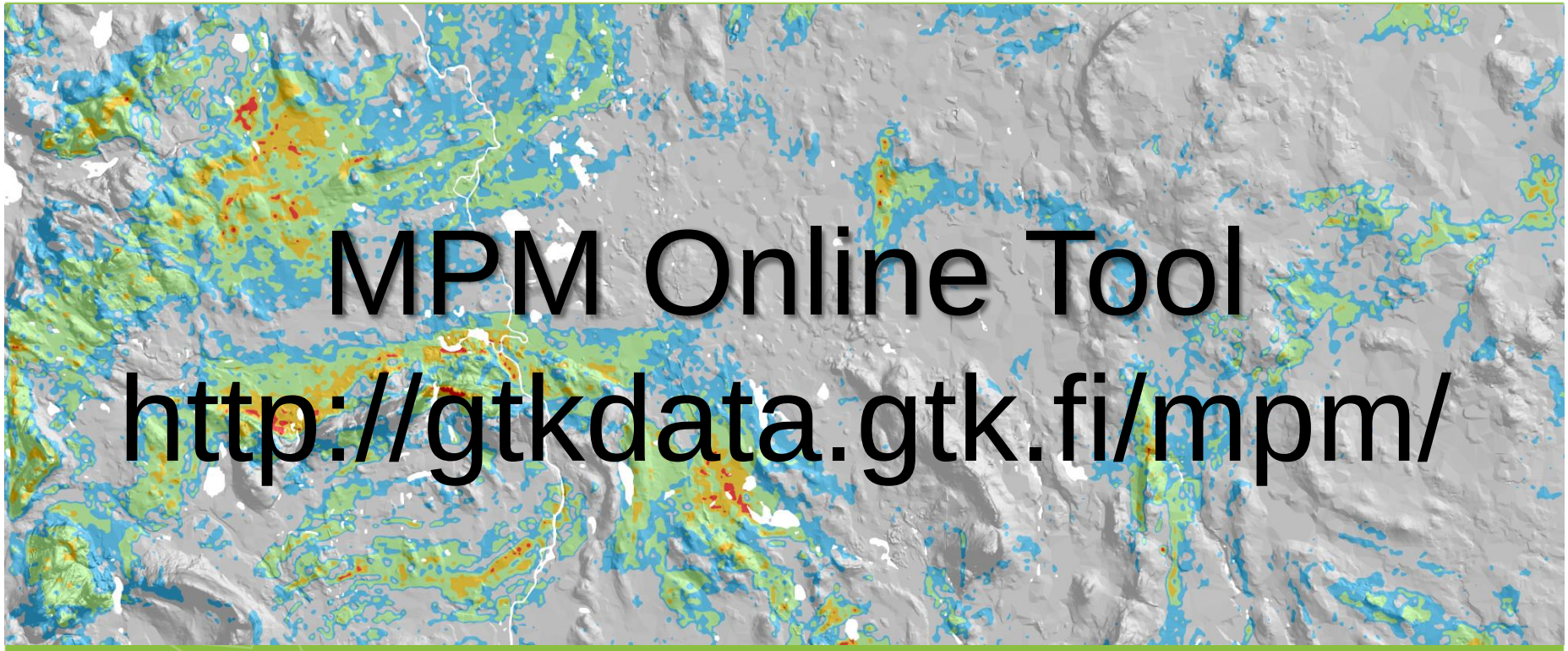


MPM Online Tool
http://gtkdata.gtk.fi/mpm/

ArcSDM 5
Final Seminar
May 4th 2018, Rovaniemi

GTK

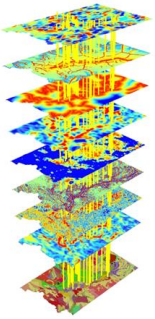
Programme for Sustainable Growth and Jobs

