Information systems and mineral potential mapping – preconditions for mining sector development

Barth, A. Beak Consultants GmbH
Freiberg, Germany

We thank our colleagues and partners from:
Geological Survey of Tanzania, Tanzania
Geological Survey Department, Ghana
Geological Survey of Namibia
Minirena, Rwanda
Department of Geological Survey and Mines, Uganda
Independent Commission for Mines and Minerals, Kosovo
Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie

Mining on Top Africa 2017 Frankfurt, 06.-07.07.2017

Beak Consultants GmbH

- **Fields of business**
  - Geology, exploration, environment
  - GIS and cartography
  - Tailor-made software
- **High quality standards**:
  - ISO 9001:2008 certificate
- **25 years of company experience**:
  - Beak International Inc. founded 1965 in Canada
  - Beak Consultants GmbH founded 1994 in Freiberg/ Germany
  - North American operations acquired by Stantec Consulting Limited in 2003
  - German operations launched as an independent company, retaining the rights to the name Beak
- **Up to 35 years employee experience:**
  - Our roots are the former East German Geological Survey

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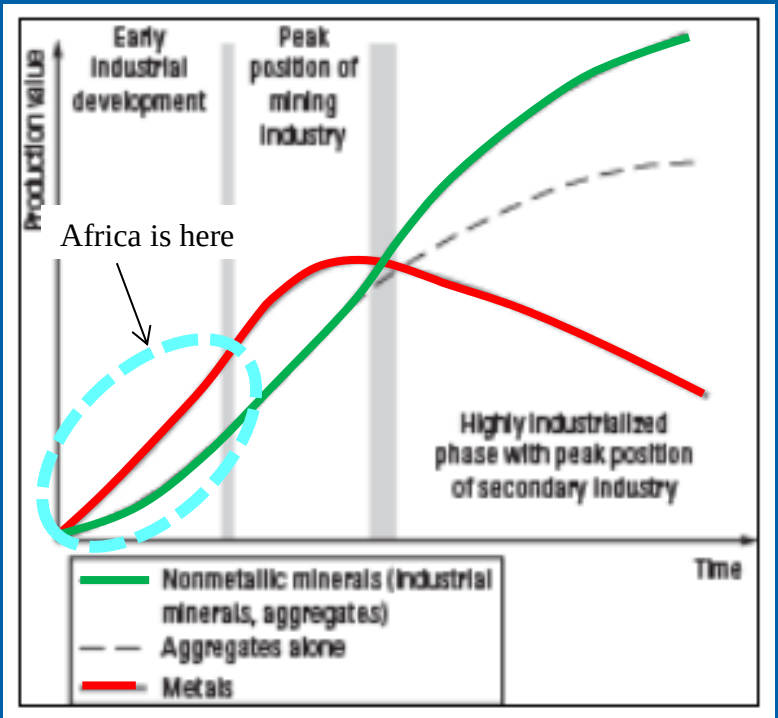
Agenda

- African Mining Sector specifics
- The mineral knowledge base
- The value of information
- How to make data available?
- Value adding products
- Conclusions

The African Mining Sector



After Wellmer & Decker-Platen, 2007

- Few big mines focussed on valueable minerals & their export (Au, metals, diamonds, ….)
- Large ASM sector, employing Millions of people
- Demand to fill the gap → medium size enterprises
- Growing demand for non-metallic materials
- Opportunities with new commodities (Li, Co, graphite …)

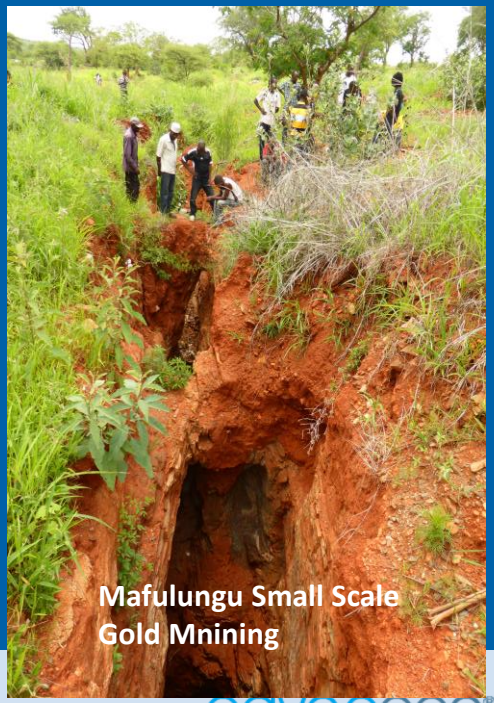
What do we have? Where is it?

Wher could be more?

Whom does it belong to? What restrictions exist?

Example: Tanzania

- Few large mines: Gold Bulyanhulu, Buzwagi, Geita, North Mara and New Luika, and the Mwadui Diamond Mine
- Few medium size mines: Phosphate Minjingu, Merelani Tanzanite One Mine, Coal Mines of Songwe-Kiriwa and Ngaka, Salt Brine workings of Uvinza
- Thousands of artisanal and small mines (ASM): gold, gemstones, …
- Vast potential



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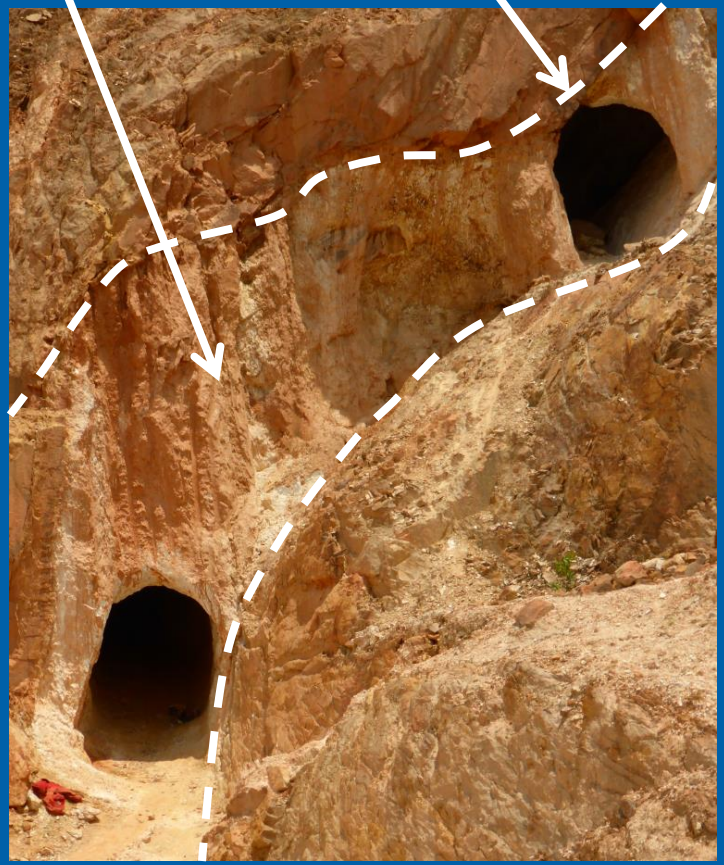
Example: Rwanda - High Losses in ASM Operations (Rwanda)

- High mining losses (70 % ?)
- High metallurgical losses (up to 900 ppm Ta in stream sediments)

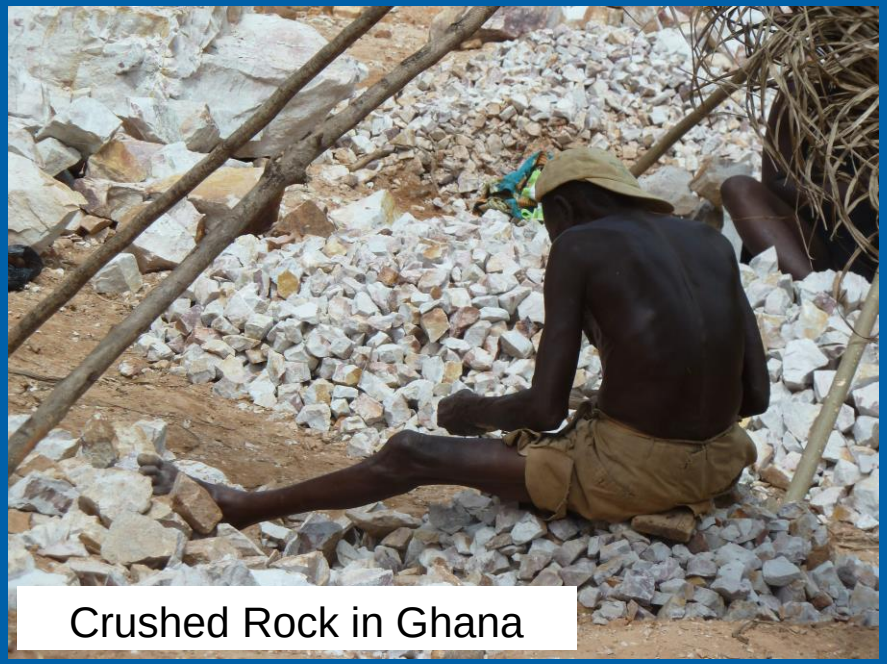
Pegmatite border

This is loss

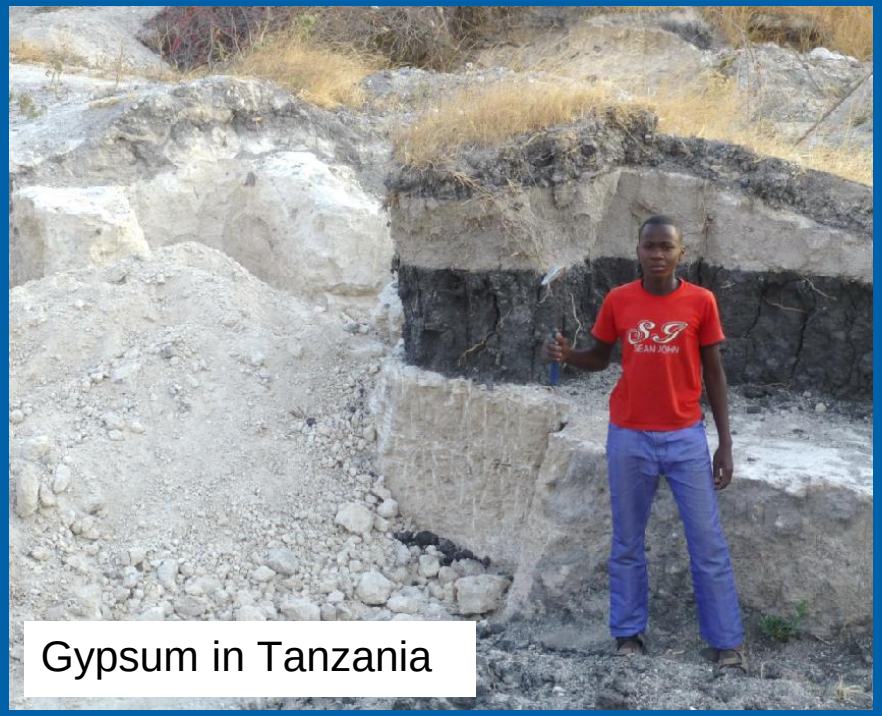


Example: Low Productivity Non-metallic Sector

- Much manual work
- No technology
- Low productivity
- Low quantities



Crushed Rock in Ghana



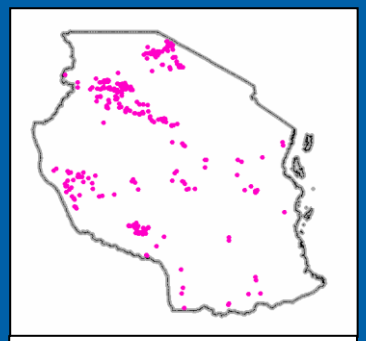
Gypsum in Tanzania

- Missing knowledge:
  - Locations ?
  - Quantity?
  - Quality ?

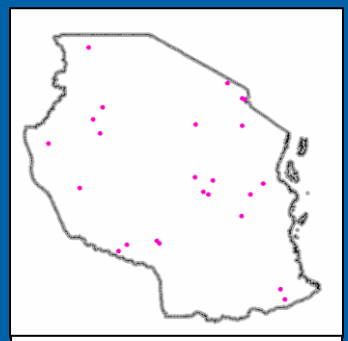
Problem: Missing Data

- **Considerable knowledge about profitable metallic minerals (Au, Cu, U, …) and diamonds**
- **Not much knowledge about other metals and non-metallic minerals**
- **Much of the systematic data is from Colonial times**

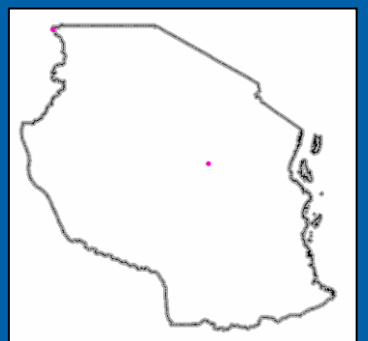
Knowledge base for mining sector diversification is weak.



