



EXPLORATION POTENTIAL OF NAMIBIA

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9 May 2019

SUSTAINABLE DEVELOPMENT OF MINERAL, ENERGY, GEOLOGICAL RESOURCES

Key Themes

- Background
- Assessing of Namibia's Potential
- Geological Knowledge
- Geological Survey Capacity
- Geoscience Data Availability
- Future Potential
- Going Forward

Background

- The mining sector is a significant contributor to economic growth in Namibia
- Considerable potential to help reduce poverty and accelerate human development, through
 - Increasing government and community revenues
 - Generating employment
 - Providing human (health, education, nutrition) and physical (transport, energy, water) infrastructure

Background

- Mineral/Hydrocarbon Exploration is a sequential process of information gathering that assesses the mineral/hydrocarbon potential of a given area.
- It starts with an idea or geologic model that identifies lands worthy for further exploration.
- Suitable areas may then be secured as licenses, claims, rights or permits
- Exploration – technical operation with a commercial objective intended to discover resources and advance assets into a production.

Background

- Geological exploration is the process of finding commercially viable mineral resource, with the objective of locating it in the **shortest possible time and at the lowest possible cost**.
 - **Geological knowledge** – geological potential for mineral resources;
 - **Geological Survey capacity** – first contact service to investors by hosting national geoscientific data sets and pertinent expertise.
 - Ability to actively acquire data, and to disseminate geoscientific data acquired by private industry in order to promote investment and development of mining industries.
 - **Geoscience data availability**



Assessing Namibia's Potential

- **Geological Knowledge:**
 - Understanding of geology provides an opportunity to explore mineral deposits formed in various tectonic settings.
 - Does the potential to discover and develop new deposits exist?
 - Do we have mineral deposits that can be re-evaluated for development?

Assessing Namibia's Potential

- **Geological Survey Capacity:**
 - Ability to actively acquire data, and to disseminate geoscientific data acquired by private industry in order to promote investment and development of mining industries.
 - Do we have the ability to acquire and disseminate data?
 - Do we have the relevant skills and expertise?
 - Do we have viable financial and human resource?
 - What about the required tools and infrastructure?

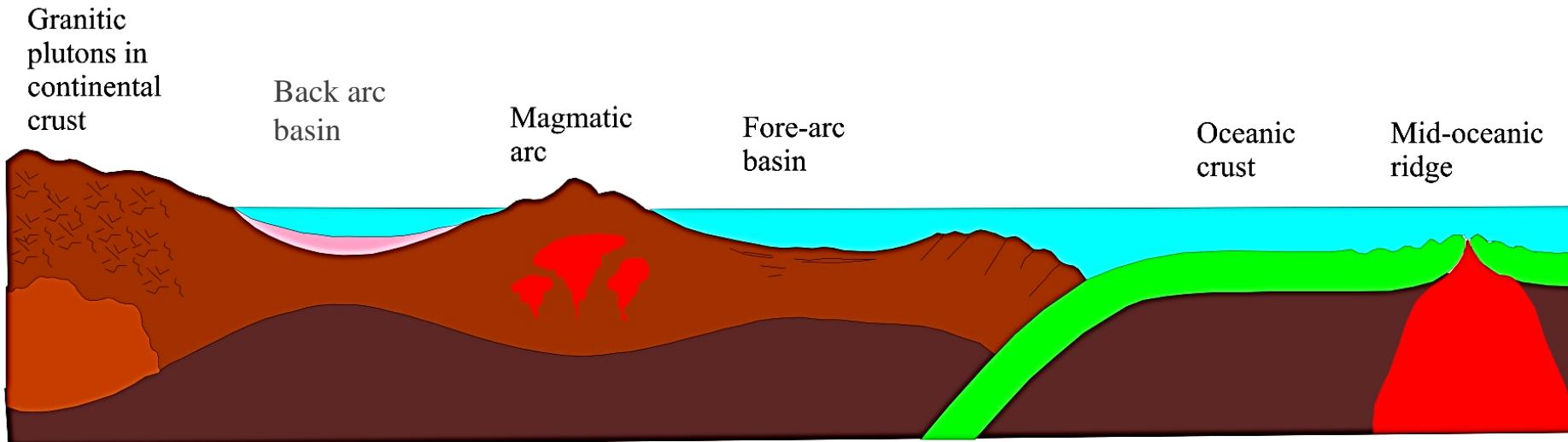
Assessing Namibia's Potential

- **Geoscience Data Availability:**
 - Bringing together all existing information and data into a platform that is readily accessible by stakeholders
- Is our data relevant and effective?
- Is it accessible?



Geological Knowledge

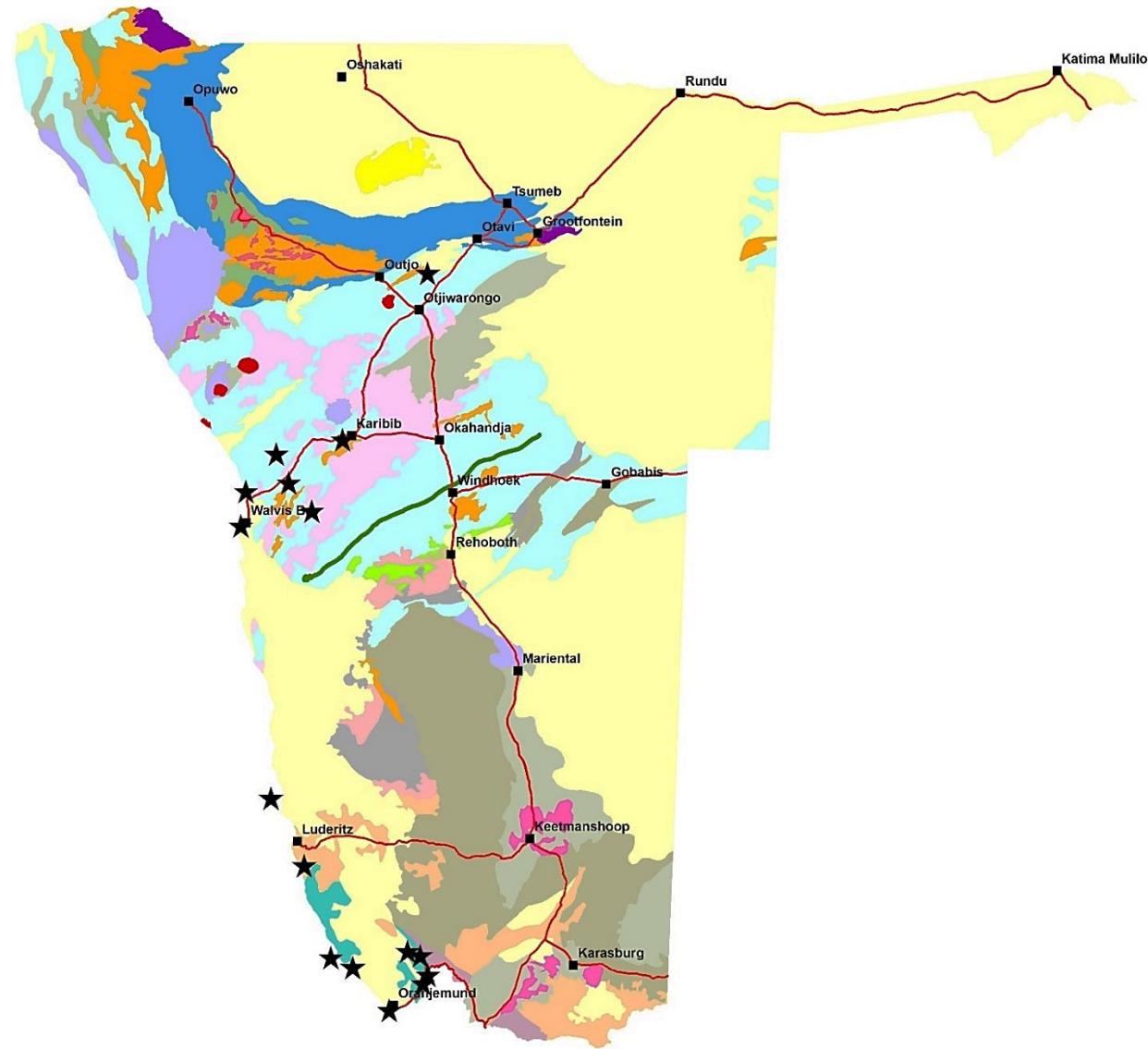
Tectonic environment and Mineral Deposits



Metals	Tin Tungsten Bismuth Copper	Copper Zinc Gold Chromium	Copper Gold Silver Tin Lead Mercury Molybdenum	Lead Zinc Copper	Chromium	Manganese Cobalt Nickel	Copper Zinc
Deposits	Vein; contact metamorphic	Volcanogenic massive sulfide, stratabound, evaporites	Porphyry copper, veins	Stratabound in sediments	Magmatic chromite	Manganese nODULES	Volcanogenic massive sulfide

