Advanced for Economic Scoping Study to Start.**
- **Discussions Commenced with Provincial Government and Land Holders.**
- **Turbine Placement Studies Started on Selected Targets in Preparation for Economic Modelling.**

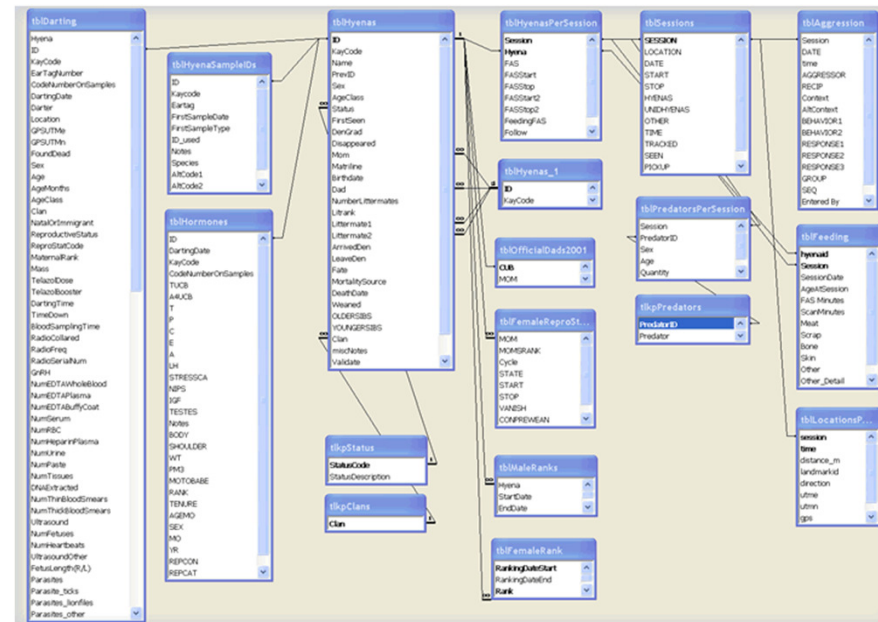
Argentina Mineral Modelling Status

- **Exploration Targeting GIS Data Acquired and Integrated.**
- **Five Stage One Prospectivity Models Completed for Porphyry Copper, Low Sulphidation Epithermal, High Sulphidation Epithermal, Skarn and Granite Related Mineralisation.**
- **Models Chosen with Appropriate Training Data and Metal Endowment.**
- **Targeting Studies Commenced with the Aim to Develop a Argentina and Chile Minerals Targeting Database.**
- **Social and Tenement Data Now Being Collected to be Integrated with Targets to Assess Acquisition Priority.**

Argentina Targets Database: Minerals and Wind Started

What are the Targets

- Surface Location
- Local Logistics
- Economic Potential
- How much and value
- Development stage
- Names of known projects
- Ownership



Target Classification

- Development Targets (Production)
- Data Acquisition Targets
- Local Scale Targets
- Regional Targets (Greenfields)

Database-Manager - [D:\ED\CLS\BPD\DATA\kundesdbf]