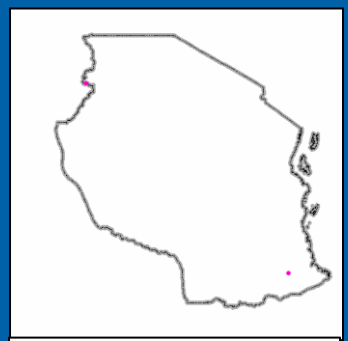
318 precious metals



24 decorative and dimension stones



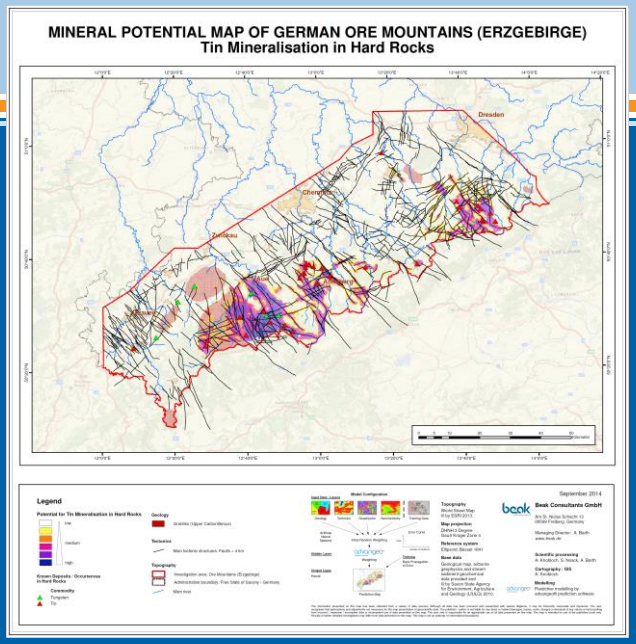
2 Lithium

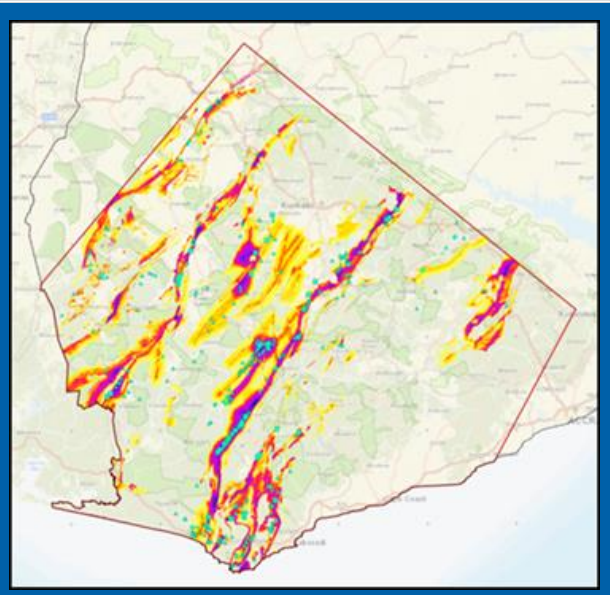


2 Cobalt

Where are the opportunities ?

- There is (some??) systematic knowledge about existing mines/ deposits
- Mineral potential maps are missing
- Guidance for medium industry?
- Guidance for small scale mining?





Value adding products is the solution

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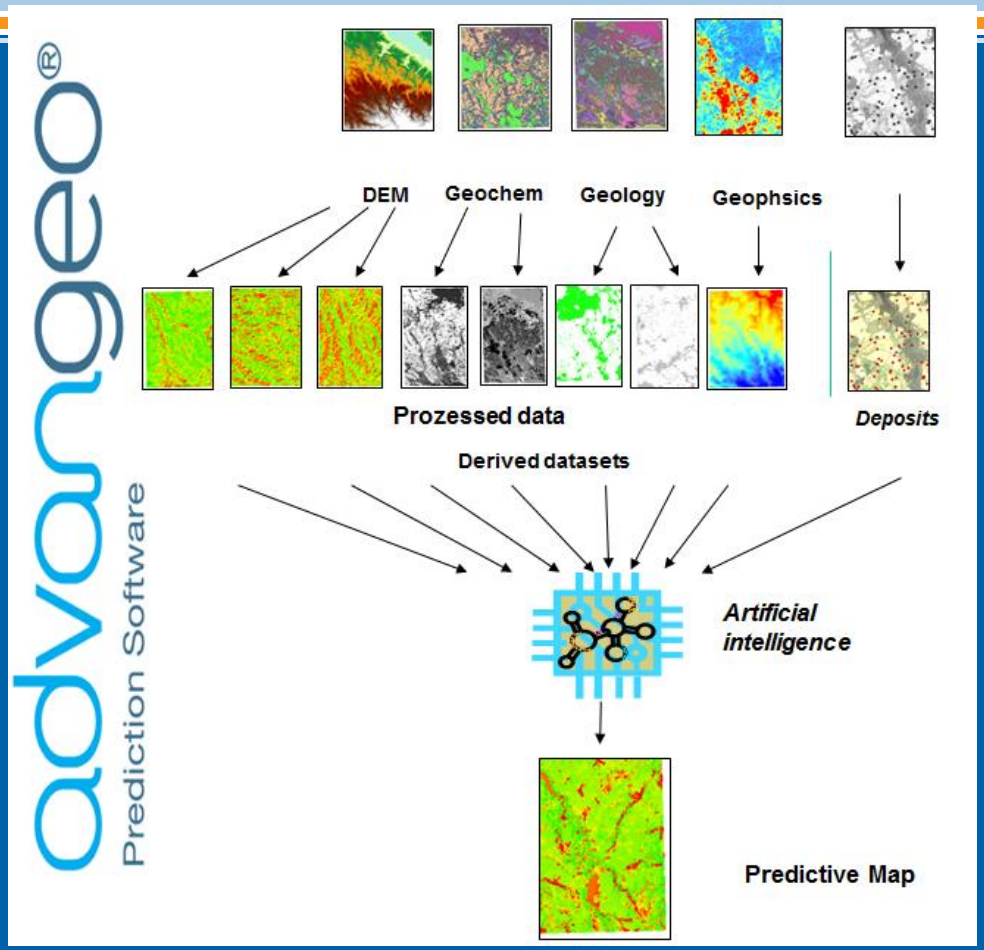
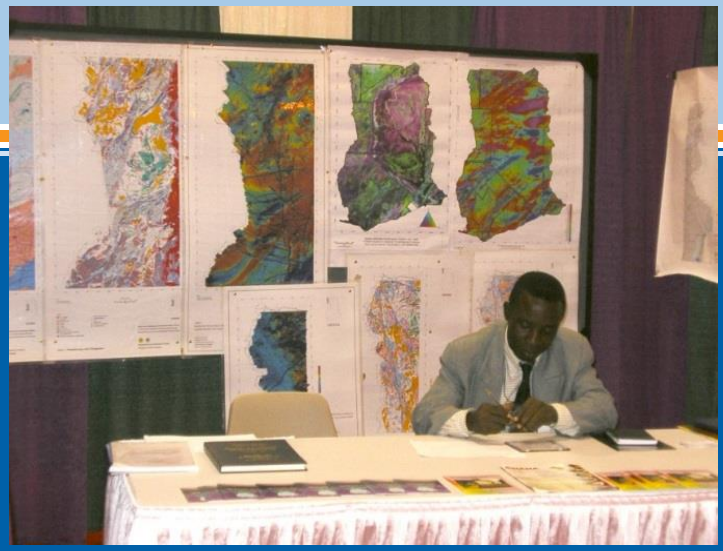
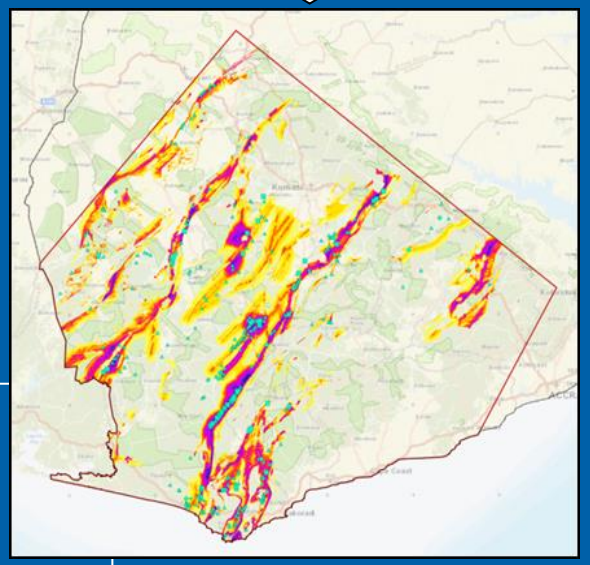
From data to opportunities







Available Data & Value Added Products:

Key Factors for Mining Sector Development

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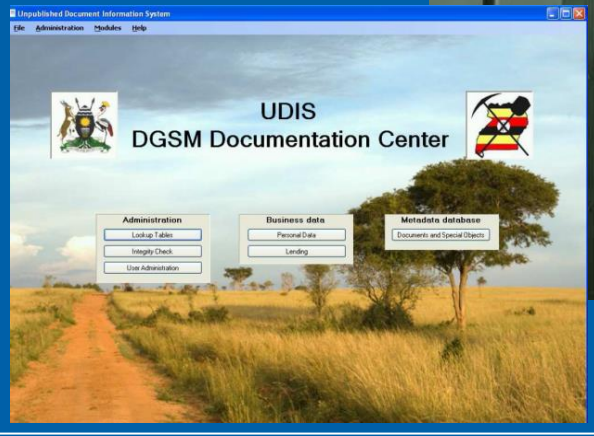
Example Uganda: Digitising the archives

- **Billions of Dollars** were spent for mineral resources and geological exploration
- **Data** is the key issue for:
  - mining sector development
  - land use and infrastructure planning
  - environmental protection
  - geo-hazard prevention
  - forestry, agriculture
  - water management
  - …
- Data availability is of top priority



Data is Money ? → Available Data is money !

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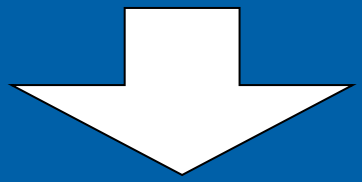
How to Make Data Available ?

- Have data „on stock“
- Centralise data management
- Standardize data structures and coding
- Have instruments for data distribution
- Regulations for data release/ usage

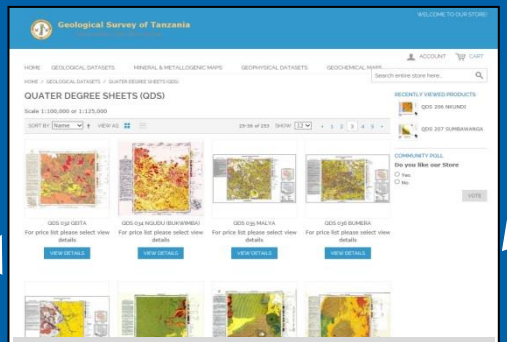
- Guarantee data security
- Prevent loss of data



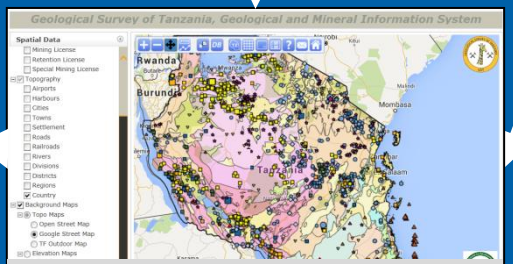
Information Management System (IMS)

Components of a Modern IMS

Institut. Website



Datashop



Data access web site

Full IMS

Public Domain

Internal System

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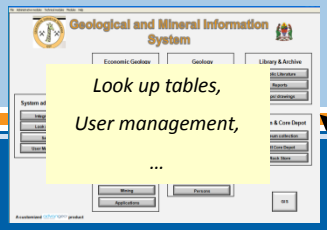
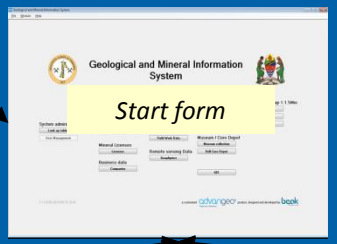
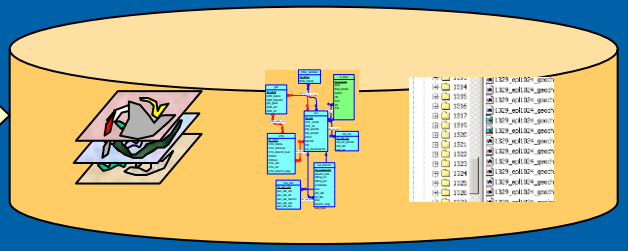
The Data Content



