

What exploration companies and investors are looking for when entering a new market

Antony Benham
Chief Operations Officer
IGS (International Geoscience Services) Ltd

abenham@igsint.com

www.igsint.com

Structure

- Introduction to IGS
- Global exploration trends
- What is important to exploration companies?
- Geodata and its value
- Case studies
- Adding value to data
- Prospectivity modelling
- Summary

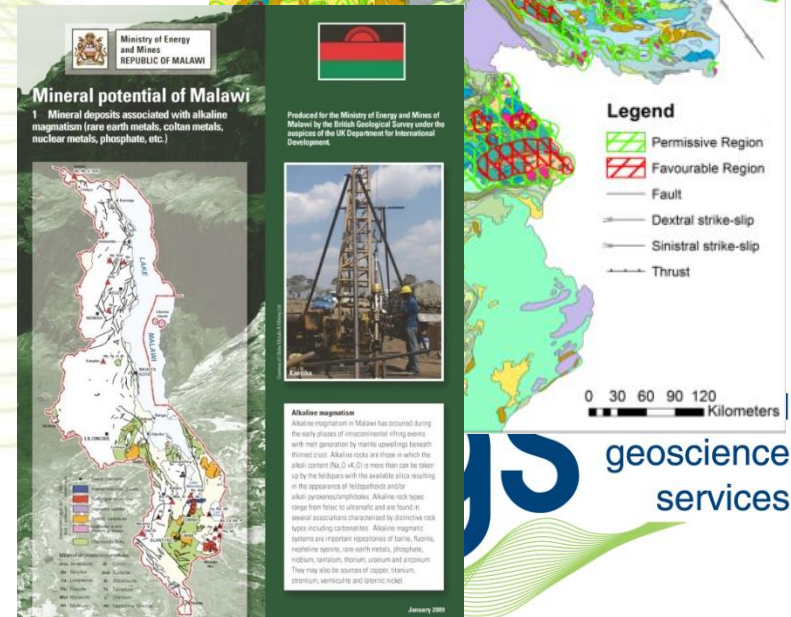
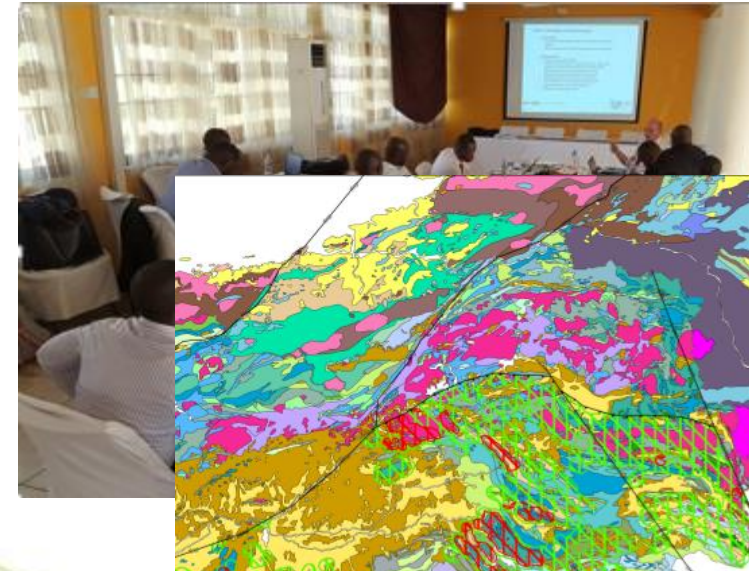
International Geoscience Services (IGS)

- IGS Ltd – Private, commercial “spin-out” from the British Geological Survey (BGS) built with staff with extensive overseas experience from the BGS, other Geological Surveys and industry
- Highly specialised – mineral exploration focussed esp. involving geodata, capacity building and institutional reform
- Involved in large-scale projects funded by aid agencies (World Bank, DFID) or National Governments
- Current/recent projects in Afghanistan, India, Kenya, Cameroon, DR Congo, Lao, Burkina Faso...to name just a few

IGS experience

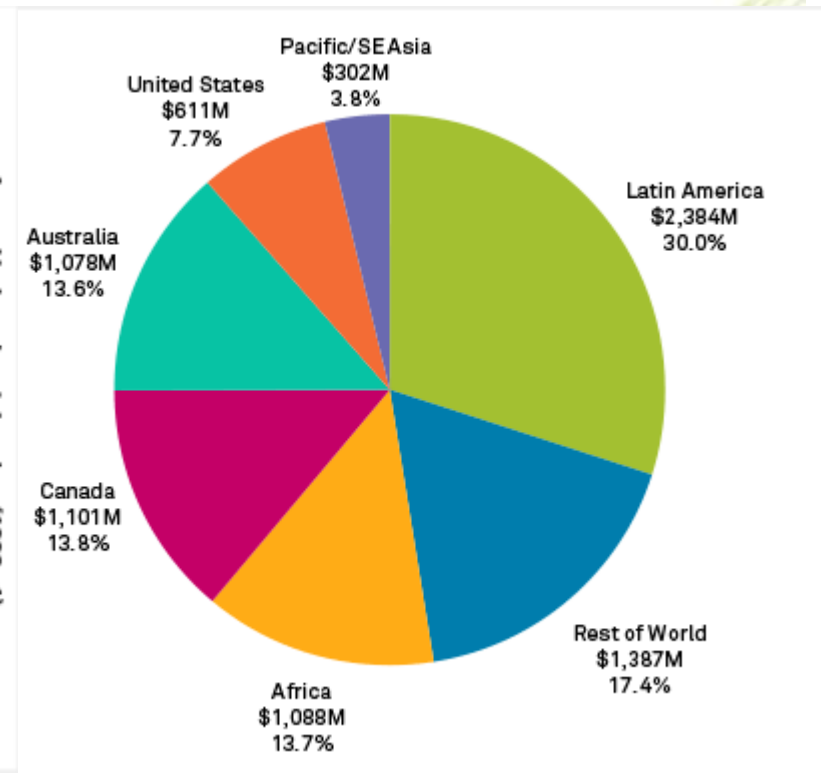
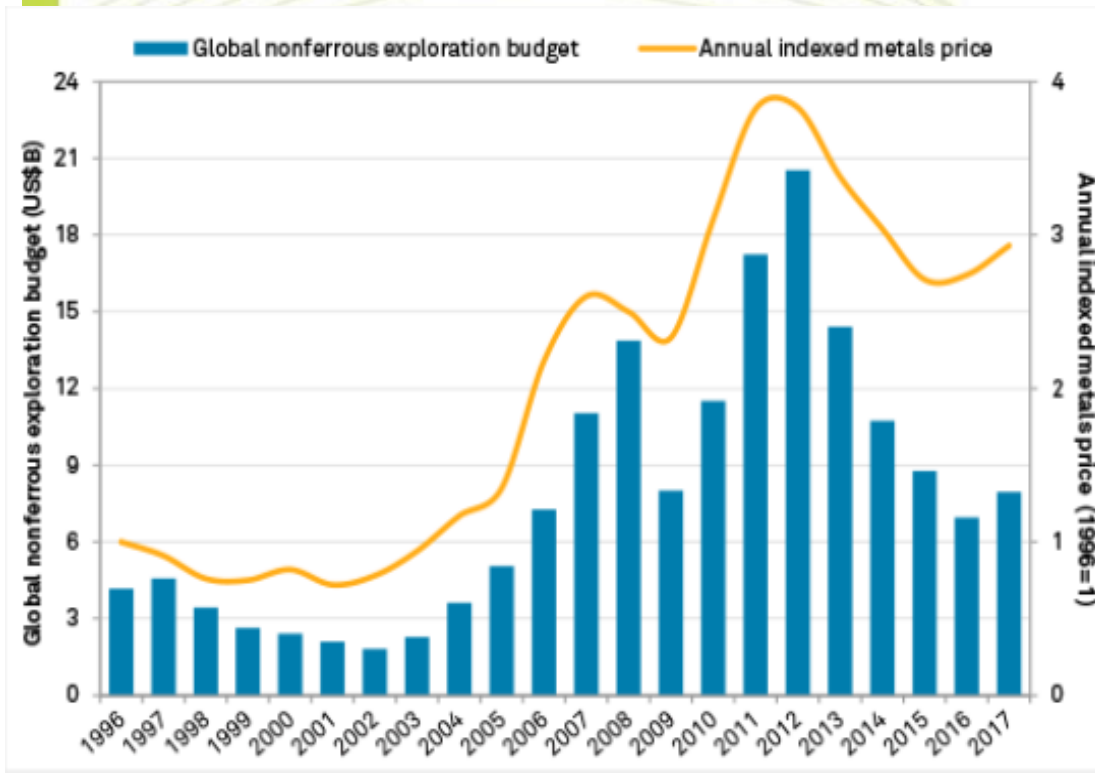
- GSO/Ministry of Mines capacity building/training
- Prospectivity mapping to help de-risk early stage exploration
- Strategic, independent advice to governments
- On-the-ground geological / geochemical mapping
- Organising and quality control of airborne surveys
- Promotional materials / trade exhibitions (eg PDAC)

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Global exploration trends

- 2016 expenditure US\$6.89 Billion, 2017 US\$7.95 Billion
- 27% of spending goes to Australia & Canada & 30% to Latin America (up from 22% in 2016)
- Average budget US\$4.4 Million per project
- Expected to reach \$21 Billion by 2025 (S&P Global Market Intelligence)
- What makes exploration companies explore where they do?



