



# STATUS OF MINERAL EXPLORATION AND DEVELOPMENT IN ZIMBABWE



BY

ERNEST.T. MUGANDANI

ZIMBABWE GEOLOGICAL SURVEY

SAIMM CONFERENCE ,

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# Presentation Outline



- INTRODUCTION
- MINING IN ZIMBABWE
  - STATUS OF BASELINE GEOLOGICAL DATA
  - LEGISLATIVE FRAMEWORK FOR MINERAL EXPLORATION
- EXPLORATION TITLES AND HISTORICAL TRENDS
- EXPLORATION EXPENDITURE AND ACHIEVEMENTS
  - HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS
- FUTURE OUTLOOK & CONCLUSION

# INTRODUCTION



- Mining industry currently Zimbabwe's biggest target by international investors
- Mineral exports account for over 50% of the country's foreign exports earnings.
- The mining sector employs over 45 000 people formally and more than 500 000 informally.
- Long history of mineral exploration and mining
- >40 different minerals are known and have been mined at one point in time.

# MINING IN ZIMBABWE



- Credited for most of present-day infrastructure in Zimbabwe.
- Majority of towns and cities developed in the vicinity of mining areas e.g Hwange, Kadoma, Kwekwe etc.
- Most railway line branches and some major roads were constructed to serve mining areas.
- Many industries arose through mining industry's needs.
- The mining sector continues to act as a magnet for investment in Zimbabwe.

# GEOLOGY OF ZIMBABWE



- Geology spanning >3000 Ma. Highly conducive for diversity of minerals.
- Divided into three main eras;
  1. The Archean
    - Also known as the Zimbabwe Craton
    - An Archaean Basement principally composed of granites and gneisses with remnants of volcano-sedimentary piles known as Greenstone Belts.
    - Covers 60% of the country, central in location.

# GEOLOGY OF ZIMBABWE cont



## 2.The Proterozoic

- Marked by the Great Dyke, a NNE-trending intrusion of mafic-ultramafic layered rocks
- Emplaced at the end of the Archean era (2 500 million years ago)
- 550km long and 4-11km wide
- Cuts across the entire Craton roughly in a N-S direction.
- Three Proterozoic Metamorphic/"Mobile" Belts surround the Craton to the north east, south, and north-west.
- The metamorphic belts are rich in economic metamorphic minerals and host several gemstones, precious and base metal mines.

# GEOLOGY OF ZIMBABWE cont



## 3.The Phanerozoic

- Consists of several sequences of sedimentary rocks covering the peripheries of the Craton
- Includes Sedimentary basins, the Permian –Triassic Jurassic Karoo Supergroup, Cretaceous sediments, and Tertiary to Recent sands of the Kalahari
- Post Karoo intrusives; various granitic rocks in the southern part of the country, alkali ring complexes, and kimberlites