Geological Overview of Namibia

- Approx.
50%
bedrock
exposure
- Remainder
 - Kalahari
and Namib
deserts

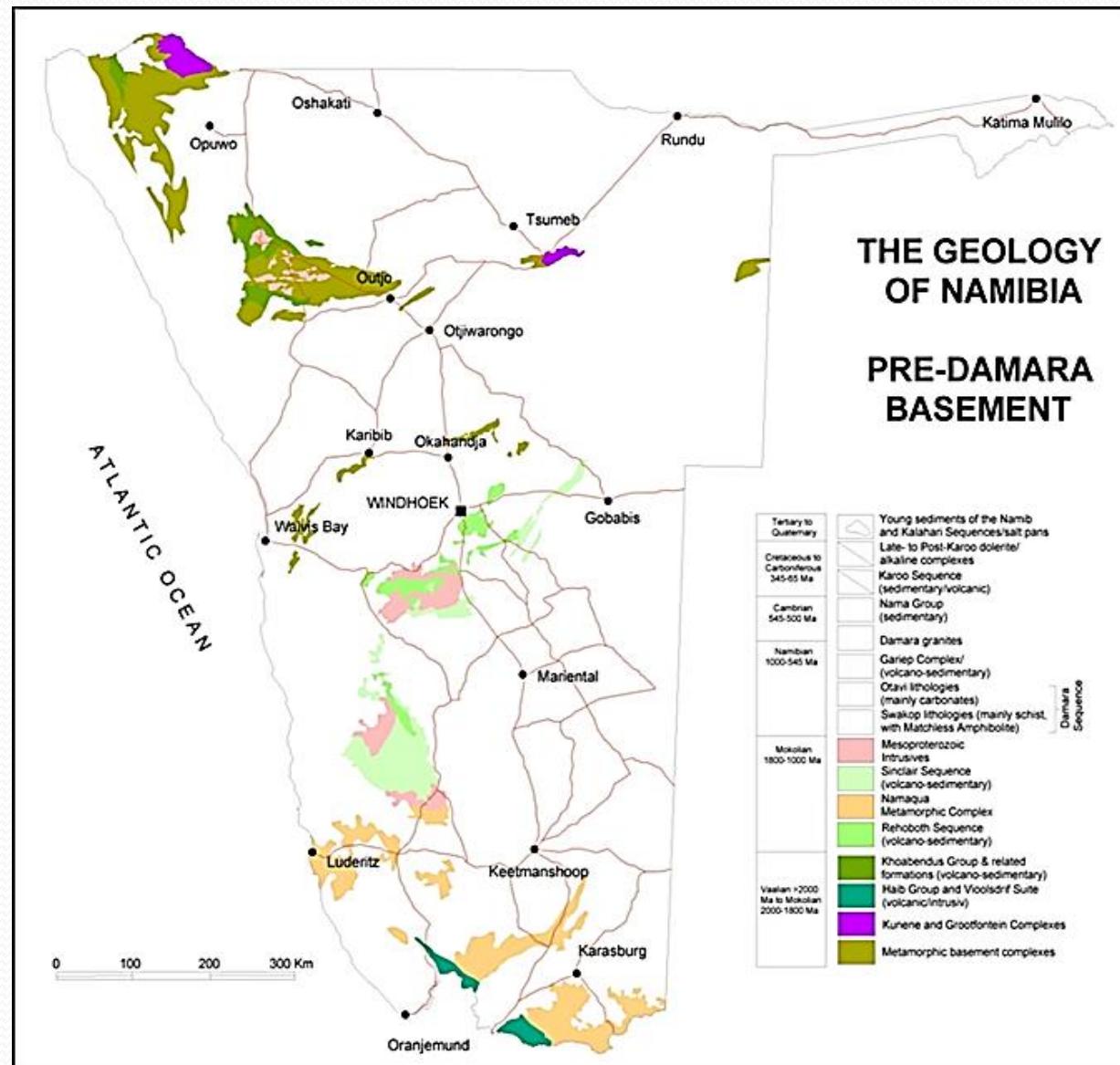


Geological Overview of Namibia

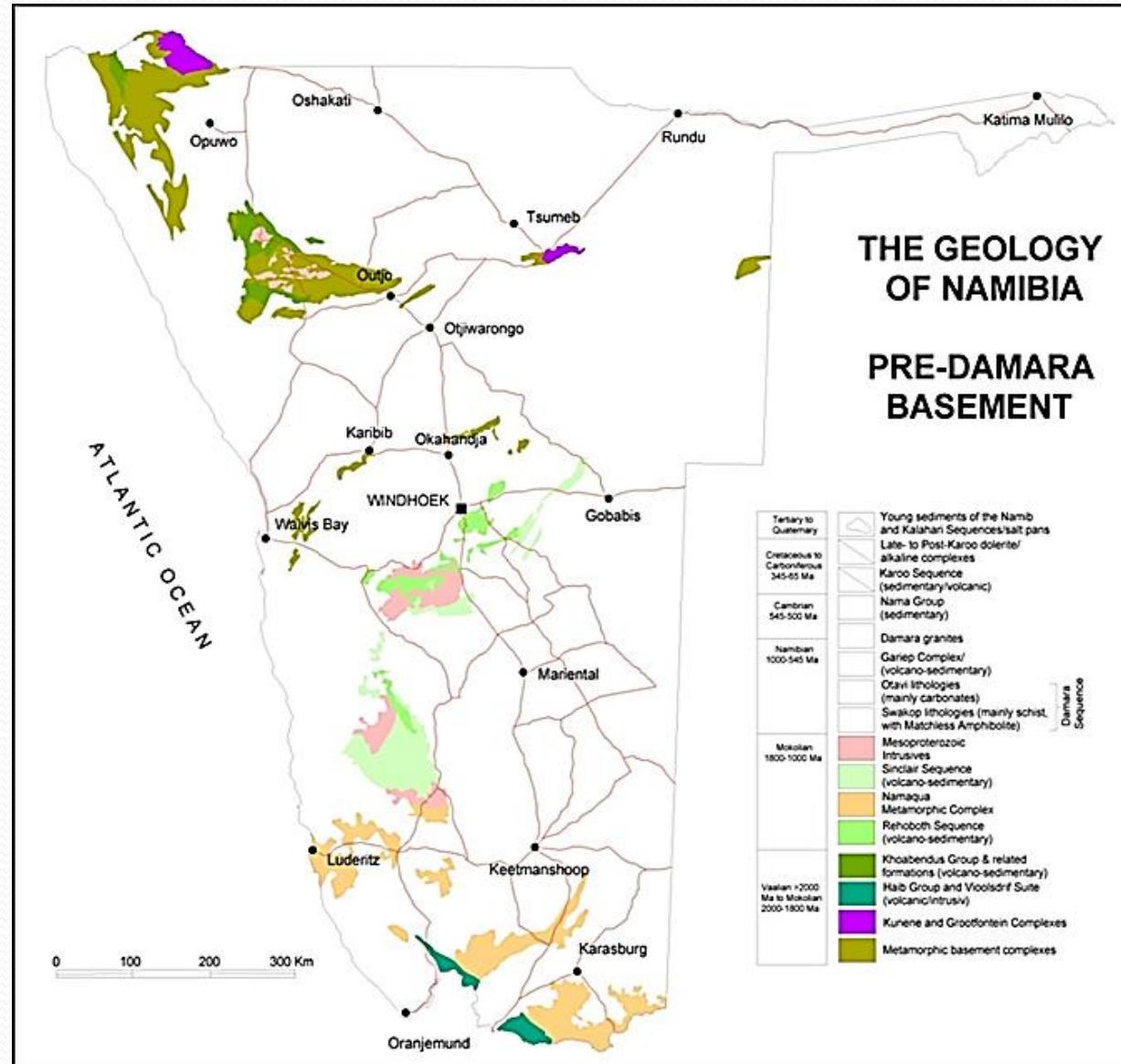
- Geological history - 5 main time spans
 - ✓ Archaean to Palaeoproterozoic (~2600 to 1800 Ma)
 - ✓ Mesoproterozoic (~1800 – 1000 Ma)
 - ✓ Neoproterozoic (~850 to 500 Ma)
 - ✓ Permian to Cretaceous
 - ✓ Paleogene to Neogene (Cenezoic)

Geological Potential

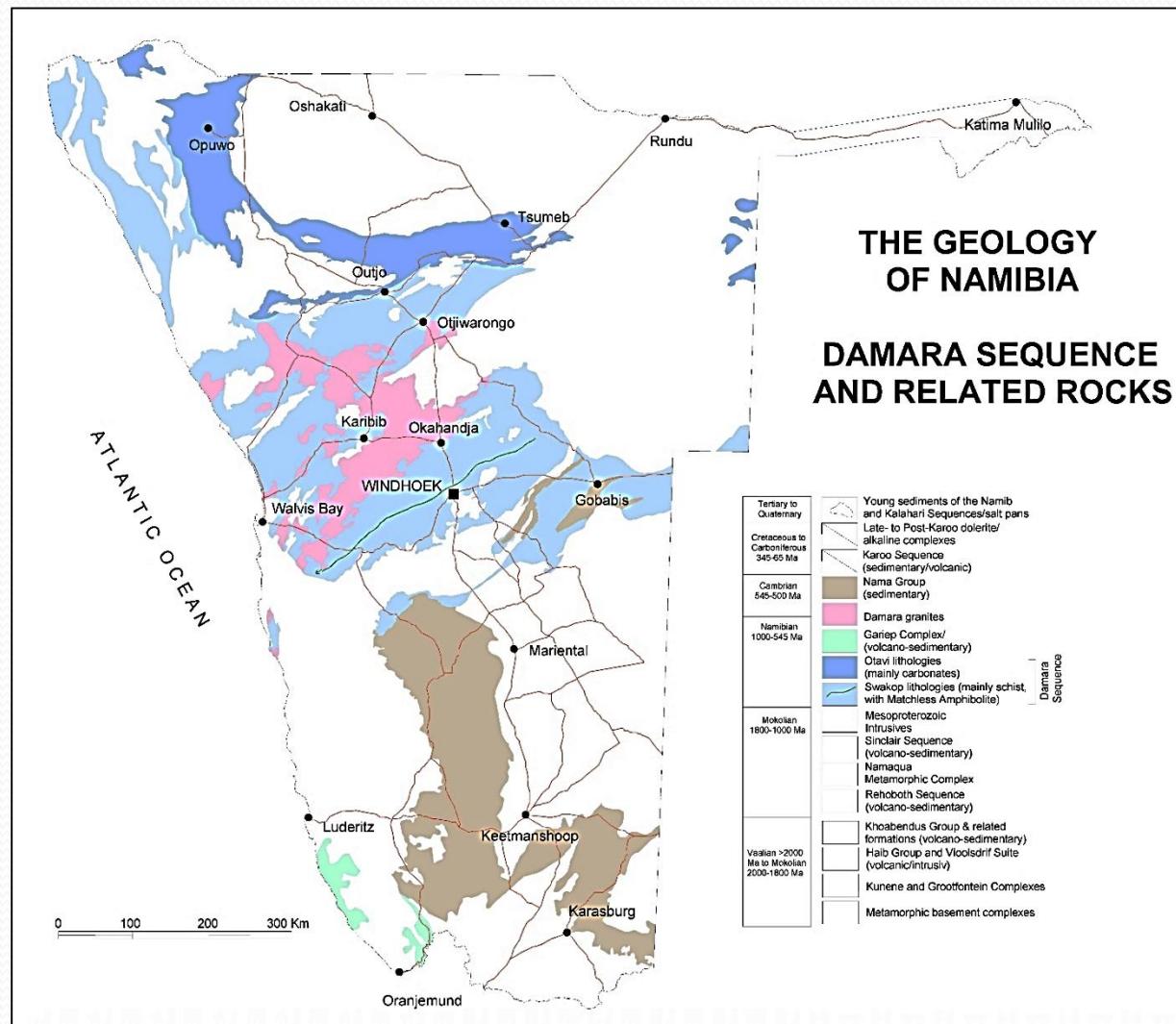
- Archaean to Palaeoproterozoic (~2600 to 1800 Ma)
 - Granitic gneisses, amphibolites and varied metasediments + associated volcanic and intrusive rocks.
- Haib and Lorelei Cu-Mo porphyry deposits



