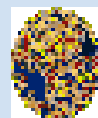


Innovative Projects in the Frame of AEGOS: Predictive Mapping on Mineral Resources with advangeo®

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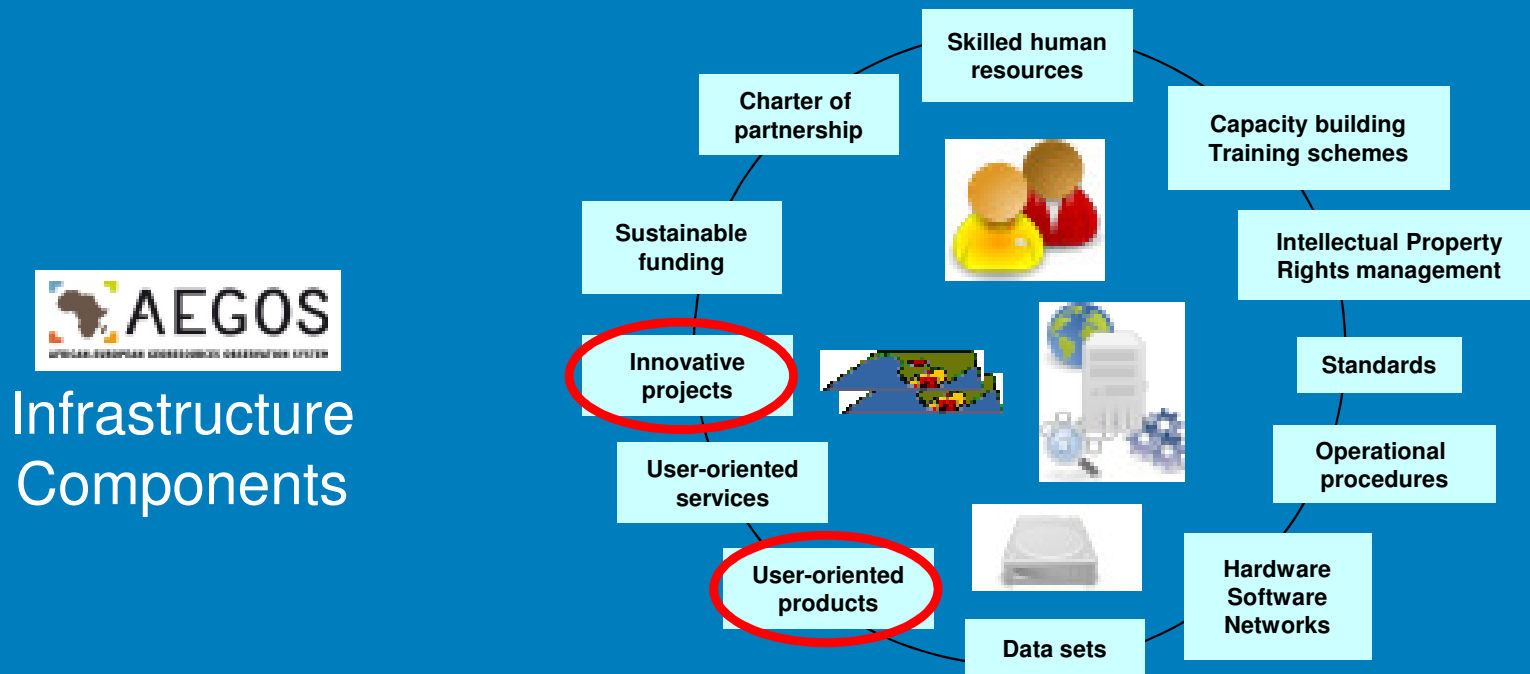


CAG23 – Workshop 6: AEGOS/GIRAF/OneGeology
Johannesburg, January 12th, 2011



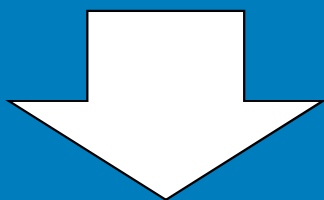
Outline

- Theoretical Background: Artificial Intelligence / Artificial Neural Networks
- Short Presentation of Developed Software: advangeo®
- Description of Work Methodology: Case Study Ghana
- Outlook / Summary



Case Study: *Exploration Targeting / Predictive Mapping for Au-Deposits / Occurrences in NW-Ghana*

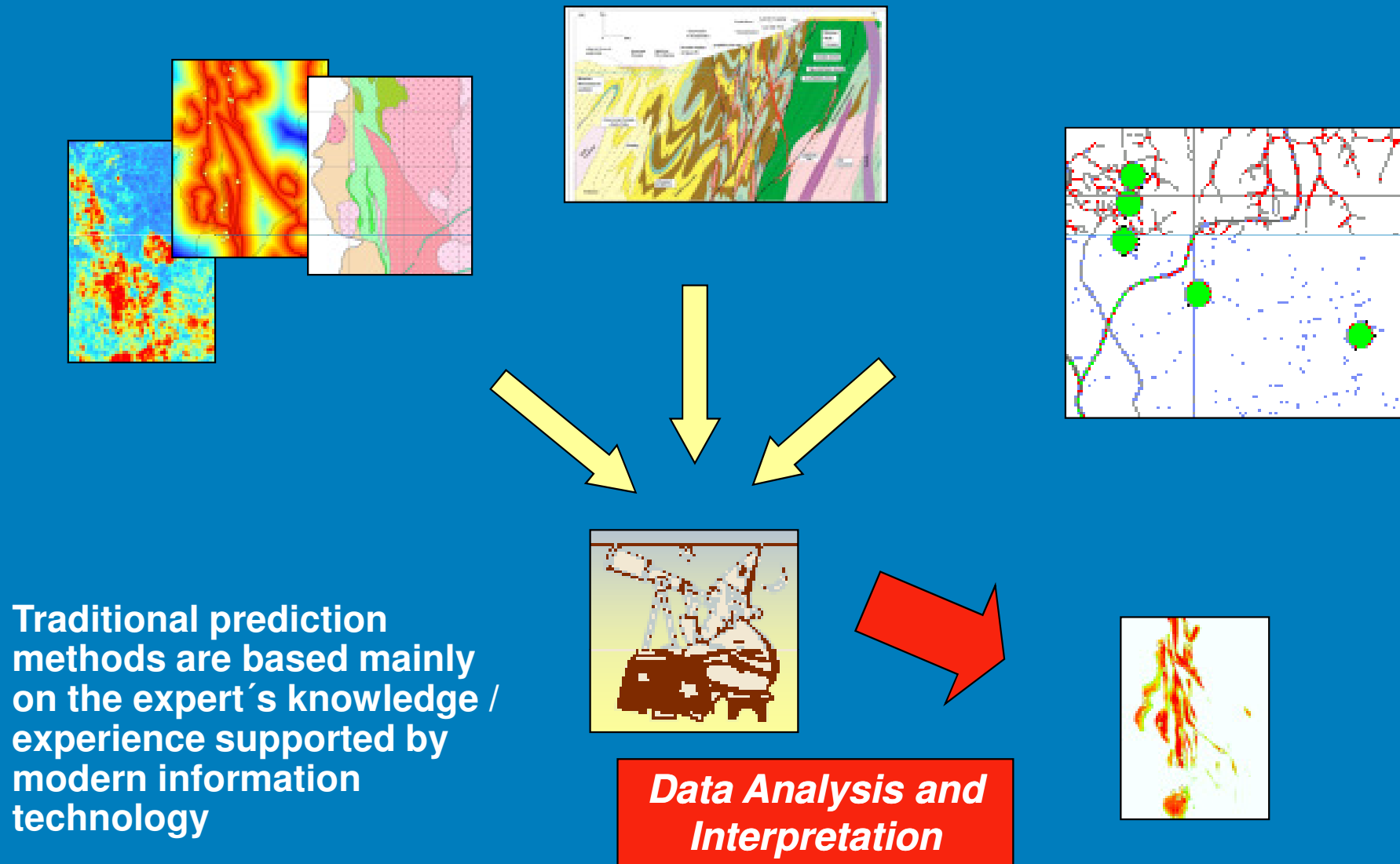
- Au generates important income in Ghana
- Au mining creates jobs and supports the local & national economy
- Au mining creates serious environmental damages
- Mineral resources must be included into the land use planning activities