# ZIMBABWE GEOLOGICAL MAP

Scale of Kilometres

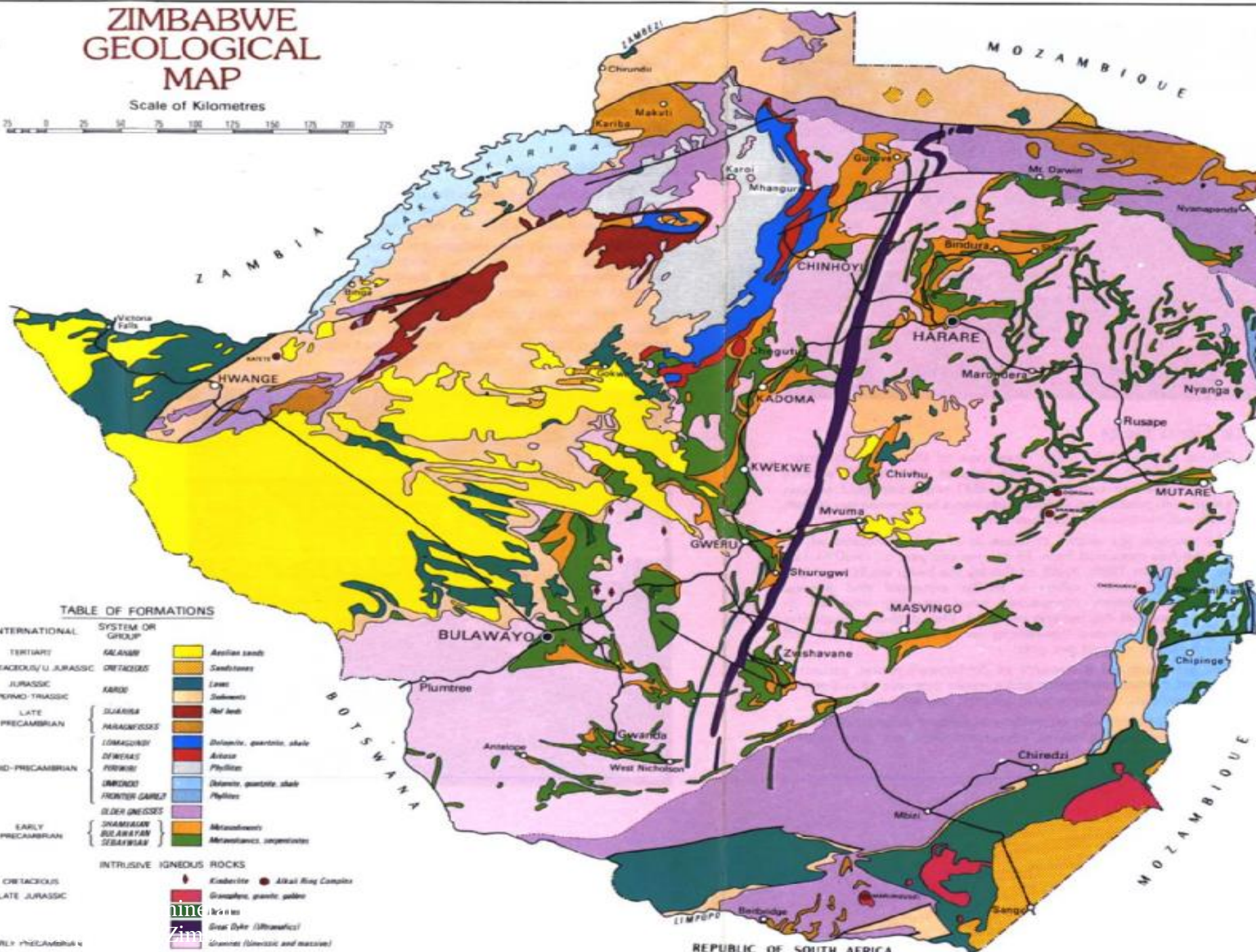


TABLE OF FORMATIONS

INTERNATIONAL	SYSTEM OR GROUP	
TERTIARY	KALAMBI	Arctian sands
CRETACEOUS/U. JURASSIC	OROTAGOS	Sandstones
JURASSIC	KARROO	Limestones
PERMO-TRASSIC		Sediments
LATE PRECAMBRIAN	CHIRINDI	Red beds
	PARAGNEISS	Dolomite, quartzite, shale
	LOMACINDI	Arctian
MID-PRECAMBRIAN	OROTAGOS	Phyllites
	FRONTIER GNEISS	Dolomite, quartzite, shale
	OLDER GNEISS	Phyllites
EARLY PRECAMBRIAN	SHAMBURO	Metasediments
	SHAMBURO	Metasediments, igneous rocks
	INTRUSIVE	
	IGNEOUS ROCKS	
CRETACEOUS		Kibabwa
LATE JURASSIC		Granulites, gneiss, gabbro
		Granites
		Great Dyke (Mafic)
EARLY PRECAMBRIAN		Granites (Gneissic and massive)