- Mesoproterozoic (~1800 – 1000 Ma)
 - Kunene Anorthosite Complex
 - ✓ Low grade Ni sulphides
 - Epembe suite - alkaline rocks
 - ✓ Sodalite - Dimension stone
 - Namaqua Metamorphic Province (South)
 - ✓ Granitic gneisses, volcanics, metasediments, felsic + mafic intrusions.
 - ✓ Post pegmatite Rare Metals
 - Sinclair Group (central)
 - ✓ Volcanic and sedimentary rocks,
 - ✓ Granites (Gamsberg and Piksteel suites)
 - ✓ Base Metals – Cu, Pb-Zn veins

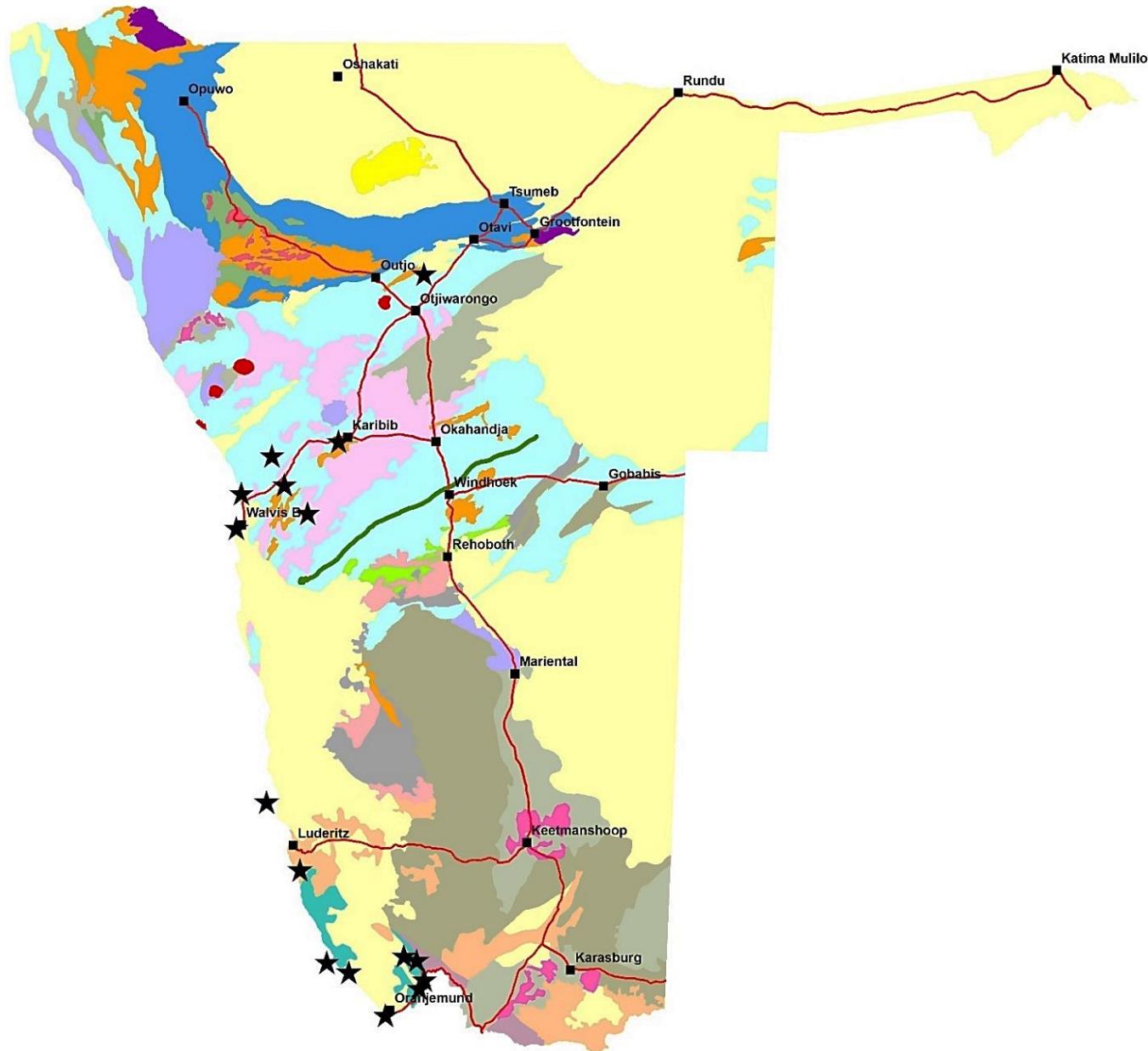


- Neoproterozoic (~ 850 – 500 Ma)
 - Damara event
 - Damara belt
 - Kaoko belt
 - Gariep belt
 - Nama + Mulden Group rocks - uplift and erosion of the Damara rocks
- Permian to Cretaceous
 - Karoo Supergroup
 - Aranos, Huab + Waterberg Basins
 - Intruded by dolerite sills + dyke swarms
 - Etendeka plateau + alkaline subvolcanic intrusions (Brandberg, Spitzkoppe, Erongo etc)
 - Gondwana break-up + the Fm of South Atlantic Ocean!

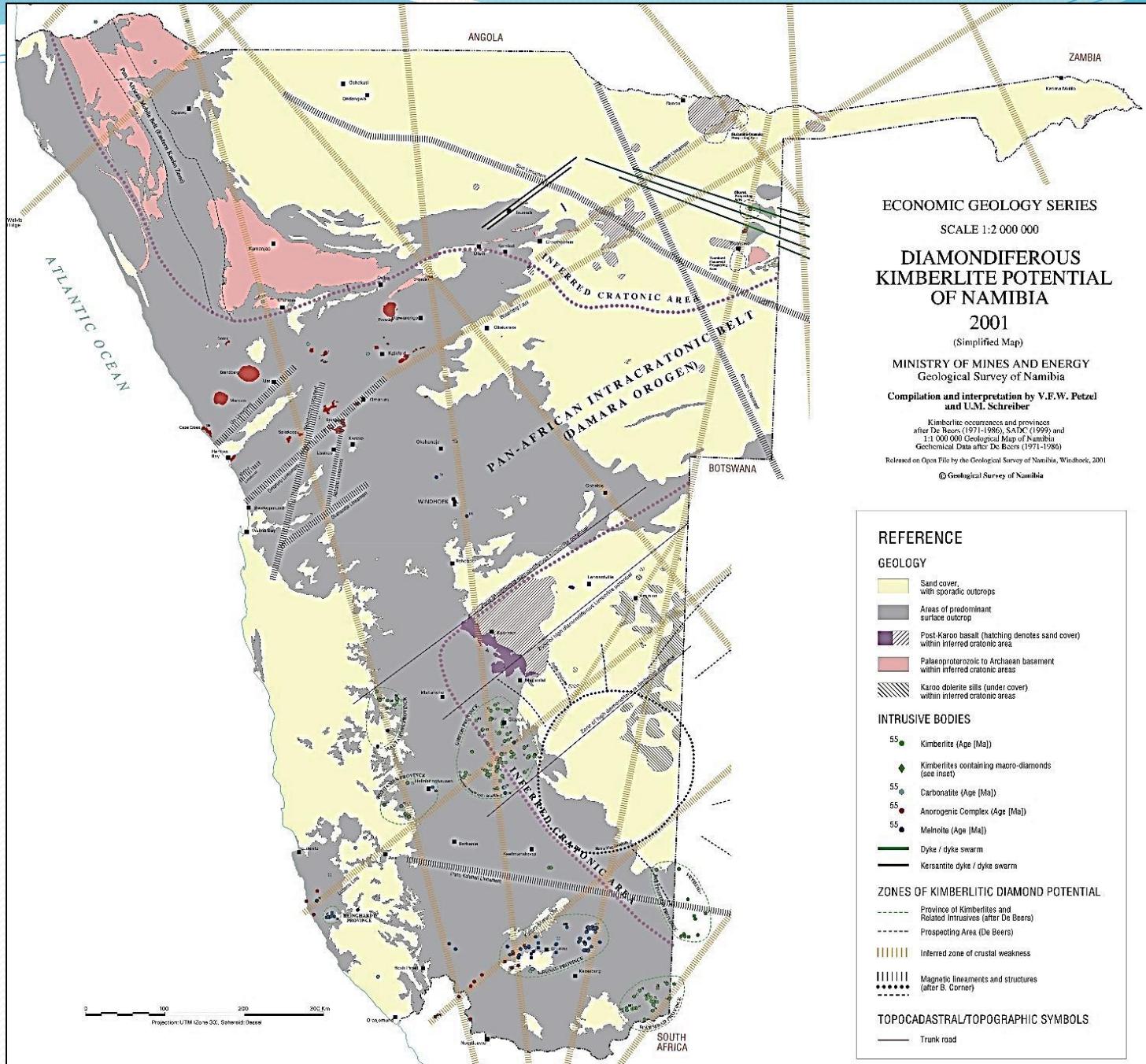


Current Mines in Namibia

1. Tschudi
2. Ohorongo
3. Otjikoto Gold
4. Okanjande Graphite
5. Otjozondou
6. Navachab
7. Desert Lion
8. Rossing
9. The Salt Company
10. Langer Heinrich
11. Salt & Chemicals
12. Husab
13. Matchless
14. Otjihase
15. Namdeb Coastal Mines
16. Debmarine Namibia
17. Skorpion
18. Rosh Pinah
19. Tantalite Valley
20. Namib Lead and Zinc
21. Uis Tin