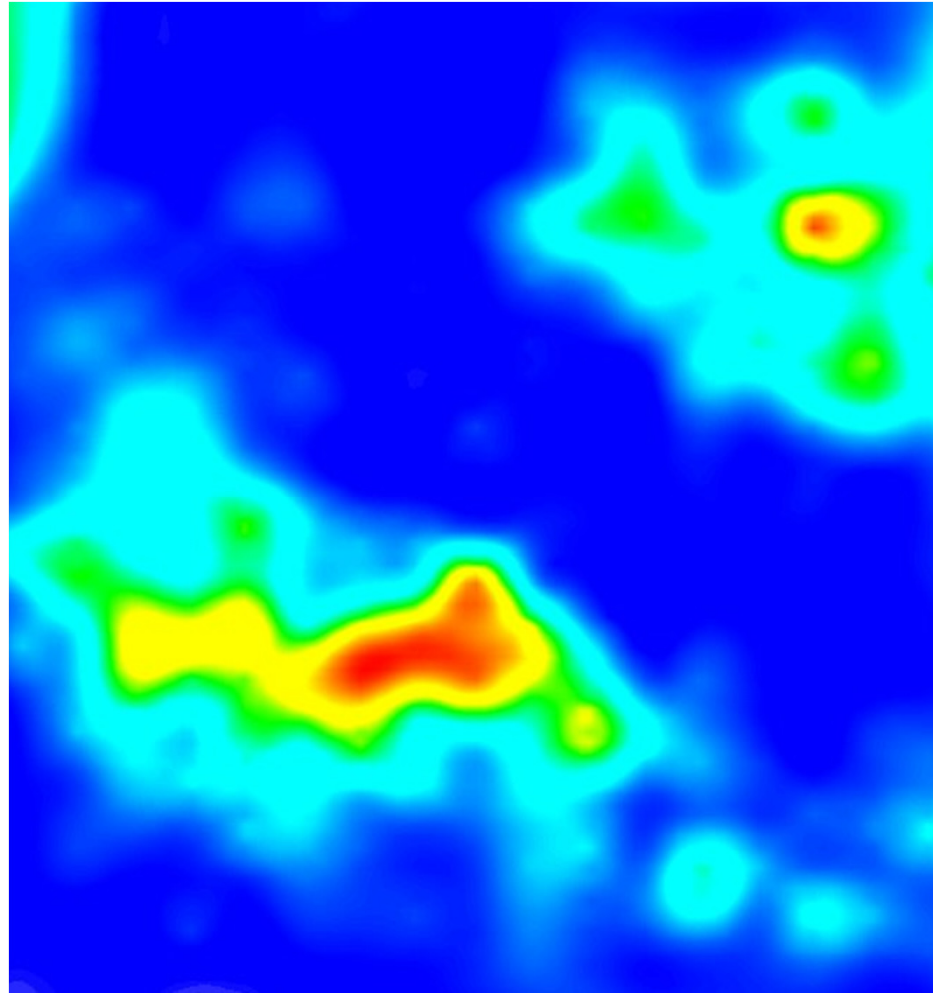
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176260282	VANICEK	21	Goetz	Helmuth	Melanie
1762643743	STENNETZ	10	Enk	Frenz	
1762649115	VANICEK	21	Honak	Anne	
1762648623	VANICEK	21	Behnert	Eva	
1762654026	STENNETZ	10	Hackl	Freia	
1762659920	PREROVSKY	26	Seidl	Josef	Glinde
1762663261	ARTNER	50	Kline	Almut	
1762663553	PREROVSKY	26	Ziborszak	Alexander	
1762663789	MOLL	5	Ebner	Wili	
1762664568	FLUCHER	7	Kern	Edison	Stefan
1762664536	VANICEK	21	Zeng	Oswen	
1762669384	BERDMANN	4	Pelzer	Evold	
1762676445	KARNER	11	Frank	Andrea	
1762698413	VANICEK	21	Cosic	Serada	
1762699711	SINGER	26	Peuc	Sinja	
1762672265	SINGER	26	Testan	Mark	