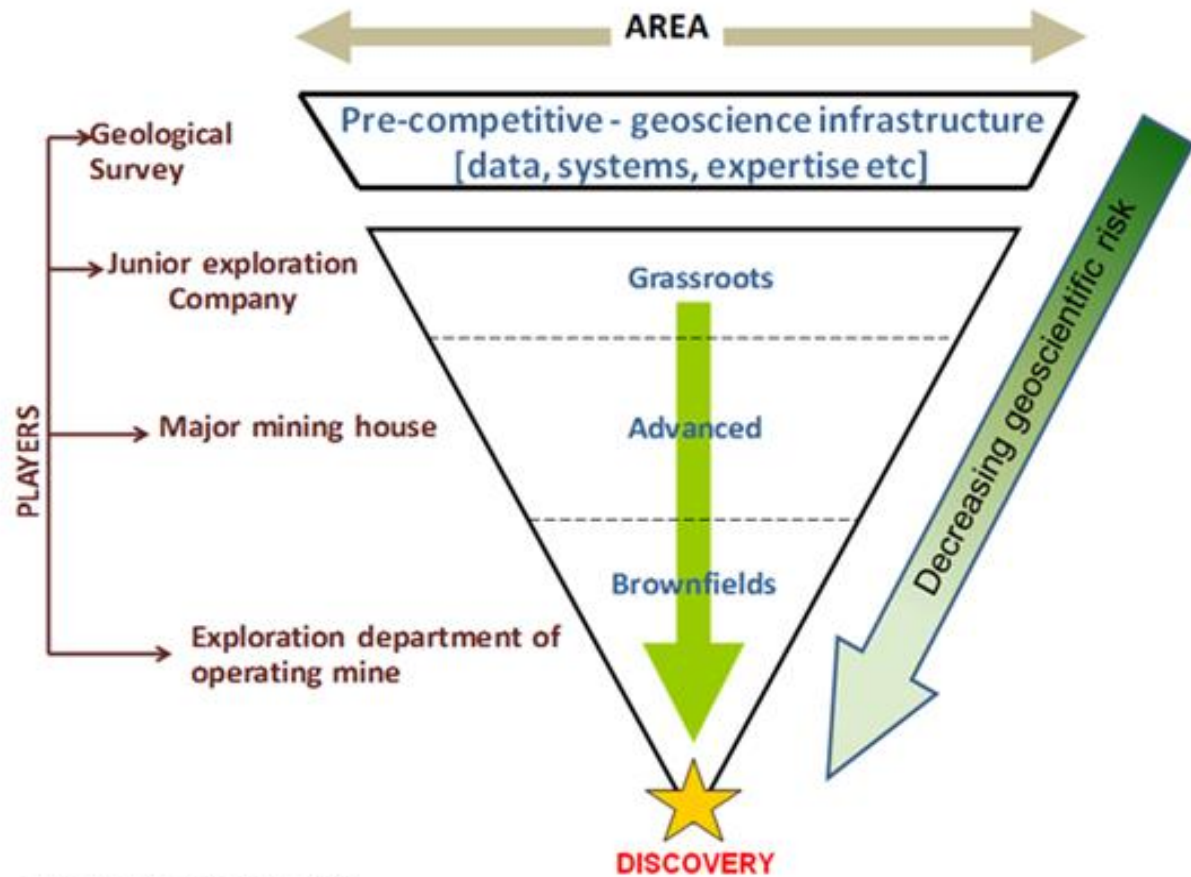


- *Mineral deposits of Zimbabwe are amongst the best documented in the region, and a search through the available literature always forms the first stage in exploration of any mineral.*
- *Baseline geological, geophysical, geochemical, Remote sensing data is necessary at this stage.*

# STATUS OF BASELINE GEOLOGICAL DATA

Geological Surveys provide pre-competitive geoscientific information used by exploration companies

