

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.**

- **Kenex Operating Profitably for Ten Years.**
- **Knowledge Based Company, Focussing on Using Spatial Data and Knowledge to Allow Prediction.**
- **Initially Out of NZ and Now Working Globally.**
- **Focus on New IT Technologies and Techniques and Digital Spatial Data for Project Development in Mineral Exploration and Other Spatially Based**

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 IT Technologies and In House Databases to Identify Opportunities in Wind and Minerals.**
- **Use Predictive Models and Databases to Identify Business Investment Opportunities.**
- **Self Fund Early Development**

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)

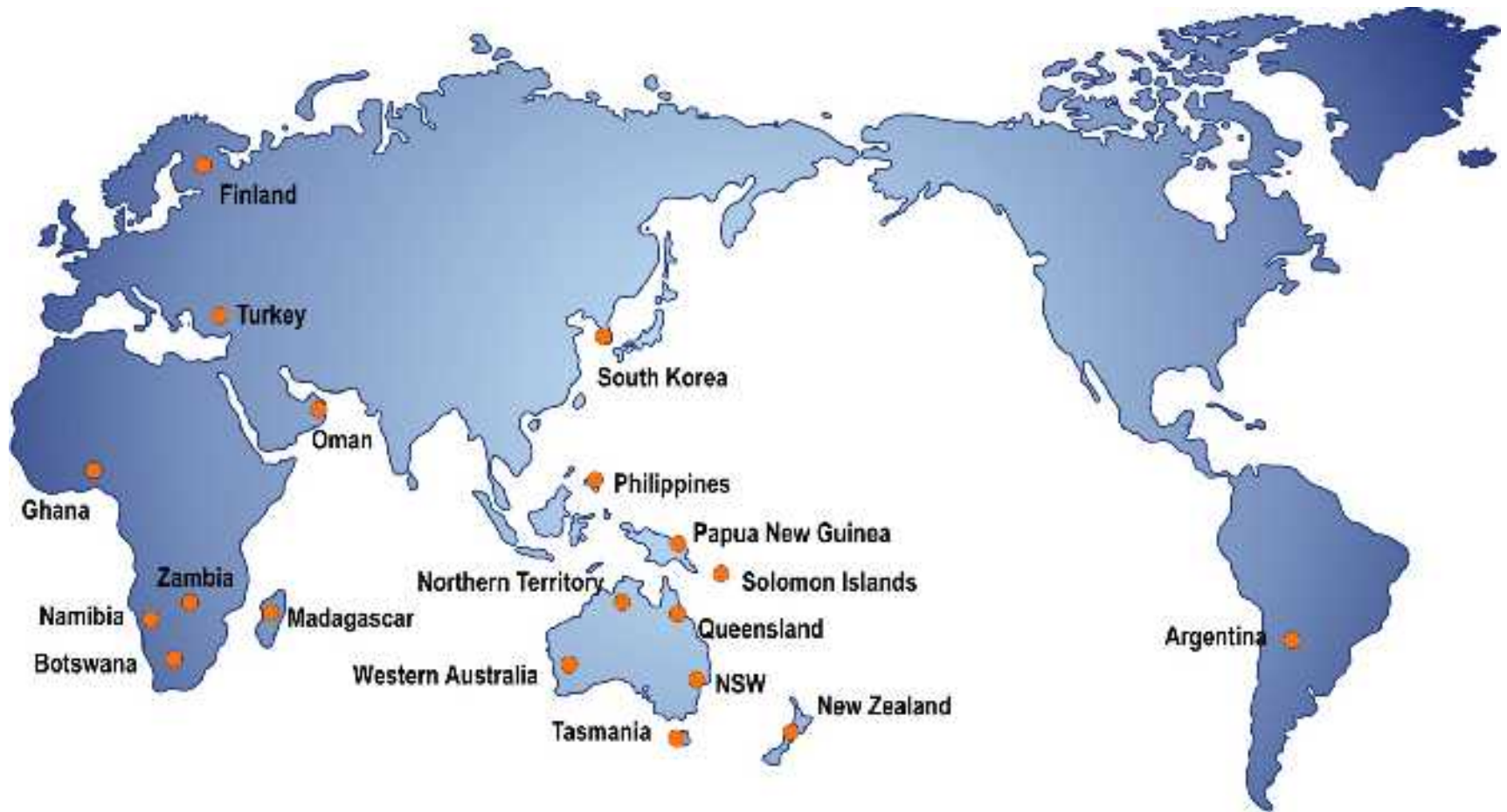
Discoveries Are Typically Made By The 5th-7th Person/Company Covering The Ground

Markets

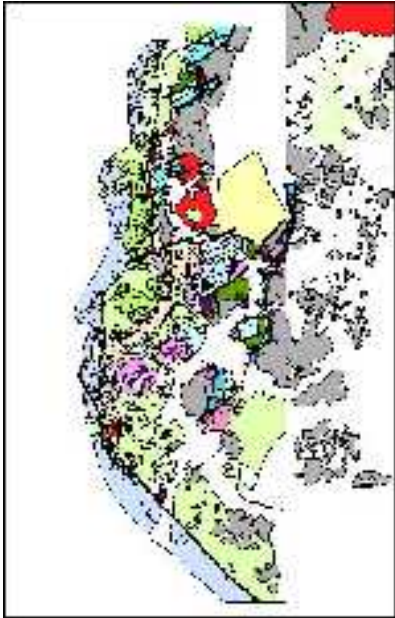
- Mineral Exploration
- Energy
- Renewable Energy
- Agriculture
- Climate
- Forestry
- Land Management
- Environmental
- Aquaculture



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.

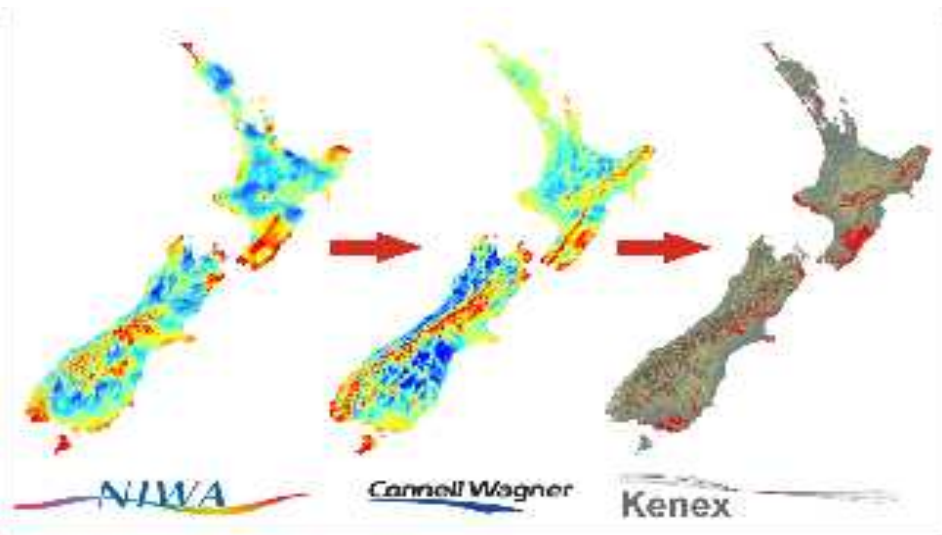
Mineral Exploration and Wind Energy are Similar.

Need to Map Key Evidence for Locating Mineral Deposits or Wind Energy.