Leverage from the EU 2014–2020

European Union
European Regional Development Fund

Funding

BUSINESS FINLAND Tekes



國家海洋局第二海洋研究所
Second Institute of Oceanography,SOA

AngloAmerican

Sakumpu Exploration Oy

S2R S2 Resources

De Beers
Group of Companies

AGNICO EAGLE
FINLAND

NEW BOLIDEN

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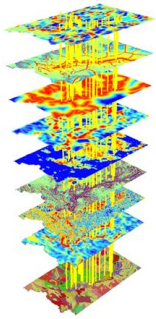

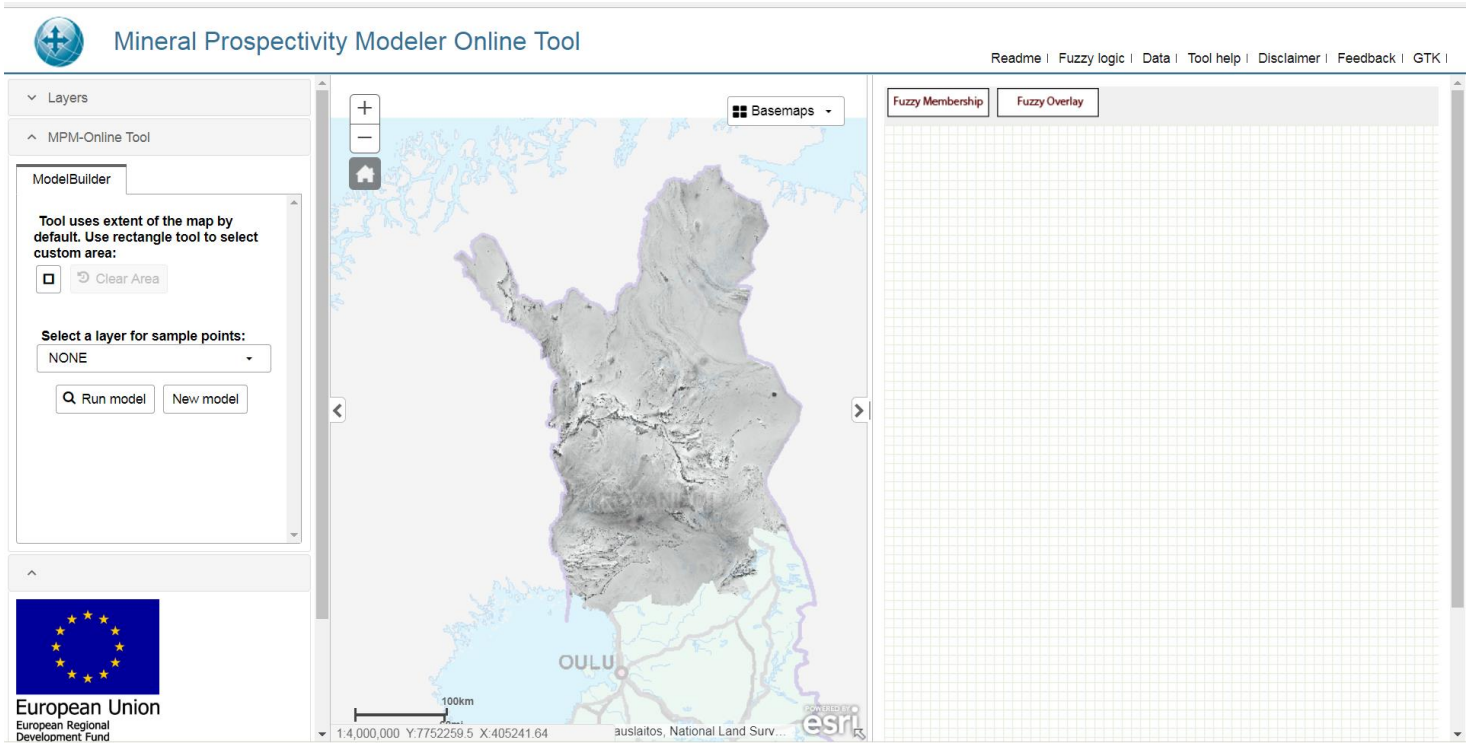

MPM Online Tool
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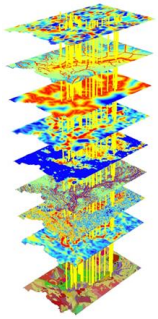
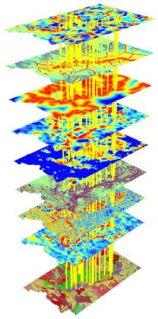