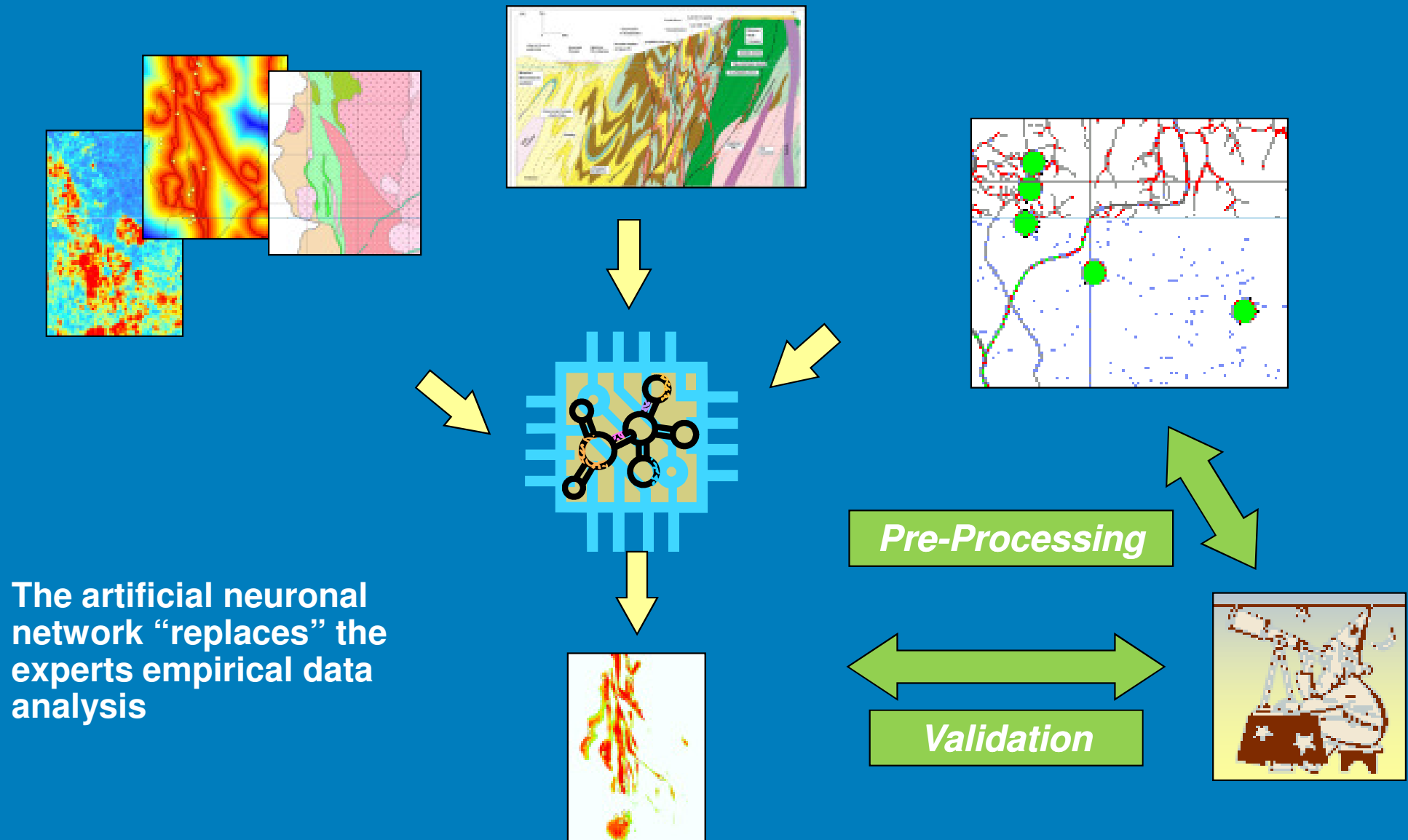
PREDICTIVE MAPS CAN PROVIDE A SERIOUS
INPUT INTO THE NATIONAL DEVELOPMENT
STRATEGY



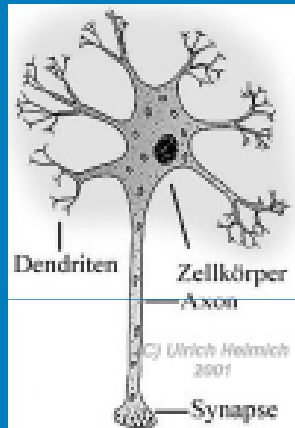
Predictive Mapping - Traditional Approach



Predictive Mapping - Modern Approach Using Artificial Intelligence



Definition: Artificial Neural Networks

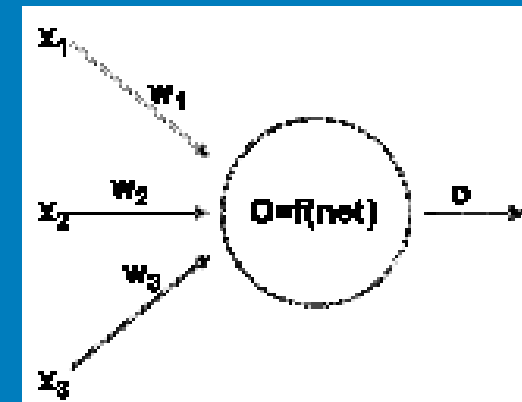


Model: Neuron Cell

- Functionality as a biological neural system
- Consists of artificial neuron cells
- Simulation of biological processes of neurons by use of suitable mathematical operations
- In most cases layer-like configuration of the neurons

The Neuron Cell as a Processor

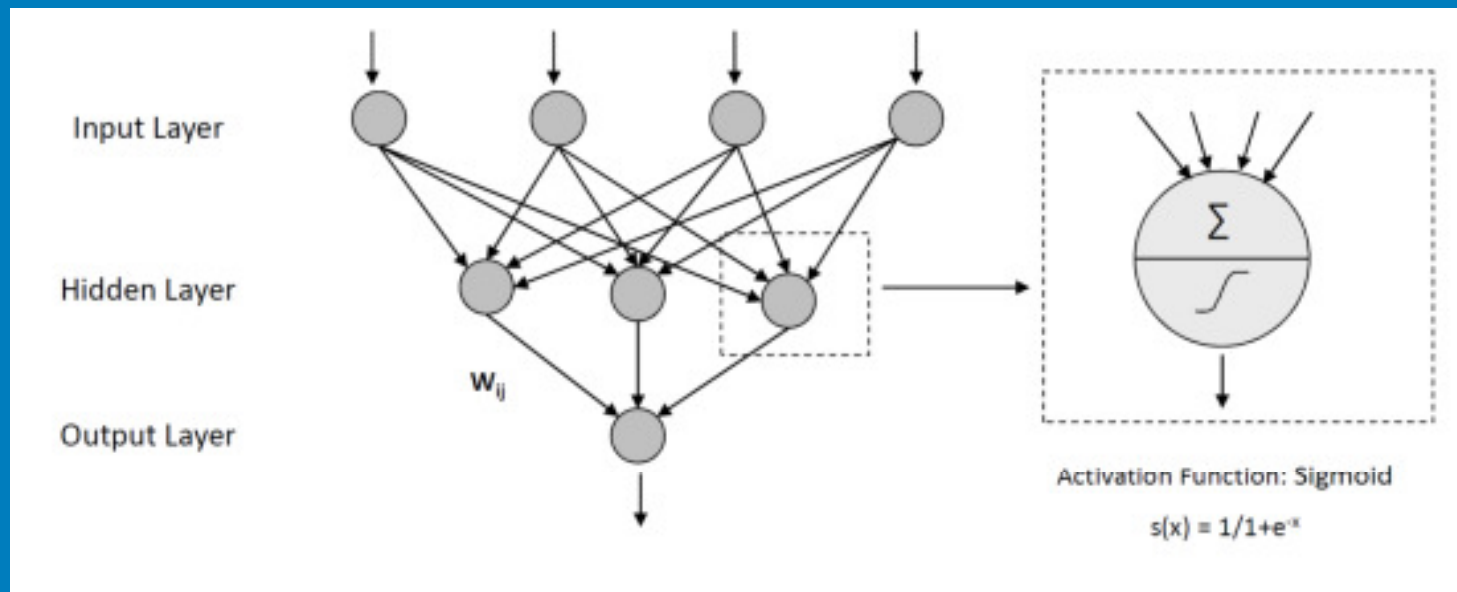
- **Connection between the neurons by weights w**
 - Enforce or reduce the level of the input information
 - Are directed, can be trained
- **Input signals**
 - Re-computed to a single input information: the propagation function
- **Output signals**
 - Activation function computes the output status of a neuron (often used: Sigmoid function)