Work from Regional 2D to 3D Local Scale

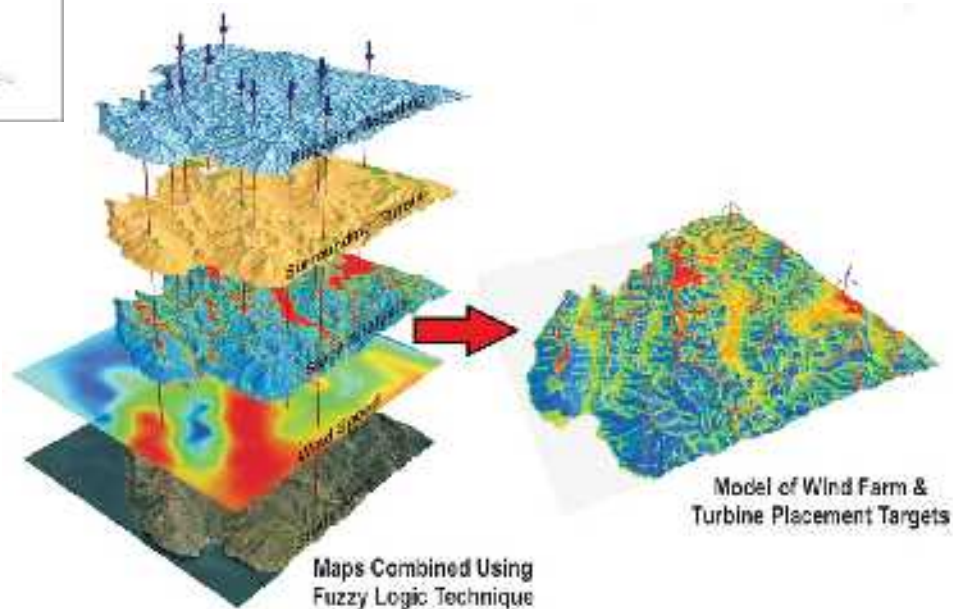


Two Stage Modelling Process



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

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



Approach to Wind and Minerals Exploration Targeting

Mineral Systems

Critical processes

Measure Prospectivity

Geological risk

Assess Cultural Issues

Geopolitical risk

Simulate Economic Value

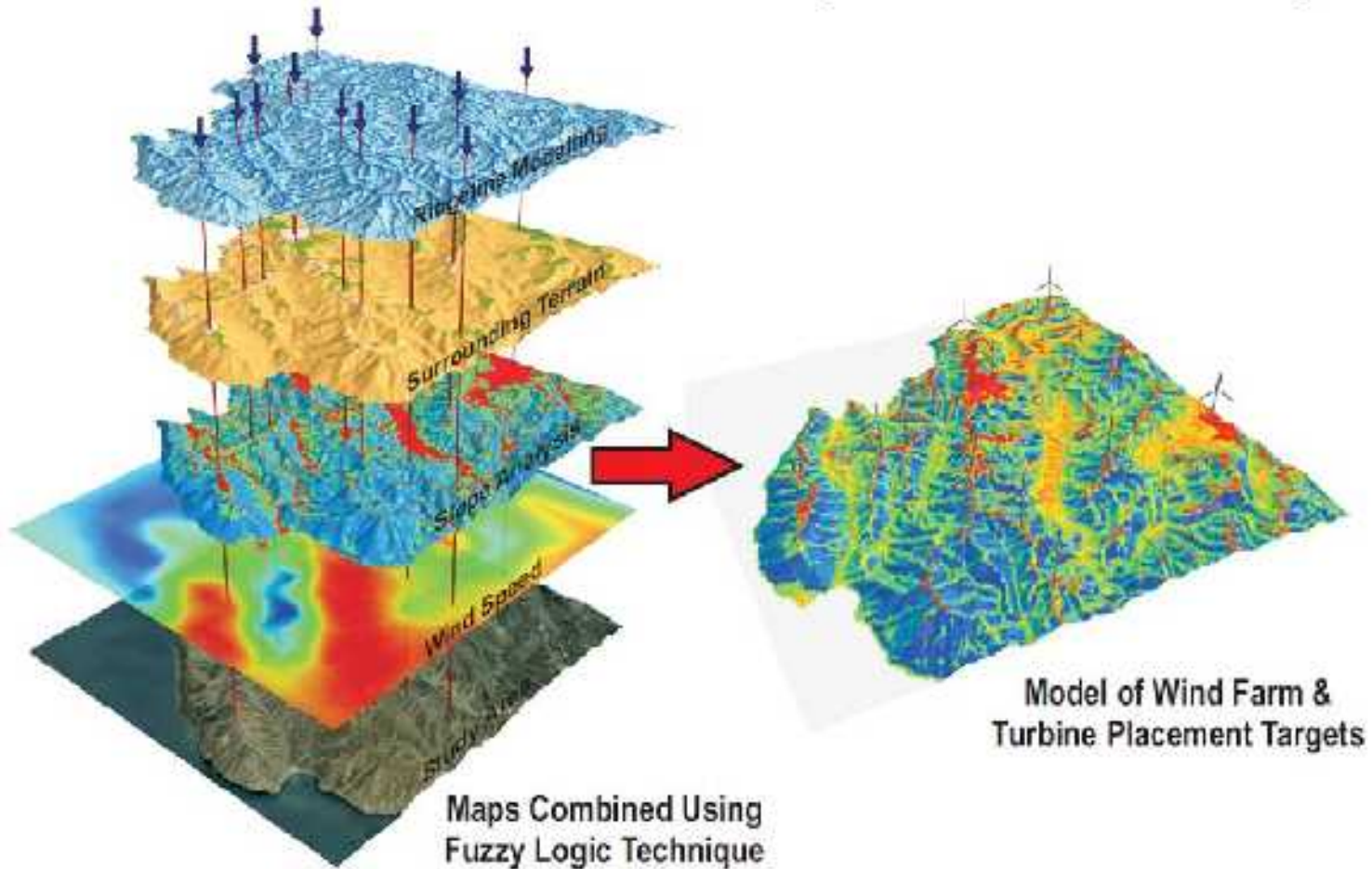
Financial risk

Prospectivity

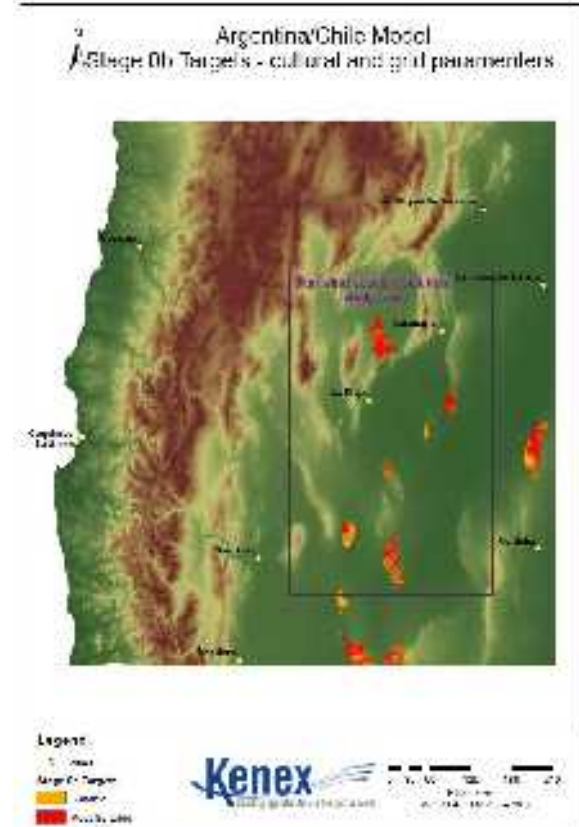
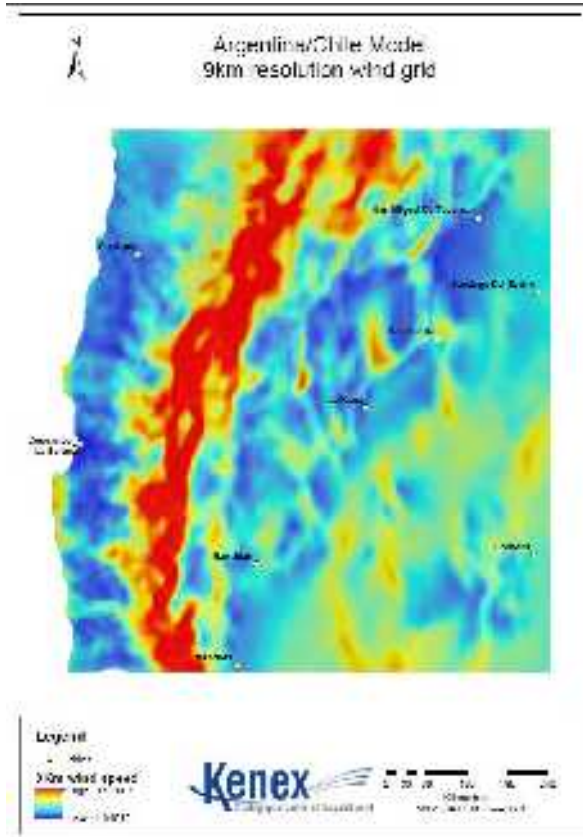
Matrix

Rank targets

More Than Wind

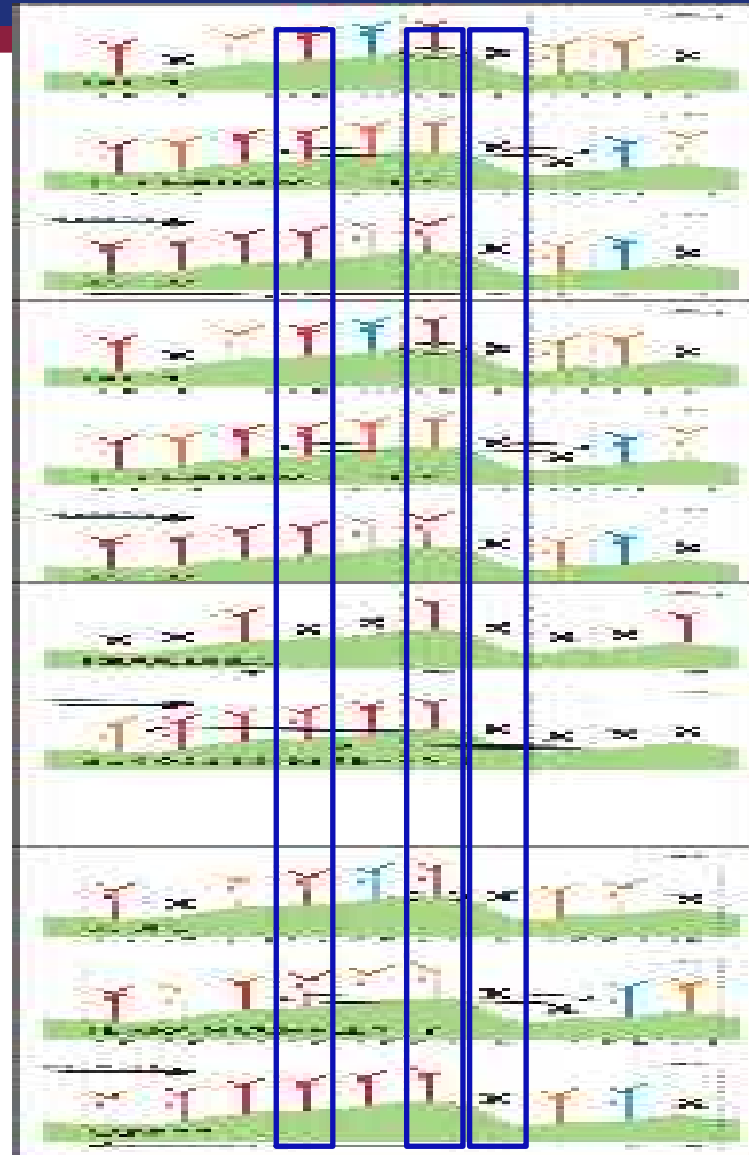






More to Wind Targeting



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.