What is important to exploration companies?



STABILITY –
Legislative and political

DATA - Geodata and
technical availability

SECURITY -
Investment and Fiscal

What is important to exploration companies?

- Legislative **stability**
 - Exploration and mining license tenures are transferrable from exploration to production, government supportive of mining with no political interference
- Investment and Fiscal **security**
 - Monies invested in a country and project are safe, easy to access with a clear taxation and royalty regime
- **Geodata** and technical availability
 - Modern, high-quality, digitally available geodata will have a significant if not dramatic effect on improving returns on exploration investment.
 - also puts the Government on an equal negotiating level (avoids “asymmetrical advantages”)

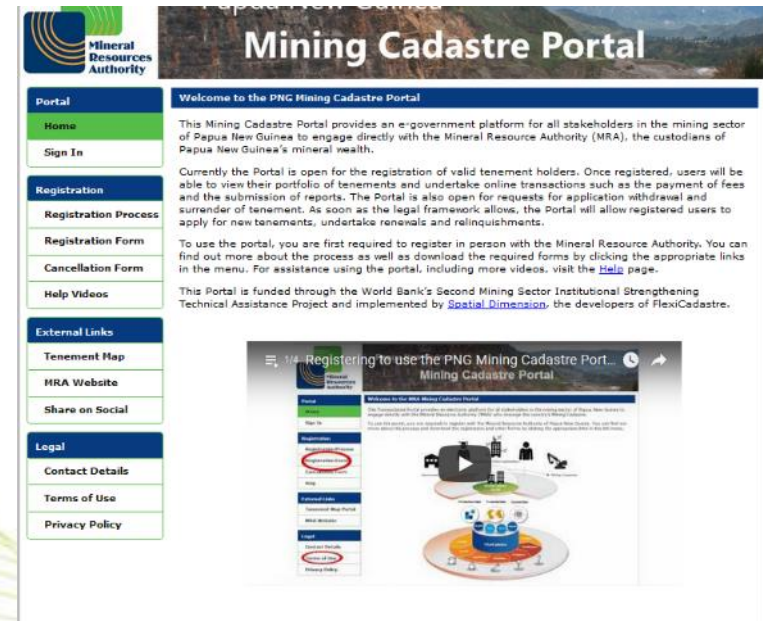
Security of tenure - Licencing

Countries currently operating a mining cadastre system on Geoportal include:

Cote D'Ivoire, DRC, Guinea
Kenya, Liberia, Malawi
Mozambique, Namibia
Papua New Guinea, Rwanda
South Sudan, Tanzania
Uganda, Zambia

- Maps and data publicly accessible with no registration required
- Able to submit and renew licence applications online, including payment of fees
- Also facilitates submission of annual reports/data as required by local law.

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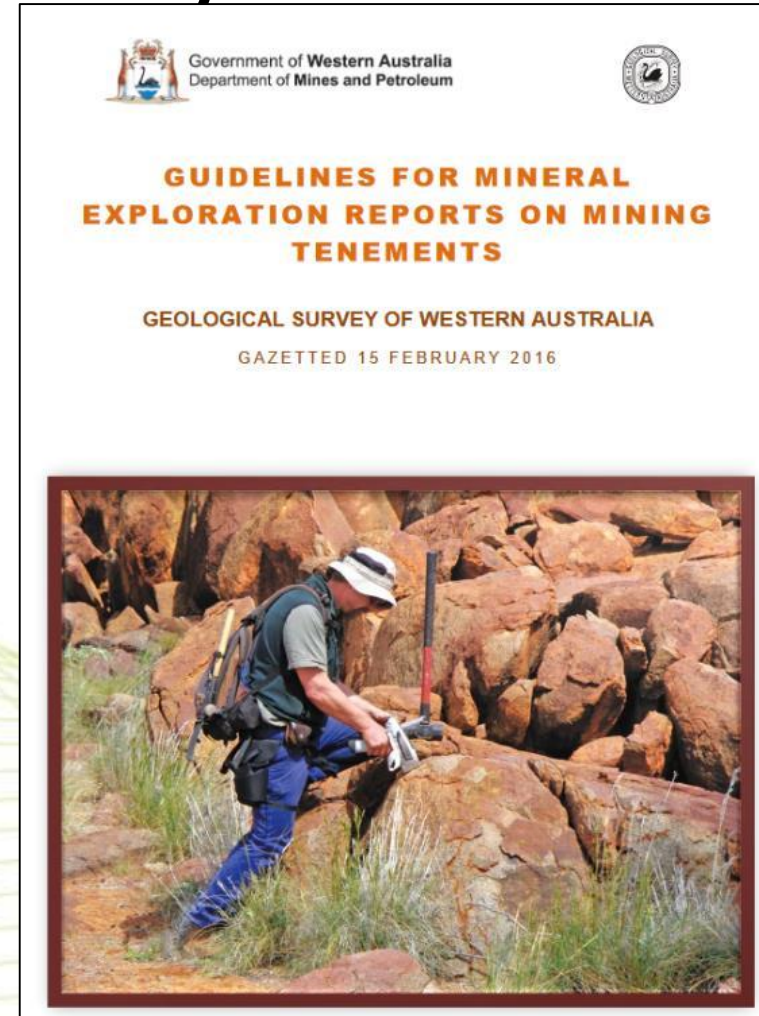


Stability - Policy

e.g. Western Australia

- Mineral explorers are required to report annually on their exploration projects.
- After a period of confidentiality (5 years), the exploration reports and data are made available to the public as open-file reports.
- Open-file reports stored in the Western Australian Mineral Exploration (WAMEX) database. Access is free of charge, copies of the reports are available for download.

This accumulation and sharing of knowledge is one of the lead drivers for exploration success and continued investment in the State



Fraser Institute 2017 rankings for policy perception index

Top 10

	Jurisdiction	Score	2016
1	Ireland, Republic of	100.00	1st
2	Finland	98.84	4th
3	Saskatchewan	91.81	2nd
4	Sweden	91.11	3rd
5	Nevada	90.50	5th
6	Northern Ireland	89.56	10th
7	Michigan	89.18	15th
8	Wyoming	87.55	7th
9	Quebec	87.47	17th
10	Newfound. & Lab.	87.46	18th

Bottom 10

	Jurisdiction	Score	2016
82	Ecuador	42.18	95th
83	Bolivia	40.45	87th
84	Indonesia	39.92	99th
85	Philippines	38.29	100th
86	China	37.46	71st
87	DR Congo	35.03	70th
88	Guatemala	29.89	89th
89	Zimbabwe	29.54	102nd
90	Chubut	26.34	98th
91	Venezuela	0.00	104th

Fraser Institute 2017 rankings for investment attractiveness

Top 10

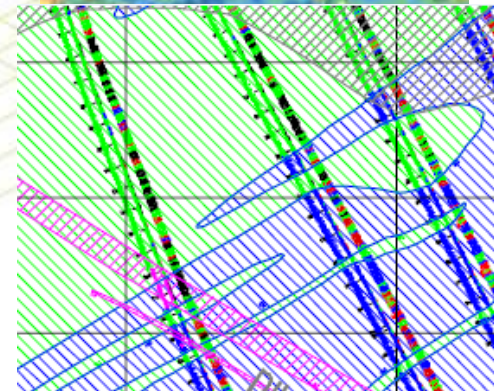
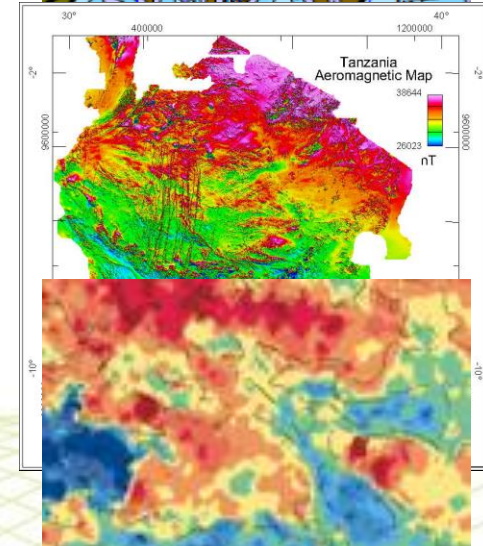
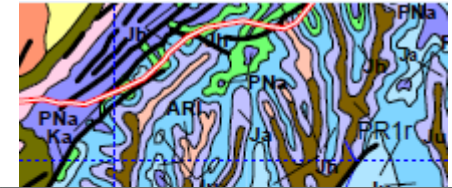
	Jurisdiction	Score	2016
1	Finland	89.04	5th
2	Saskatchewan	87.18	1st
3	Nevada	85.45	4th
4	Republic of Ireland	84.40	9th
5	Western Australia	83.56	3rd
6	Quebec	83.08	6th
7	Ontario	82.15	18th
8	Chile	81.51	39th
9	Arizona	81.11	7th
10	Alaska	80.74	14th

Bottom 10

	Jurisdiction	Score	2016
82	Nicaragua	42.18	71st
83	China	40.45	54th
84	Romania	39.92	69th
85	Venezuela	38.29	102nd
86	Bolivia	37.46	83rd
87	Mozambique	35.03	95th
88	Chubut	29.89	101st
89	Mendoza	29.54	98th
90	Kenya	26.34	86th
91	Guatemala	0.00	88th