Principle Setup of Artificial Neural Networks

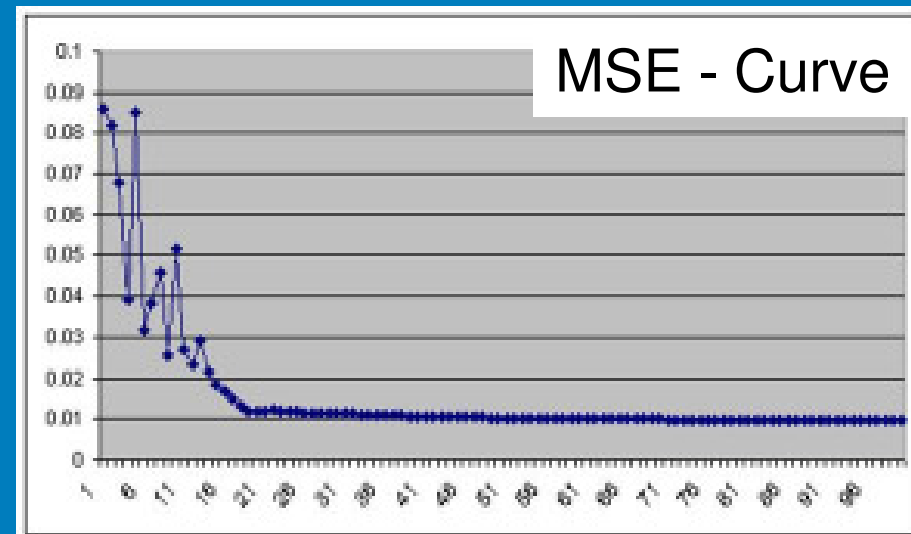
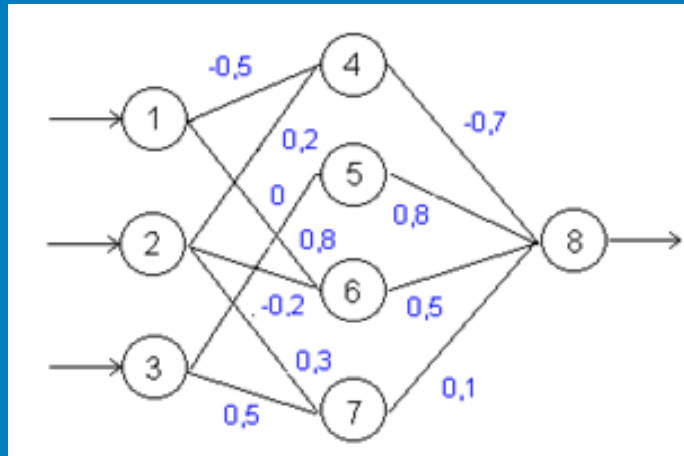
Network Topology: MLP (Multi Layer Perceptron)

- Set-up of neurons in layers
- Direction and degree of connections
- Amount of hidden layers and neurons



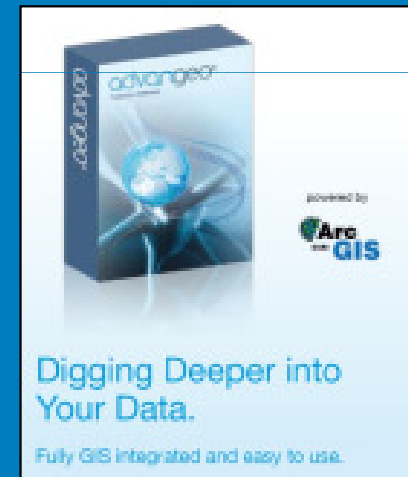
Learning Algorithm: Back-Propagation

- Repeated input of training data
- Modification of weights w
- Reduces error between expected and actual output of the network



- **Easy Access** to Methods of Artificial Intelligence for Spatial Prediction
- **Documentation** of Working Steps
- Capture and Management of **Metadata** for Geodata
- **Tools** for Data Pre-Processing, Post-Processing and Cartographic Presentation
- Integration into Standard **ESRI ArcGIS**-Software

advangeo®
Prediction Software



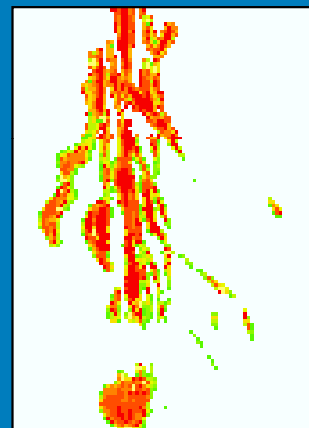
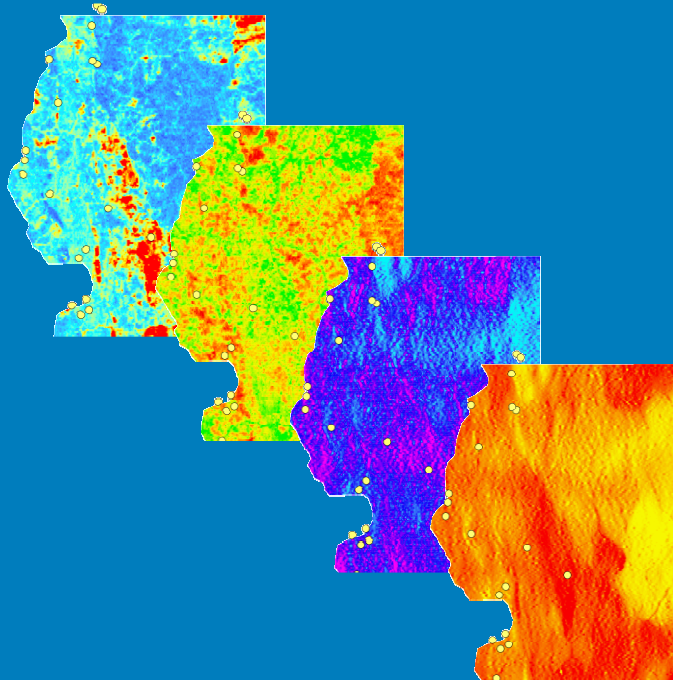
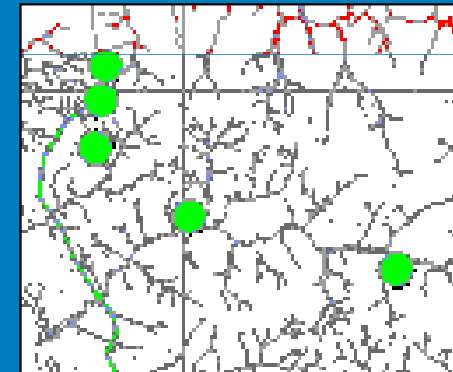
Case Study: Mineral Deposits (Ghana)

Input Data:

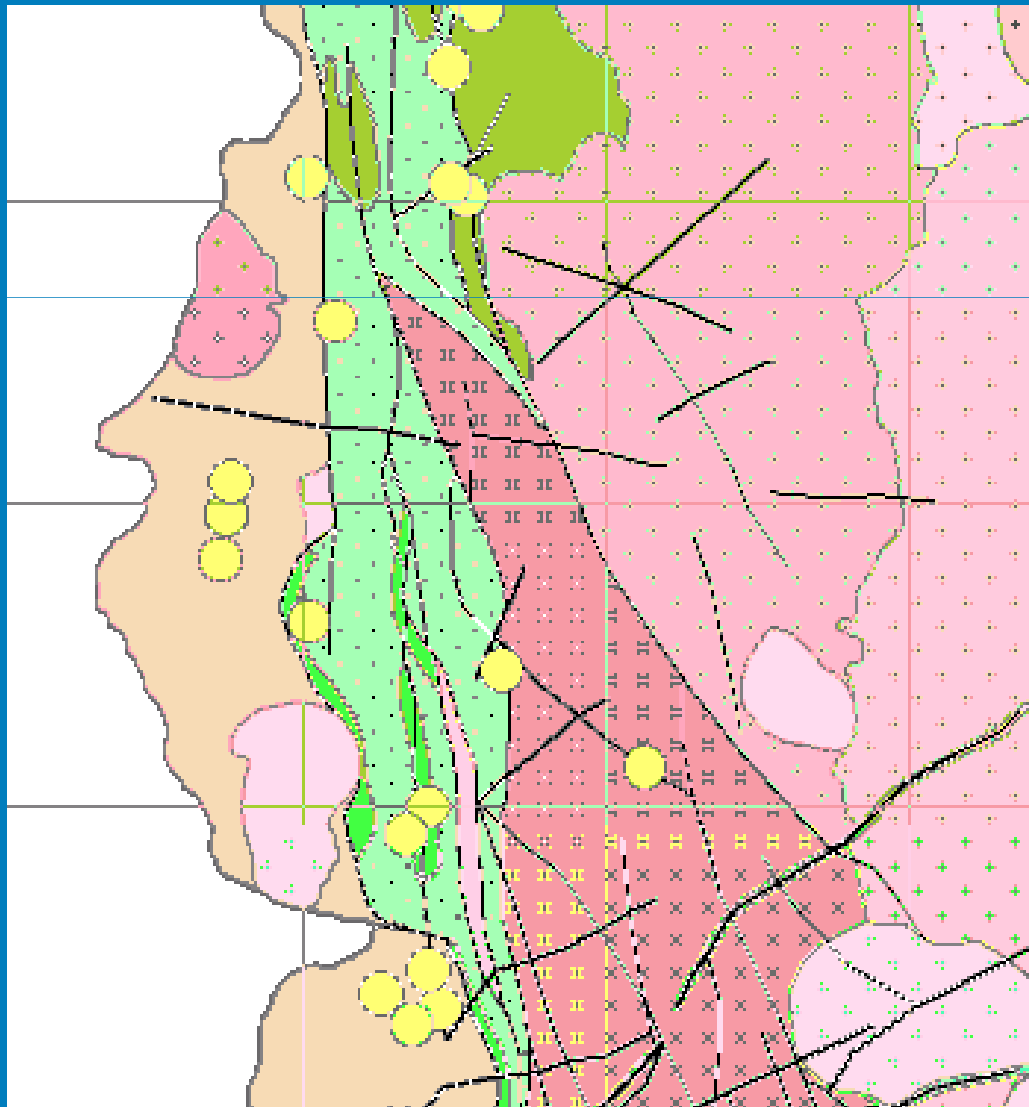
Airborne Geophysics: U, Th, K, Total, Magnetics
Distance to Tectonic Structures
Intersections of Tectonic Structures
Rock Type from Geology
Important Rock Contacts

Trainings Data:

Known
Mineralisations



Case Study: Mineral Deposits (Ghana)



Training Data:
Known Deposits and Occurrence
From Geodatabase Ghana

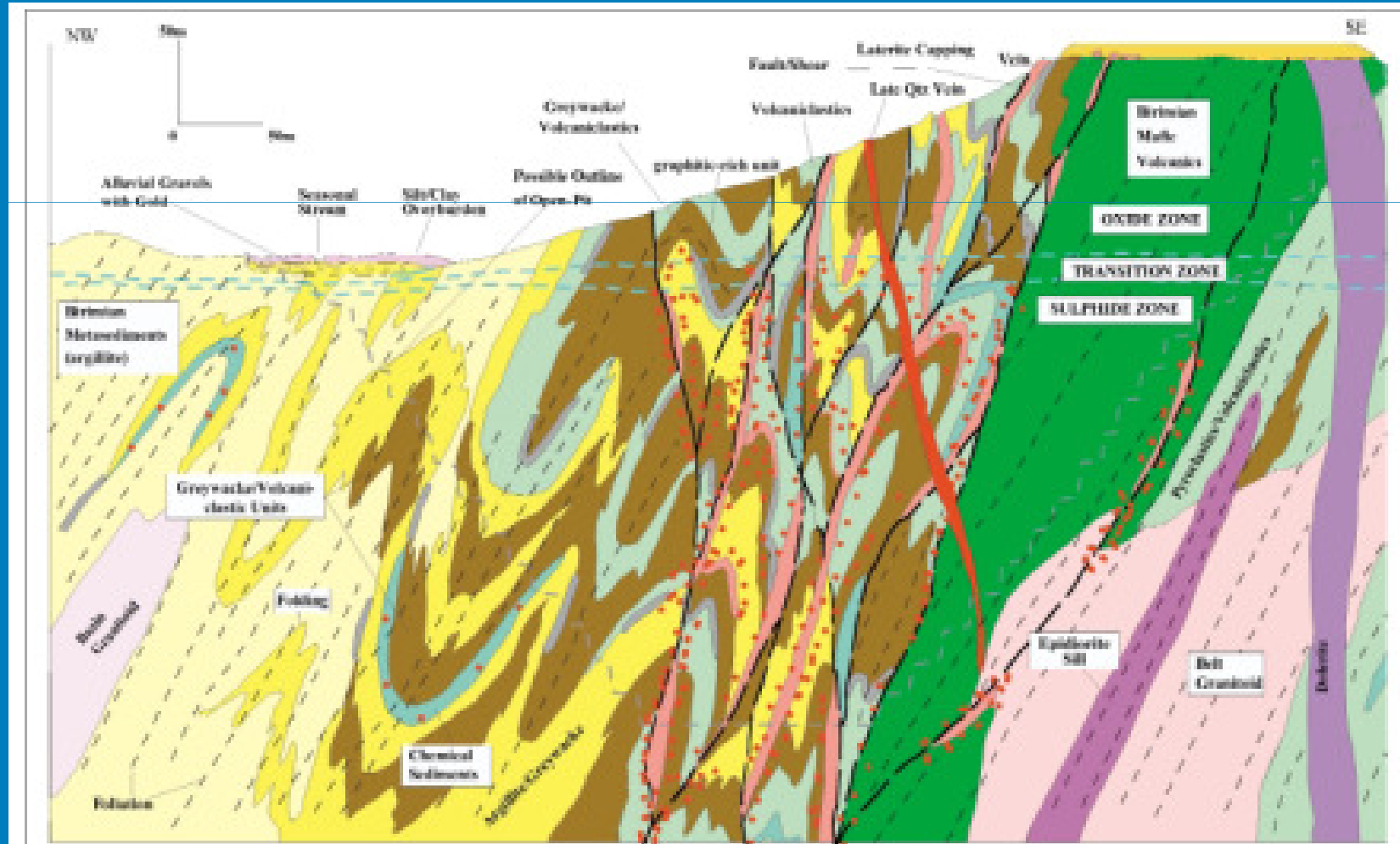
The screenshot shows the 'GEODATABASE GHANA' web application interface. It features a header with the Ghana coat of arms and the 'Geomatics Engineering Limited' logo. The main content area is organized into a grid of buttons for different data layers:

- Mining:** Mineral Occurrence, Mine, Mining Mining Permit/Plan, Mining Prospecting/Plan/Report
- Economic Geology:** Heavy Metals, Light Metals, Non-ferrous Heavy Metals, Non-ferrous Heavy Metals
- Geology:** Lithology, Geological Formations, Geologic Structures, Property Data
- Mineral Trade:** Mineral Trade Areas, Mineral Trade Areas
- Platinum Grouping Data:** Platinum Grouping Data, Platinum Grouping Data
- Minerals Endowment:** Mineral Endowment, Mineral Endowment
- Administration:** Regions/Districts, Districts, Towns
- Business Data:** Business Data, Business Data
- Environmental:** Environmental Data, Environmental Data

At the bottom right, there is a 'Call' button and a search bar.

Case Study: Mineral Deposits (Ghana)