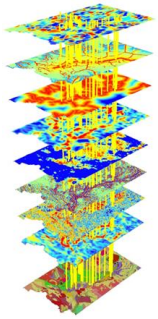
- Web tool for assessing **regional scale mineral prospectivity** in northern Finland with geospatial datasets in GIS.
- The primary aim of the MPM online too is to support strategic planning of companies conducting mineral exploration in northern Finland.
- Appropriate modelling with the MPM online tool may indicate for the most prospective areas making land claims for further advanced exploration.
- We encourage Universities to use the MPM Online Tool for teaching of prospectivity modelling.

MPM Online Tool
http://gtkdata.gtk.fi/mpm/



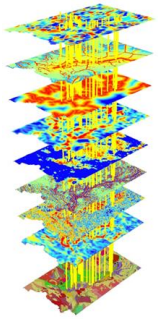
- The available input data for MPM Online Tool are open source spatial geological, geophysical and geochemical data provided by the GTK.
- The MPM online tool can be operated with any modern web browser (Chrome, IE, Firefox) without installing any additional software onto the user's own computer.
- The MPM online input data and modelling tools are stored and outputs are run on the GTK server. Users cannot add their own data into the models and store the geoprocessing models or outputs onto their own computer neither.

MPM Online Tool
http://gtkdata.gtk.fi/mpm/



- The MPM online tool uses ArcGIS for Server as a geoprocessing server. ESRI Javascript API (Application Programming Interface) is used to send data to the geoprocessing tools.
- Geoprocessing tools are made by using ArcGIS Spatial analyst functions (Fuzzy Overlay, Fuzzy Membership). CMV.io mapping framework is used to display various widgets and map in the browser (https://cmv.io).
- MxGraph diagramming library is used to create Model Builder canvas for user drawn models (https://github.com/jgraph/mxgraph).

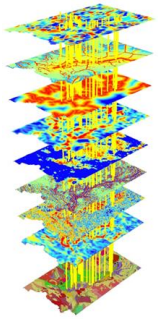
MPM Online Tool
Data



Three types of data are available for modelling and visualization in the MPM online tool.

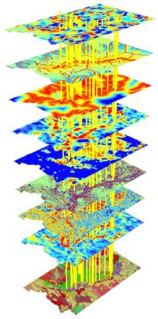
Data type	Purpose in the MPM tool	Link
Modelling input data by GTK	Inputs into the prospectivity models	Described below
Background data by GTK	Visualisation	Same as in http://gtkdata.gtk.fi/mdae/index.html
Background data from other sources	Visualisation	Same as in http://gtkdata.gtk.fi/mdae/index.html

MPM Online Tool
Data



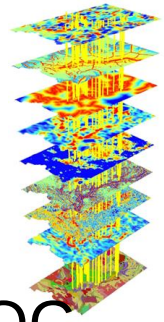
- The available input data are spatial geological, geophysical and geochemical data provided by the GTK and derivatives calculated from a chosen set of features.
- All dataset dedicated for modelling are in raster format. Known mineral deposits for model validation are given in point vector format.
- These created modelling input dataset specific to MPM Online Tool are under the GTK Basic license (http://tupa.gtk.fi/paikkatieto/lisenssi/gtk_basic_licence_1.pdf).

