

# Introduction to Prospectivity Modelling with MI-SDM

## Introduction

This document provides an overview of the steps you *might* take to create a prospectivity model using MI-SDM. The actual procedures you use to create a prospectivity map will depend on the input data layers that you are using, as well as your expert knowledge.

The process of generating a Weights of Evidence prospectivity map uses known deposits and various layers of exploration data to derive the probability that a given location will host a deposit. If you don't have deposit points available to use as training points, then a supervised or expert procedure is necessary, such as Fuzzy Logic (see the MI-SDM User Guide for more information about Weights of Evidence and Fuzzy Logic).

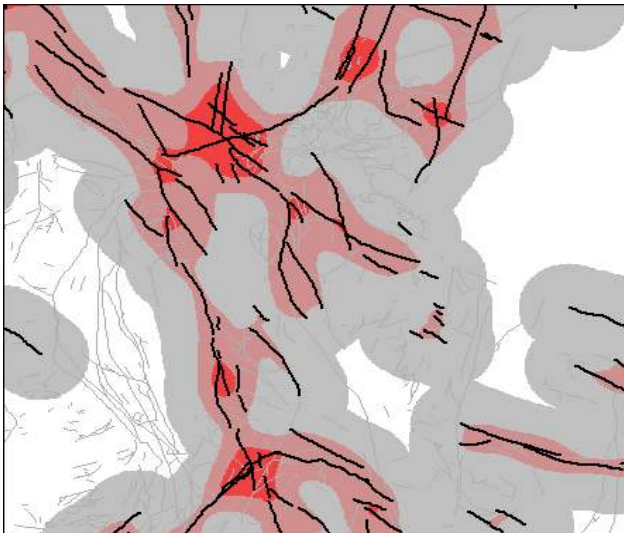
Unless noted, all steps can be carried out using MI-SDM and MapInfo. Use this document in association with the MI-SDM User Guide, which gives detailed information about all the required functions.

### 1. Choose the study area and the unit cell area

- a. The study area should encompass all ground (explored and unexplored, prospective and unprospective) within a set boundary such as a terrain, political or geographic boundary.
- b. Unit cell area may be chosen as the minimum area that can hold an economic deposit. However, the prospectivity map is not very sensitive to the unit cell area (as long as it is not too large).

### 2. Select the training points

- a. Ensure the deposits selected as training points are all examples of the same deposit model. For example, you probably don't want to mix hard-rock and alluvial gold deposits.
- b. Thin the training point dataset, so that there is no more than 1 training point per unit cell.



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## 3. Preparing Data Layers for Prospectivity Modelling

- Use any polygon, line, point or grid data
- You must be able to divide the layer into two or more classes (eg. by lithology, distance to structures, Cu%), though you may need to transform the data into polygons or a classified grid which can be classified.
- Calculate layer weights, reclassify if necessary and recalculate weights. If there is no clear association between deposits and a layer, then it will not contribute any information to the prospectivity map.
- The sections below give examples of how different types of exploration data can be prepared and transformed, to be used in a prospectivity model.

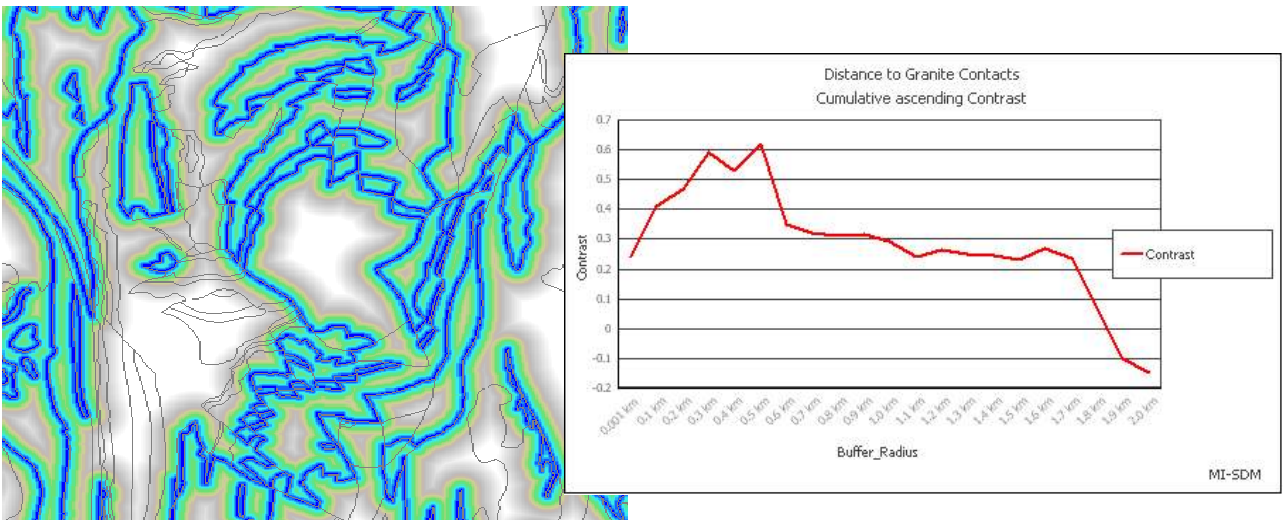
## 4. Linear Structures such as faults and folds