Geodata and its value

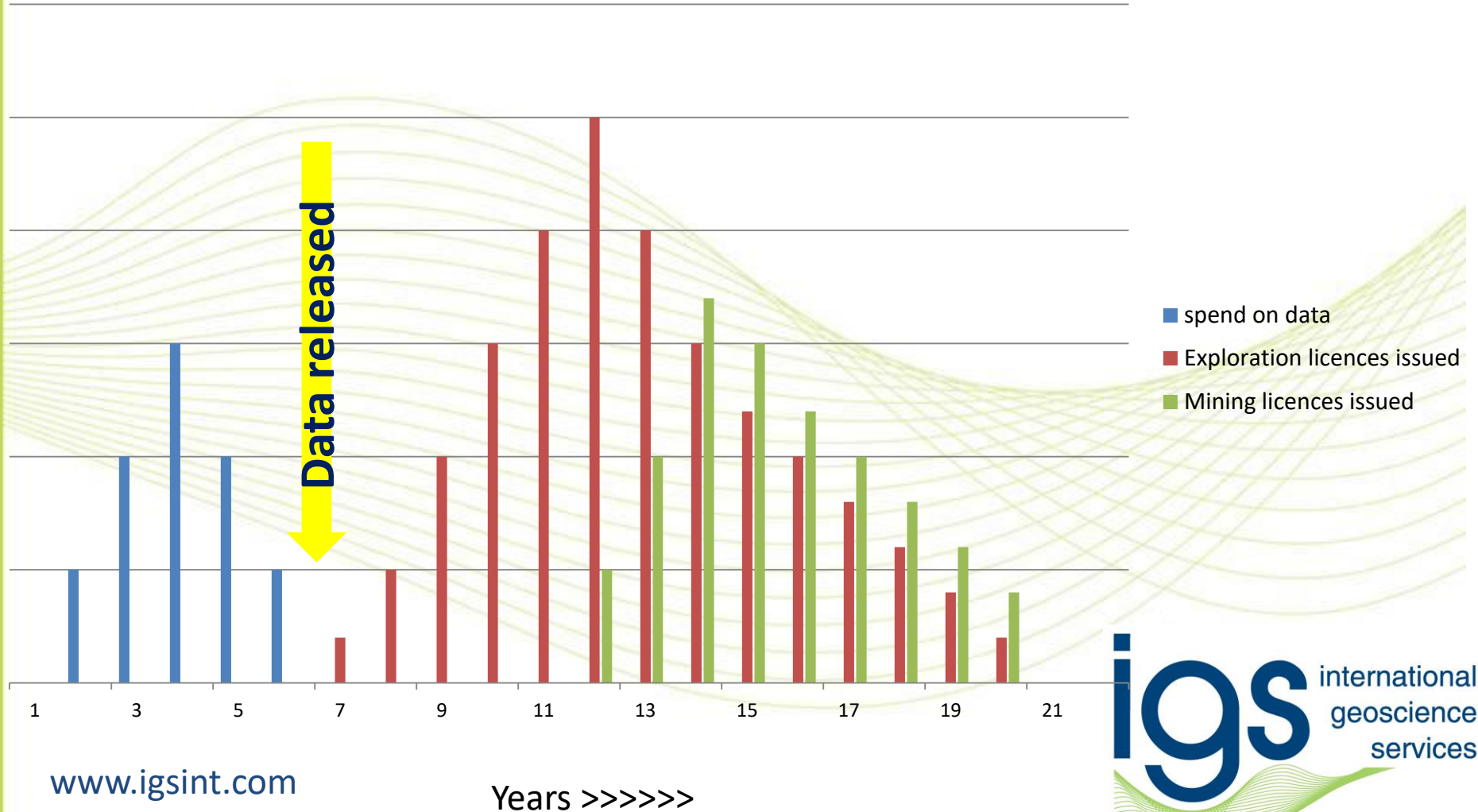
- Geodata includes:
 - Geological mapping as detailed as possible (at least 1:250,000 or better)
 - Geophysical surveying (Magnetics, Radiomagnetics, Gravity, Electromagnetics, etc)
 - Geochemical surveying (as many elements as possible in as much detail as possible)
 - Borehole data (if available)
 - **Preferably available in the right format!**



Why is geodata important?

- Widely accepted association between geological knowledge & economic growth
- Problem of analysis – long time delay between geological input & value of mining output
- Reedman et al. 2000 using case studies concluded a multiplying effect of 100-1000 times
- Canadian analysis concluded a multiplying effect of 125 times by increasing in-situ resources & 50 person years employment for every C\$1m invested into geoscience
- Geoscience investment gives a good rate of return

Typical geodata investment / return profile



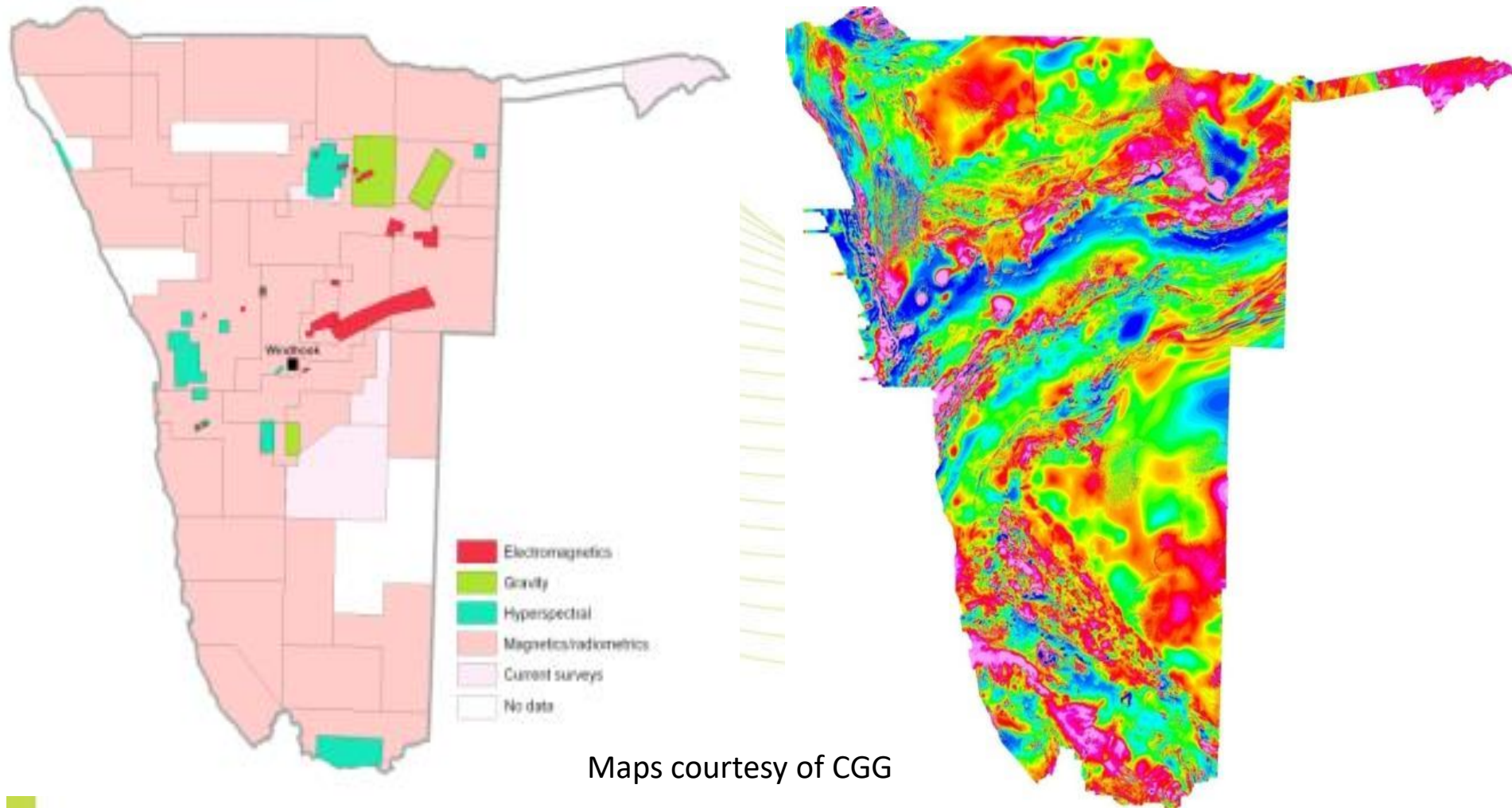
Case studies (1)

Namibia (824 000km²)