Diamonds

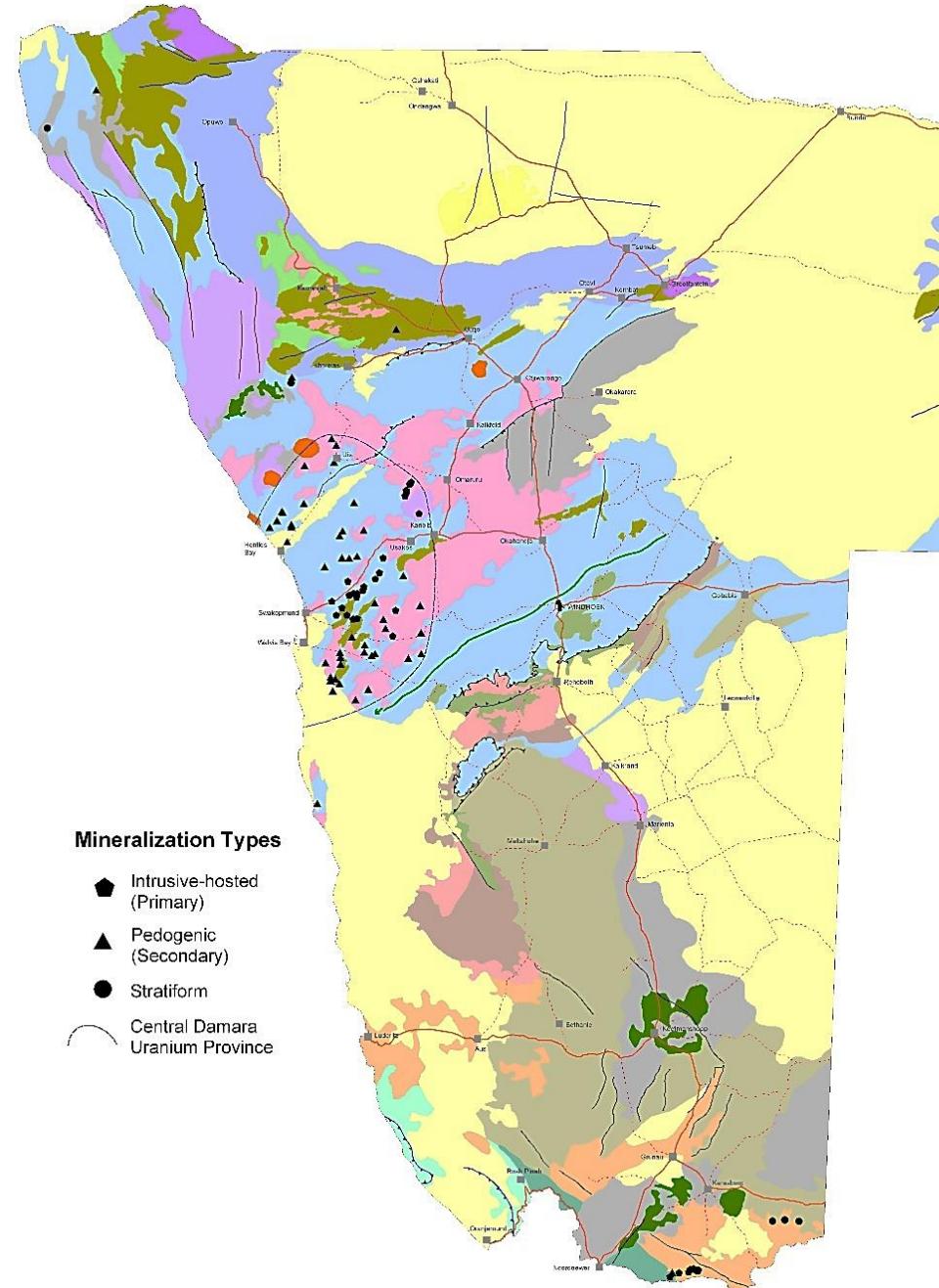


Uranium

Mineralization Types

- ◆ Intrusive-hosted (Primary)
- ▲ Pedogenic (Secondary)
- Stratiform

Central Damara Uranium Province



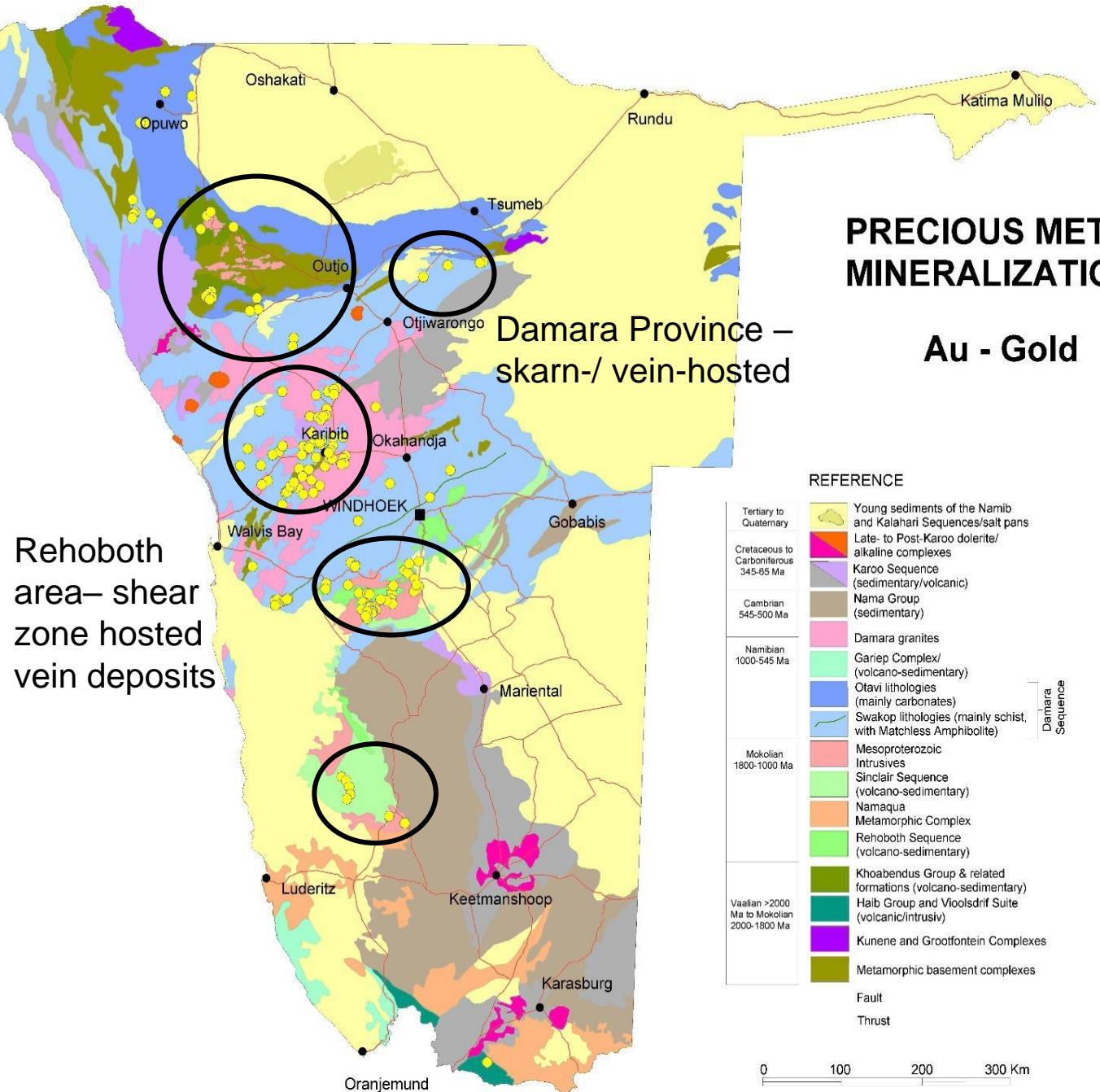
DISTRIBUTION OF URANIUM OCCURRENCES IN NAMIBIA

REFERENCE

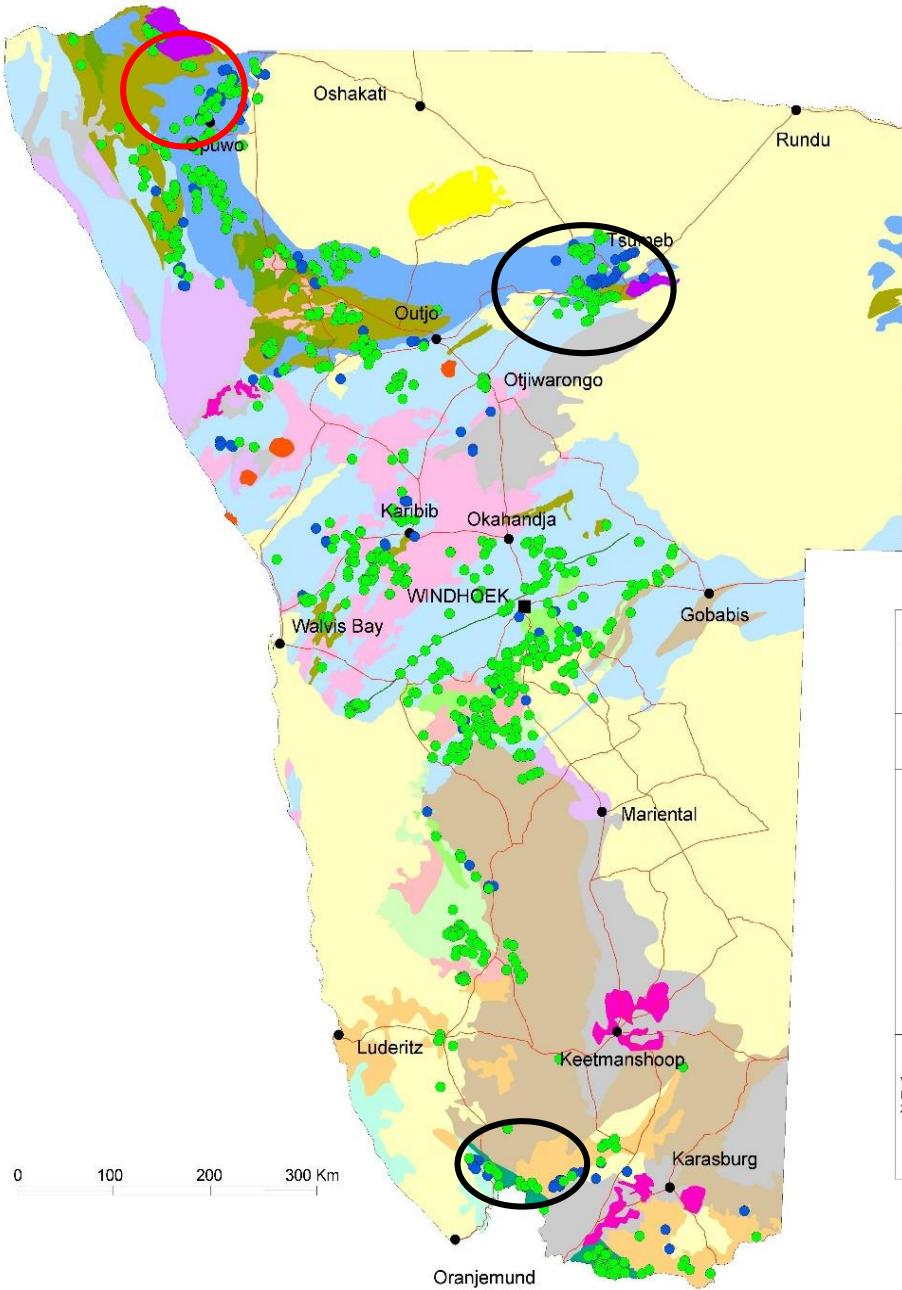
Tertiary to Quaternary	Young sediments of the Namib and Kalahari Sequences/salt pans
Cretaceous to Carboniferous 345-65 Ma	Late- to Post-Karoo dolerite/alkaline complexes
Cambrian 545-500 Ma	Karoo Sequence (sedimentary/volcanic)
Namibian 1000-545 Ma	Nama Group (sedimentary)
Mokolian 1800-1000 Ma	Damara Sequence
Vasilian >2000 Ma to Mokolian 2000-1800 Ma	Damara granites
	Gariep Complex/(volcano-sedimentary)