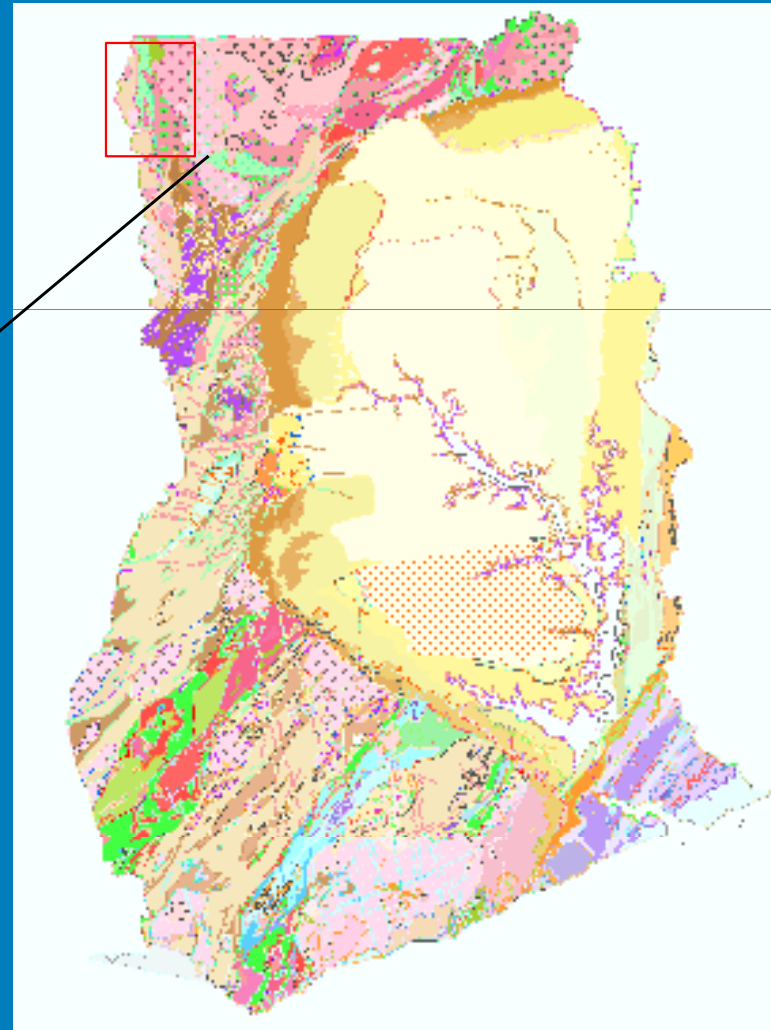
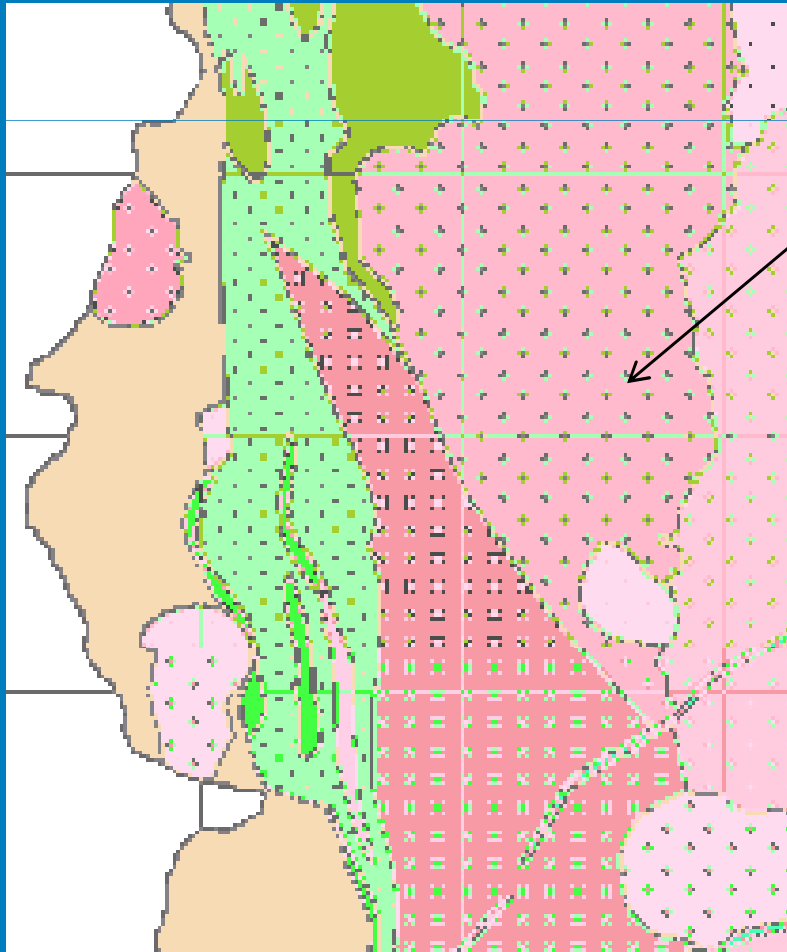
Knowledge: Existing Deposit Model



Source: Gold deposits of Ghana, Minerals Commission, Ghana, ROBERT J. GRIFFIS, KWASI BARNING, FRANCIS L. AGEZO, FRED K. AKOSAH, 2002

Case Study: Mineral Deposits (Ghana)

Input Data:
Geological Map 1:1.000.000

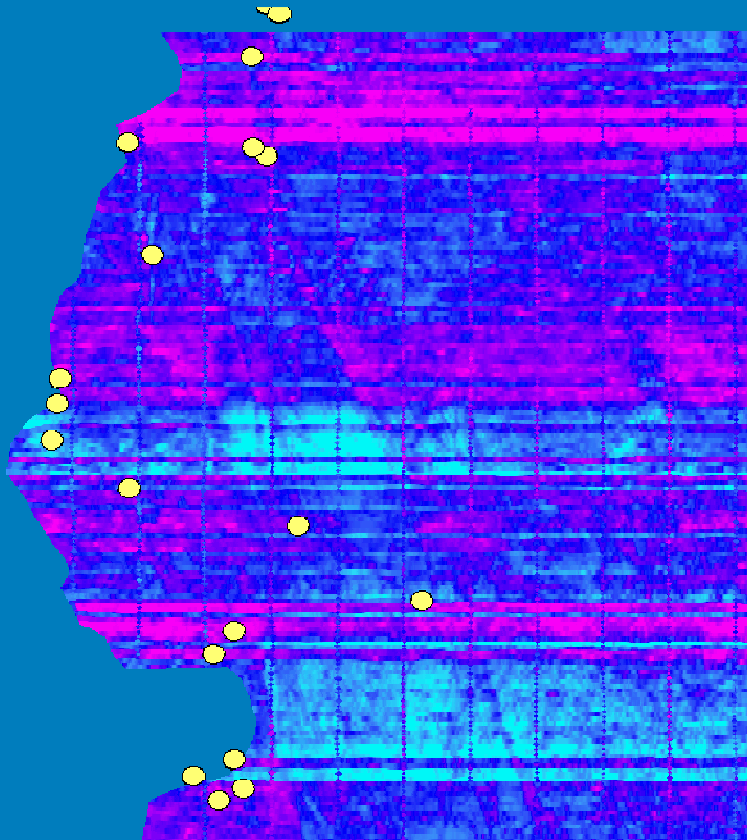


*Source: Geological Map of Ghana, 2010
Geological Survey Department, Ghana
Bundesanstalt für Geowissenschaften und Rohstoffe, Germany*

Case Study: Mineral Deposits (Ghana)

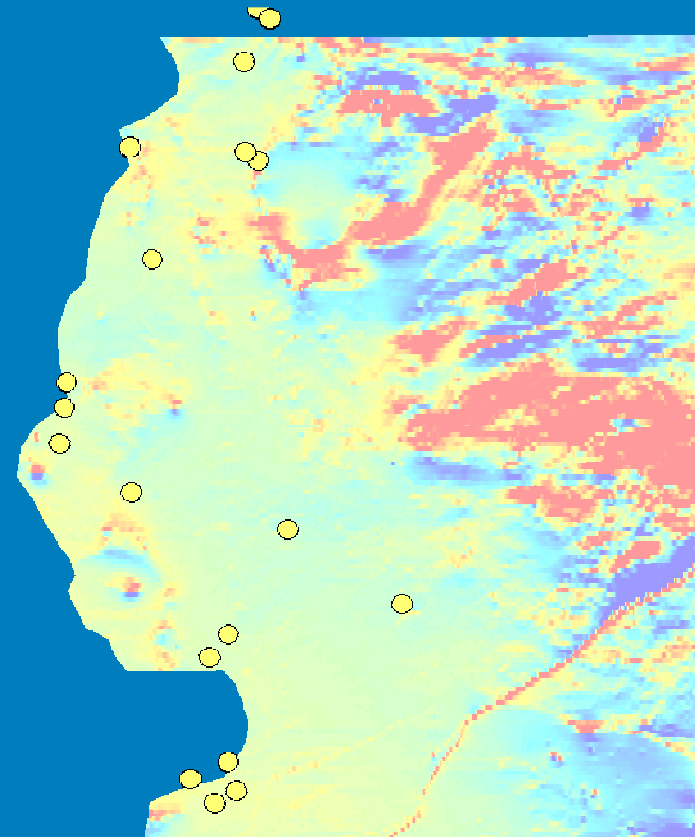
Input Data:

Airborne Geophysical Survey -
Electromagnetic



Input Data:

Airborne Geophysical Survey –
Magnetic

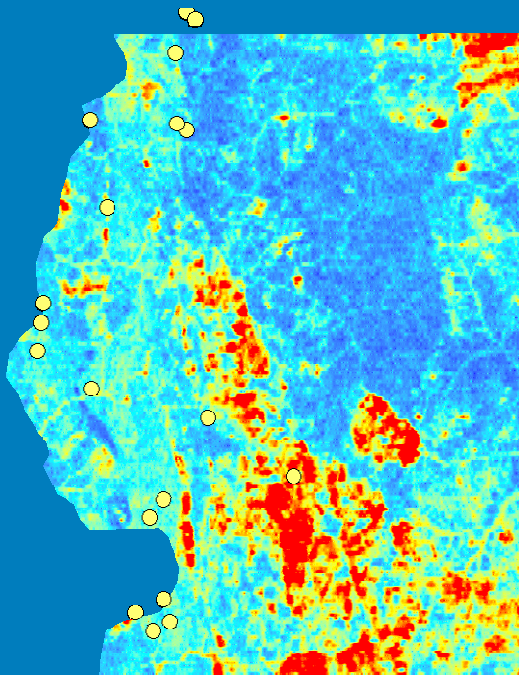


Source: Geological Survey Department of Ghana

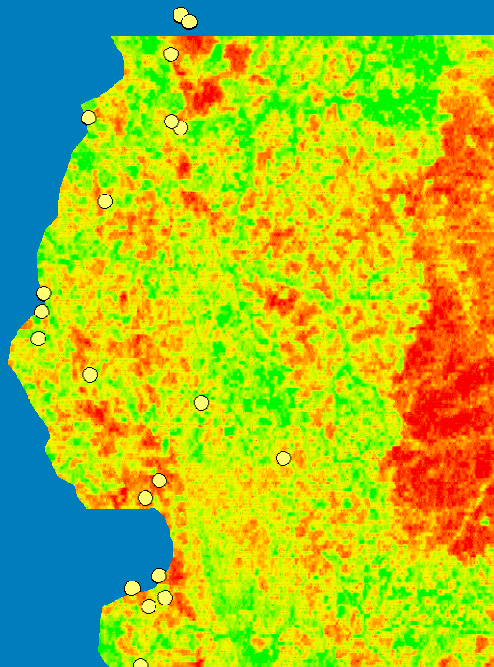
Case Study: Mineral Deposits (Ghana)

Input Data:

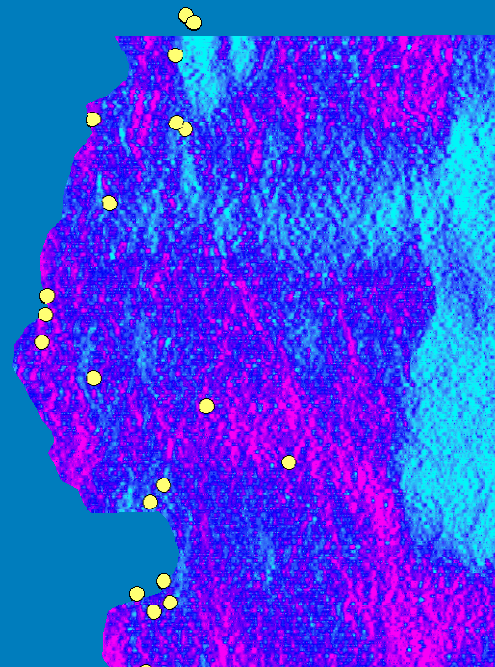
Airborne Geophysical Survey - Radiometric



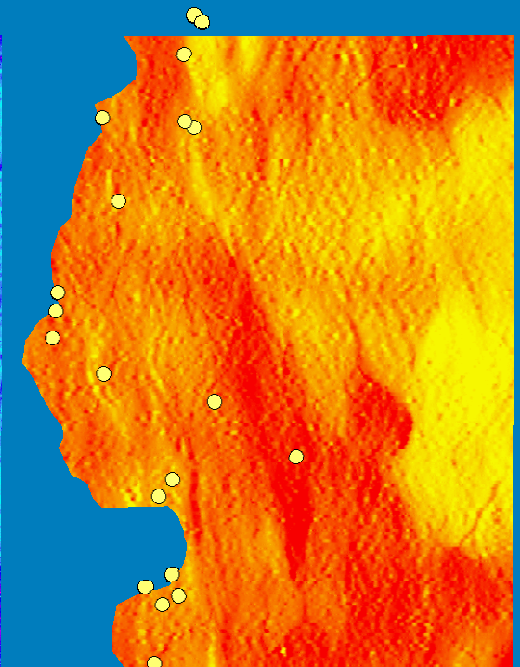
Potassium



Thorium



Uranium

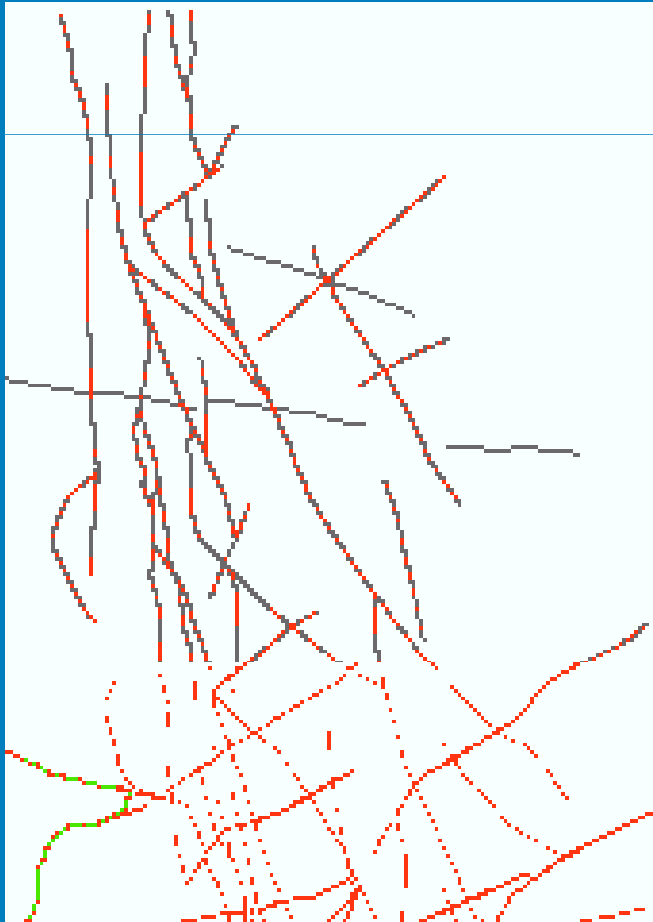


Total

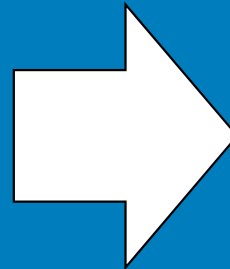
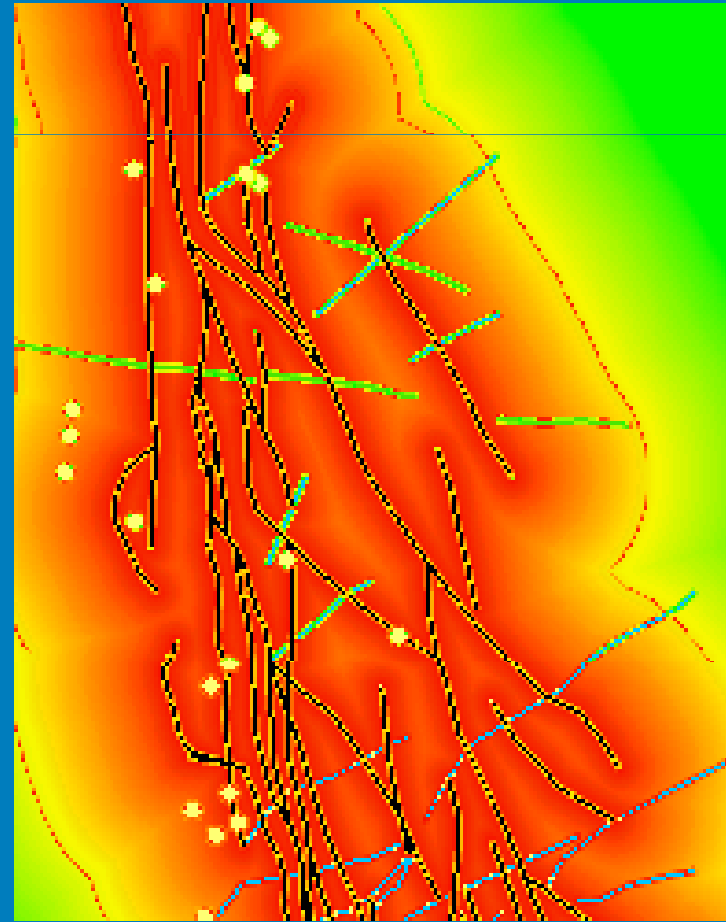
Source: Geological Survey Department of Ghana