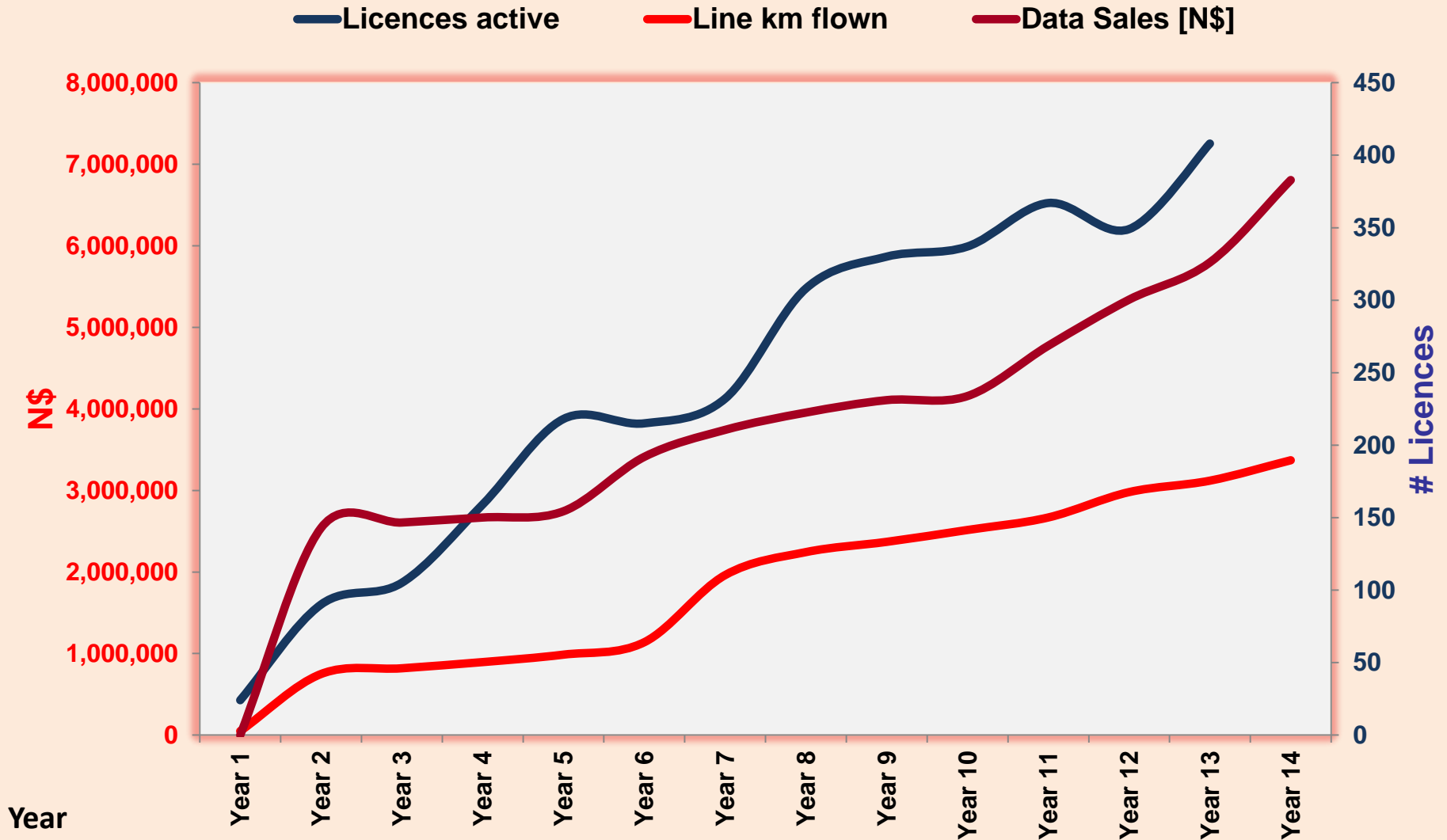
- Geological Mapping
 - 1:250,000 scale is now 100% complete
- Geophysical Mapping
 - A high resolution (200 m line spacing) airborne geophysical survey was completed in 2008/9
- Impact of Geoscience Mapping on Minerals Sector
 - Acquiring and releasing geophysical data has directly increased the number of exploration licences in country

Attracting Exploration Investment – Namibia

- Namibia - country wide magnetic and radiometric survey coverage



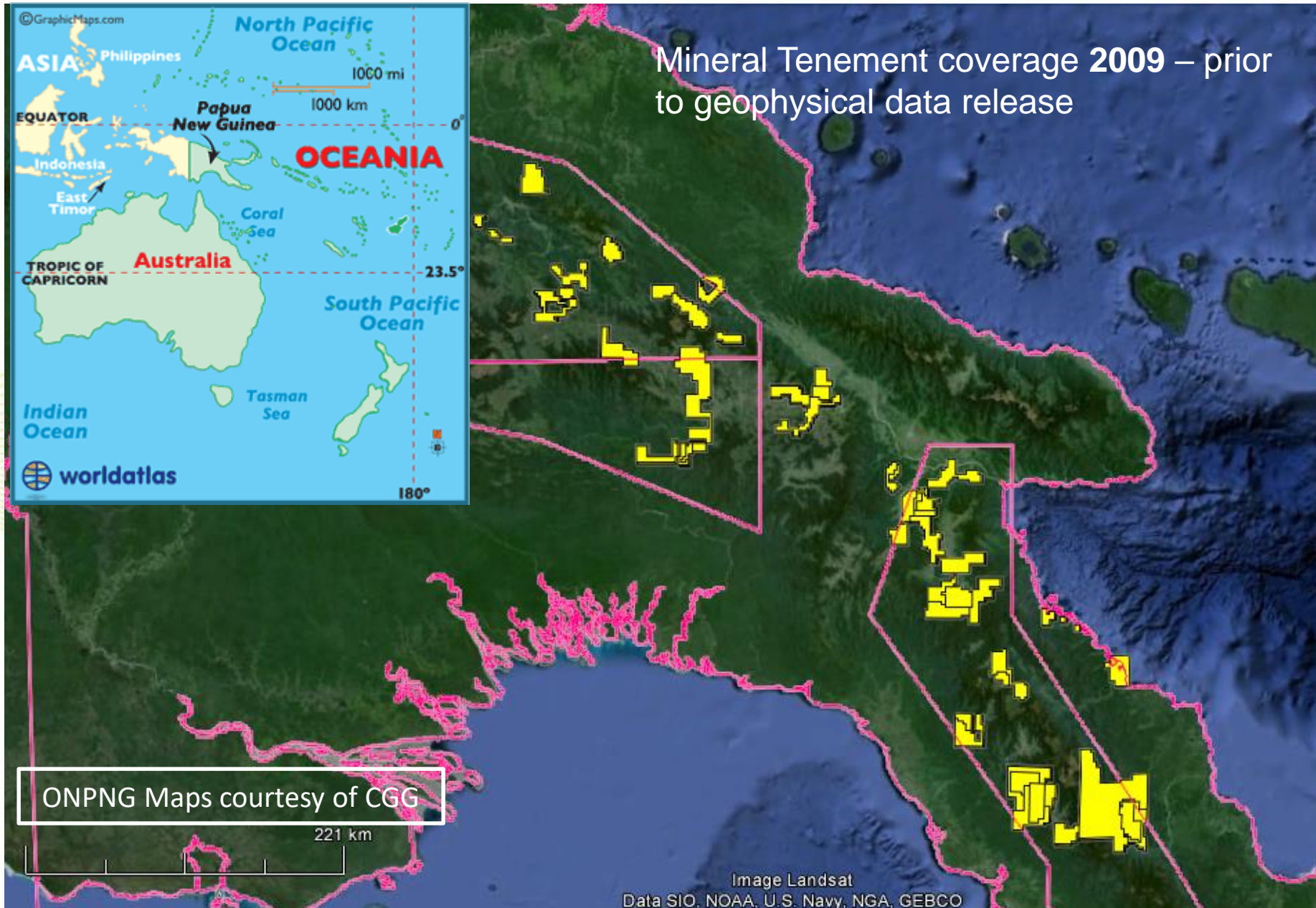
Attracting Exploration Investment – Namibia



Case Studies (2) PNG



Mineral Tenement coverage 2009 – prior to geophysical data release



ONPNG Maps courtesy of CGG

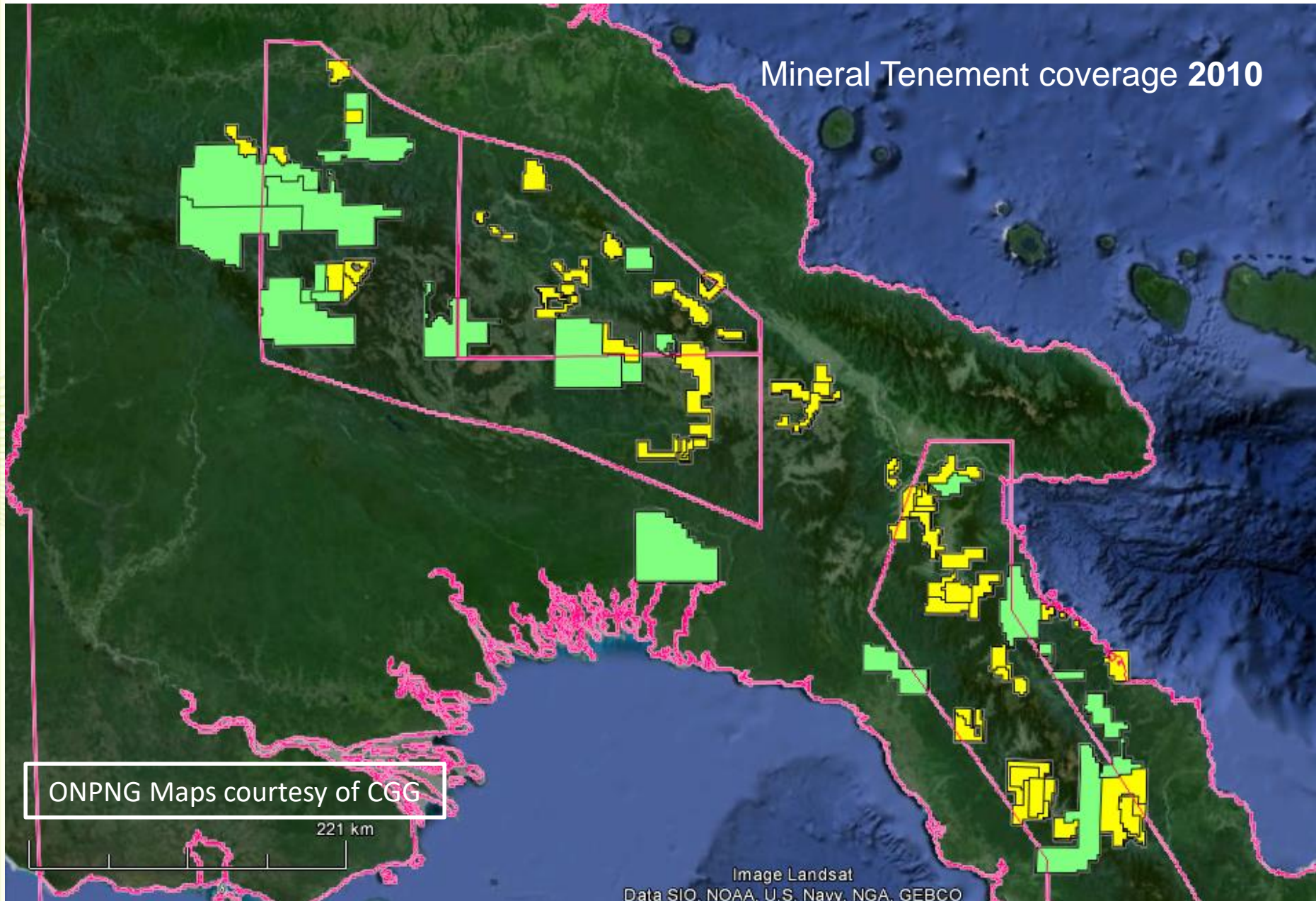
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Mineral Tenement coverage 2010