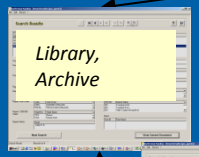
Database Management

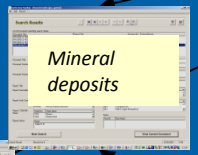
Meta data & files

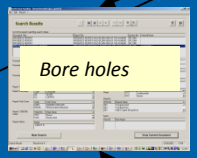


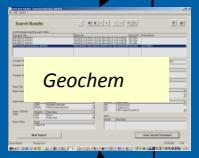


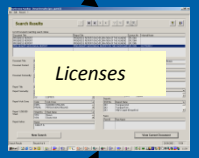
Real data

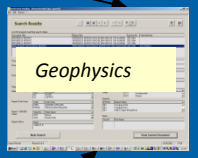


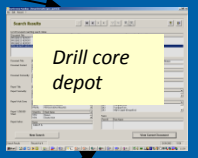


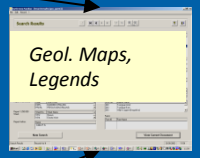


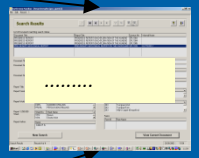


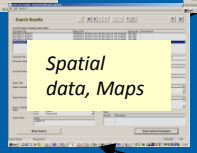




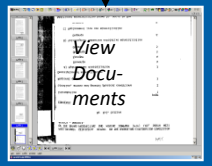


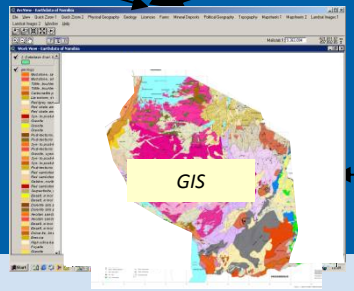


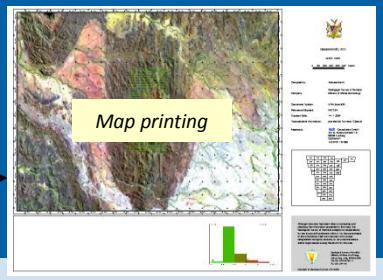




View Maps in GIS







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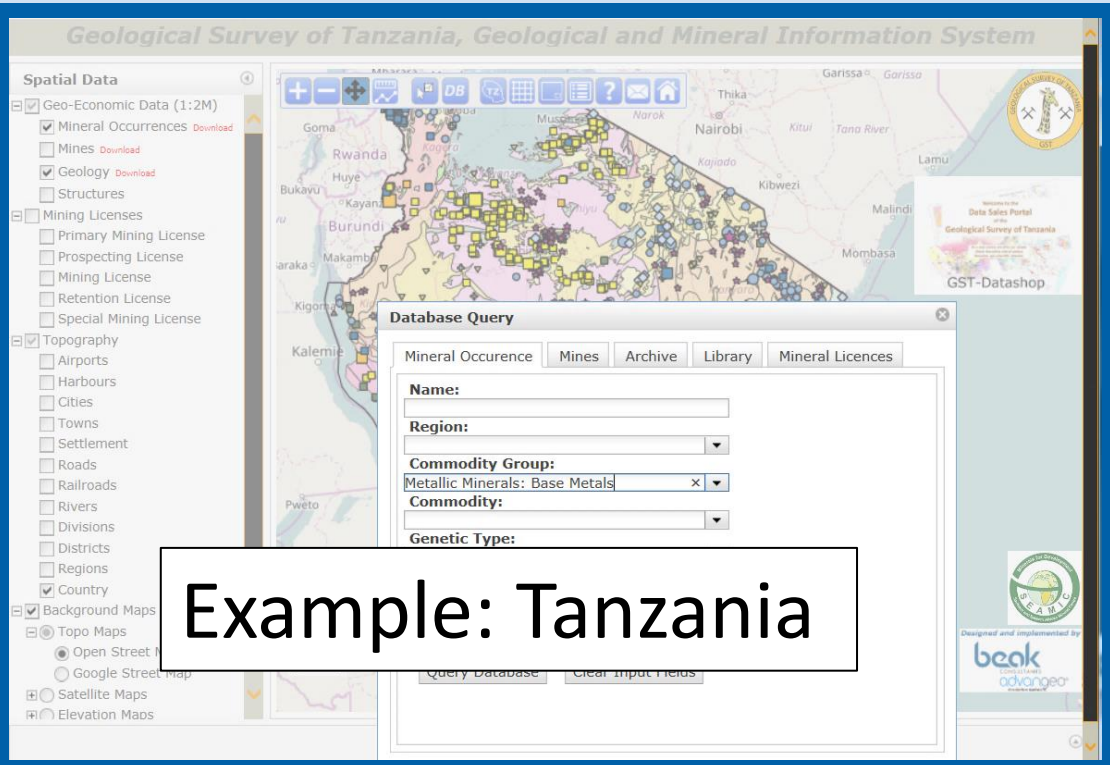
The Data Access Web Portal



- Access to GIS and database
- Geological and Cadastral data under one roof
- Free Download of low resolution data
- Link to Institution's web site and Data Shop

- www.gmis-tanzania.com
- www.earthdatanamibia.com
- www.kosovo-mining.org

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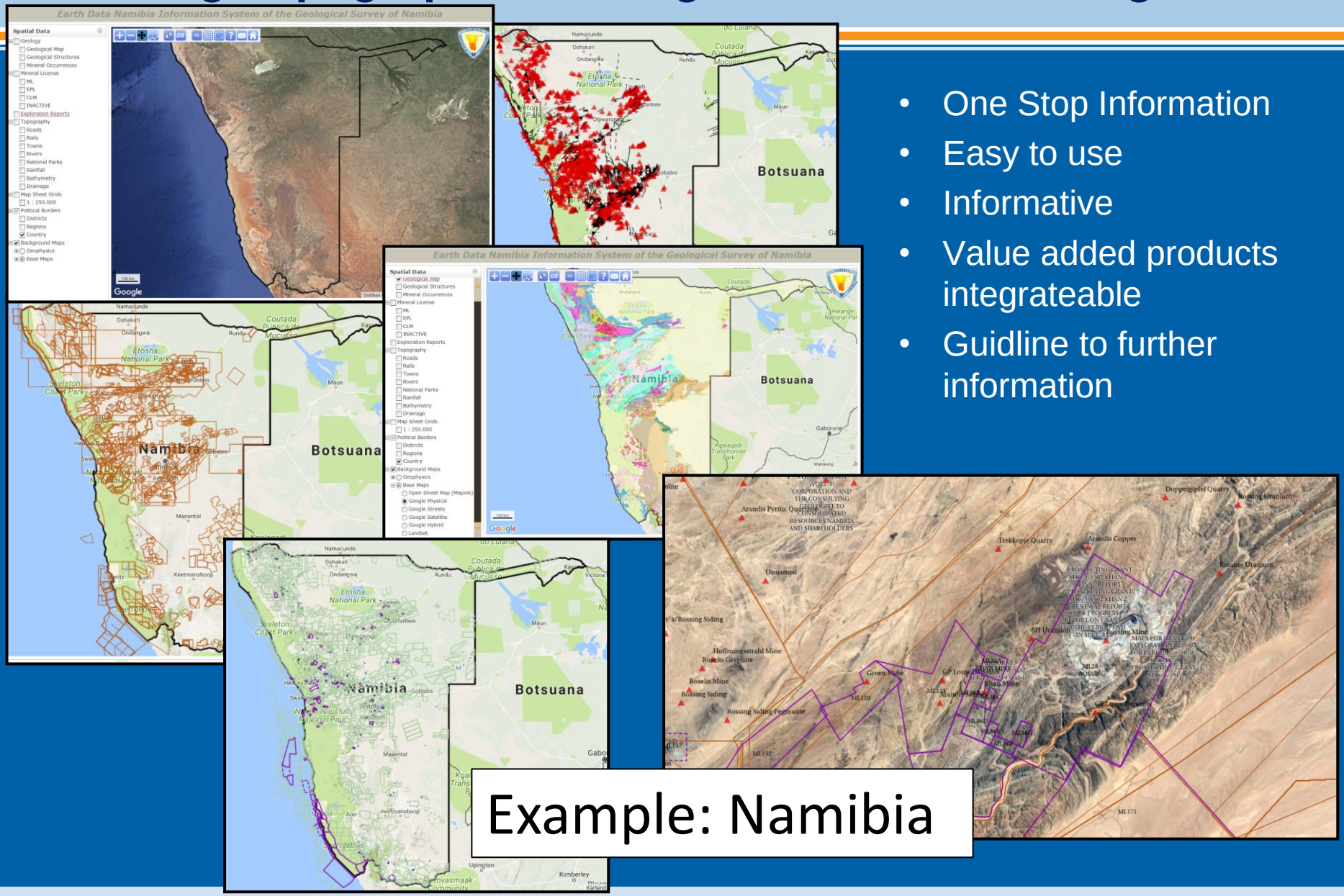
Linking Topographic, Geological, Mineral and Legal Data



- One Stop Information
- Easy to use
- Informative
- Value added products integrateable
- Guidline to further information

Example: Namibia

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The Internet tells us: Who is using our data?

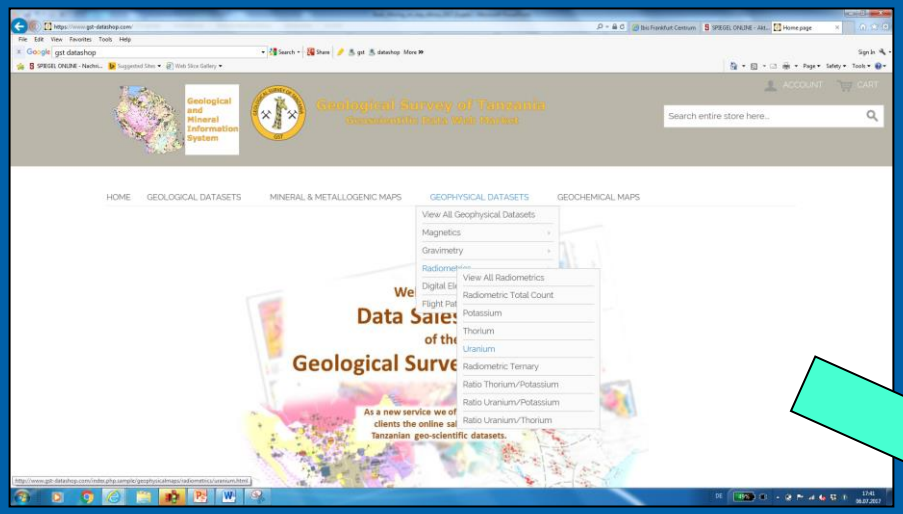
Location of users

Access histories reflect stakeholder response

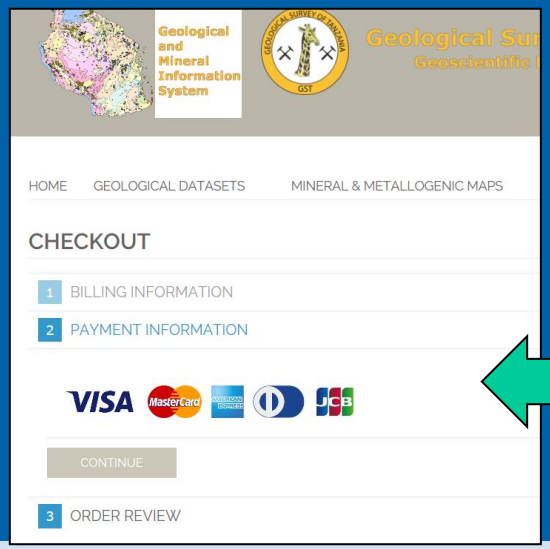
Number of users/ country/ time period

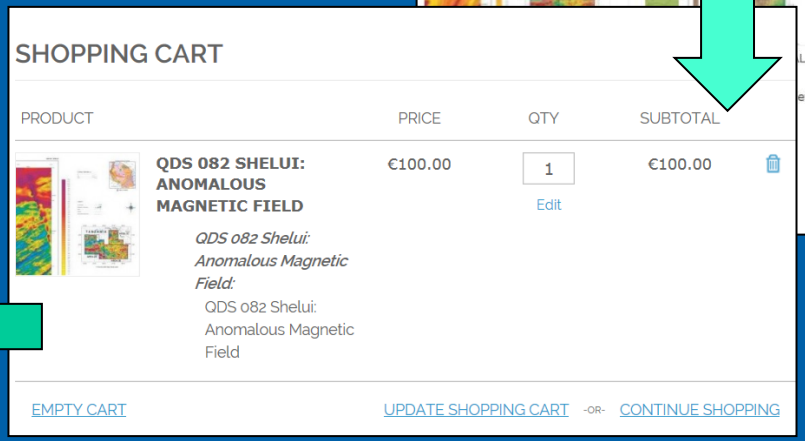
1.	Russia	4.442
3.	United States	1.667
4.	(not set)	1.107
5.	Germany	1.009
6.	United Kingdom	500
7.	India	329
8.	China	296
9.	Brazil	284
10.	Australia	212
11.	Japan	200
12.	South Africa	200
13.	Canada	160
14.	Italy	158
15.	Netherlands	152
16.	Kenya	140