	Otavi lithologies (mainly carbonates)
	Swakop lithologies (mainly schist, with Matchless Amphibolite)
	Mesoproterozoic Intrusives
	Sinclair Sequence (volcano-sedimentary)
	Namaqua Metamorphic Complex
	Rehoboth Sequence (volcano-sedimentary)
	Khoabendus Group & related formations (volcano-sedimentary)
	Haib Group and Vioolsdrif Suite (volcanic/intrusiv)
	Kunene and Grootfontein Complexes
	Metamorphic basement complexes
	Fault
	Thrust

0 100 200 300 Km

Gold



Copper, Lead and Zinc, Cobalt

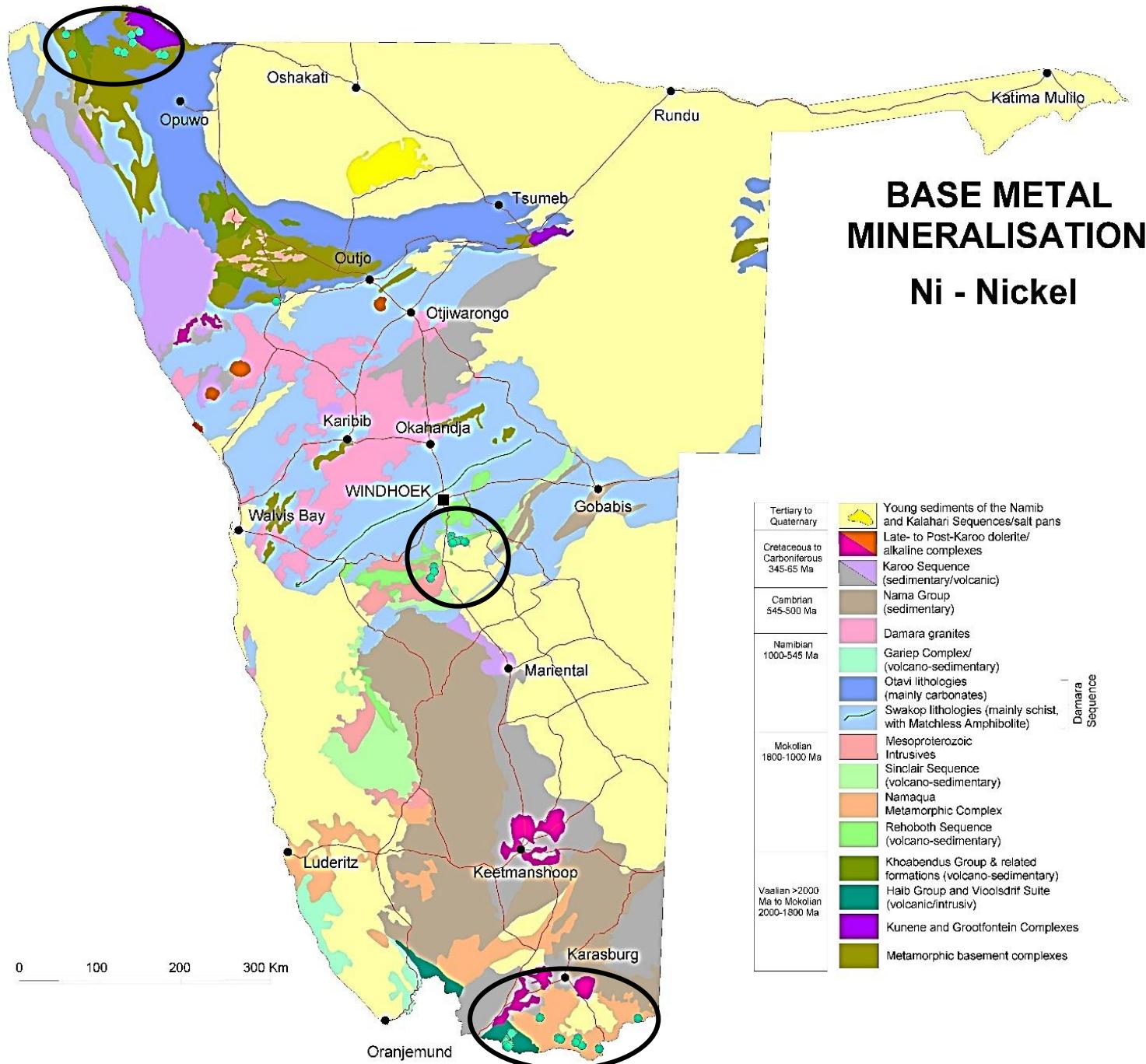


BASE METAL MINERALISATION

- Cu - Copper
- Pb/Zn - Lead/Zinc

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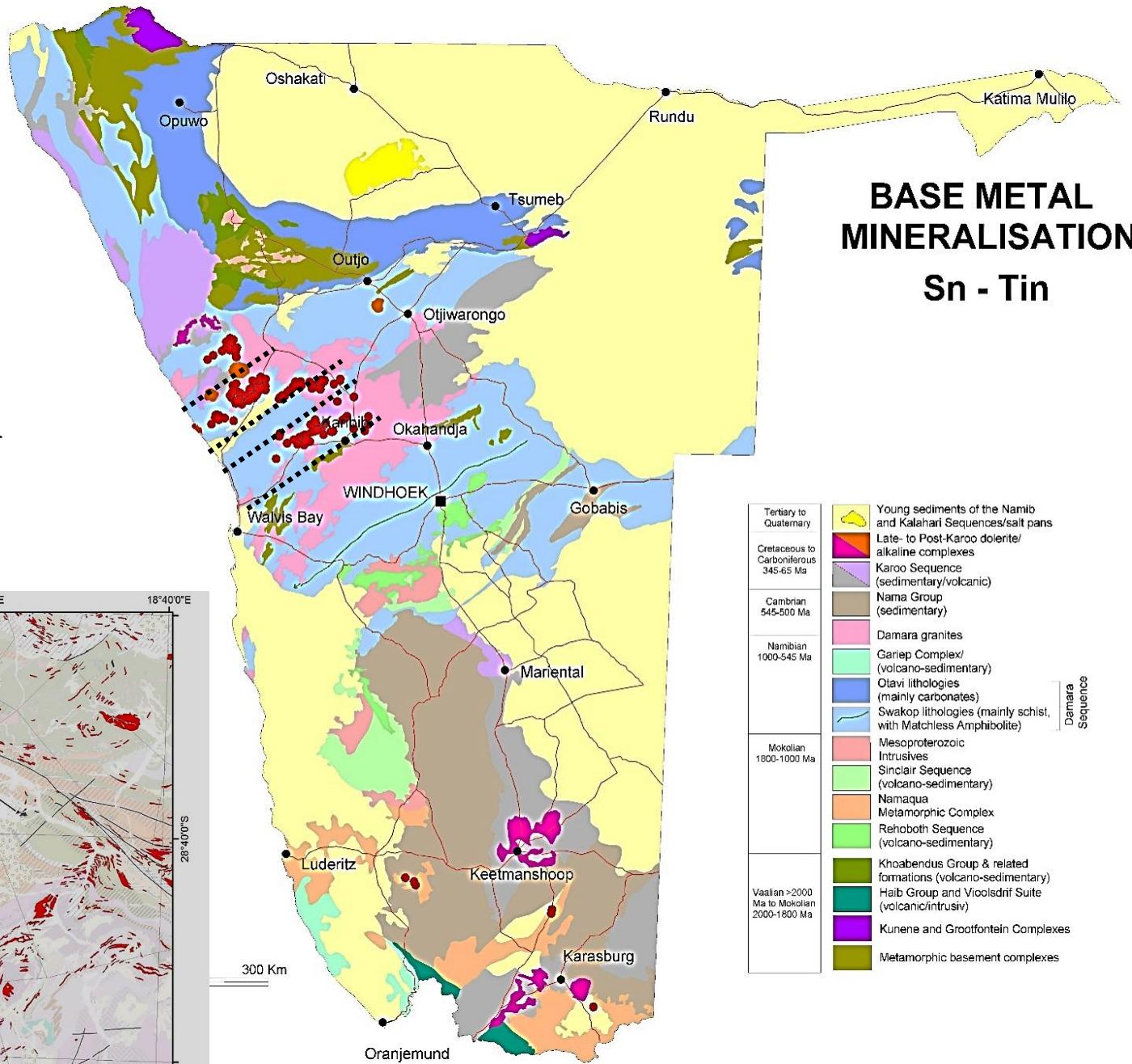
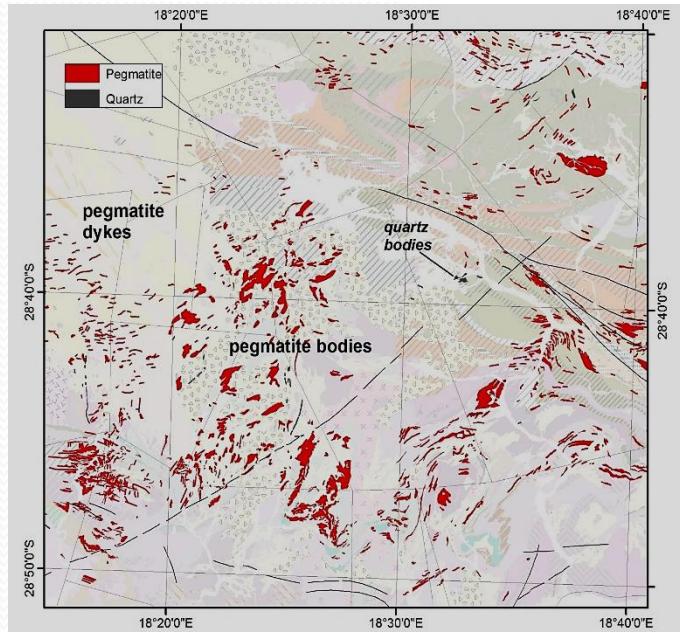
Nickel