-  Highly Suitable
-  Suitable
-  Possibly Suitable
-  Not Suitable

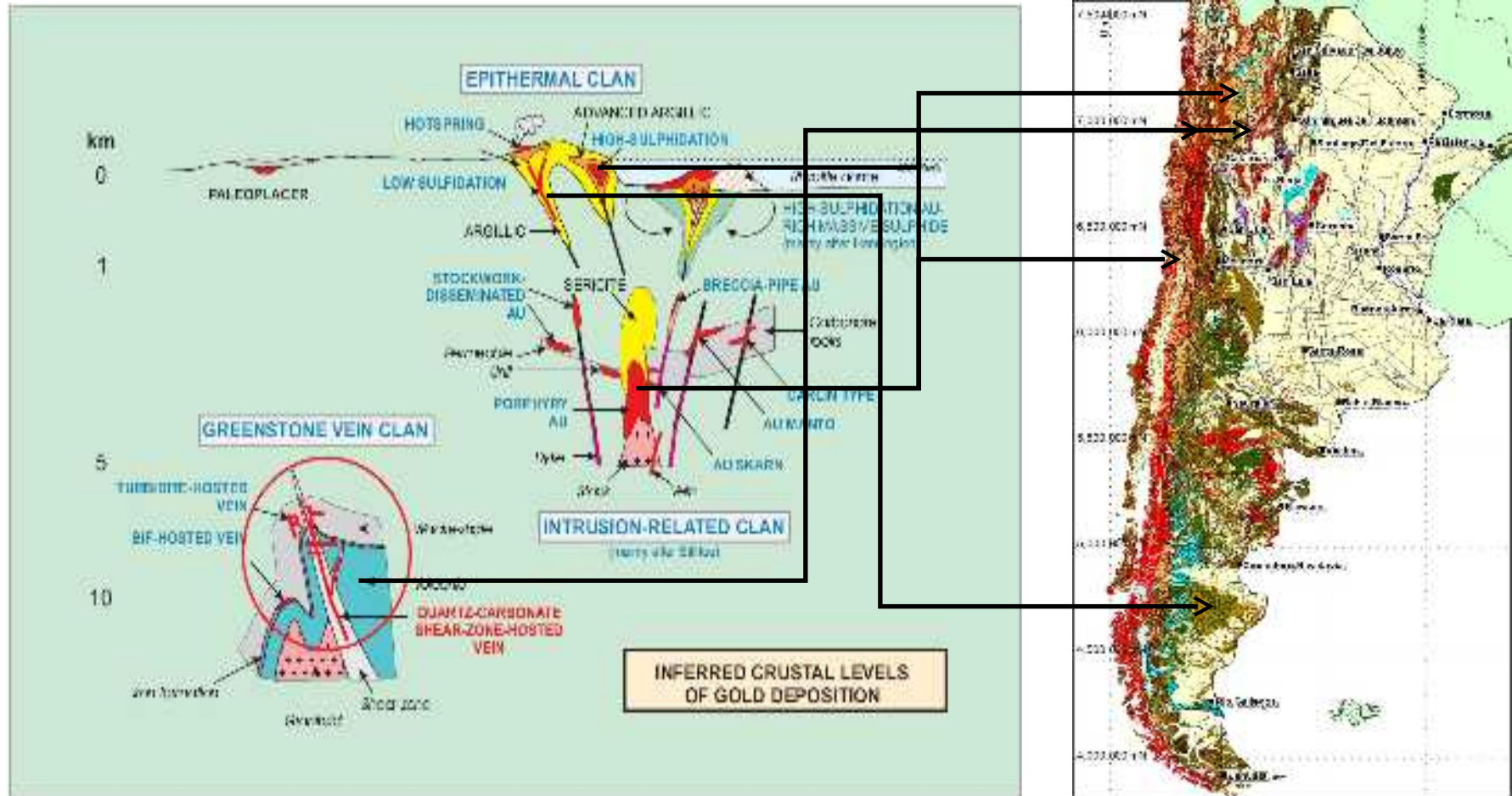
Mineral System

- **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.**

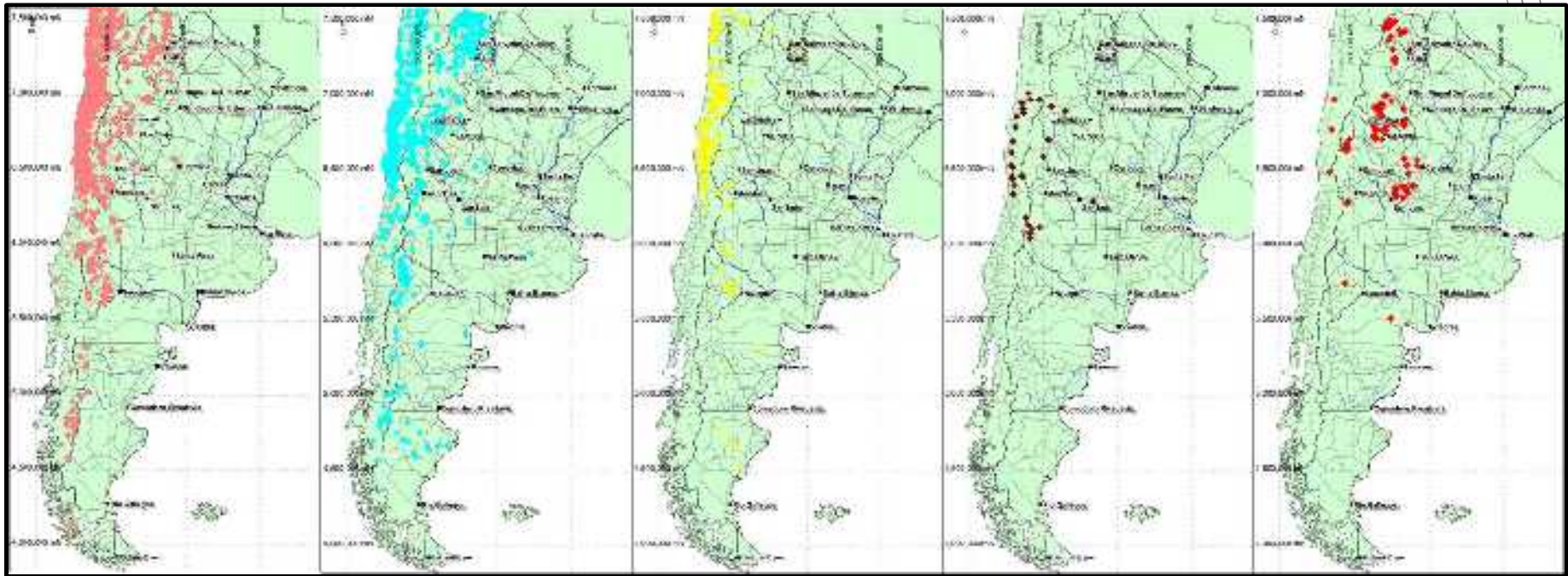
Targeting Approach

- **Taking Spatial Data and Information and Using New Technology and Research Add Value by Combining Knowledge of Process and Data**
- **Utilise New GIS Based Modelling Techniques**
- **Spatial Data Modelling Allows Prediction**
- **This Creates Business Opportunities and Better Management of Current Operations**
- **Works with Industries Who Operate in the Spatial World: Minerals, Agriculture, Forestry, Energy.....**

Modelling for Minerals in Argentina



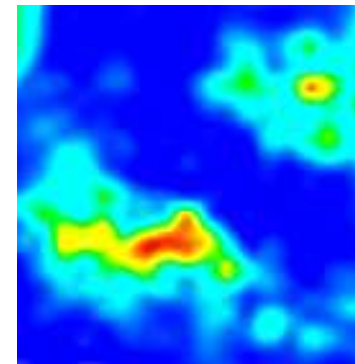
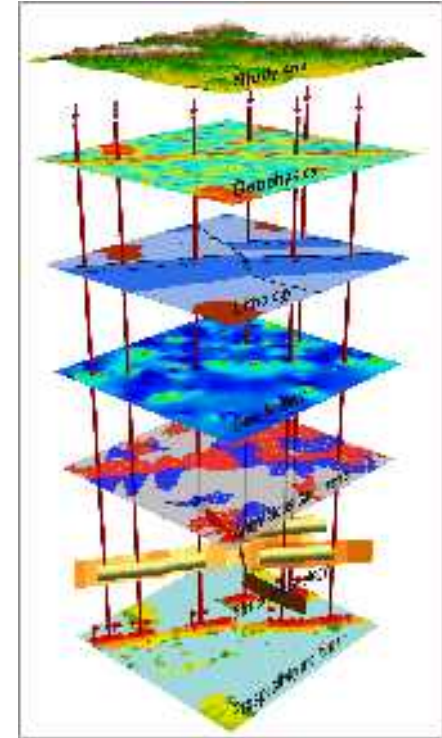
Mineral Systems of Argentina and Chile