The Data Shop



- Purchase of data with common Credit Cards
- 24/7 availability
- Reliable, affordable and quick
- Data comes via e-mail





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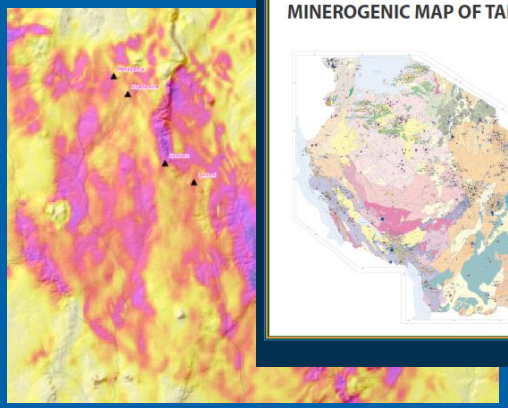
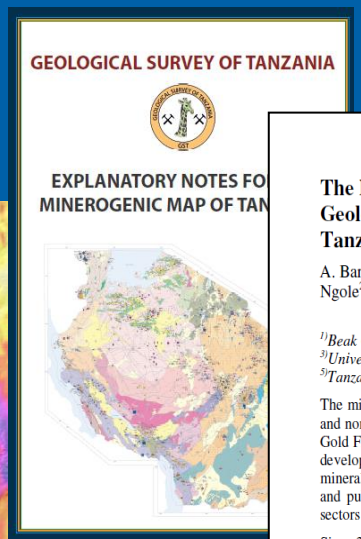
About Value Added Products

- Evaluations
- Compilations
- Recommendations
- Guidelines/ Laws

- Metallogenic Map
- Mineral Potential Maps
- Mineral Occurrence Passports
- Investment Opportunities
- Governmental Maps
- And much more …





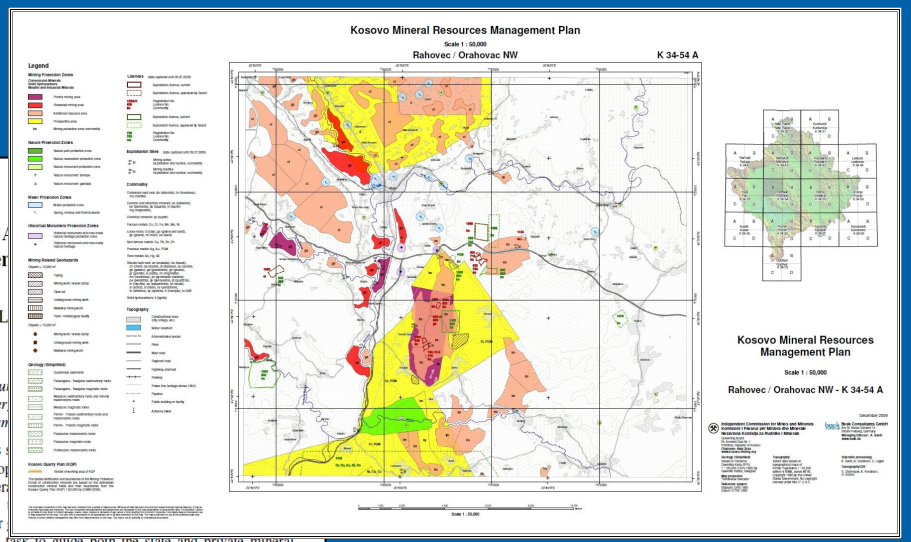
The New Minerogenic Map of Tanzania –
Geological and Mineral Information Syste
Tanzania

A. Barth[1], N. Boniface[3], M. Kagya[5], A. Knobloch[1], C. L
Ngole[2], K. Stanek[4], T. Stephan[1]

[1]Beak Consultants GmbH, Freiberg, Germany, [2]Geological Su
[3]University of Dar es Salam, Dar es Salam, Tanzania, [4]TU Ber
[5]Tanzania Petroleum Development Corporation, Dar es Salaam

The mineral wealth of Tanzania comprises of many valuables
and non-metallic minerals. Especially since the massive develop
Gold Field, starting in the late 1990s, the potential of the miner
development of the country became obvious. Consequently,
mineral sector as one of the key factors to contribute to further
and publication of mineral and geological data is a strategic task to guide both the state and private mineral
sectors to new discoveries, enhance investment and support national planning activities.

Since 2013, the Geological Survey of Tanzania (GST) and Beak Consultants GmbH are implementing a modern Geological and Mineral Information System (GMIS). The system is designed to host and manage the principle geo-scientific information about the territory of Tanzania, such as geo-scientific maps, mineral occurrence



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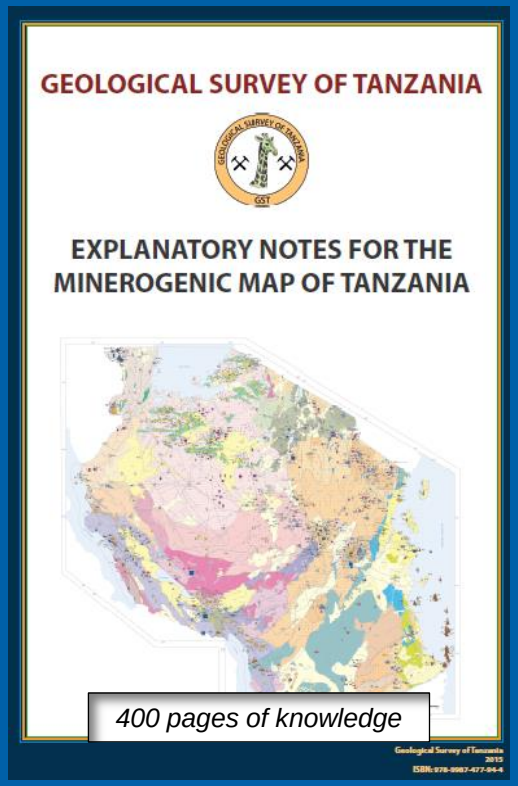
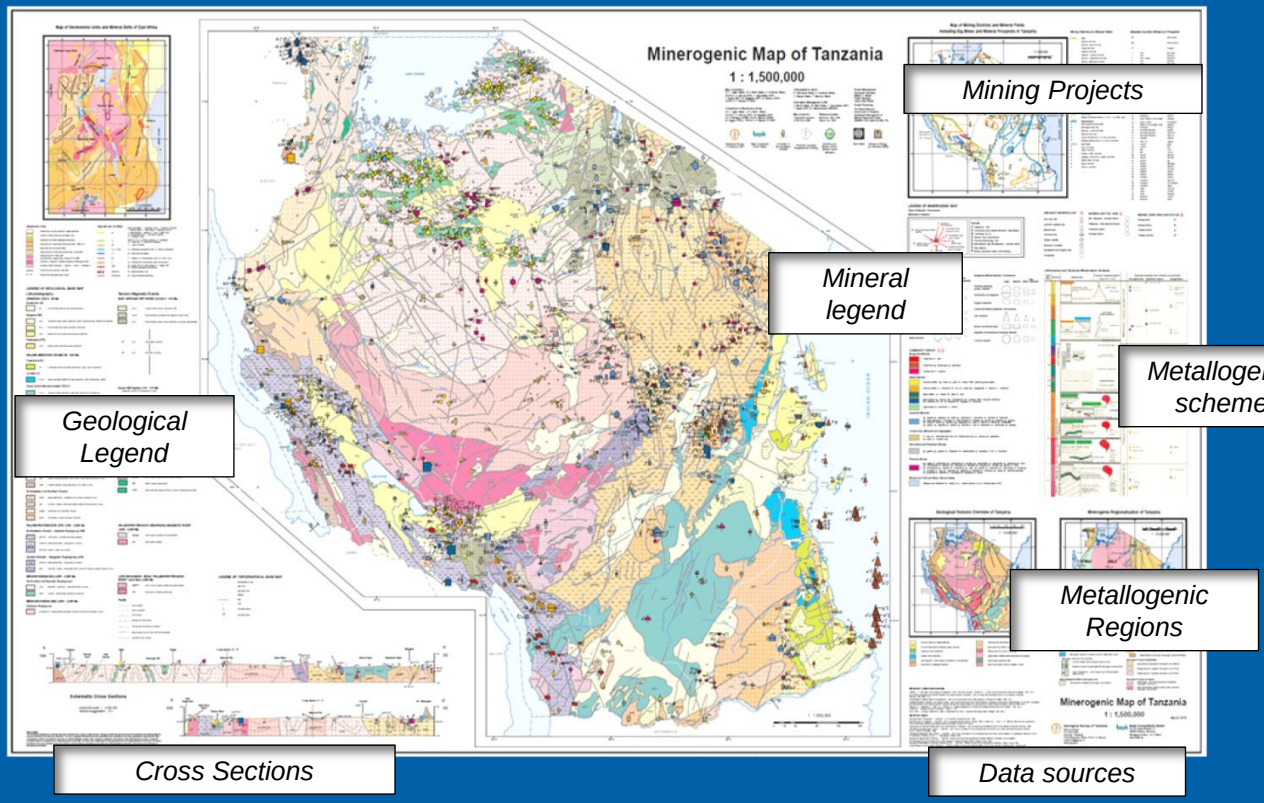
Example: Minerogenic Map of Tanzania





Summary of geology and tectonics, descriptions of 1100 mineral occurrences, metallogenic considerations and conclusions