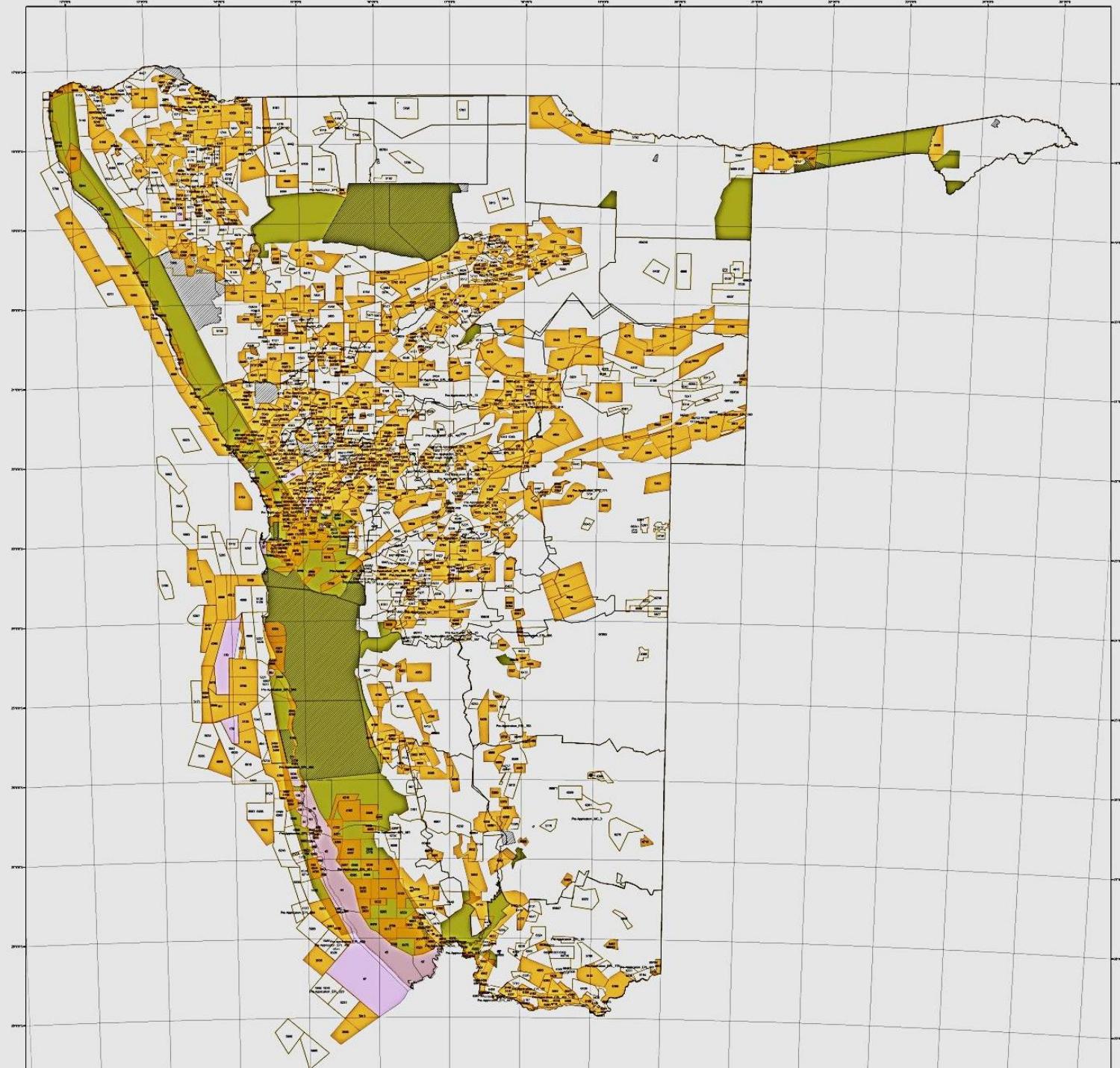
*Tin

* Orange River Pegmatite Belt

- Tantalum
- Lithium

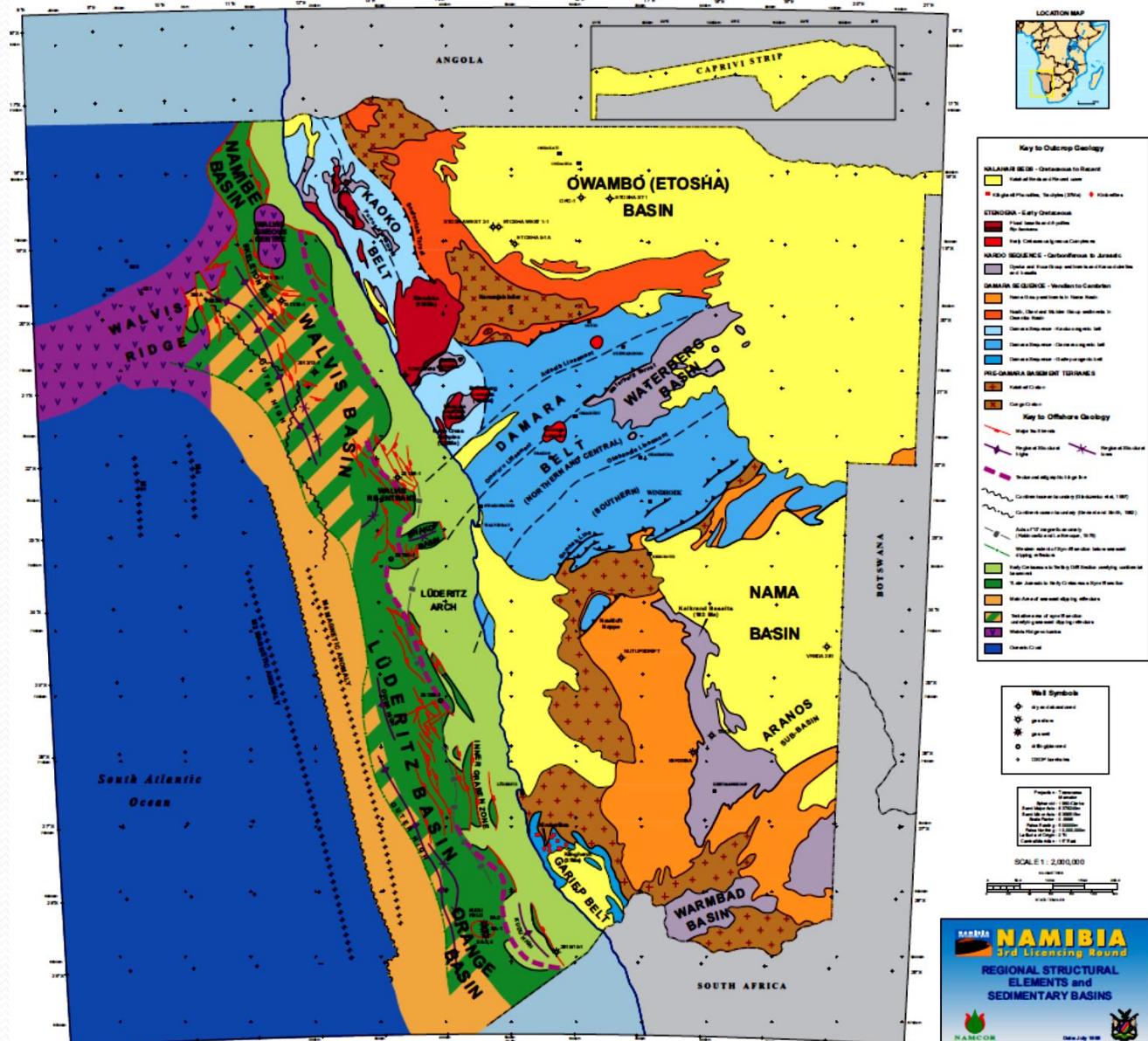


Mineral License Map

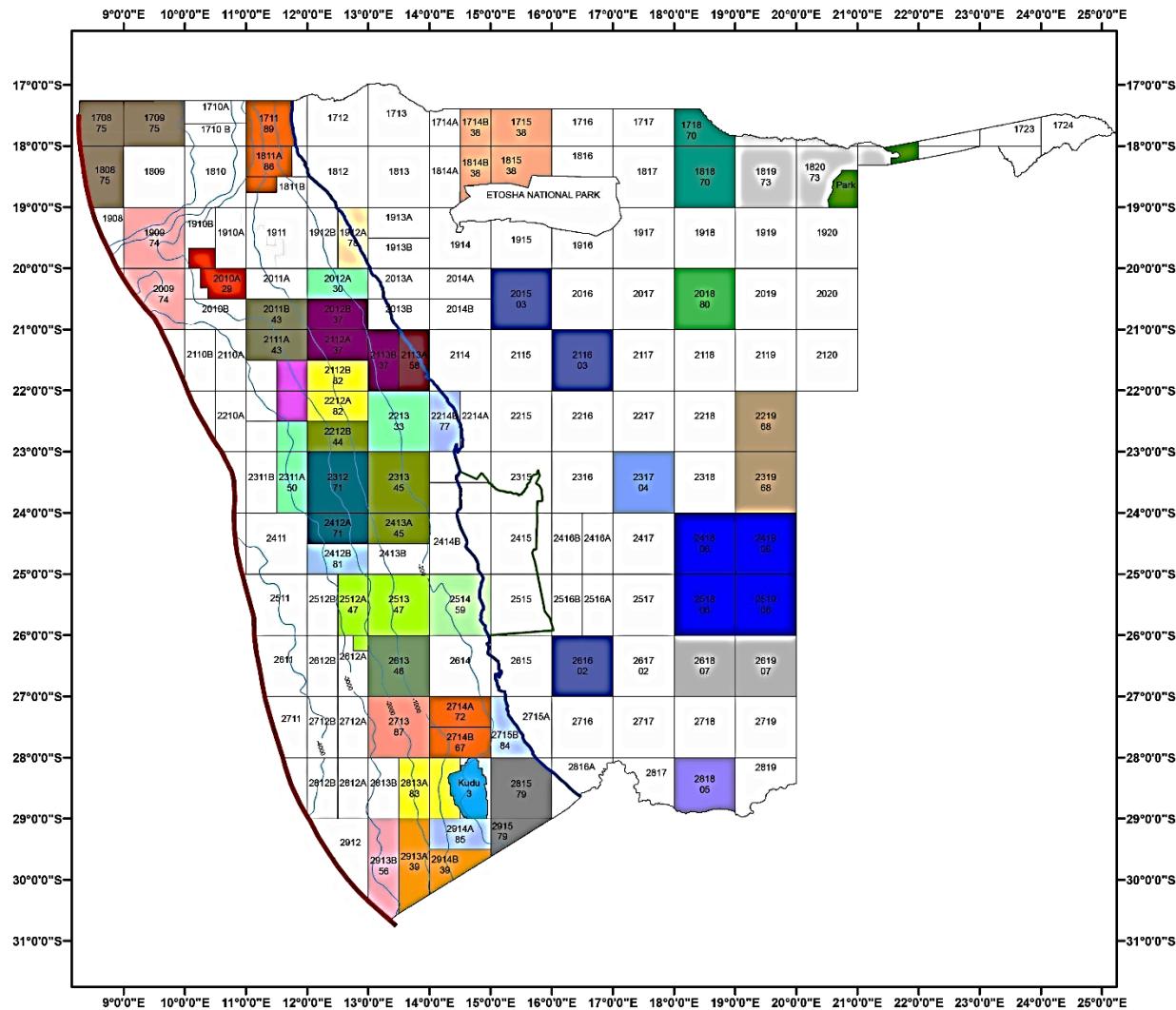
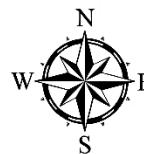


Hydrocarbon Potential

- Coal in Permian rocks - Karoo Supergroup,
 - e.g. Aranos basin
 - Oil + Gas
 - e.g. Kudu gas field, Orange Basin
 - Oil prone source rock discovered offshore



HYDROCARBON LICENSE MAP



Legend

— Limit Exclusive Economic Zone

— Isobath

— Shore line

Etosha national Park

World Heritage Zone

Production License

(PL 3) BW Kudu / NAMCOR

Exploration License

(PEL 29) Jupiter Petroleum Namibia

(PEL 76, 77, 84, 85) Rhino resources

(PEL 78) Global Oil and Gas

(PEL 79) Windfire Petroleum

(PEL 34) Azinam / ECO

(PEL 80) Methacarb Investments

(PEL 38) Hydrocarb Namibia Energy Corp

(PEL 81) Sungu Sungu

(PEL 39) Shell Exploration & Production

(PEL 82) Galp Energia / ExxonMobil

(PEL 43) Oronto Petroleum

(PEL 83) Galp Energia

(PEL 44, 45) Maurel & Prom Namibia

(PEL 87) Pancontinental Orange

(PEL 46) Cowan Oil and Gas Namibia

(PEL 47) Serica Energy Namibia

(PEL 56) Total / Impact

(PEL 58) Nabirn Energy Services

(PEL 59) Lekoil E&P

(PEL 67, 72, 86, 89) NAMCOR

(PEL 68) Alumni Expl East Namibia

(PEL 70) ACREP-Exploracao Petrolifera

(PEL 71) Enigma Oil and Gas

(PEL 73) Reconnaissance Energy