MPM Online Tool
Data: Shape Files



- This group of files includes a vector polygon file of Northern Finland and vector point files of mineral deposits derived from GTK's "Mineral deposits of Finland" data base (data layer Mineral Deposits). The full metadata of the Mineral deposits of Finland can be viewed at http://tupa.gtk.fi/paikkatieto/meta/mineral_deposits.html (in Finnish).
- Four mineral deposit-type layers are extracted from the mineral deposits data according to their genetic type. These are:
  - Orogenic Au,
  - IOCG (Iron oxide-copper-gold),
  - Magmatic PGE and
  - Magmatic Ni-Cu layers.
  - These were generated to be used as validation points of the fuzzy modelling results in the MPM Online Tool. For each of the different data sets a Fuzzy Membership Value column was added. Fuzzy Membership values were estimated based on each deposits metal content and/or economical potential. Data layer names and explanations are given in Table 2.

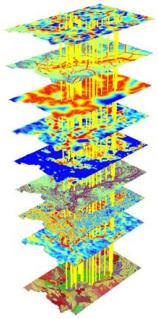
MPM Online Tool
Data: Shape Files



- Mineral deposit data layers available to be used for ROC validation in the MPM Online Tool

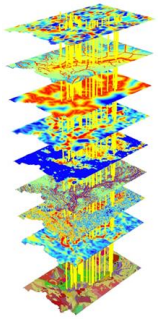
Layer name	Explanation
IOCG	Iron oxide-copper-gold deposits and occurrences
Magmatic PGE	Magmatic PGE deposits and occurences
Magmatic Ni-Cu	Magmatic Ni-Cu deposits and occurrences
Orogenic Au	Orogenic gold deposits and occurrences

MPM Online Tool
Data: Geophysical data



- The geophysical data consist of GTK's low-altitude aerogeophysical data acquired during 1972−2007. The parameters for original data were: flight altitude 30−40 m, the nominal flight line spacing 200 m and sample distance along the survey line 6−50 m (Airo 2005).
- The dataset has been recalculated for 500 m by 500 m cell size grids. The geophysical parameters measured are the Earth's magnetic field, the electromagnetic field and natural gamma radiation. Magnetic measurements determine the Earth's magnetic field strength (magnetic flux), obtaining the total magnetic intensity of the Earth's magnetic field as a parameter.
- Airborne electromagnetic measurements give information about the electrical properties of the ground. Measured components are real (in-phase) and imaginary (quadrature) components. Also apparent resistivity is calculated using a half space model.
- The MPM Online Tool data set includes total magnetic field, apparent resistivity, quadrature (em-imaginary) and in-phase (em-real) components. Some errorneous negative values appear in the aerogeophysal dataset. However, in fuzzy logic negative values cannot be handled. Thus a small constant number was added to the values to shift the data distribution to include only positive values (Recalc, see Table 3). Metadata of the original data layers can be viewed here http://tupa.gtk.fi/paikkatieto/meta/lentogeofysikaaliset_matalalentokartat_20k.html (in Finnish).

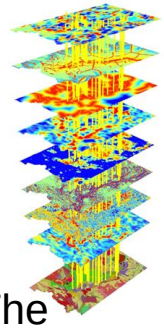
MPM Online Tool
Data: Geophysical data



- The geophysical layers available for fuzzy modelling in the MPM Online Tool.

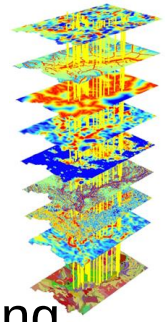
Layer name	Explanation
Recalc magnetic	total magnetic field
Recalc apparent resistivity	apparent resistivity
Recalc EM quadrature	quadrature (em-imaginary)
Recalc EM real	in-phase (em-real)