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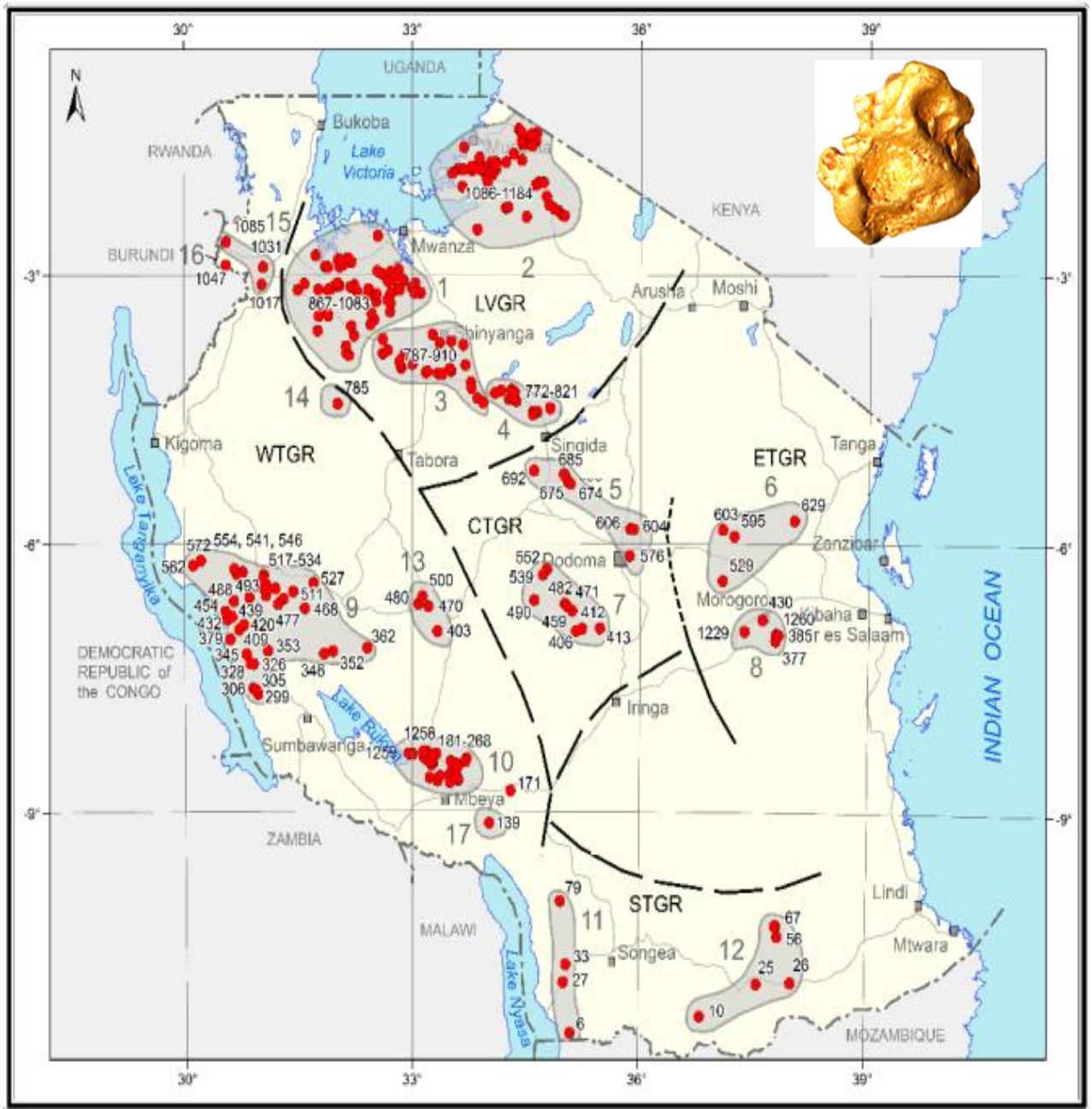
Mineral Potential of Tanzania: Gold



Big Mines:

- Geita
- Buzwagi
- Bulyanhulu
- North Mara
- New Luika

Thousands of small scale operations

The potential is exceptional

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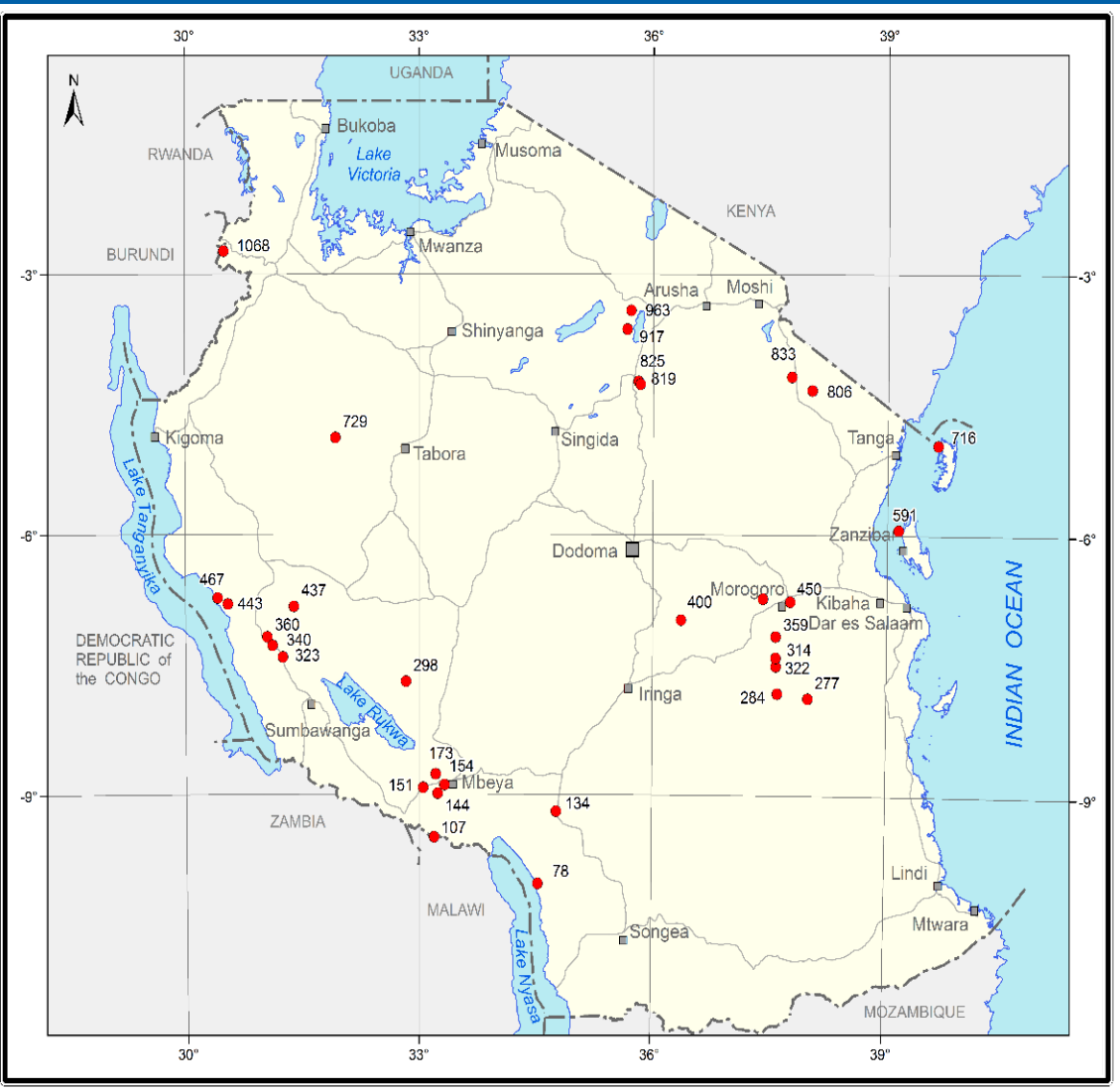
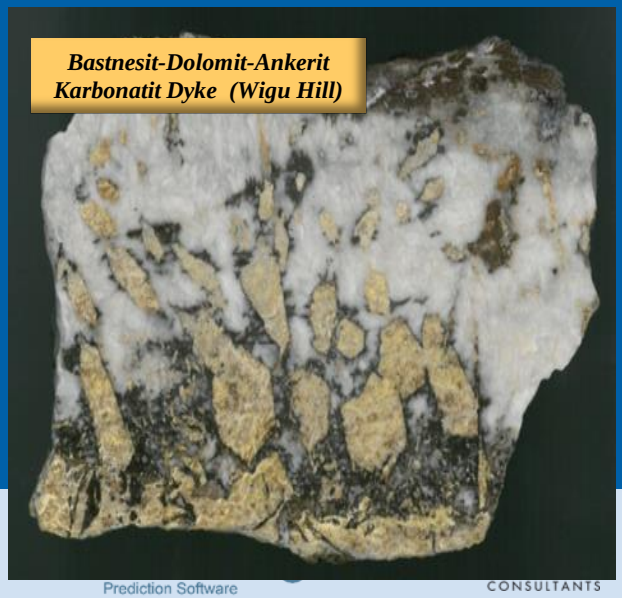
Mineral Potential of Tanzania: Rare Earth Elements

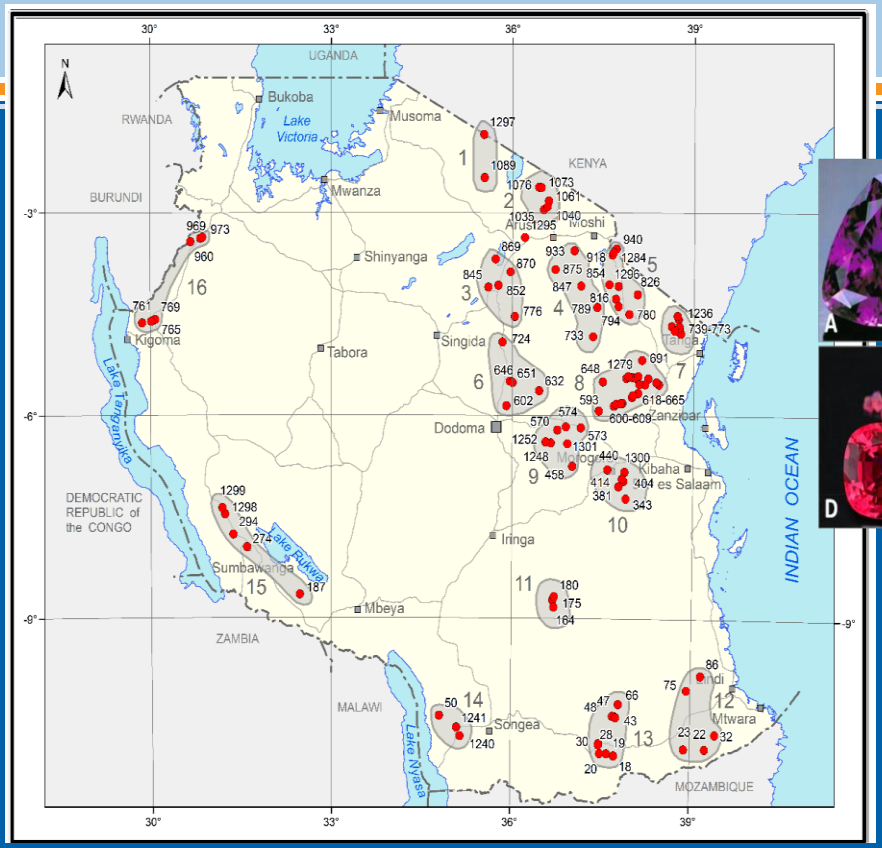


- Located in Carbonatites
- Often together with Apatite, Fluorite and Nb
- Bound to rift structures of different ages
- Considerable ressources, e.g.
- 42 Mt @ 4.19 % REE (Ngualla),
- Very high grade, up to 20 % REE (Wigu Hill).

- Vast potential



Mineral Potential of Tanzania: Coloured Gemstones



- High quality stones (Tanzanite, Ruby, Garnet, Sapphire, Amethyst, Emerald, Aquamarin, Beryll, Spinel, Tourmalin…)
- In Mozambique Belt metamorphics
- Exclusively small scale mining