(PEL 74) Tse Oil & Gas

(PEL 75) Camelot Investment Group

Reconnaissance License

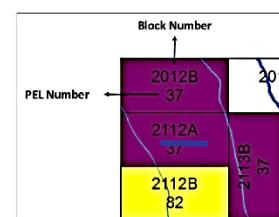
(02, 03) Tristone Africa Namibia

(04) Atlantic Petroleum

(05) Oshikoto Power

(06) Namibia E Source Petroleum

(07) CGP Energy

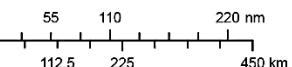


For further information:

www.namcor.com.na

www.mme.gov.na

Updated: 12 April 2018





Geological Survey Capacity

Geological Survey Capacity

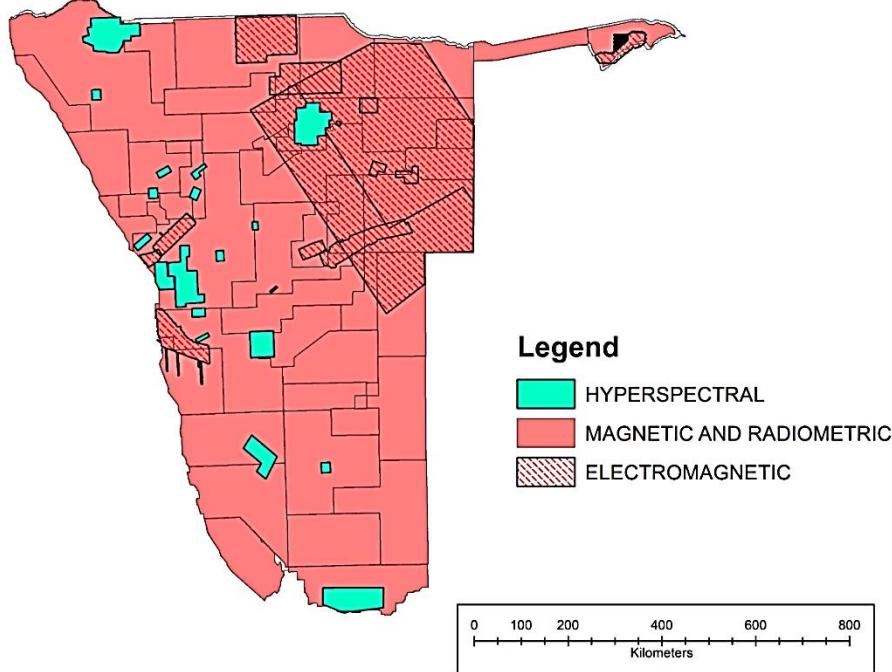
- Do we have the ability to acquire and disseminate data?
 - Continuous data acquisition and dissemination through research and surveying
- Do we have the relevant skills and expertise?
 - Young and vibrant geoscientific workforce with potential of developing specialized skills
- Do we have viable financial and human resource?
 - Minimum level
- What about the required tools and infrastructure?
 - Moderately equipped



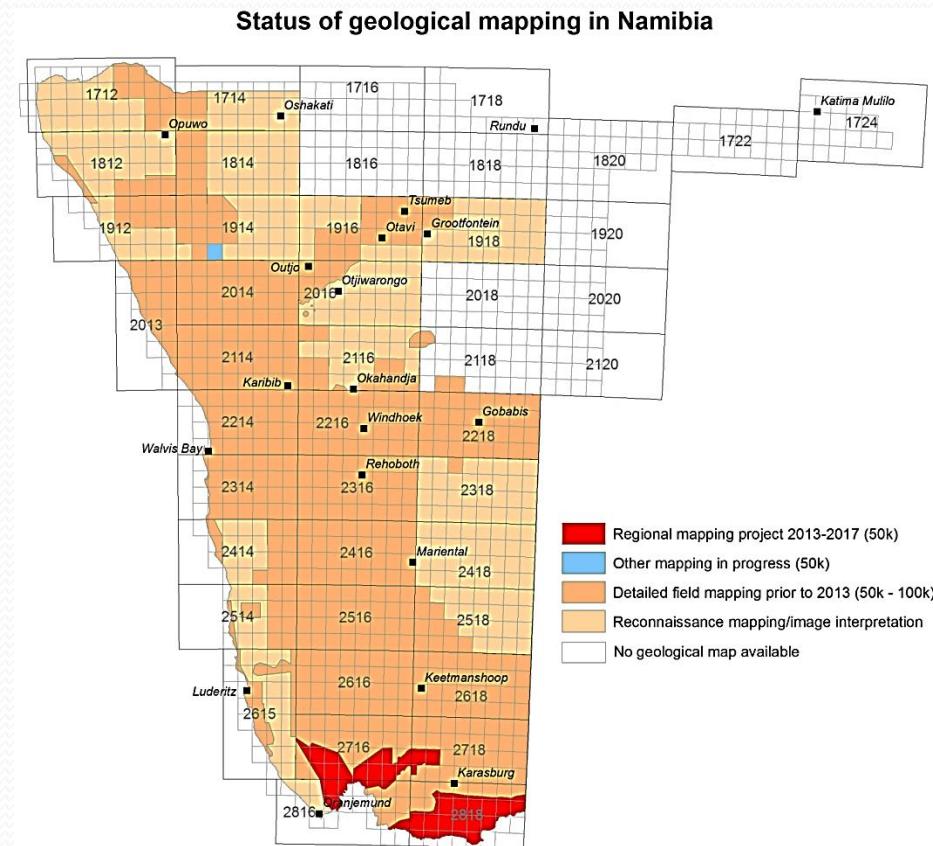
Geoscience Data Availability

Geoscience Data Availability

AIRBORNE GEOPHYSICAL SURVEY COVERAGE INDEX MAP



Baseline Data – Geophysics and Geological Mapping



Geoscience Data Availability



Earth Data Namibia



Mining
Mineral Licenses
Mineral Provinces
Mines, Plants, Dumps

Resources and Exploration
Mineral Deposits
Geochemistry
Drill Holes

Documents
Reports
Documents
Spatial Data incl. Metadata
Literature
Documents of Literature