You may want to transform your linear data with any of these steps:

- Sub-select by orientation, generation or other attribute
- Multiple ring buffers around the structures, or distance to nearest structure (creating a distance grid is usually quicker and provides more flexibility than ring buffers).
- A density grid highlights areas of intense activity as shown above
- Create buffers or a distance grid for intersections, bends and jogs

## 5. Continuous Polygon Layers such as geology

- Use as polygons, may need reclassifying to reduce the number of classes, then convert to classified grid
- Extract important contacts and calculate a distance grid. The example below shows distance to granite-metasediment contacts



- A graph of weights for distance to contact shows the contrast ( $W^+ - W^-$ ) plotted against distance from the contact. The distance at which the contrast is a maximum (here 0.5km) is often used to reclassify the layer into 2 classes (< 0.5 km and > 0.5 km).

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## 6. Discrete Polygon Layers

Use as polygons (eg. stream sediment sample catchments), build distance grids (eg. alteration zones) or density map for small polygons (such as outcrops). Then classify the layer and calculate layer weights. For distance grids, density maps and similar ordered data, the weights should be calculated as either cumulative ascending (such as for distance, where the smallest values are likely to have the most association with deposits) or cumulative descending (such as for density).

## 7. Geochemistry

After levelling (eg. by geology, analysis method etc) and any other pre-processing (eg. principal components), the transformation method used for geochemistry data will depend on the type of data:

- a. Catchment polygons for stream sediment sampling
- b. Interpolated surface for gridded soil sampling (will require classification)
- c. Fixed width buffers or distance grid for more sparsely distributed data

Similarly to the example above for distance to contacts, with ordered classes of geochemistry values you will want to calculate cumulative descending weights.

## 8. Other Points (structure readings, field mapping etc)

You may also wish to create distance grids, density maps or other interpolations for point layers. For example:

- a. Vein density
- b. Standard deviation of cleavage
- c. Buffers around rock chip samples above threshold value

## 9. Geophysics Grids (mag, grav, em, radiometrics etc)

- a. Once the geophysical data has been processed externally (for example calculation of gravity worms or 1<sup>st</sup> vertical derivative for magnetics), the grid can be imported by MI-SDM or opened directly in MapInfo.
- b. If required, grids can be stitched, reprojected, clipped and resampled
- c. Continuous grids must then be classified before they can be used with weights of evidence modelling.

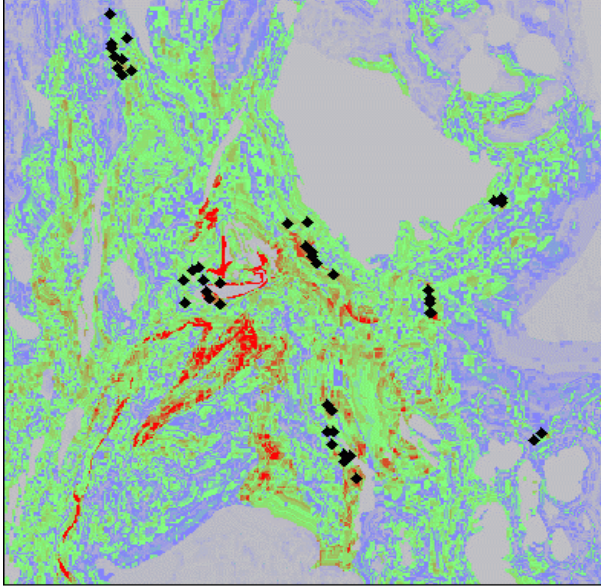
## 10. Check pair-wise conditional independence of these layers

If some of the evidential layers are highly spatially correlated (that is, there is conditional dependence between those layers), the probabilities calculated in the prospectivity model may be biased. The final prospectivity model should include layers that are as conditionally independent as possible.

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## 11. Combine the evidential layers to create a Weights of Evidence prospectivity map

When all required layers are combined, the resulting map contains the sum of probabilities at each location. The values in the prospectivity map are the probability that a unit cell will contain a deposit.



## 12. Revise the Model or Post-Process

It is now easy to add or remove layers from the model, re-transform or reclassify existing layers within the model, or to change the deposit training point dataset.

You may wish to combine the prospectivity map with additional weighting layers to better indicate areas with high exploration potential.

For example combining the prospectivity map with an outcrop mask can give more weight to under-explored areas.

You can also use the same evidential layers to create a “conventional” grid overlay model, or a fuzzy logic model. With these methods, you need to assign normalized weights to the layers and then decide how the input layers are to be combined. The resulting prospectivity map can be used in the same way as the weights of evidence probability map.

## 13. Extract areas of high probability and tabulate

For example:

Location	Area	Probability	Confidence	Tenement
A	2.5 sq km	0.43	High	EL 4033-A3
B	4.5 sq km	0.41	High	Free
C	13.0 sq km	0.19	Low	PP/M 816
D	7.0 sq km	0.16	Medium	EL 911 & EL 8481

## 14. Explore !