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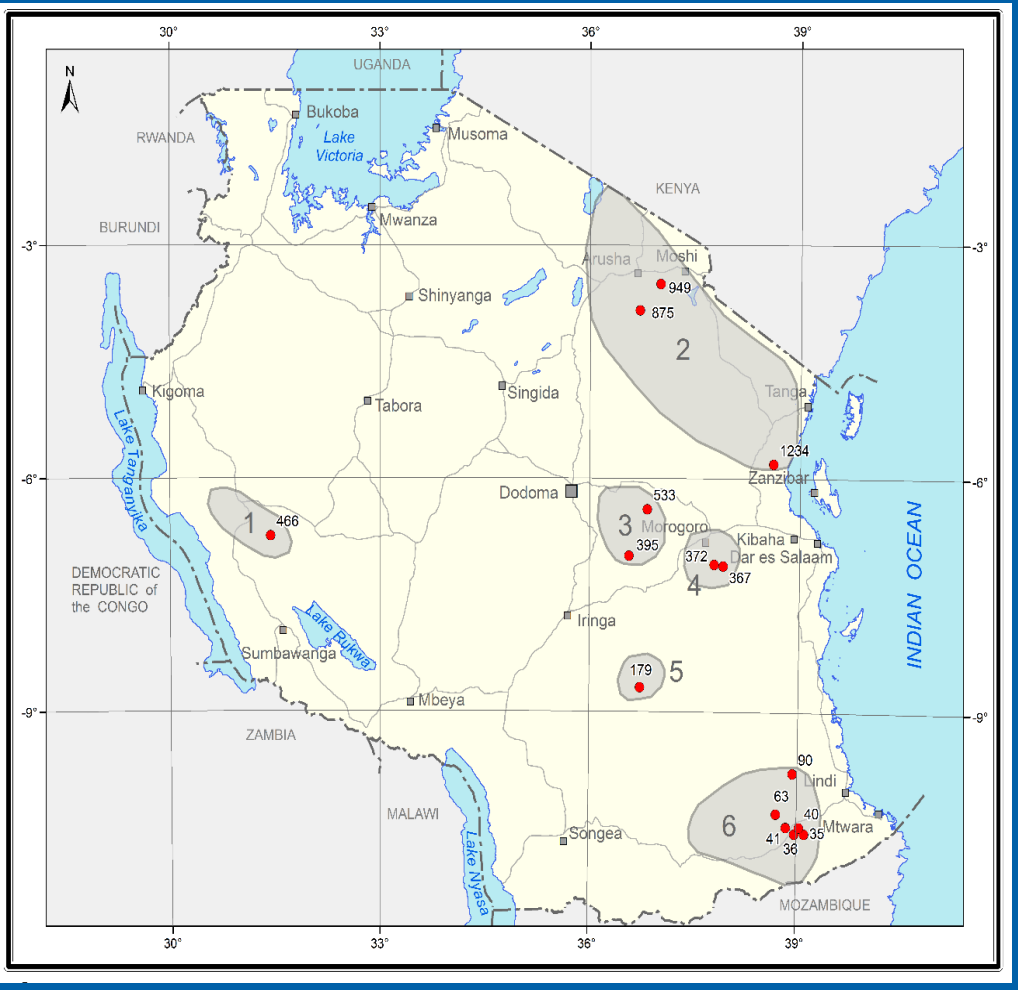
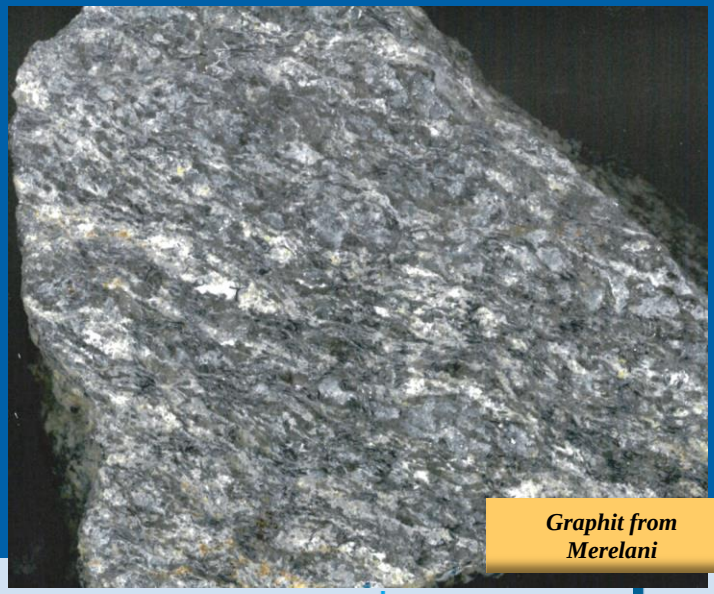
Mineral Potential of Tanzania: Graphite



- Mainly in Granulite-Gneis-rocks
- World class deposits:
- Merelani-Arusha: 7,6 Mt ore @ 11,2 % graphite, proven reserves,
- Epanko with “large flake graphite“, 14,9 Mt ore @ 10.5 % graphite
- In exploration: Mahenge, Nachingwea
- Current development: Kibarran ressources



Graphit from Merelani

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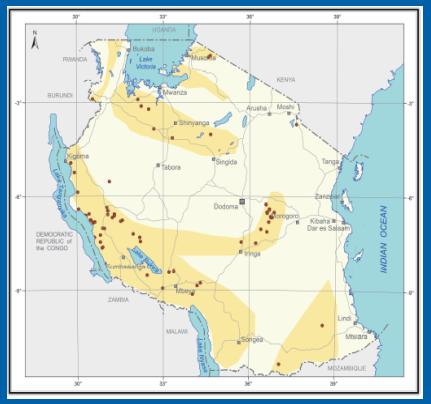
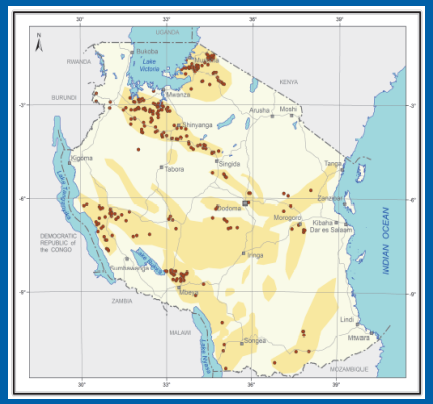
Mineral Maps for Mining Sector Development

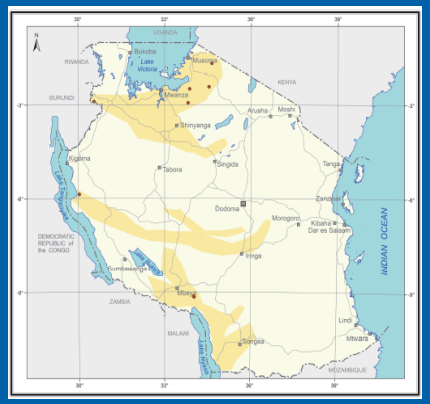
Copper



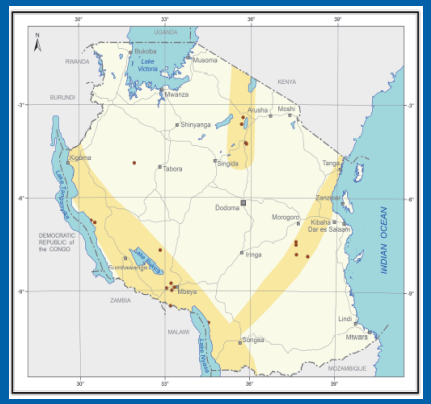
Gold



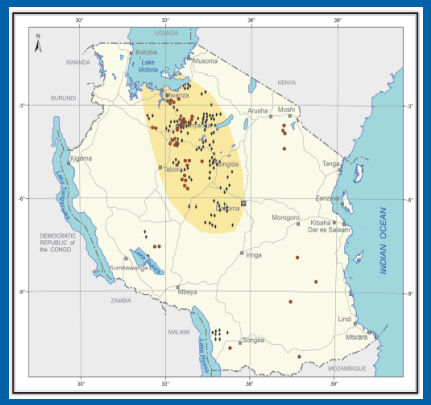
PGM



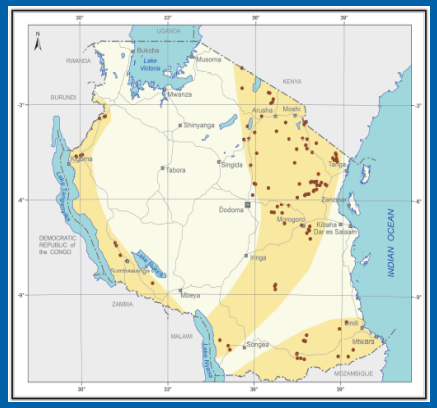
REE



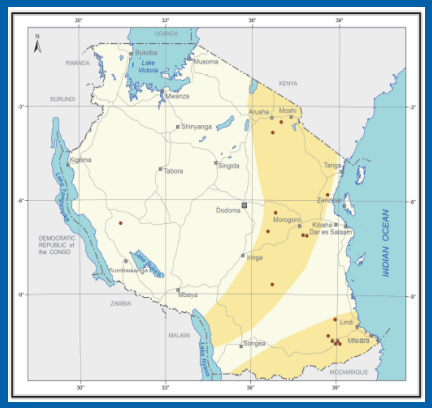
Diamond



Gemstones



Graphite



Kaolin

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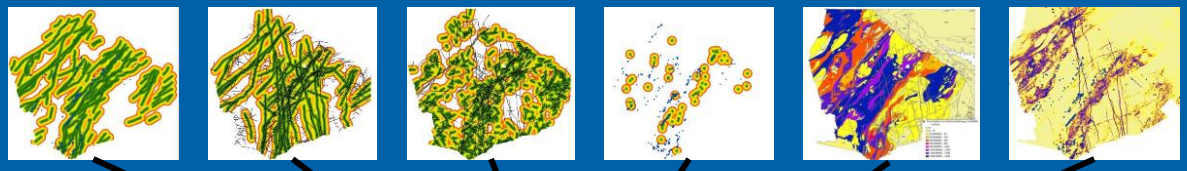
Artifitial Intelligence helps with Data Processing



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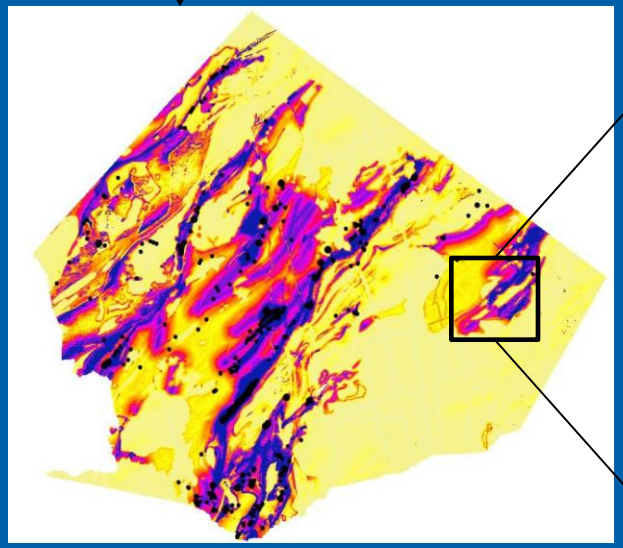
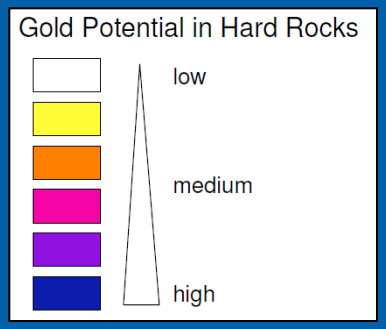
Input Data

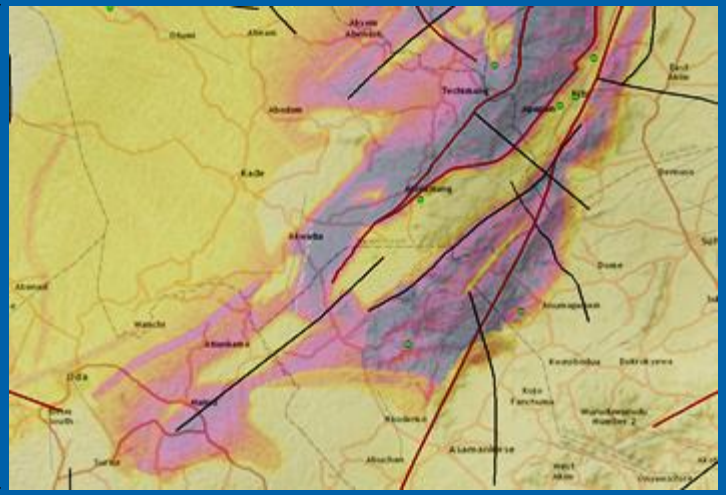
- Large faults
- Striking direction
- Junctions
- Small faults
- Geology
- Airborne magnetics

Gold Potential Map of SW-Ghana





Detail Map: Kibi Belt Area



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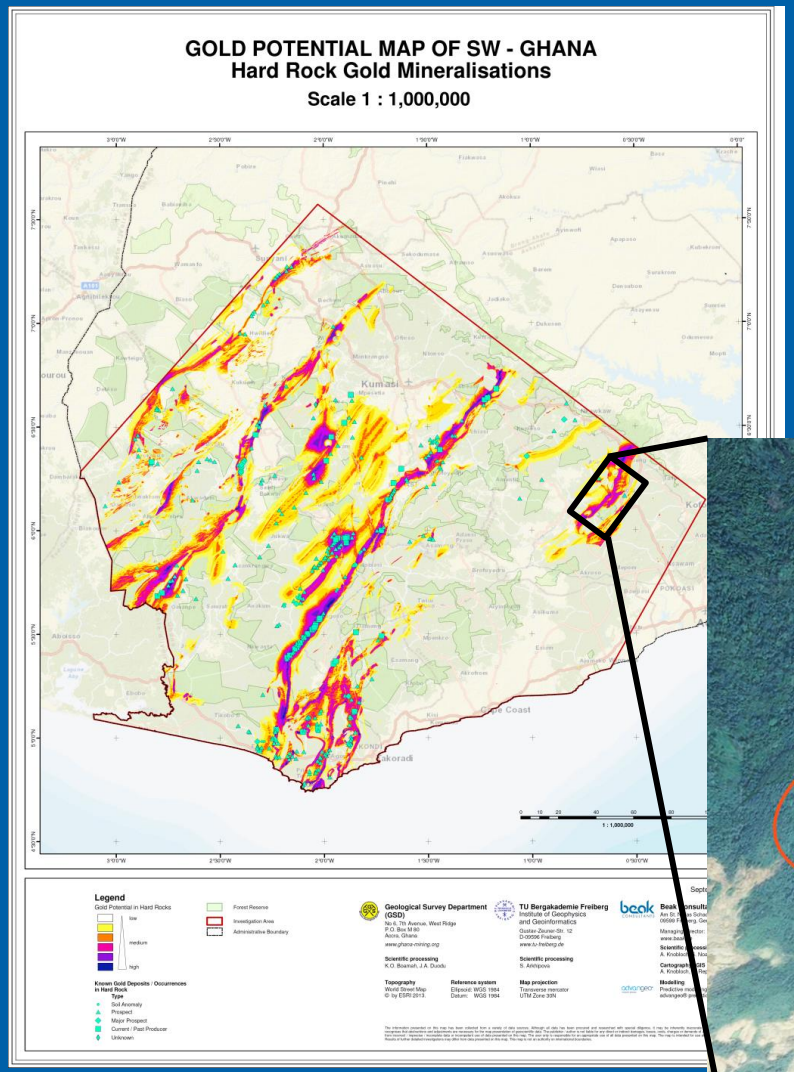
Example: High Resolution Mineral Potential Map