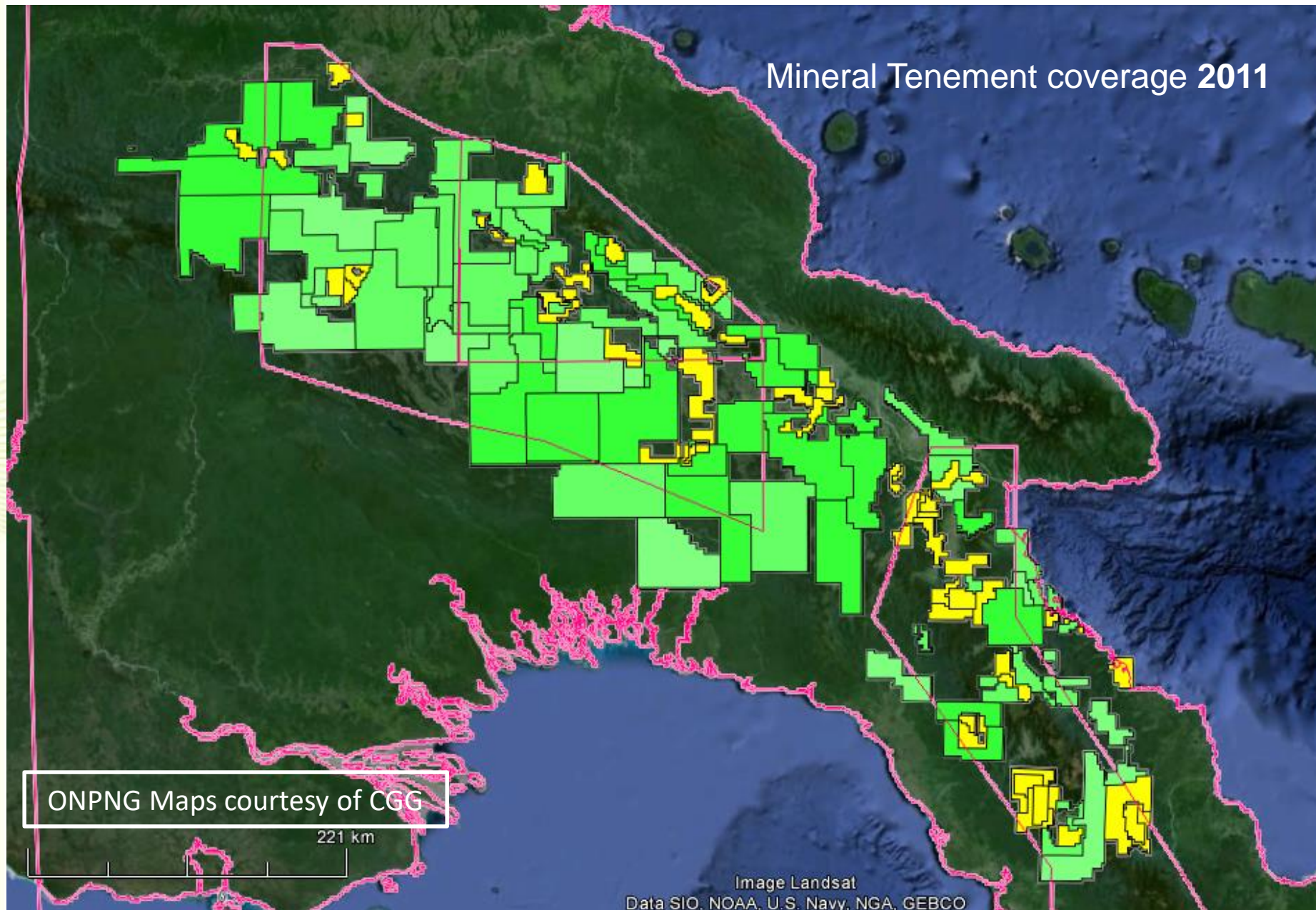
ONPNG Maps courtesy of CGG

221 km

Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO



Mineral Tenement coverage 2011

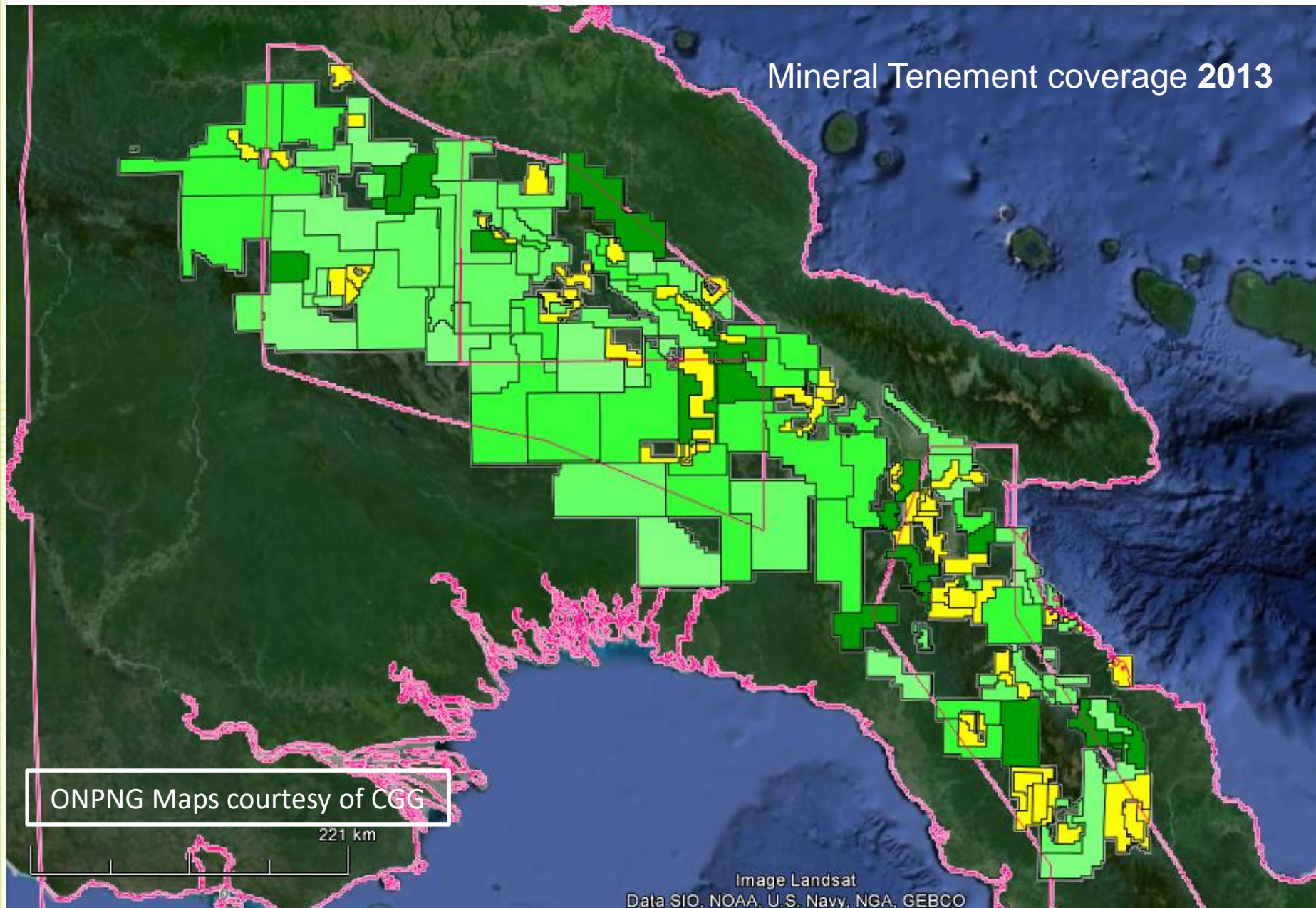


ONPNG Maps courtesy of CGG

221 km

Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Mineral Tenement coverage 2013