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

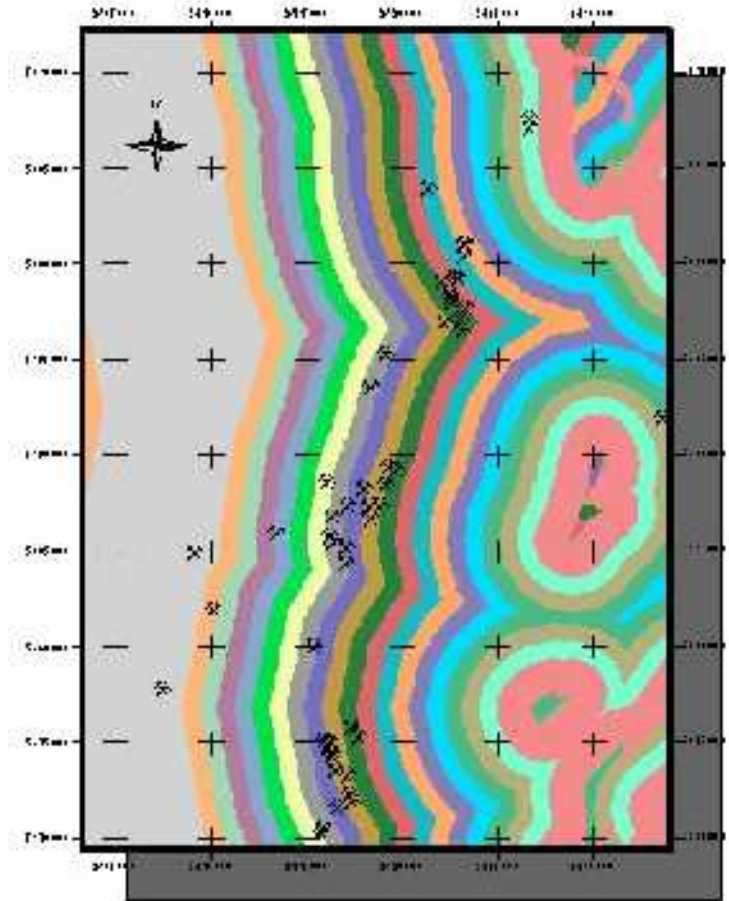
Spatial Data Modelling Approach

- **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**



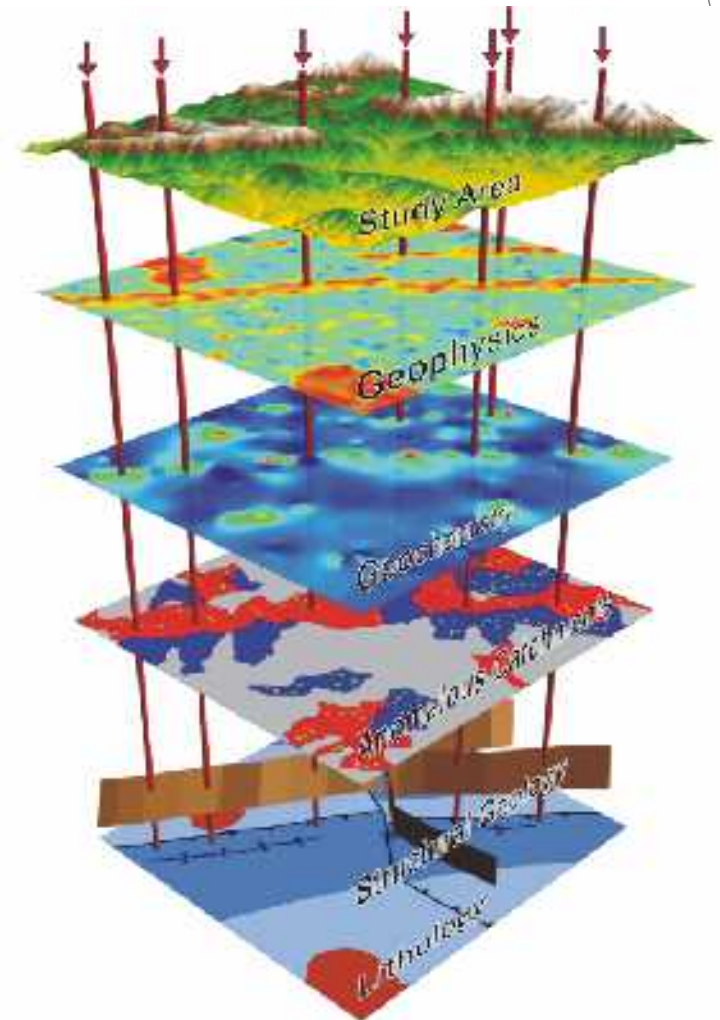
Predictive Maps are Key

- **Data That Map Key Processes in Mineral System**
- **Lithology**
- **Geochemistry.**
- **Structure.**
- **Rock Physics.**
- **Mineral Occurrences.**



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

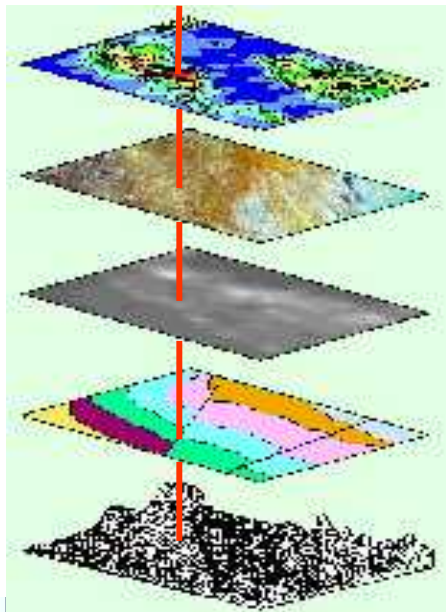
Using Expert Estimates of Weights (f)

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

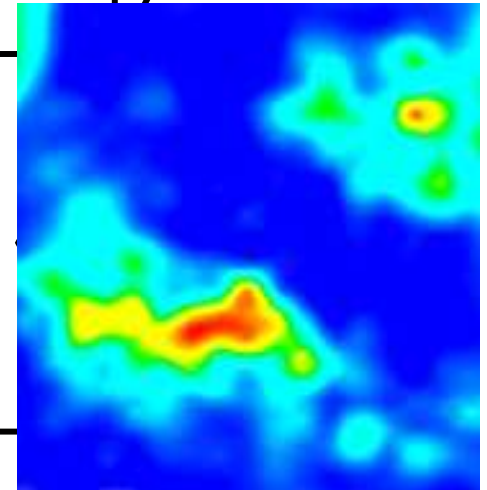
Maps Combined Using Combinations of And, Or, Sum, Product and
Gamma

Good for Poorly Explored Areas, Depends on Experts!