Record 107 of 18744

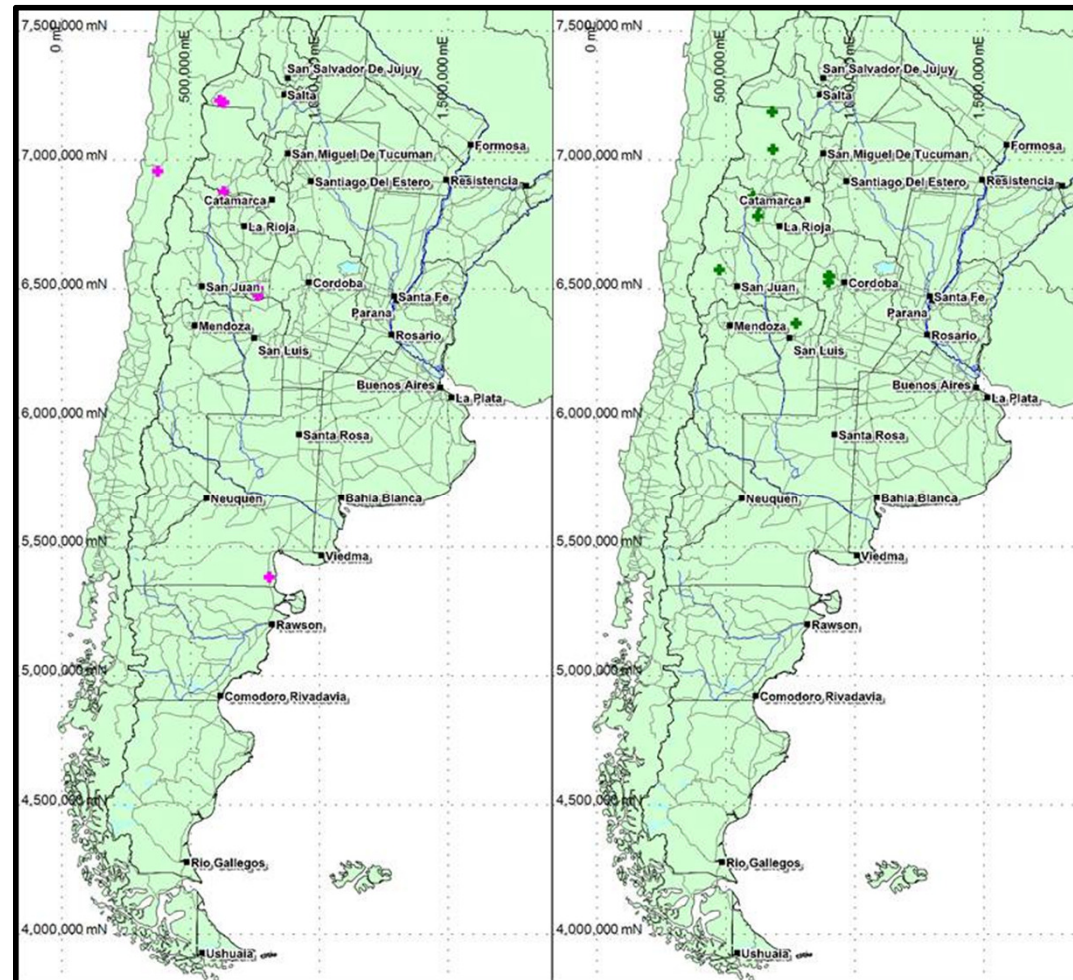
Wind Farm Economic Analysis

ID	Area	SPEED	Type	No	MW	Op Cost	Capital	Prob	Revenue	NPV	Risk	NPV Chance	Risk Chance
WF1	6.44	strong	Large	38	95.0	\$3.80	\$190	0.913	\$43.27	\$79.45	\$57.93	96.0%	91.8%
WF2	3.94	strong	Medium	23	34.5	\$1.38	\$69	0.865	\$17.23	\$47.98	\$33.07	99.5%	97.7%
WF3	1.52	strong	Medium	9	13.5	\$0.54	\$27	0.892	\$6.74	\$18.79	\$14.12	99.5%	98.2%
WF4	4.15	strong	Medium	25	37.5	\$1.50	\$75	0.885	\$18.72	\$52.23	\$38.51	99.8%	98.4%
WF5	3.73	strong	Medium	22	33.0	\$1.32	\$66	0.885	\$16.48	\$45.91	\$33.84	99.5%	98.3%
WF6	1.13	strong	Large	6	15.0	\$0.60	\$30	0.885	\$7.49	\$21.24	\$15.75	99.5%	98.5%
WF7	1.73	strong	Large	10	25.0	\$1.00	\$50	0.885	\$12.48	\$35.49	\$26.35	99.7%	98.5%
WF8	1.39	moderate	Large	8	20.0	\$0.80	\$40	0.862	\$9.99	\$28.39	\$19.58	99.7%	98.2%
WF9	97.6	strong	Medium	589	883.5	\$35.34	\$1,767	0.885	\$441.15	\$1,230.72	\$907.50	99.5%	97.8%
WF10	1.23	moderate	Medium	7	10.5	\$0.42	\$21	0.830	\$4.78	\$8.45	\$3.80	95.3%	81.2%