ONPNG Maps courtesy of CGG

221 km

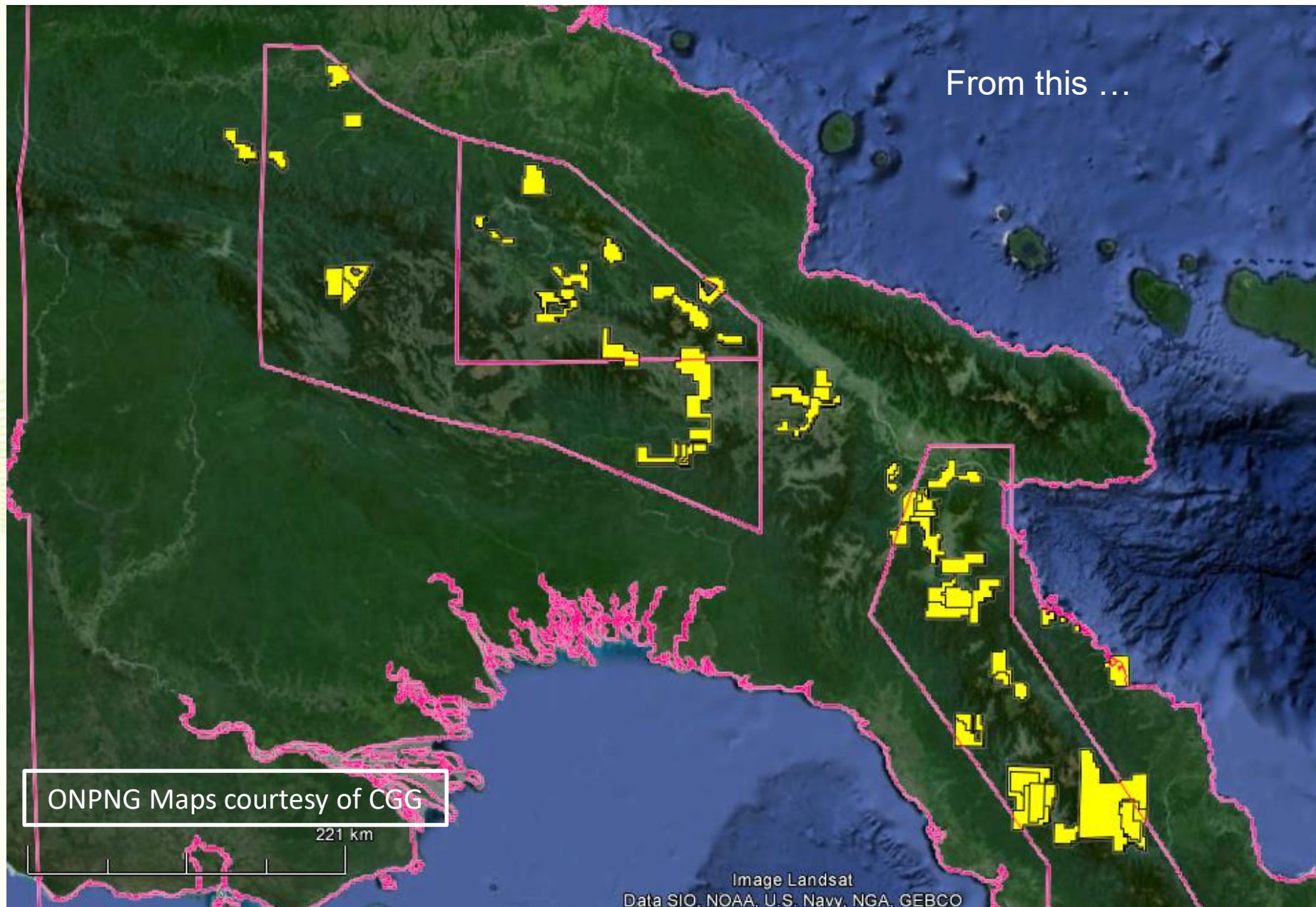
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

From this ...

ONPNG Maps courtesy of CGG

221 km

Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO



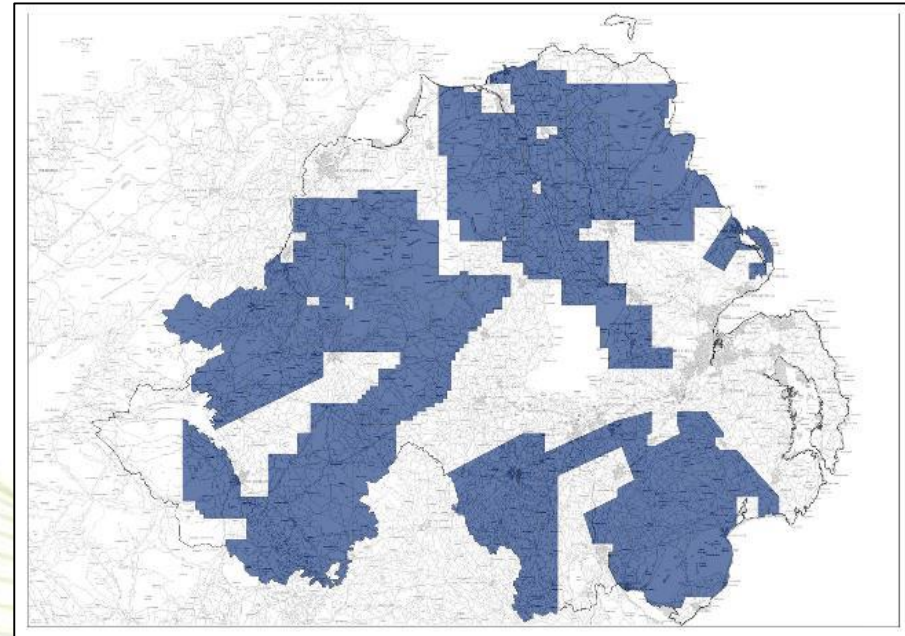
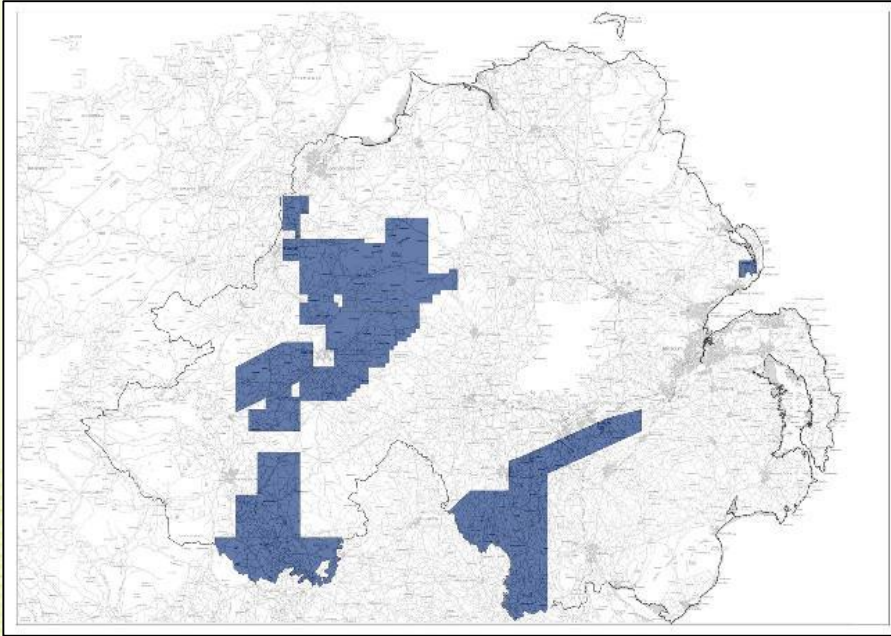
To this... In just 4 years.

ONPNG Maps courtesy of CGG

221 km

Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Case studies (3) Northern Ireland



Northern Ireland Maps
courtesy of GSNi

License take-up pre and post the TELLUS survey data release which included high resolution airborne geophysical survey and regional geochemical sampling in Northern Ireland in 2007.

N Ireland ranked 6th in world in policy perception index

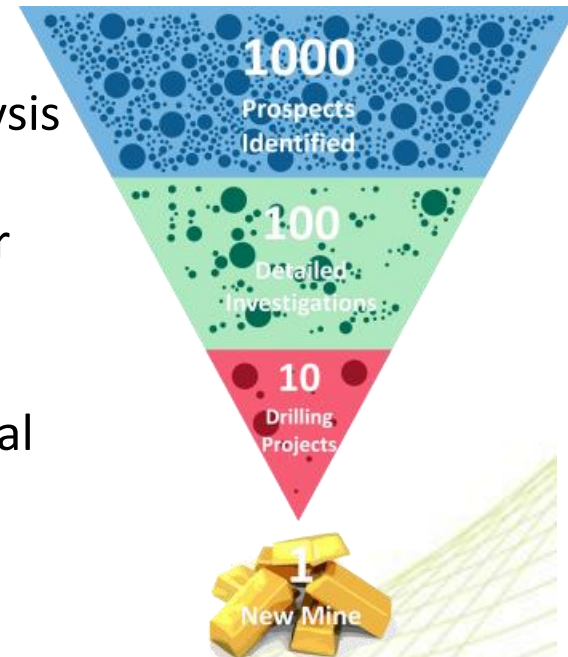
Adding value to geodata

- Geodata needs to be modern, relevant, as detailed as possible and be available in the right format
- Data needs to be available for companies to access
- GSOs are vital in maintaining geodata and making this available to others
- Mineral prospectivity analysis very useful to highlight prospective areas for mineral deposits
- Proven successes in attracting exploration

Prospectivity Modelling

What is prospectivity modelling?