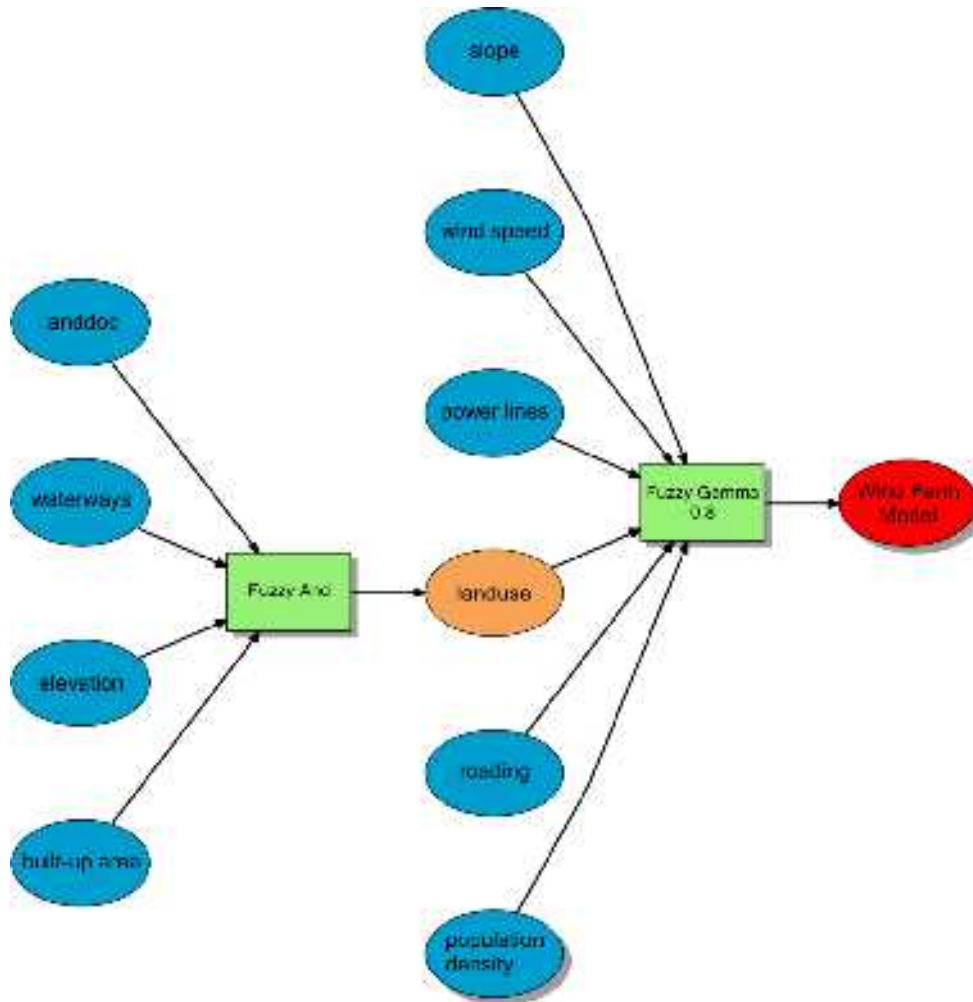
Mineralisation Potential



**A weighted
aggregation
process**



Extra Step for Combining Wind Maps



MAP 1

0.25	0.15	0.5
0.5	0.75	0.25
0.6	0.25	0.25

MAP 2

0.35	0.5	0.15
0.75	0.75	0.5
0.25	0.25	0.25

MAP 3

0.35	0.3	0.5
0.5	0.75	0.25
0.25	0.25	0.25

Fuzzy AND = Min(Map1, Map2)

MAP 4

0.25	0.75	0.5
0.5	0.75	0.25
0.5	0.25	0.25

MAP 5

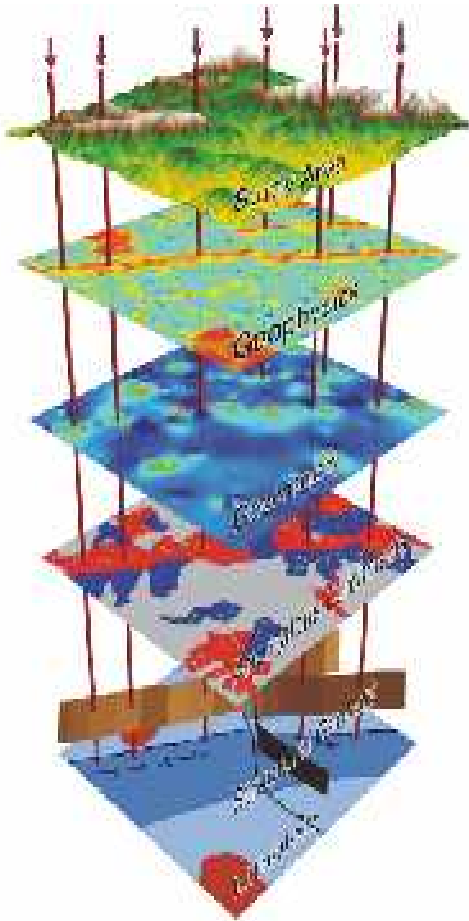
0.25	0.5	0.15
0.75	0.75	0.5
0.25	0.25	0.25

RESULT

0.15	0.57	0.57
0.47	0.73	0.25
0.25	0.17	0.17

Fuzzy GAMMA =
 $(\text{Fuzzy PRODUCT})^{0.6} \times (\text{Fuzzy SUM})^4$

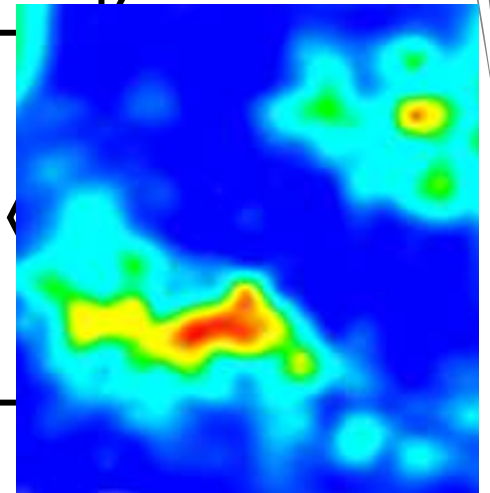
Weights of Evidence : Data Driven



A weighted
aggregation
process

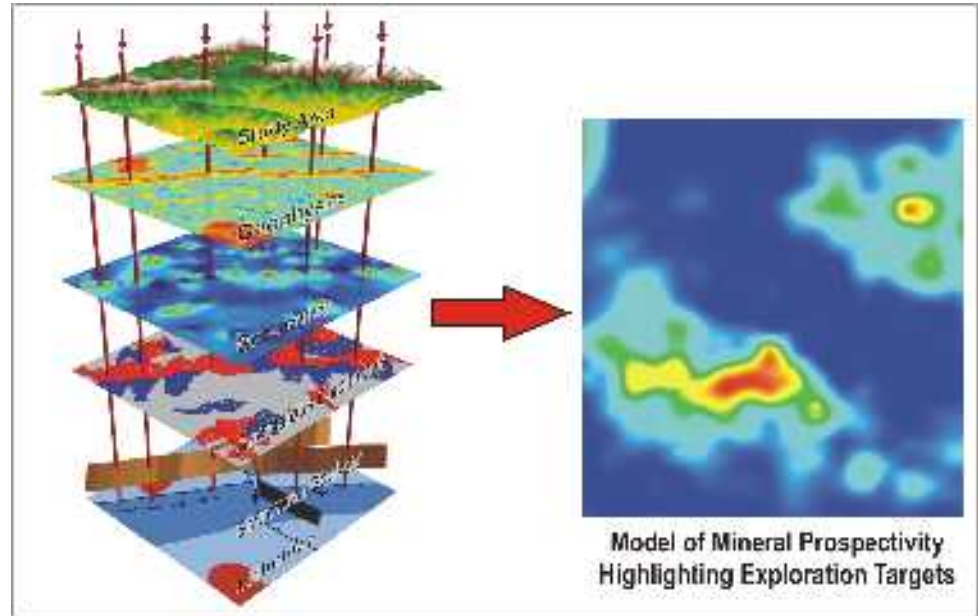
**Risk &
Cost**

**Geological
Potential**



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.**

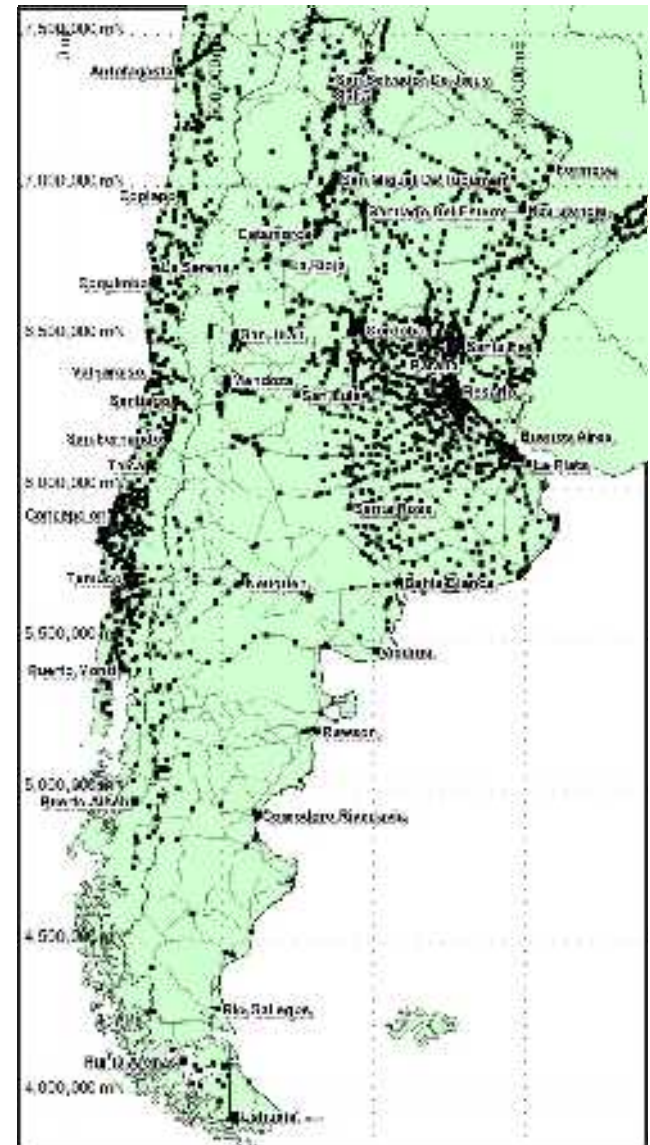
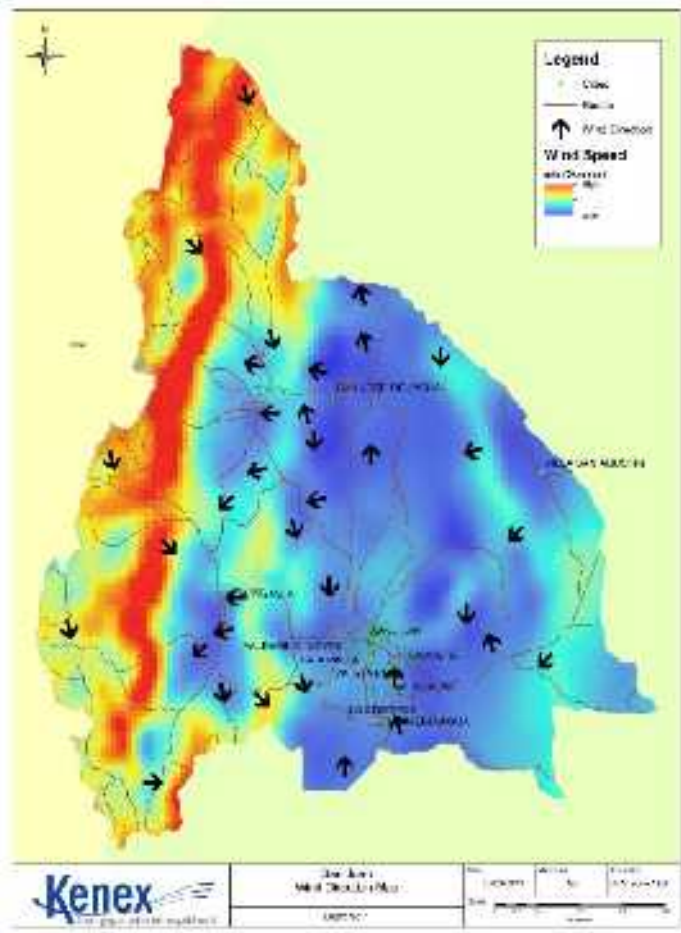