- Exploration targeting
- Protect undiscovered resources
- Land use planning:
  - Housing, Infrastructure
  - Water
  - Agriculture

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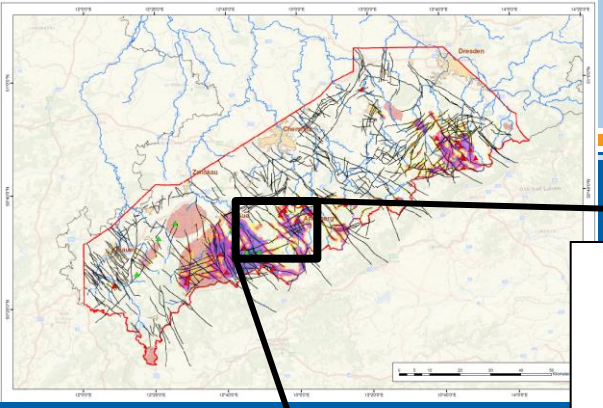
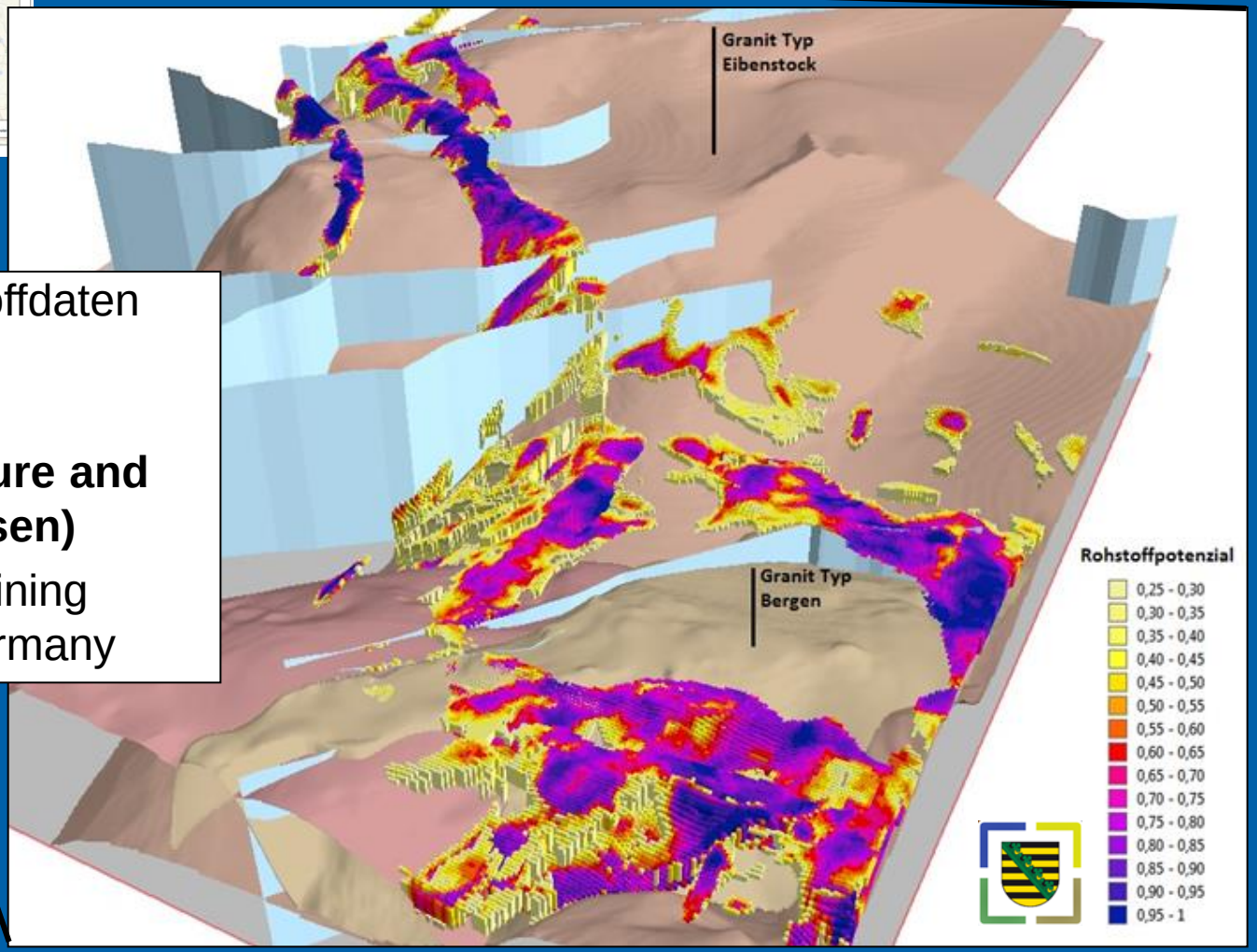
Example: 3D Mineral Potential Models



Project **ROHSA** (Rohstoffdaten Sachsen)

Saxon State Office for Environment, Agriculture and Geology (LfULG Sachsen)

Aim: Rehabilitation of Mining Activities in Saxony/ Germany



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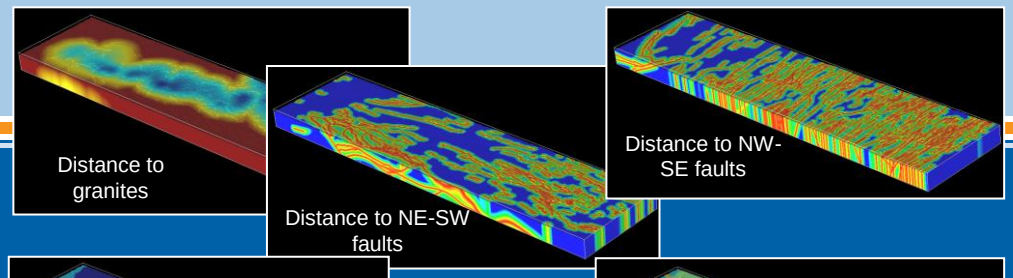
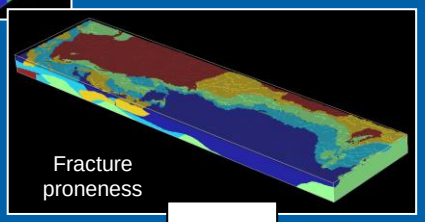
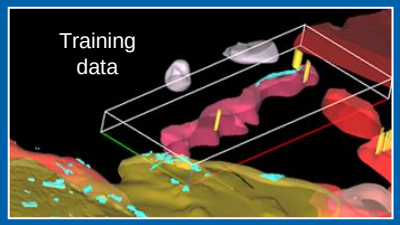
Sn potential above concealed intrusives



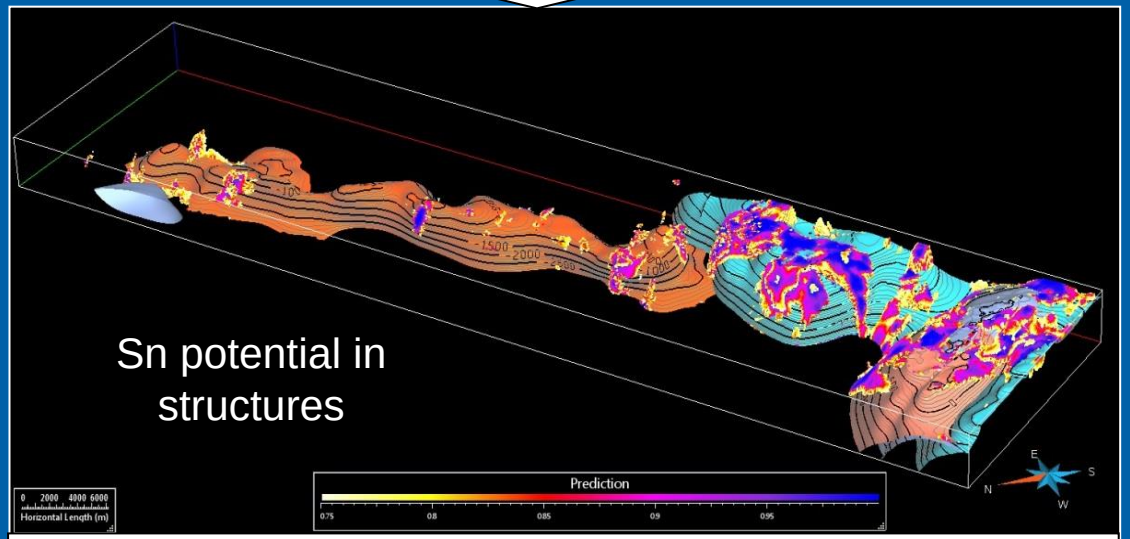




3D advangeo® Prediction Software

Consideration of real 3D properties derived from the geological model.

Sn skarn and Sn vein potential modelled by using ANN.



Base Data provided by Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie

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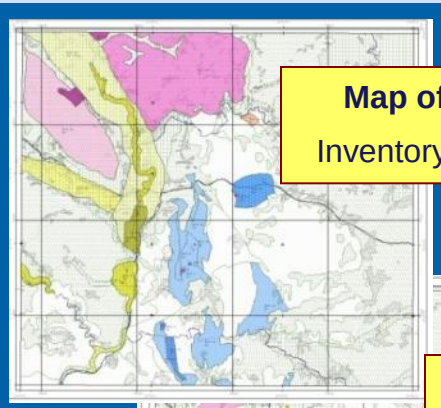
Example: Governmental Maps - Identification of Mineable Resources