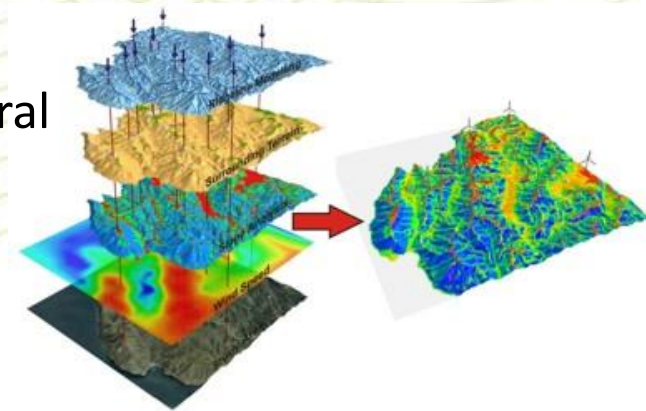
- Making intelligent exploration decisions based on analysis of spatial data
- Allows statistical probability assessment for a particular deposit type based on available data
- Existing systems use GIS or subjective mathematical criteria such as weights of evidence, fuzzy logic or neural networks
- Current systems do not take geology into consideration



IGS Xplore

- IGS developed Xplore to use semantic technology to undertake prospectivity analysis
- Xplore codes geological meaning into analysis with knowledge of well established peer-reviewed mineral deposit models
- Transparent, defensible, objective not subjective, editable

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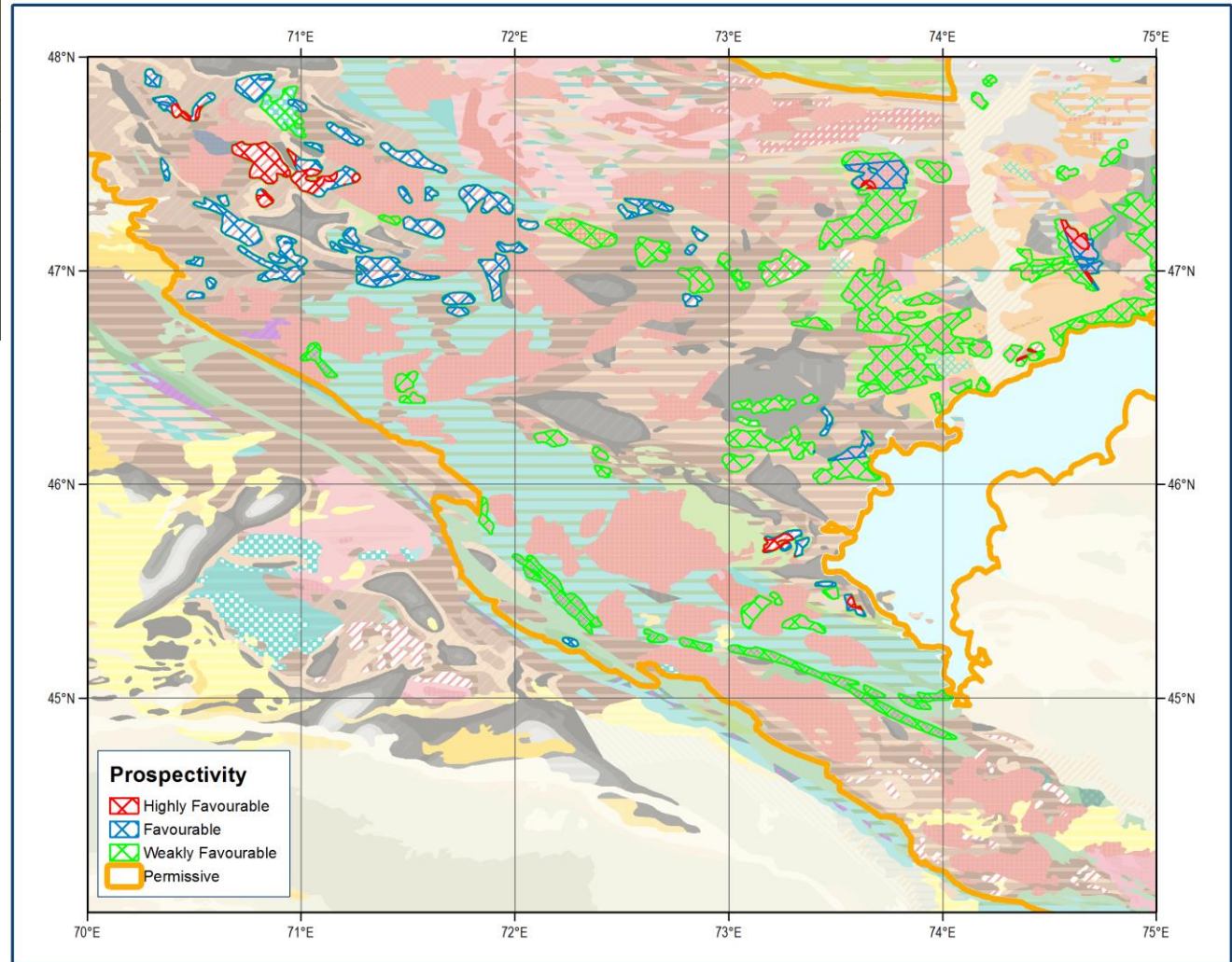


Selection of Deposit Types – *IGS Xplore*

Au Epithermal	Cu-Mo Porphyry	Polymetallic replacement / manto
Au Greenstone hosted orogenic	Fe Algoma type	Potash
Au Intrusion related	Fe Superior Type	Primary Diamond
Au Skarn	Fe-Ti Anorthositic	SEDEX
Au Turbiditic	Flake Graphite	Sediment Hosted Gold
Au-VMS	IOCG	Sn-W Granite
Base Metal Kipushi-type	LCT Pegmatite	Surficial & Buried Placer
Base Metal MVT	Mn Sedimentary	U Metasomatite
Base metal Skarn	NiCo Laterite & Bauxite	U-Au Unconformity related
Broken Hill Type	Ni-Cu Sulphide	VHMS Bimodal Mafic
Carbonatite	NYF Pegmatite	VHMS Ophiolite
Chromite	Paleoplacer	VMS Besshi Type
Cu Sedimentary	Peralk Intrusion related	VMS Felsic dominated
Cu-Au Porphyry	Phosphorite	VMS Mafic Dominated

IGS Xplore Lake Balkhash (Kazakhstan)

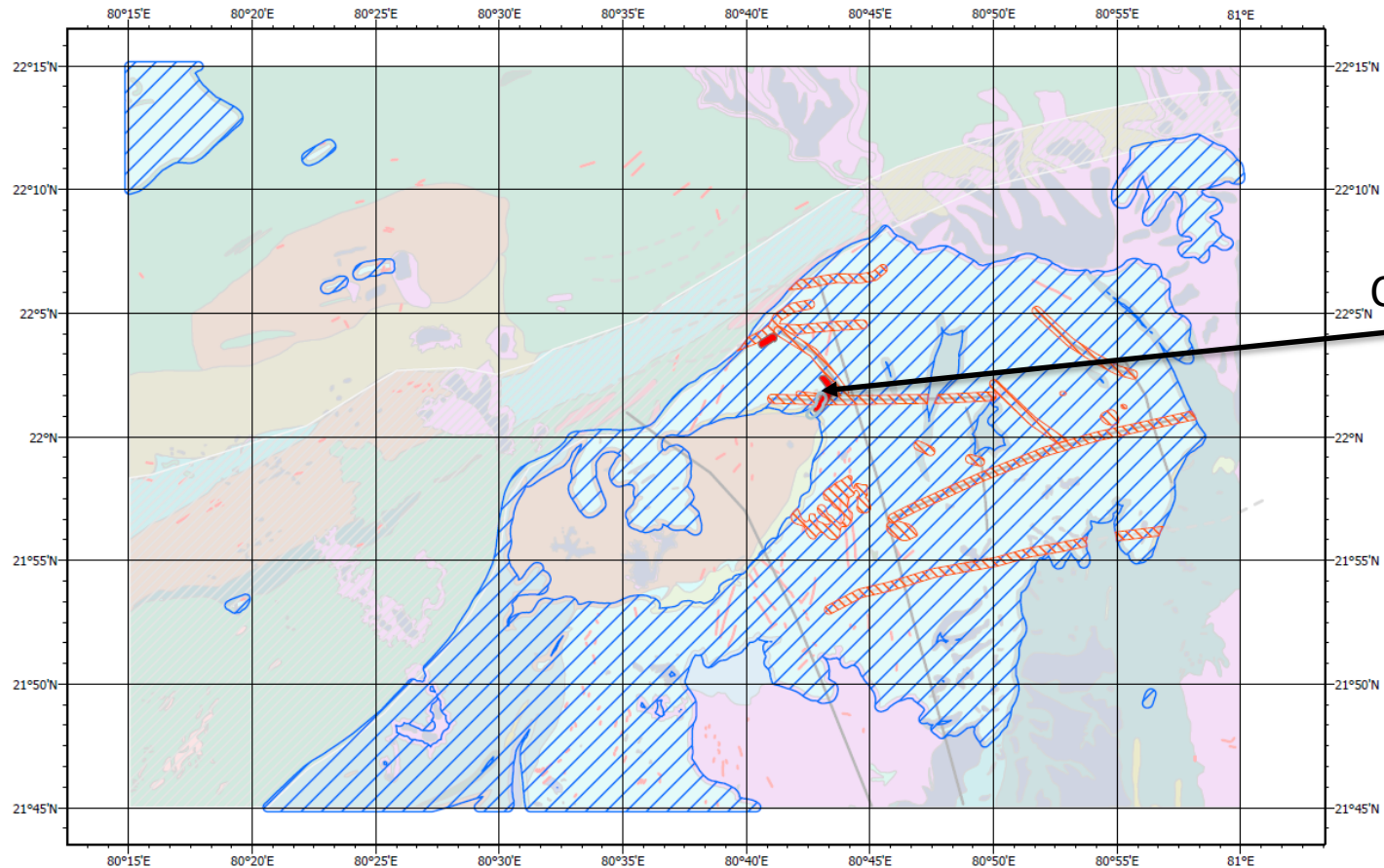
Cu-Au Porphyry Prospectivity Map from CERCAMS Database