Training Data

- **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.**

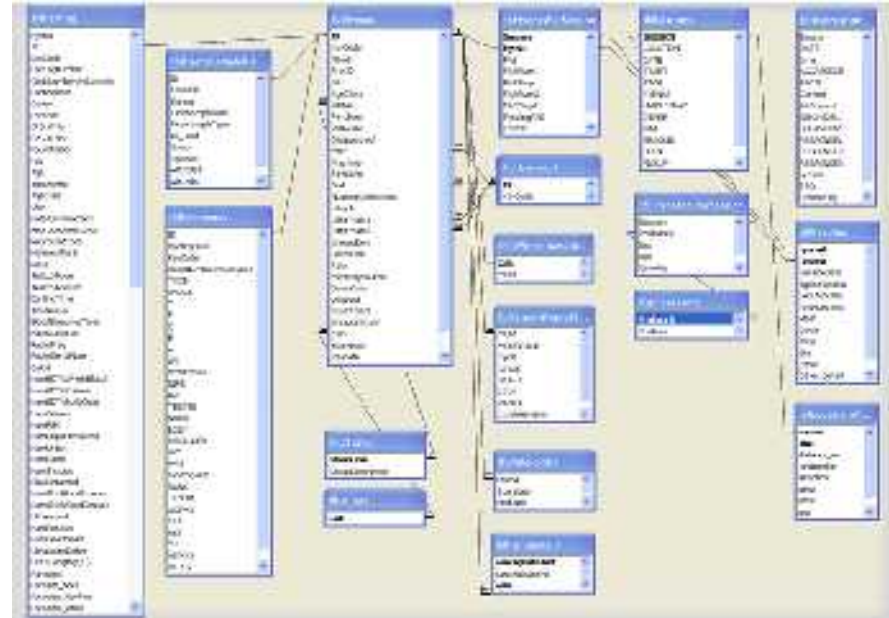
Argentina Mineral Modelling Status

- **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**

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



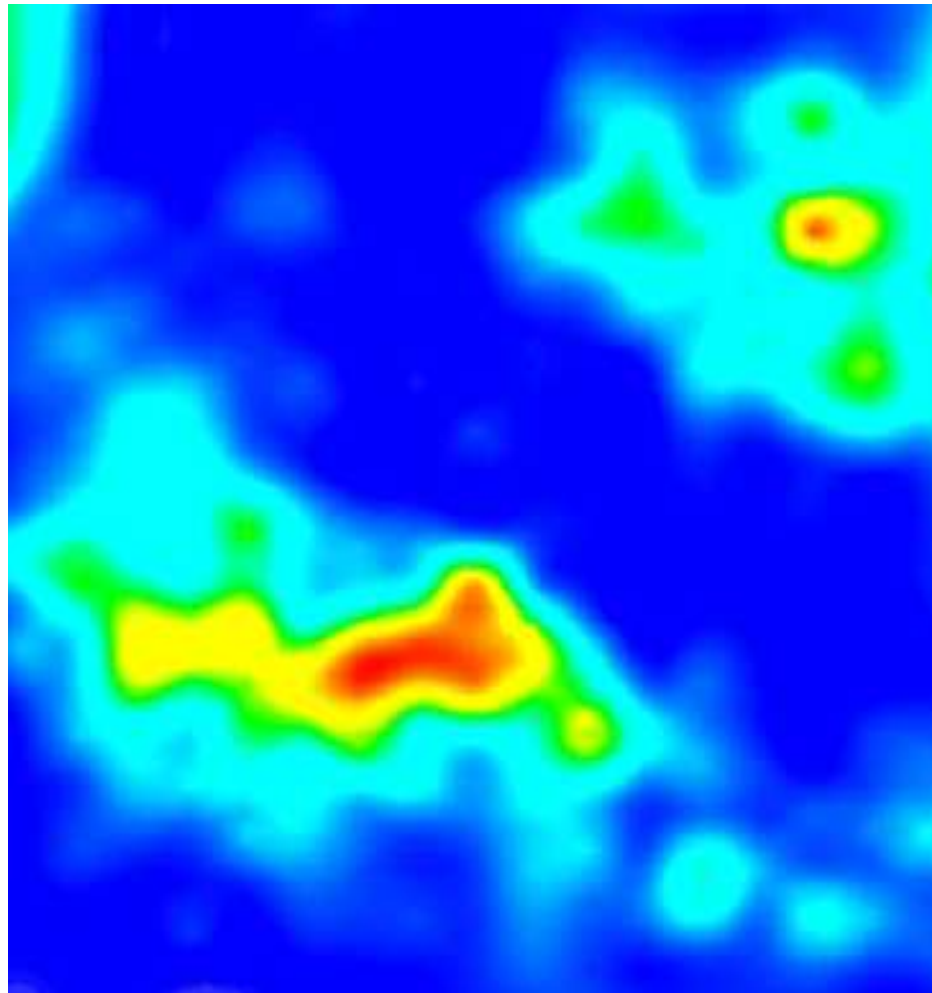
- Development Targets (Production)
- Data Acquisition Targets
- Local Scale Targets
- Regional Targets (Greenfields)

ID	Nombre	Categoría	Estrategia	Actividad
1	PROYECTO VIENTO	2	1	1
2	PROYECTO MINERAL	3	2	2
3	PROYECTO VIENTO	2	1	1
4	PROYECTO MINERAL	3	2	2
5	PROYECTO VIENTO	2	1	1
6	PROYECTO MINERAL	3	2	2
7	PROYECTO VIENTO	2	1	1
8	PROYECTO MINERAL	3	2	2
9	PROYECTO VIENTO	2	1	1
10	PROYECTO MINERAL	3	2	2