MPM Online Tool
Data: Geochemical data



- Regional till geochemistry describes the distribution of 25 elements in basal till. The sampled material was chemically unchanged C-horizon till preferably under the water table. The average sampling depth was approximately 1.5-2 m. Sampling was done during years 1983-1991. The sampling density was one sample per 4 km2. The whole country was covered by the till sampling and the total amount of samples is 82062. The samples were collected as composite of 3-5 subsamples.
- The coordinates of each sample are calculated based on coordinates of these subsamples. Part of the subsamples are originally from targeting till geochemical sampling. From dried samples the < 0.06 mm fraction was sieved for analysis. From hot aqua regia assay abundances of 25 elements were determined. The primary aim of the geochemical mapping program was to produce data for mineral exploration (Salminen 1995).
- Metadata can be viewed at http://tupa.gtk.fi/paikkatieto/meta/regional_till_geochemistry.html (in Finnish).
- Raster layers were interpolated from these for 15 elements using inverse distance method with variable search radius and number of points 12. The geochemical rasters are named "Till gc" followed by respective element abbreviation (Table 4).

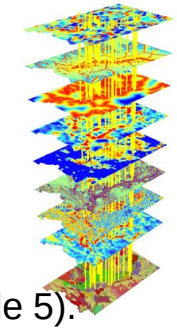
MPM Online Tool
Data: Geochemical data



- Available till geochemical raster layers as inputs for fuzzy modelling in the MPM Online Tool. See Salminen 1995 for further details of the data quality.

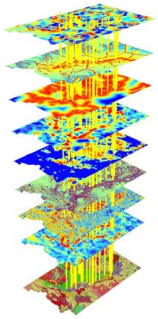
Layer name	Element	Notes
Till gc Au	Au	Poor field precision
Till gc Ba	Ba	
Till gc Ca	Ca	
Till gc Co	Co	
Till gc Cr	Cr	
Till gc Cu	Cu	
Till gc Fe	Fe	
Till gc K	K	
Till gc La	La	
Till gc Mn	Mn	
Till gc Ni	Ni	
Till gc P	P	
Till gc Te	Te	Poor field precision
Till gc Th	Th	Intermediate laboratory precision
Till gc V	V	

MPM Online Tool
Data: Derivatives



- The data set included derivative maps calculated from geological and geophysical data (Table 5).
- The geological data is extracted from GTK's digital bedrock map of Finland (Bedrock of Finland - DigiKP) which is a unified bedrock map dataset covering the whole Finland. It has been compiled by generalising the scale-free bedrock map feature dataset. The dataset consists of a lithological/stratigraphic geological unit polygon layer and linear layers, in which faults, diverse overprinting lines and dykes are represented. The metadata of the DigiKP (i.e. Bedrock of Finland 1:200000) can be viewed at http://tupa.gtk.fi/paikkatieto/meta/bedrock_of_finland_200k.html (in Finnish). The structures, domain boundaries, black shales and domain boundaries were selected from the DigiKP and their density and distance was calculated.
- The gravity worms represent maximas of spatial gravity gradients at different upward continuation levels. The processing technique, multiscale edge detection, was first presented by Hornby et al. (1999) and later discussed by Archibald et al. (1999) and Holden et al. (2000). The the density of the worms and distance to the worms was calculated. The regional Bouguer data (1 observation per 25 km2) was used in the processing. The Bouguer anomaly map is the regional gravity data provided by the Finnish Geodetic Institute and the Geological Survey of Finland. Metadata of the original data can be found at http://tupa.gtk.fi/paikkatieto/meta/bouguer_anomaly_map_of_finland.html (in Finnish).

MPM Online Tool
Data: Derivatives



- Structural and lithological derivatives available for modelling in the MPM Online tool.

Layer name	Explanation
Density of structures	Density of structural lines
Distance to domain boundaries	Euclidean distance to domain boundaries
Distance to structures	Euclidean distance to structures
Distance to black shales	Euclidean distance to black shales
Density of lithological contacts	Density of lithological contact lines
Distance to worms	Euclidean distance to gravity worms
Density of worms	Density of gravity worm lines

MPM Online Tool
http://gtkdata.gtk.fi/mpm/