IGS Xplore Malanjkhand (India)

- Highly_Favourable
- Favourable
- Permissive

Malanjkhand District Cu-Mo Porphyry Prospectivity



Current Mine



IGS Xplore Yazd (Iran)

IGS Xplore Prospectivity Analysis of the Yazd Area

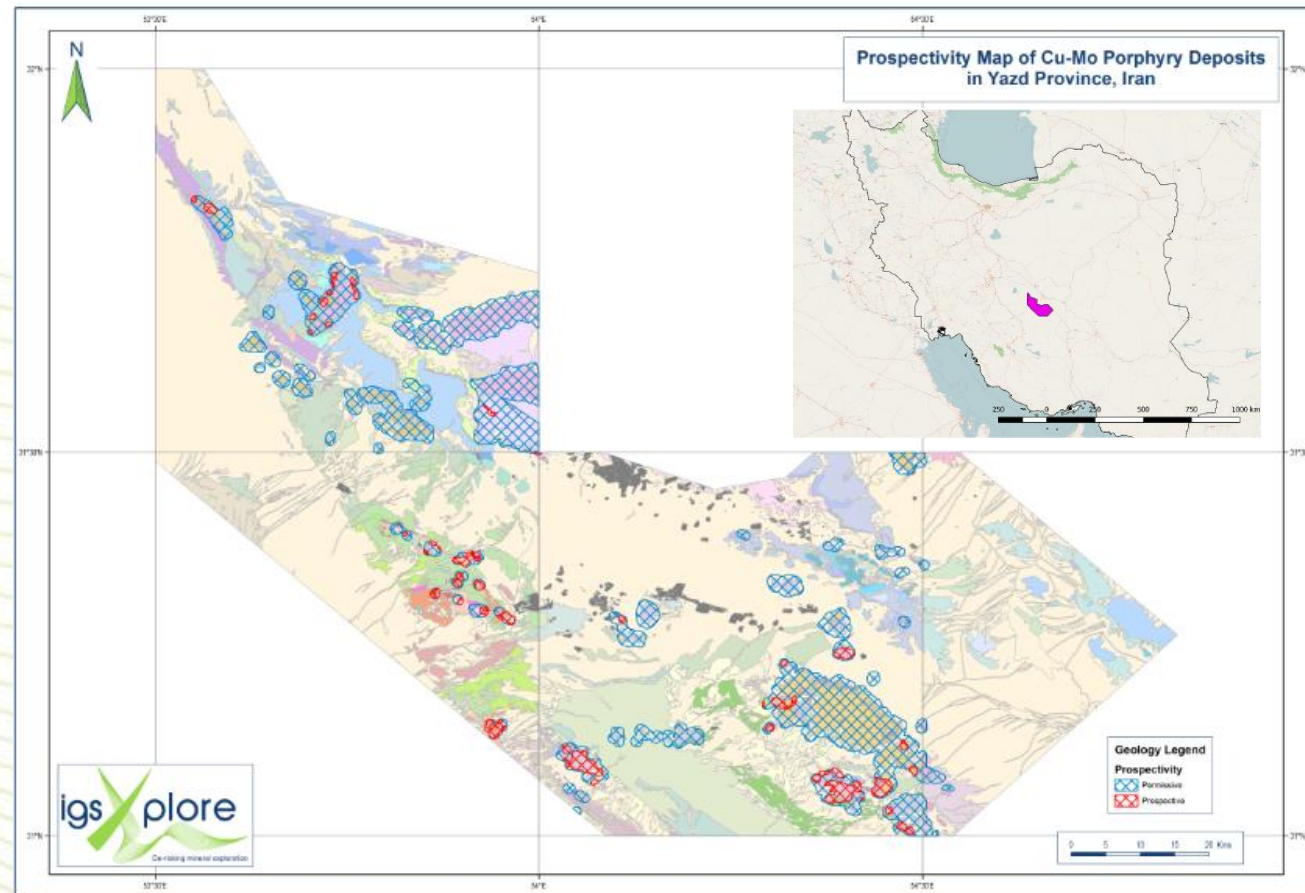


Report Prepared by

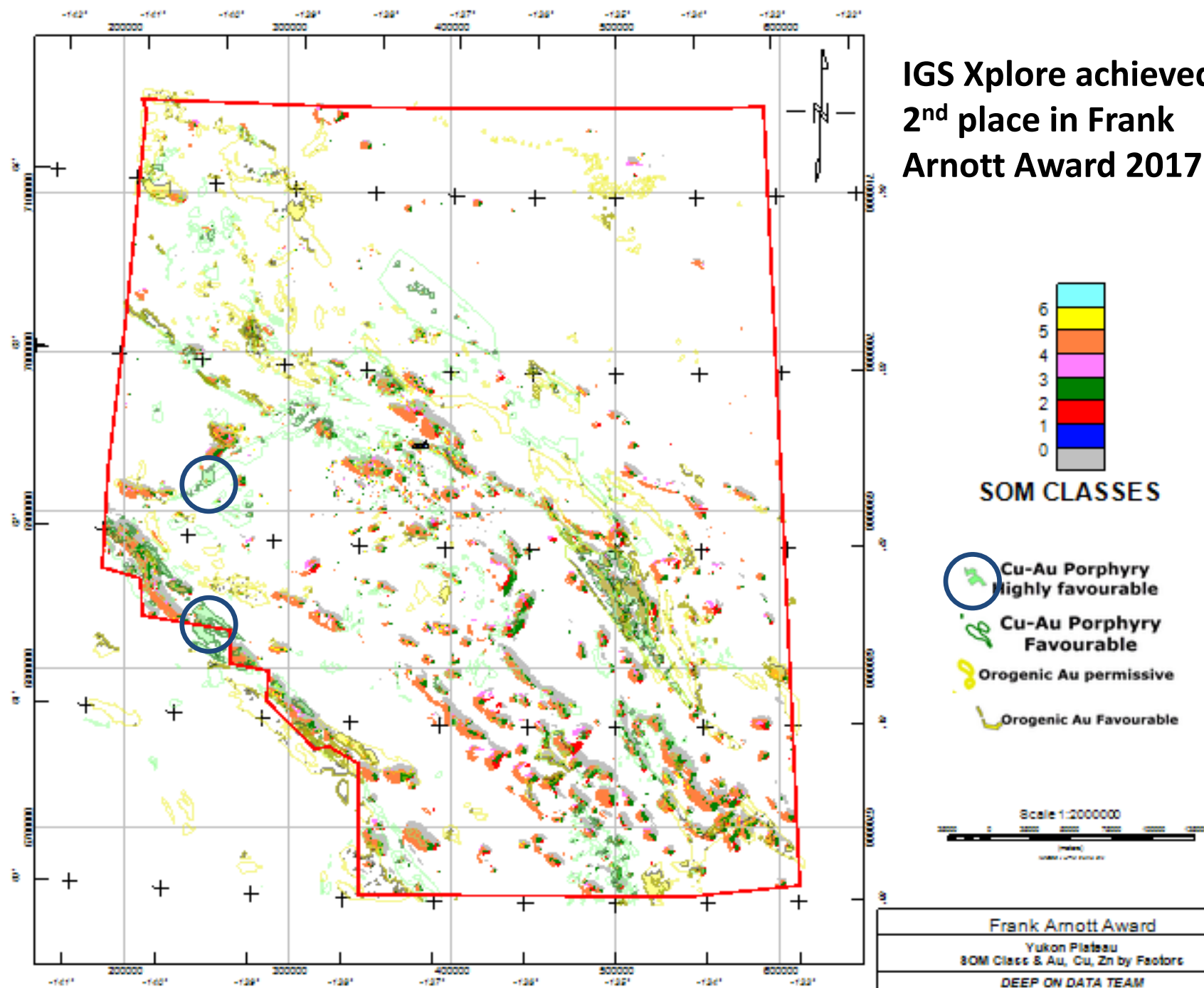


July 2017

on behalf of



IGS Xplore achieved
2nd place in Frank
Arnott Award 2017



Summary

- Availability of reliable geodata is as important as a stable fiscal and legislative regime
- Geodata needs to be modern, relevant, as detailed as possible and be available in the right format
- GSOs are vital in maintaining geodata and making this available to others
- A Geoportal is a good way of making this information available to potential investors
- Propsectivity analysis can provide exploration companies with vital information for licencing areas
- IGS Xplore specifically developed to make analysis more transparent and defensible

Thank you for your attention

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