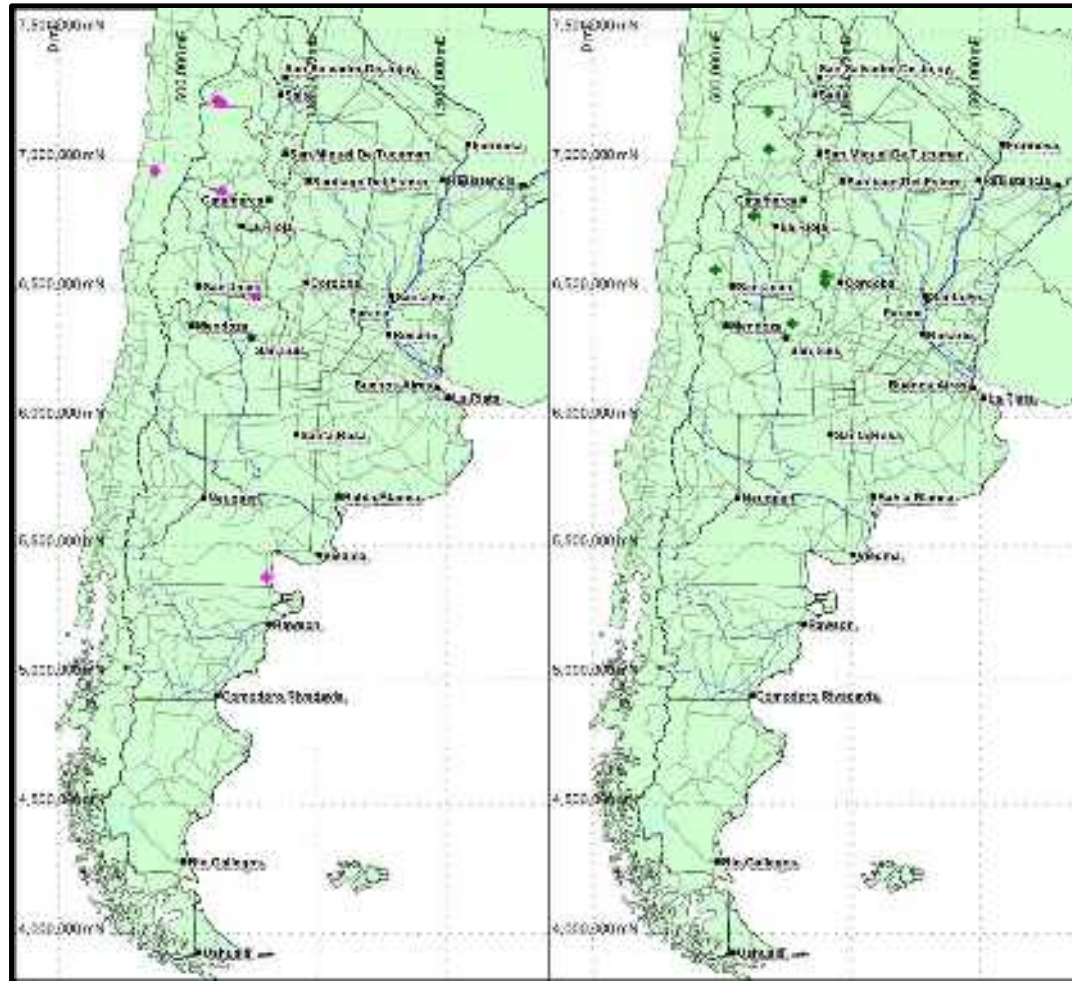
Wind Farm Economic Analysis

ID	Area	SPEED	Type	No MW	Op Cost	Capit al	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	58	9	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%	

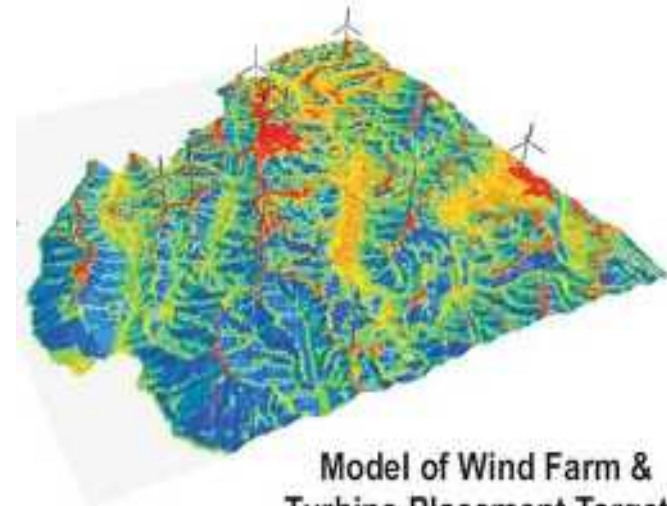
Future Work



Under Explored Mineral Systems

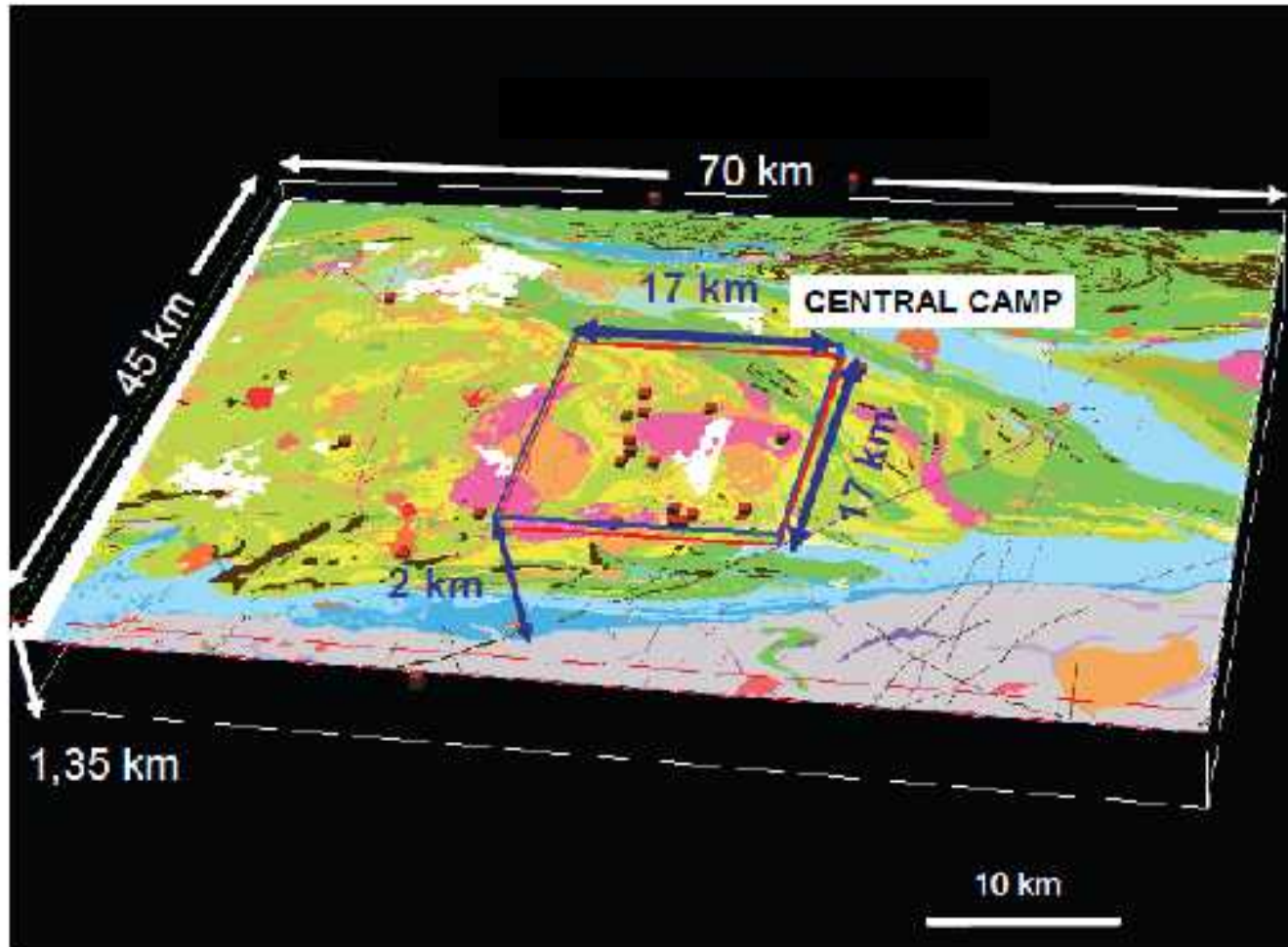


Next Prospect Scale Development



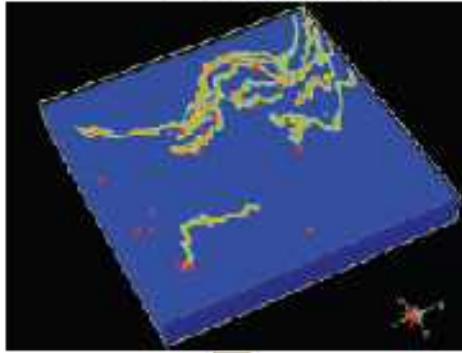
Model of Wind Farm & Turbine Placement Targets

3D GIS and Exploration Targeting

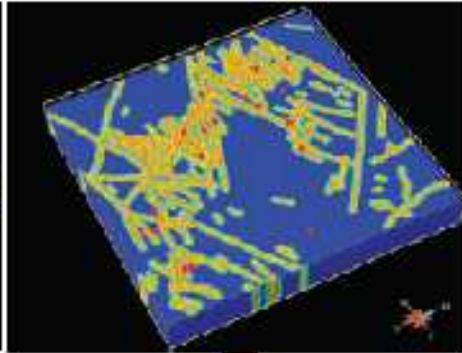


Development of 3D Predictive Maps

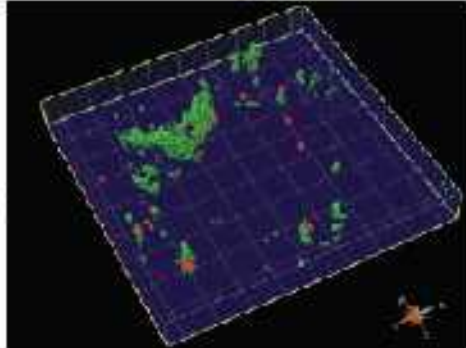
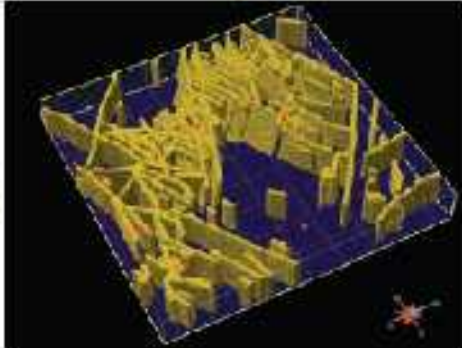
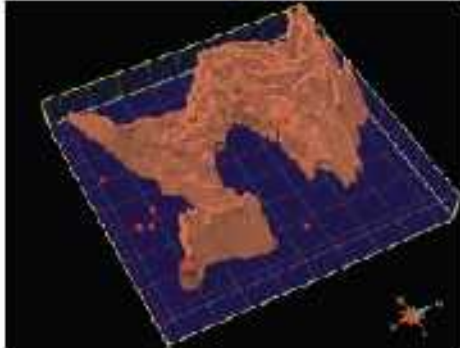
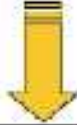
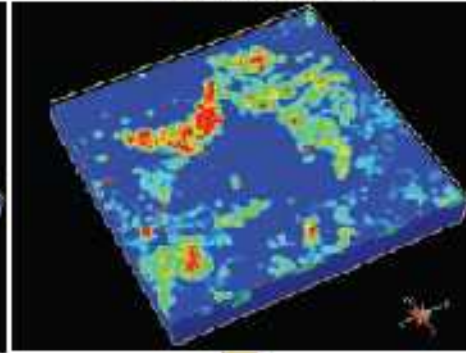
Exhalites