Environment
Sites of environm. Concern
Groundwater Monitoring
Soil, Sediment Sampling
Surface Water Sampling
Radon Monitoring
Air Monitoring

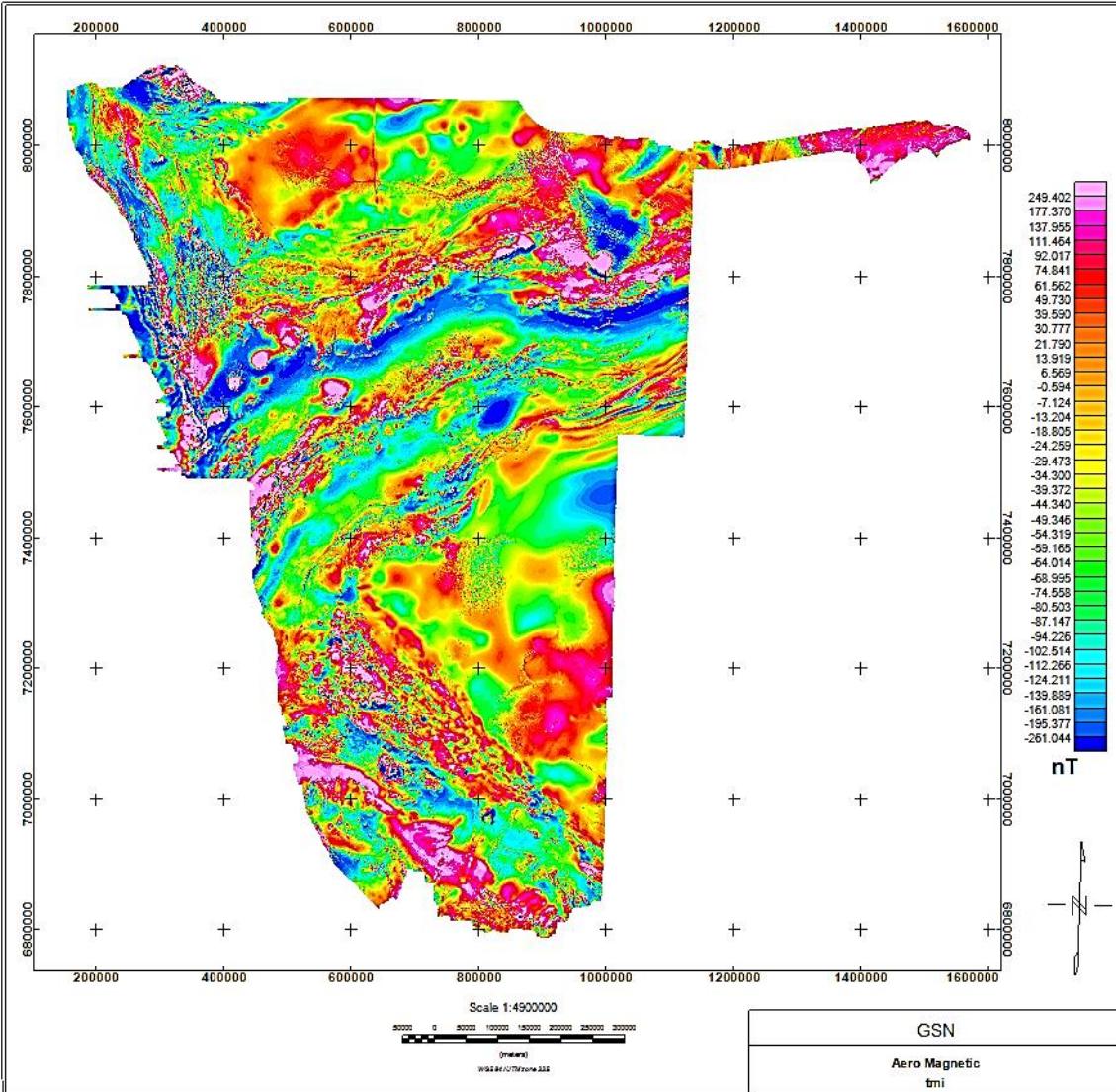
Geology
Geological Map 1:1.000.000
Geological Map 1:250.000

Property
Farms
Addresses

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Mineral Exploration Database

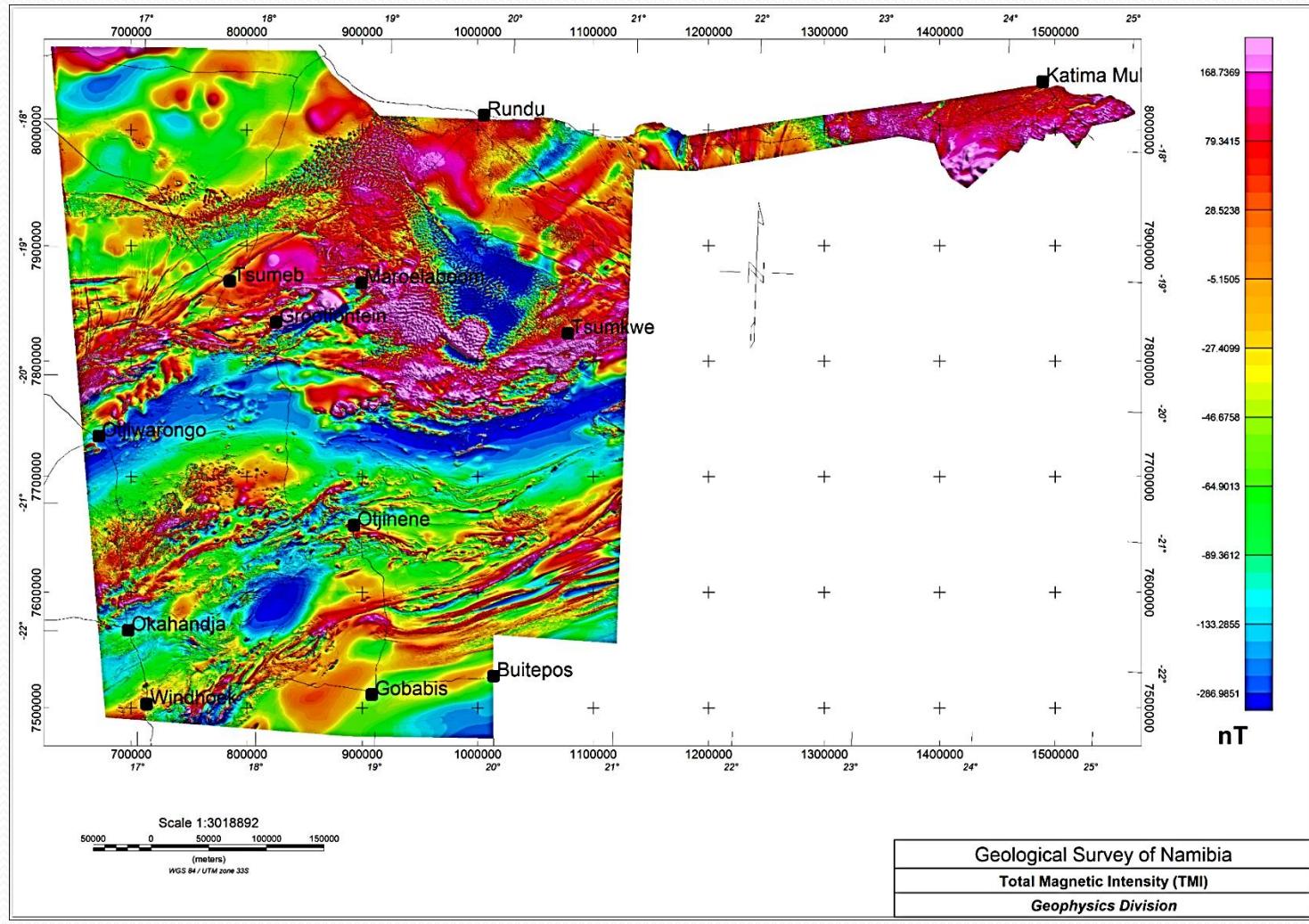


Future Potential

- Detailed regional geological mapping project in Southern Namibia
- Integrated interpretation of geophysical data in Zambezi, Otjozondjupa and Omaheke regions (3 years)
 - To stimulate economic development of a largely unexplored and potentially mineral-rich region
 - To compliment regional mapping through geophysical interpretation and drilling of 9 boreholes at 500m.
- Regional Geochemical mapping
- Target thematic mapping and economic assessment of mineral resources
- Marine Geology???



Integrated Geophysical Interpretation



SUSTAINABLE DEVELOPMENT OF MINERAL, ENERGY, GEOLOGICAL RESOURCES

IN SUMMARY

- Namibian geology provides an opportunity to explore mineral deposits formed in various tectonic settings
- Potential exists - discover and develop new deposits including to re-evaluate known mineral deposits
- Mineral exploration baseline data - incentive exploration programme.
- Ability to utilize remote sensing and geophysical techniques in conjunction with geological mapping to narrow the search for targets
- Ability to continually update datasets and to generate raw data and data-products at various scales

- We need to develop our mineral commodities using environmentally responsible practices
 - This requires expertise from across government, industry and academia to collectively address mining-related challenges in Namibia
 - Addressing legacy problems from earlier mining to eliminate existing social or environmental problems;
- Invest in strengthening the collection and dissemination of geological data in Namibia
 - Invest in IT/Technology programs and infrastructure for sustainable geoscience data accessibility
- Namibia's extractive industry and services sector should establish the expertise and capacity for self-sustainability.
 - This requires targeted / systematic assessment of capacity gaps
 - Mutually beneficial bilateral arrangements
 - When we have highly skilled geoscience professionals, knowledge and data about our national mining potential, it improves our ability to regulate mining exploration and attract investment in a sustainable manner and allows for long term economic, physical and social planning!



Geology Underlies Everything!

THANK YOU!