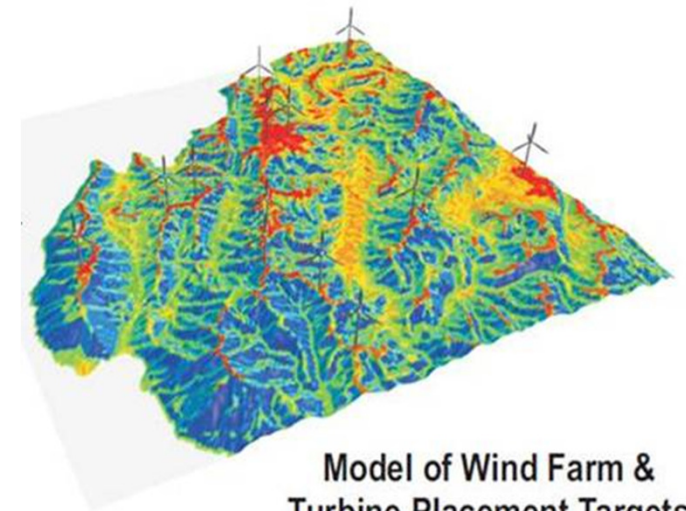
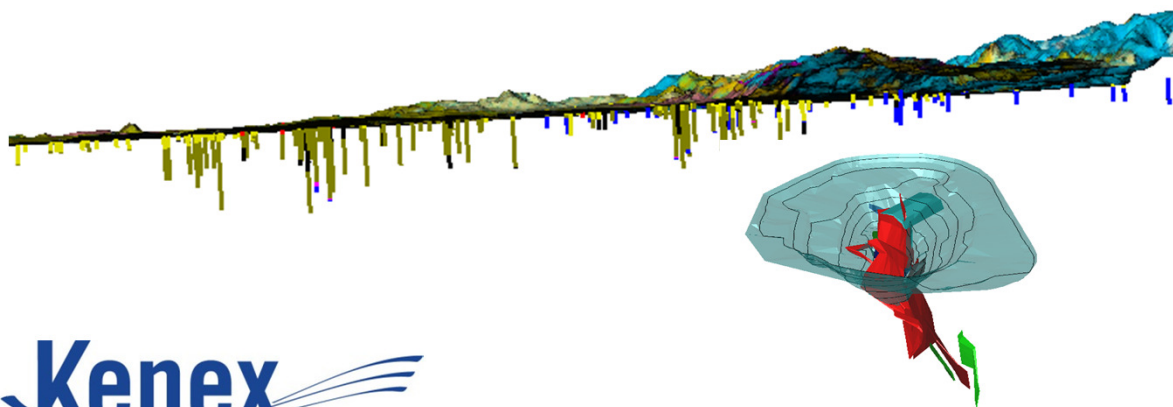
Future Work