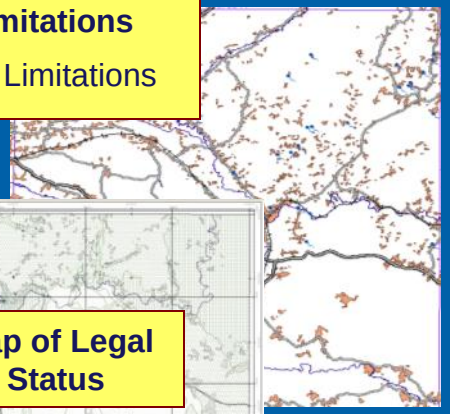


Map of Minerals

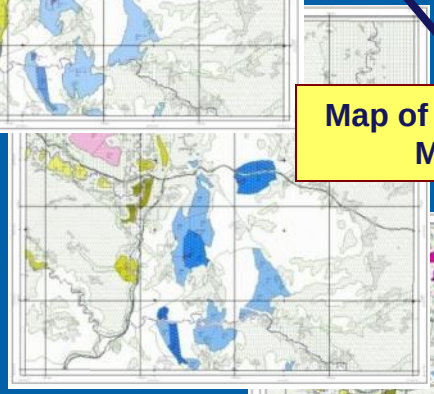
Inventory of Minerals

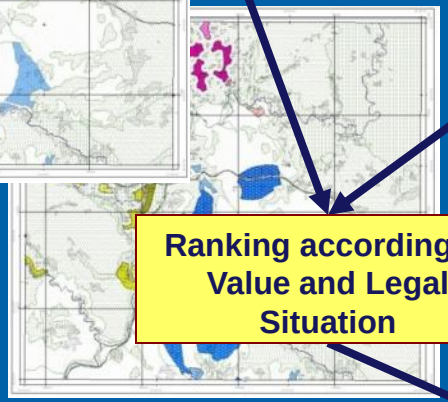
Map of Limitations

Inventory of Limitations

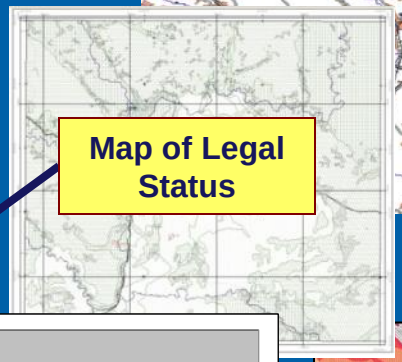


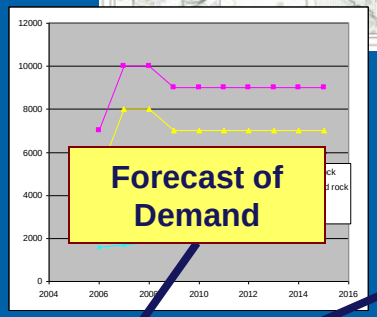
Map of Non-Blocked Minerals



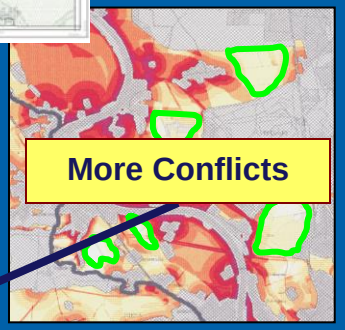


Map of Legal Status



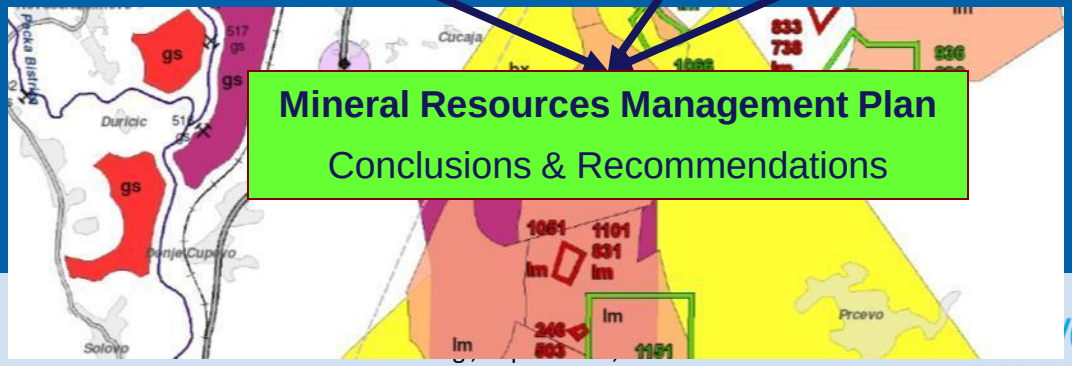


Forecast of Demand



More Conflicts

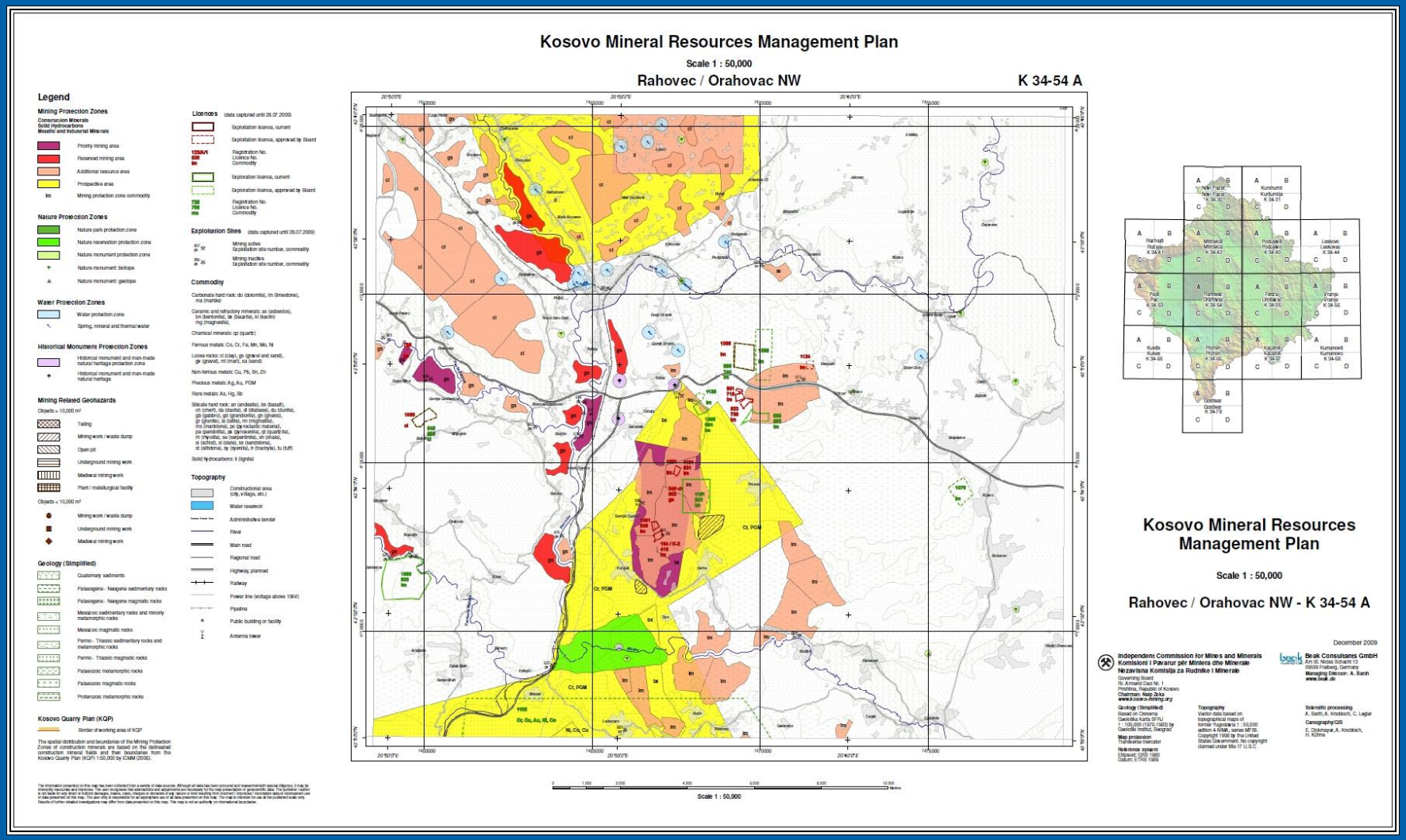
Ranking according to Value and Legal Situation



Mineral Resources Management Plan

Conclusions & Recommendations

Governmental Maps guide Exploration and Exploitation



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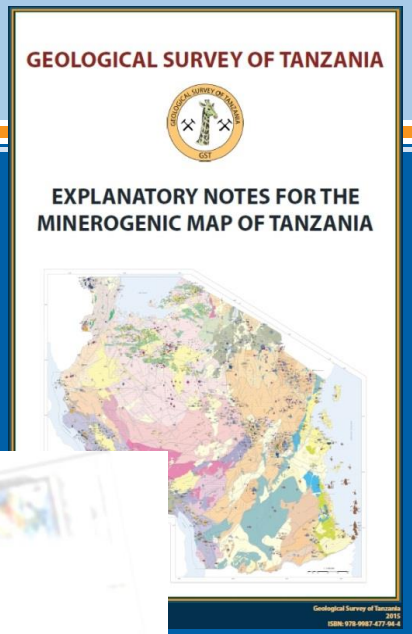
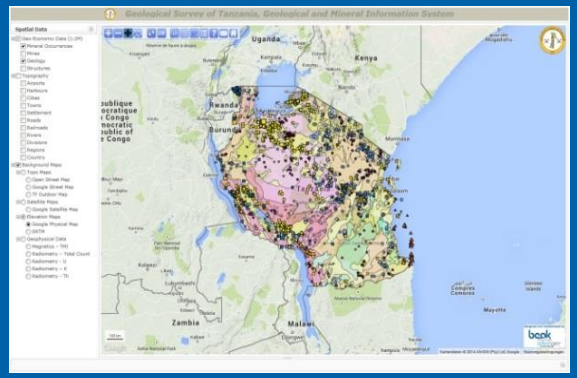
Conclusions

- Mining Sector development & investment attraction need a knowledge base
- IMS are living systems
- IMS are a national task
- Data availablity is the key
- Value added products help with decision making & investment attraction
- Governmental maps shall guide mining sector development





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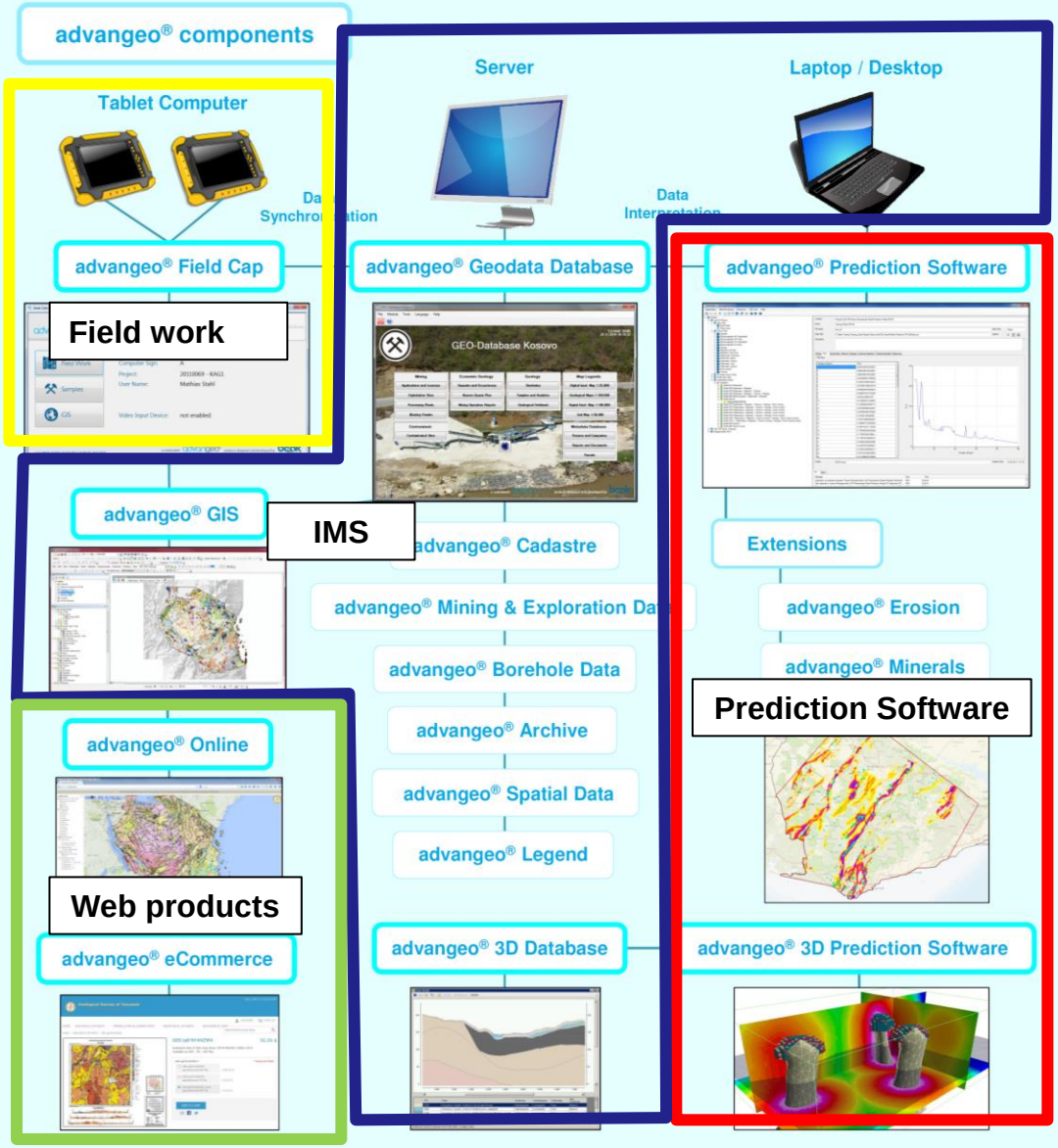
Software Products

- Geo-data Management & Cadastre
- Archive Data
- GIS
- Field Cap
- Internet Portals
- Prediction Software



Thank You !

We thank our colleagues and partners from:

Geological Survey of Tanzania
Ghana Geological Survey
Geological Survey of Namibia
Minirena, Rwanda
Department of Geological Survey and Mines, Uganda
Independent Commission for Mines and Minerals, Kosovo
Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie

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