Case Study: Mineral Deposits (Ghana)

Input Data:
Tectonic elements



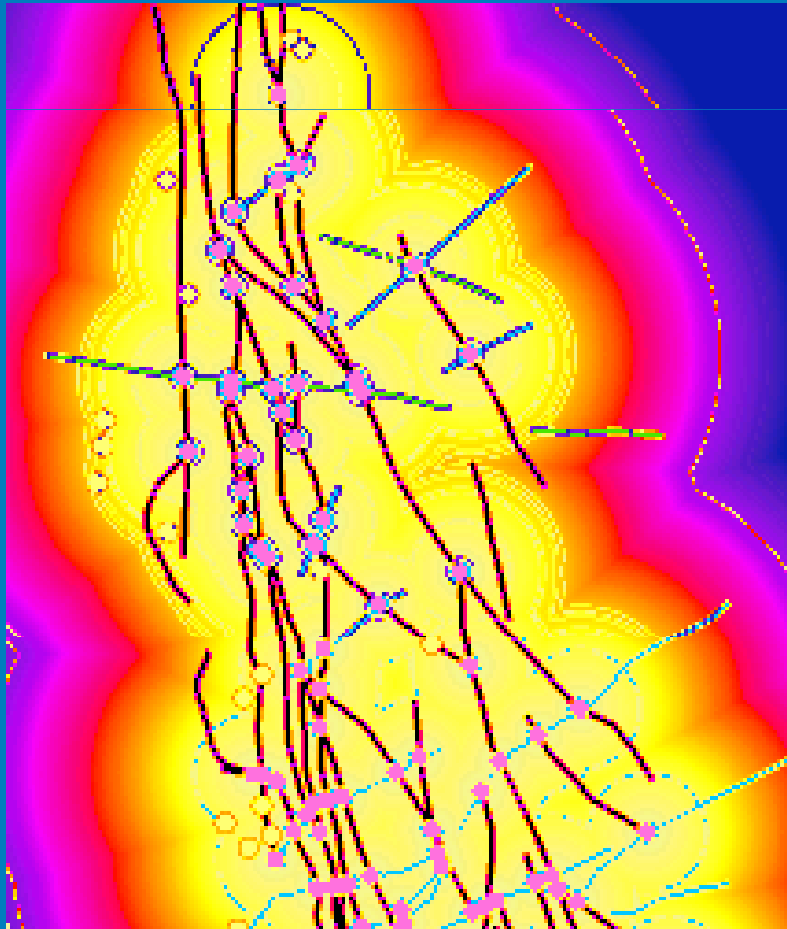
Input Data:
Euclidian distance to faults



Case Study: Mineral Deposits (Ghana)

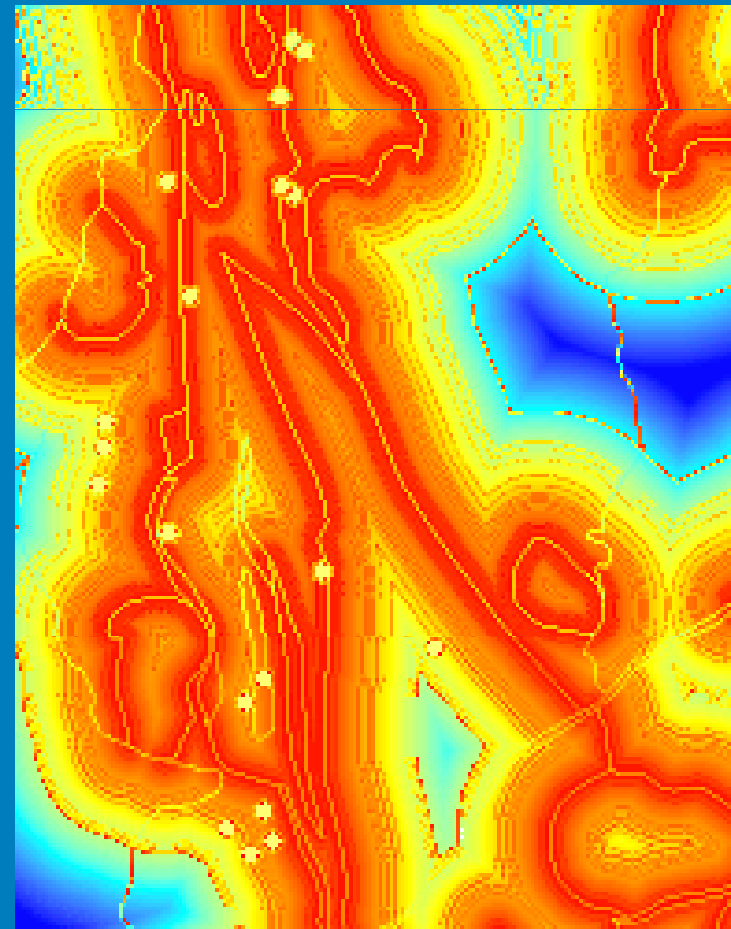
Input Data:

Euclidian distance to tectonic intersections

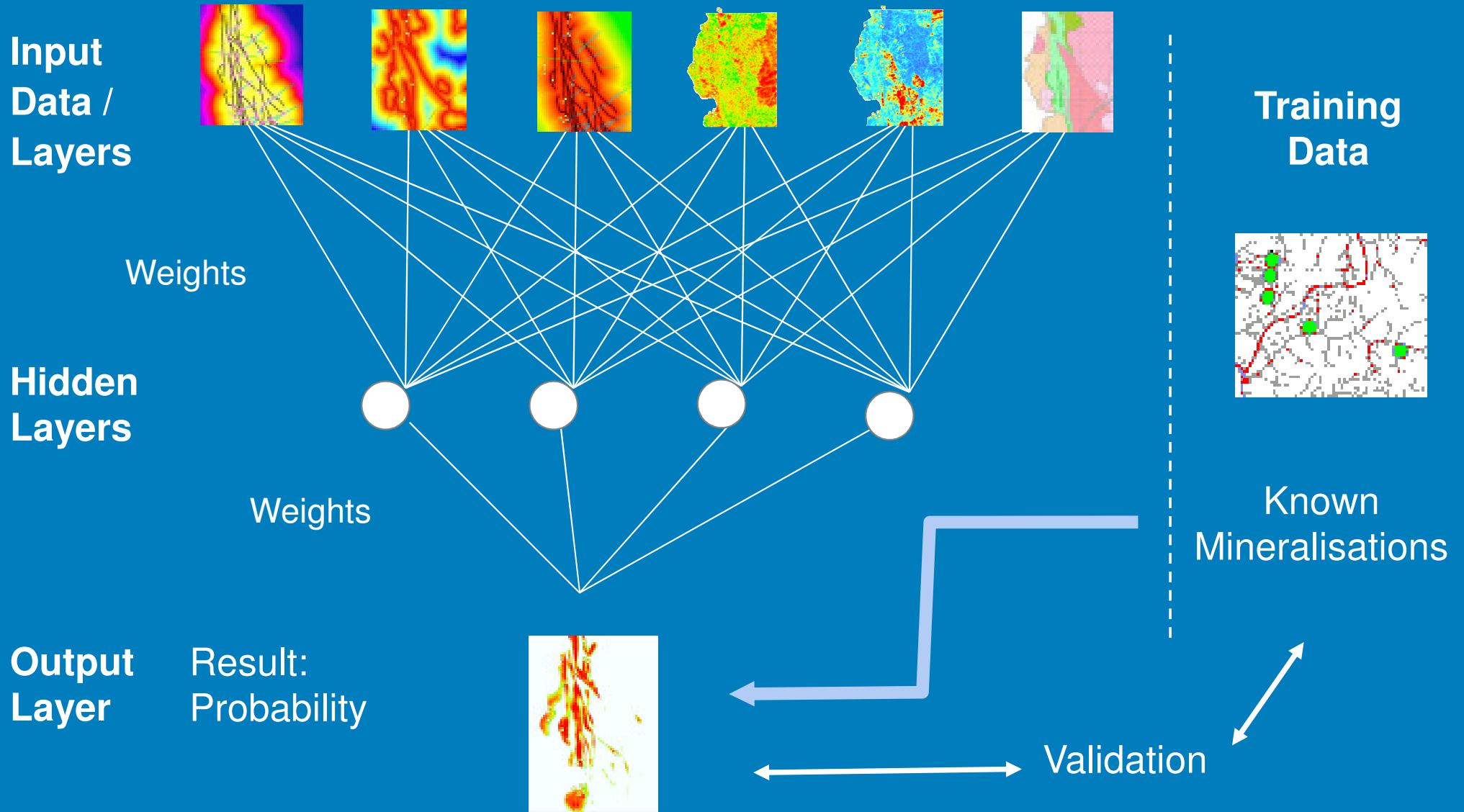


Input Data:

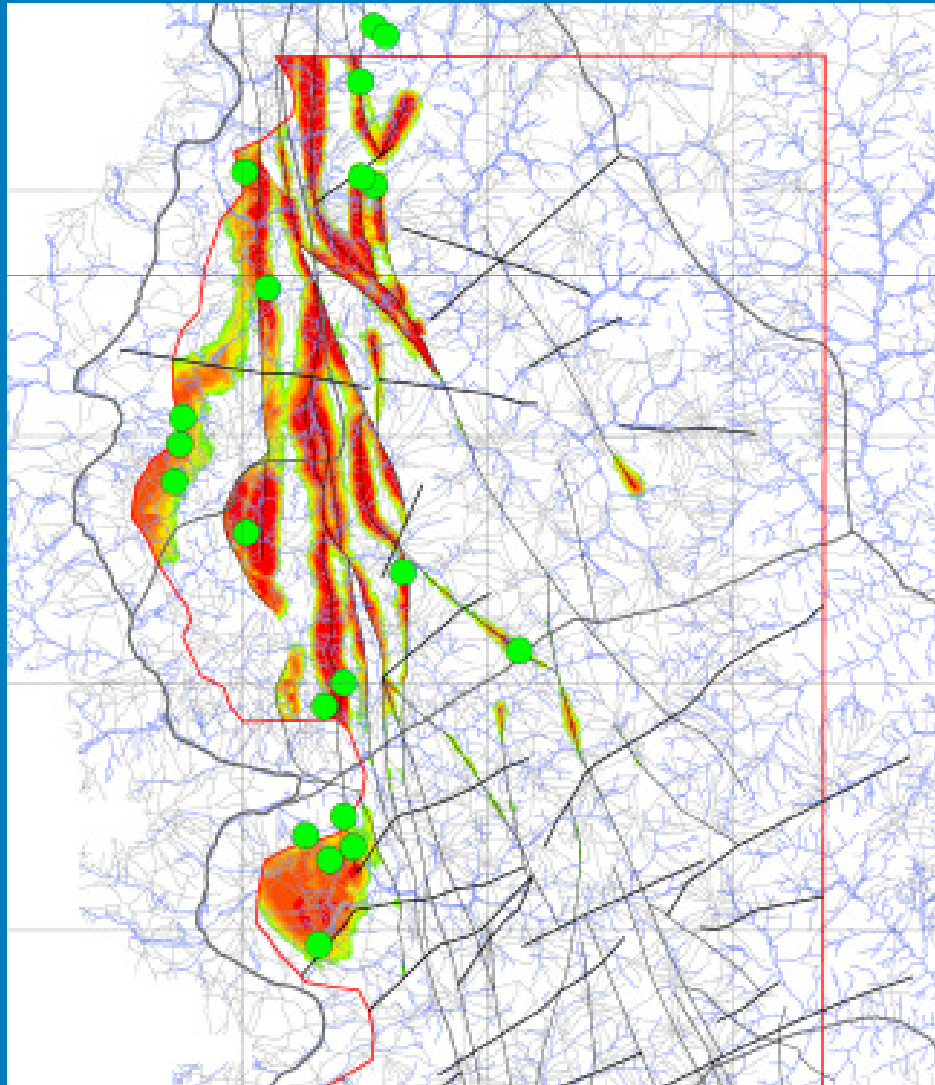
Euclidian distance to important rock contacts



Case Study: Mineral Deposits (Ghana)



Case Study: Mineral Deposits (Ghana)

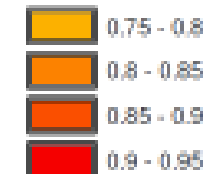
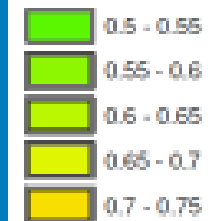


Known Gold Occurrences

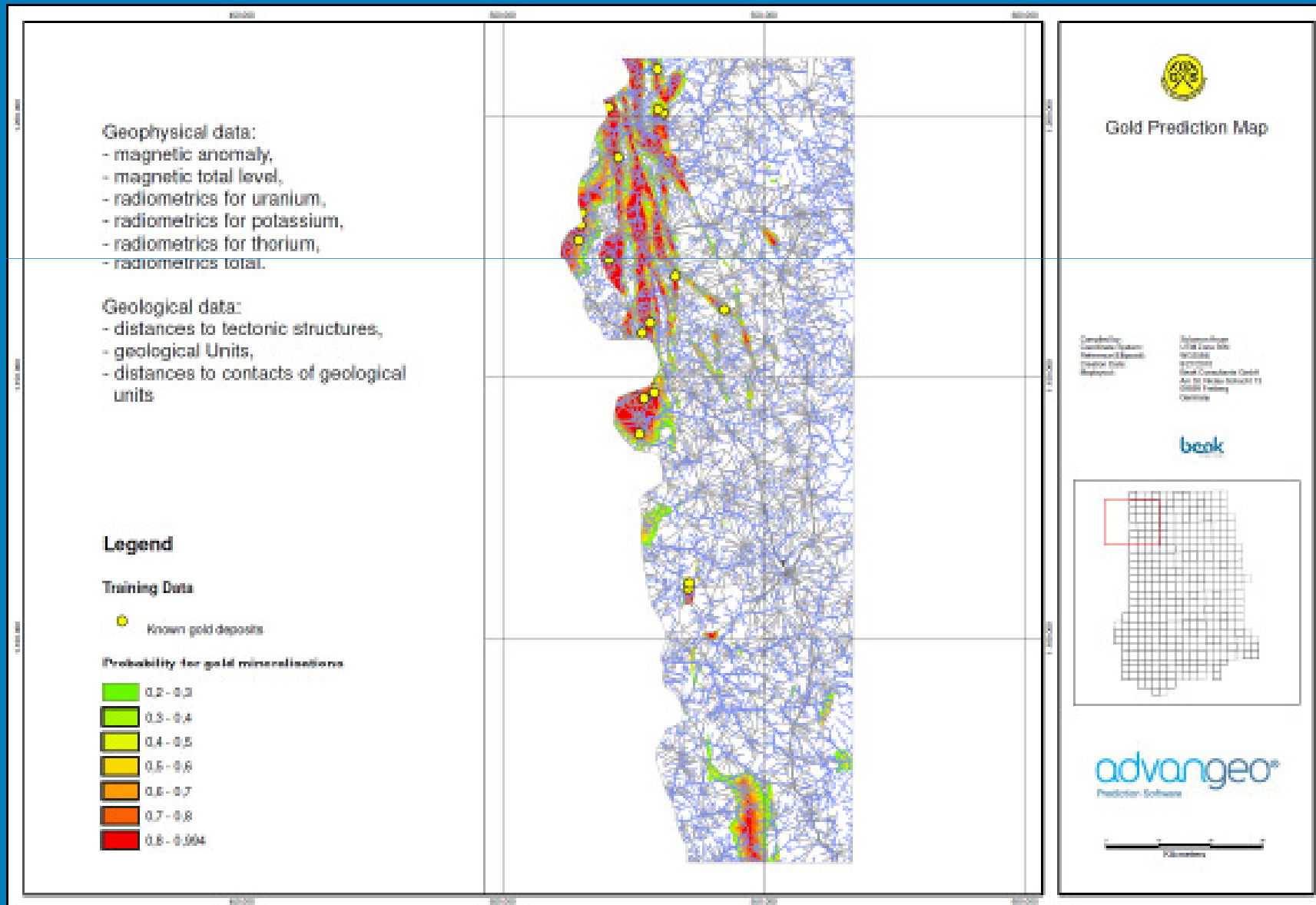


Area of Predictive Mapping

Probability for gold mineralisations



Case Study: Mineral Deposits (Ghana)



Summary / Outlook

- **AEGOS** provides infrastructure (access to data) to execute innovative projects based on existing / available geo-data
- Multiple possible fields of applications of the developed methodology using artificial neural networks and GIS with **advangeo®** in geosciences

www.aegos-project.org

www.advangeo.com

www.beak.de