Under Explored Mineral Systems

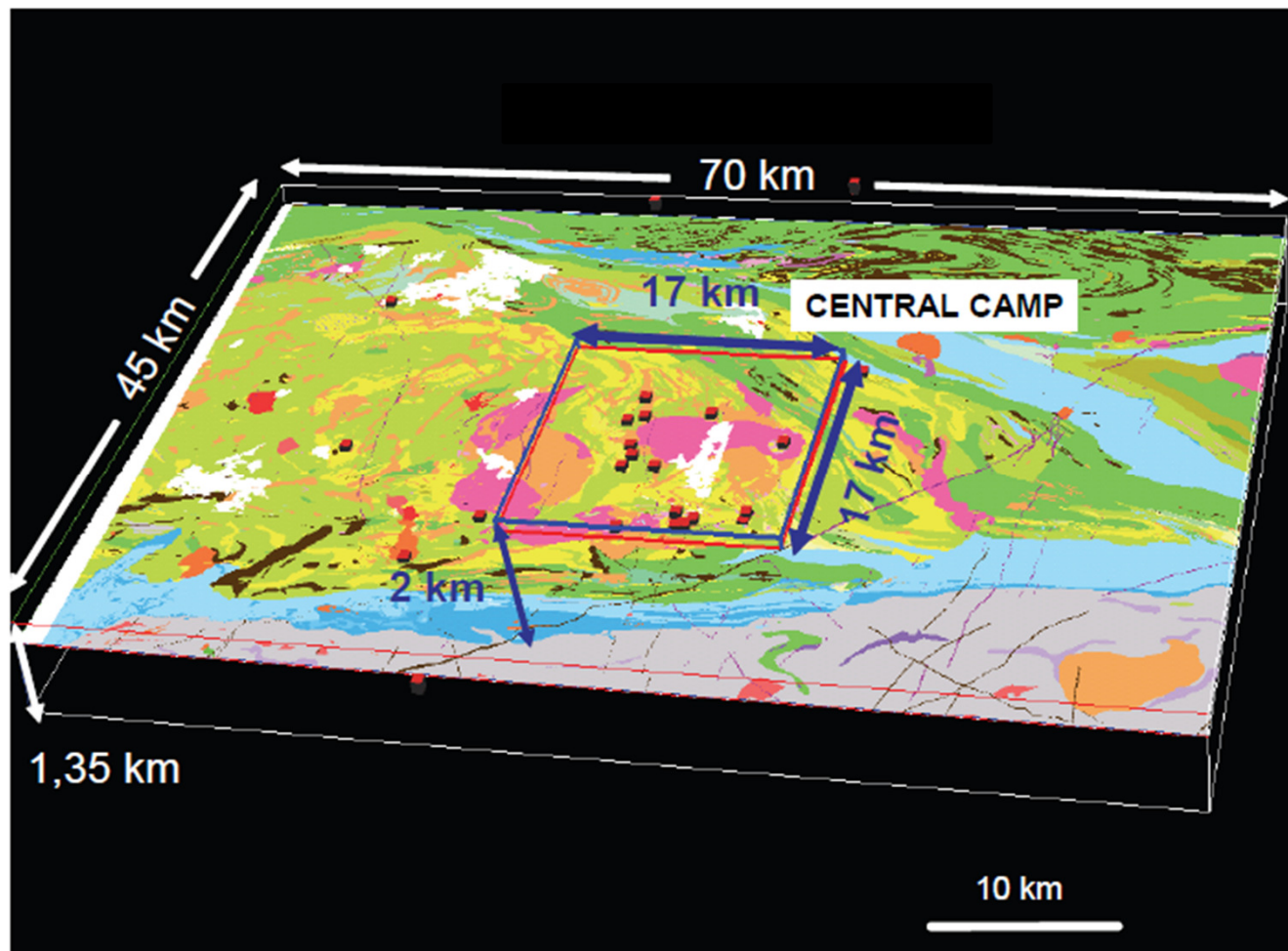


Next Prospect Scale Development



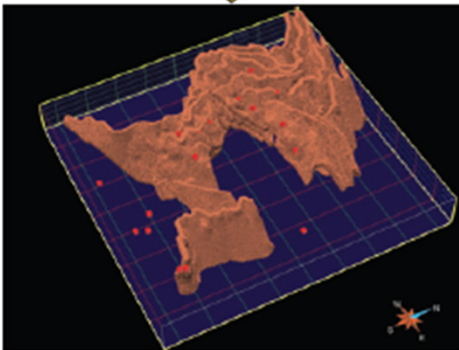
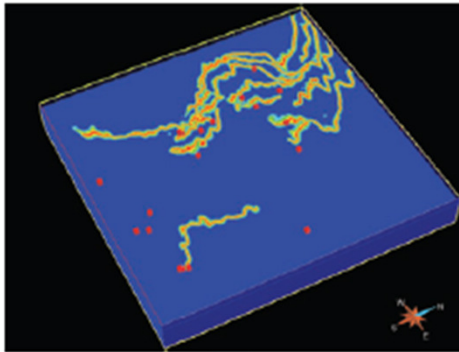
Model of Wind Farm &
Turbine Placement Targets

3D GIS and Exploration Targeting

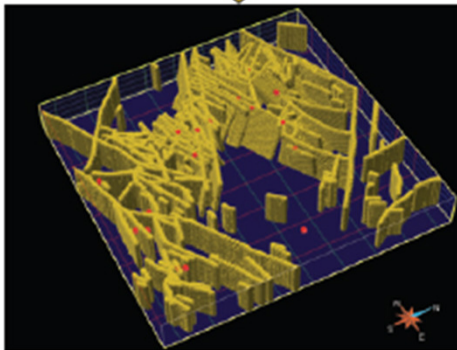
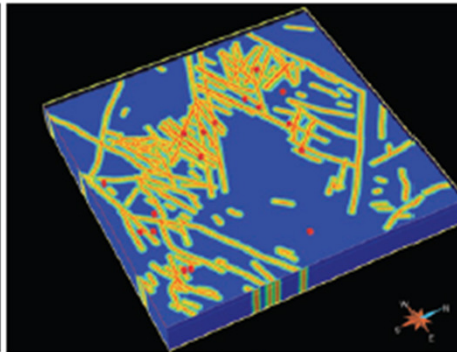