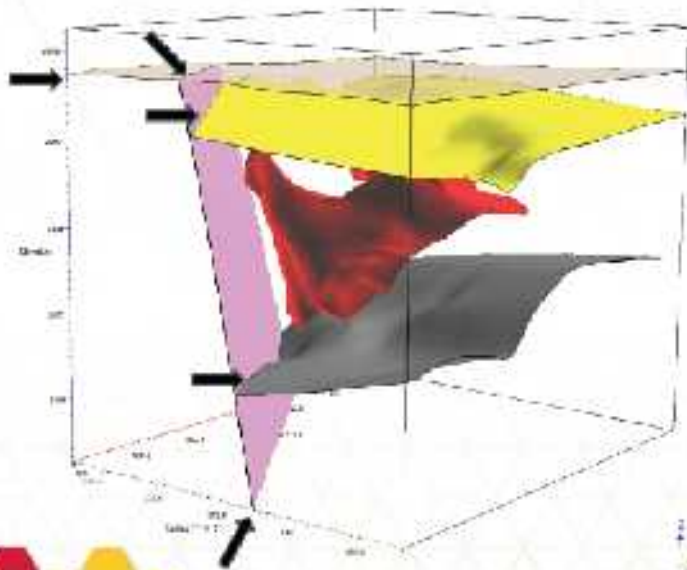
Faults



Alteration



3D Weights of Evidence Modelling



Mira Geoscience
...modelling the earth

The screenshot shows the Mira Geoscience software interface. The main window displays the 'Weights of Evidence' model configuration. The interface includes a toolbar at the top, a project tree on the left, and a main workspace on the right. The workspace is divided into several sections:

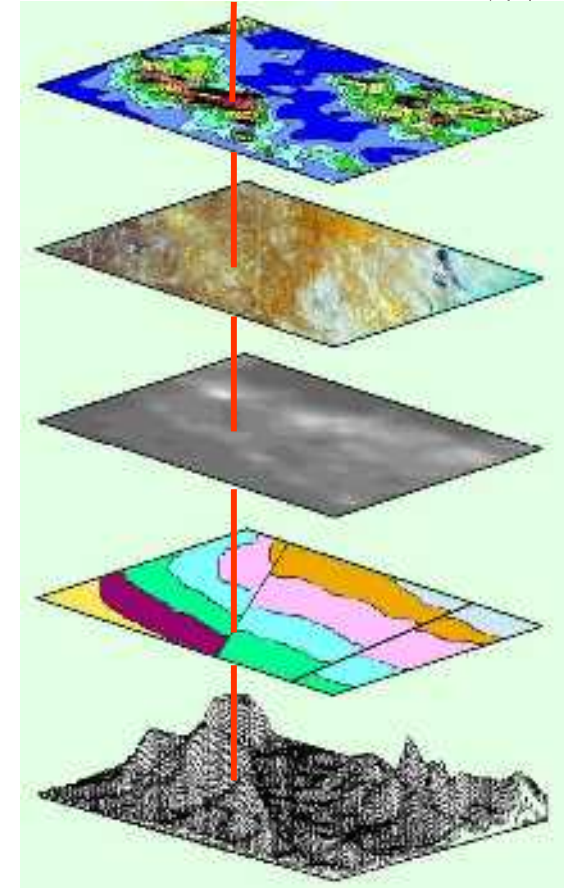
- Select production model:** A section for selecting the production model, with a 'Production Model' dropdown set to 'WoE'.
- Weights of Evidence:** A section for configuring the WoE model, including a 'Weights of Evidence' dropdown set to 'WoE', a 'Weights of Evidence' slider set to '0.5', and a 'Weights of Evidence' button.
- Define target class accessibility:** A section for defining target class accessibility, with a 'Target Class' dropdown set to 'None', a 'Target Class' button, and a 'Target Class' button.

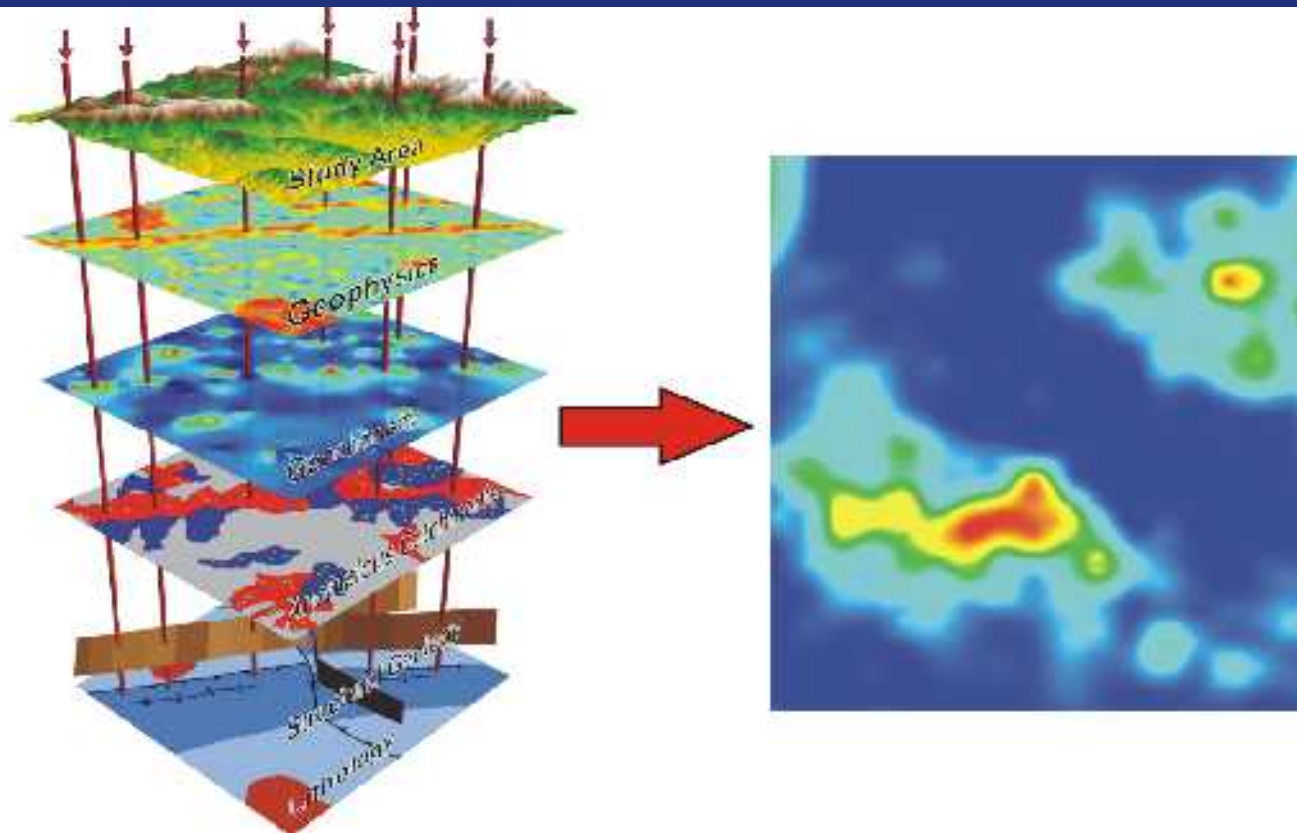
At the bottom of the interface, there is a table with the following data:

Index	Class Name	Value	Weight	Priority	Order
1	1	2.17722e-08	1147	25	-
2	2	1.512e-08	132	25	C 000000
3	3	1.11111e-08	100	16	F 000000
4	4	2.00000e-08	100	25	L 0 0

Argentina Developments for 2013

- **Stage Two Provincial Wind Models Completed.**
- **Economic Studies of Various Stage Wind Two Targets.**
- **Project Acquisition.**
- **Stage Two Mineral Models Completed.**
- **Tenement GIS Database Completed and Operational.**
- **Tenement Acquisition.**
- **3D Targeting Underway.**





Kenex: Creating Opportunities in the Spatial World