Development of 3D Predictive Maps

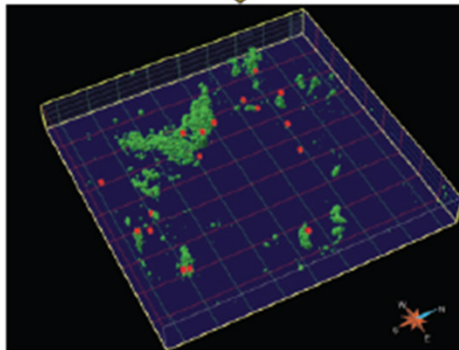
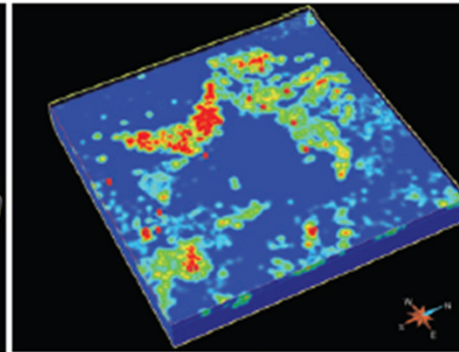
Exhalites



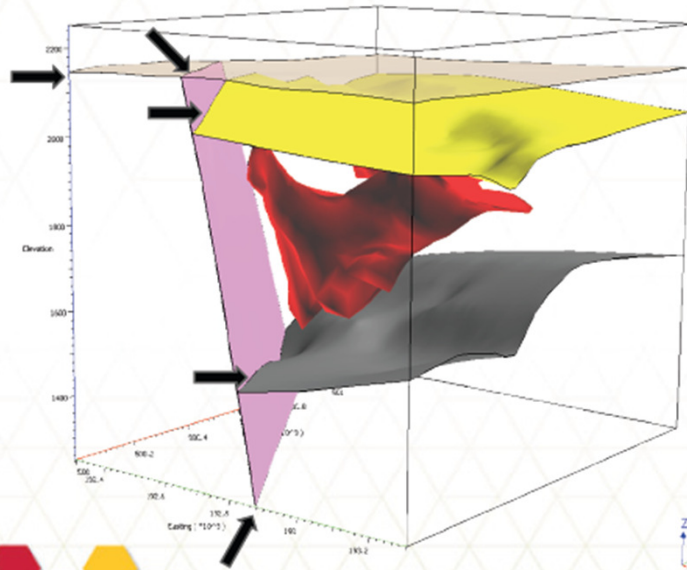
Faults



Alteration



3D Weights of Evidence Modelling



Mira Geoscience
...modelling the earth

Task Pane

Objects Attributes Workflows TW_Study GIS - Query

Step Value

Targeting Workflow (TW_Study) ✓

Targeting Method ✓

Pre-Processing

Processing

Post-Processing

Targeting

1 Select prediction model

Prediction Model: Model2

Do you want to refine your model using a predefined sub-volume?
i.e. unexplored areas, distance from surface, inside claim boundaries

☒ Yes ☐ No

Intersecting Region: 4Targeting

Prediction Model Statistics

Theoretical: Min: 0 Max: 1

Actual: Min: 0 Max: 1

Show Histogram

2 Finalize model

Target Cutoff: 95 % → 0.451911025794185

Create High Potential Region

3 Define target cluster connectivity

☒ Corners ☐ Edges ☐ Faces

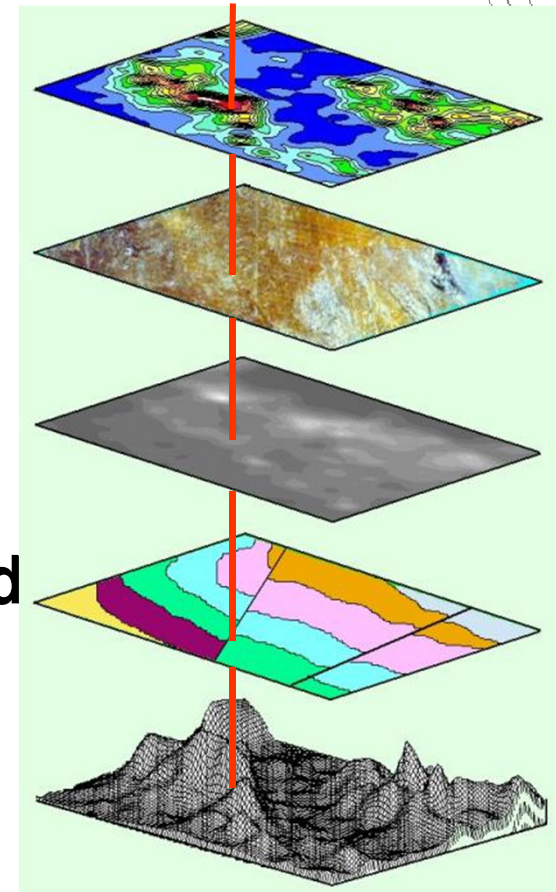
Rank Clusters

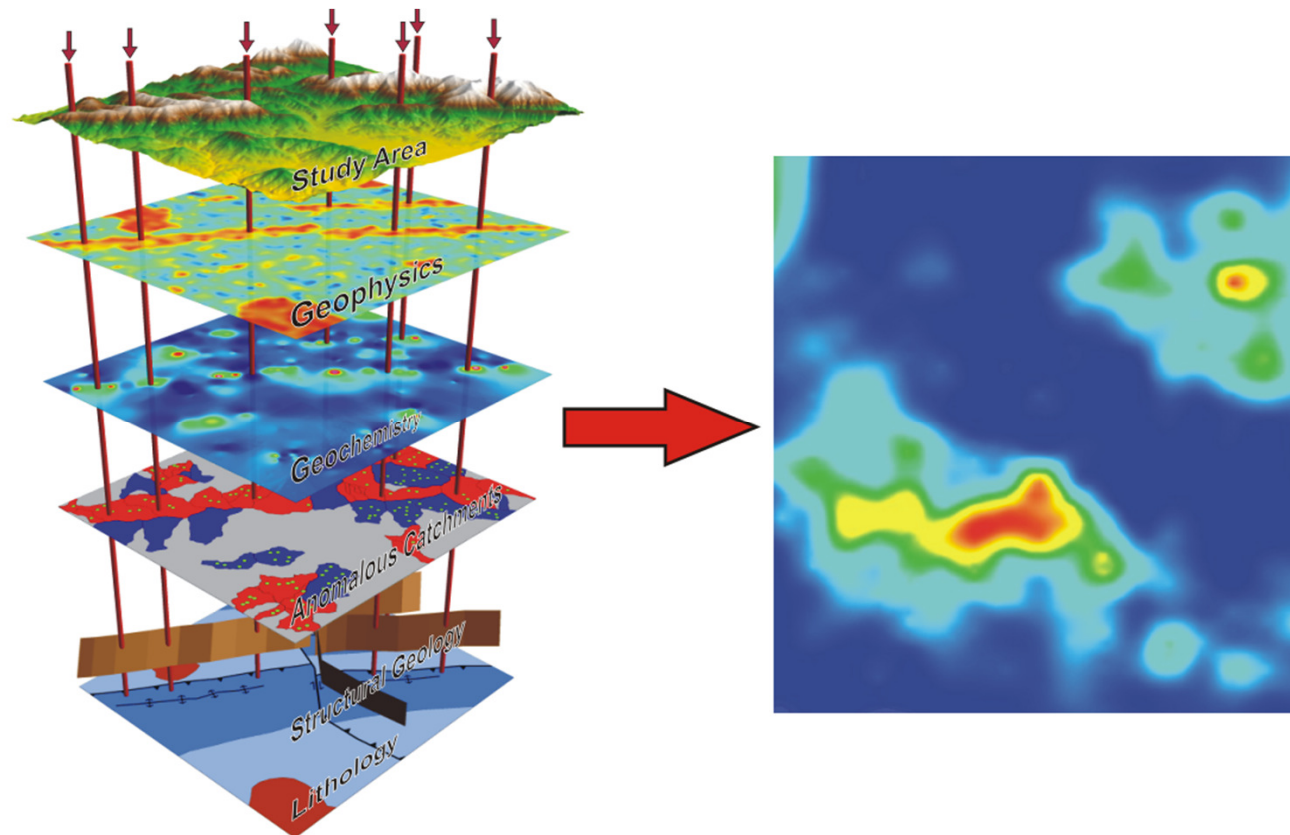
Cluster Rank	Cluster Volume	# of Cells	Min Model Value	Max Model Value
1	7.173126e+08	11477	0.5	1
2	3.945e+08	6312	0.5	0.5833333
3	1.50375e+08	2406	0.5	0.5833333
4	5.756251e+07	921	0.5	0.875

Back Finish Report Help

Argentina Future Developments

- **Stage Two Provincial Wind Models Completed.**
- **Economic Studies of Various Stage Two Wind Targets.**
- **Project Acquisition.**
- **Stage Two Mineral Models Completed.**
- **Tenement GIS Database Completed and Operational.**
- **Project Acquisition and 3D Targeting.**
- **Understand Value of Wind Energy to Mining and Hydro Projects.**





Kenex: Creating Opportunities in the Spatial World