## Model of Geological surveys in the mining Sector



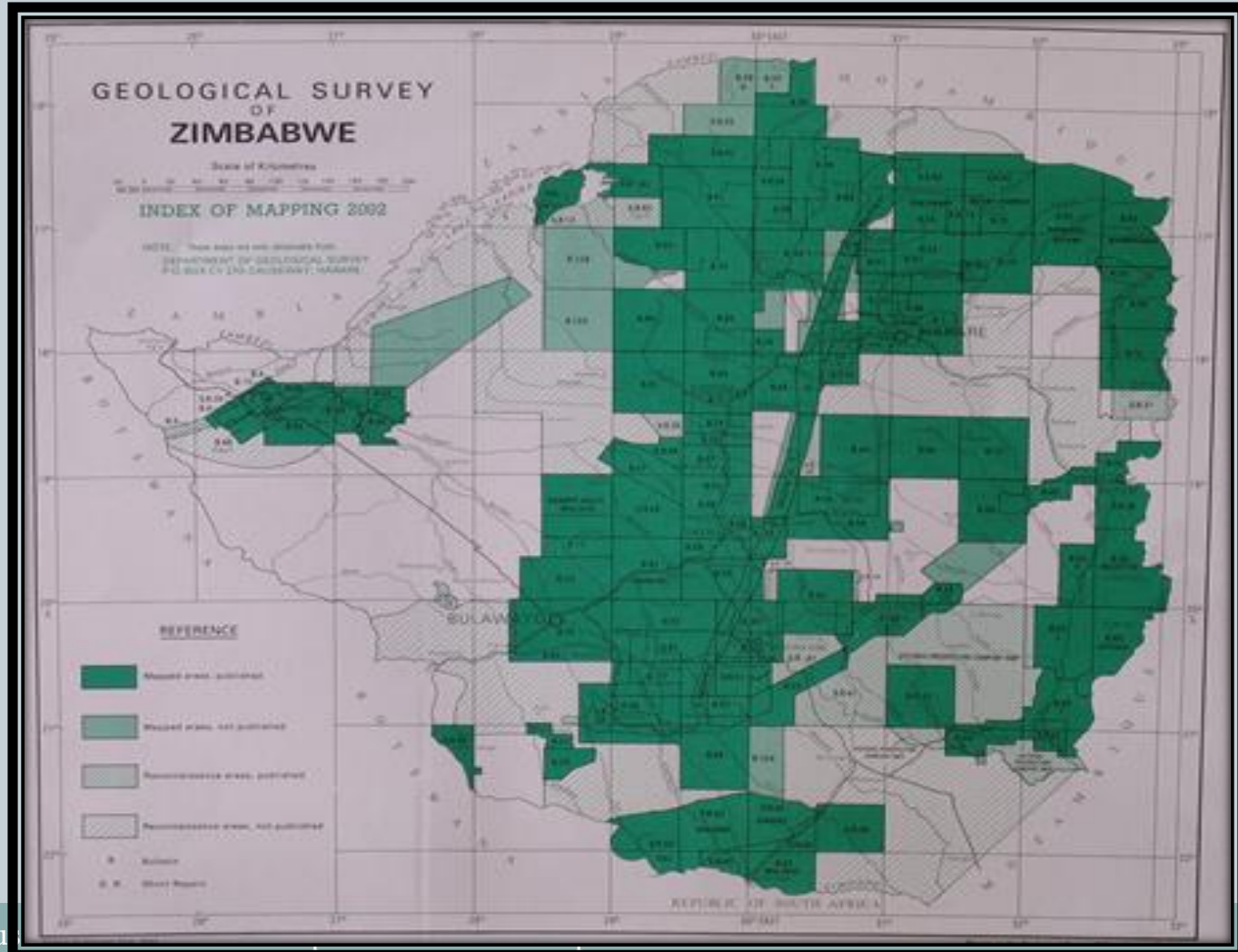
\* Modified after Blight D.F., 2002

# STATUS OF BASELINE GEOLOGICAL DATA

- **GEOLOGICAL MAPPING**

**About 60 - 65%  
of the country  
has been mapped  
in detail.**

**Each block has been  
mapped at a scale of  
1:50 000 but maps  
published at  
1:100 000  
accompanied by  
a descriptive text**

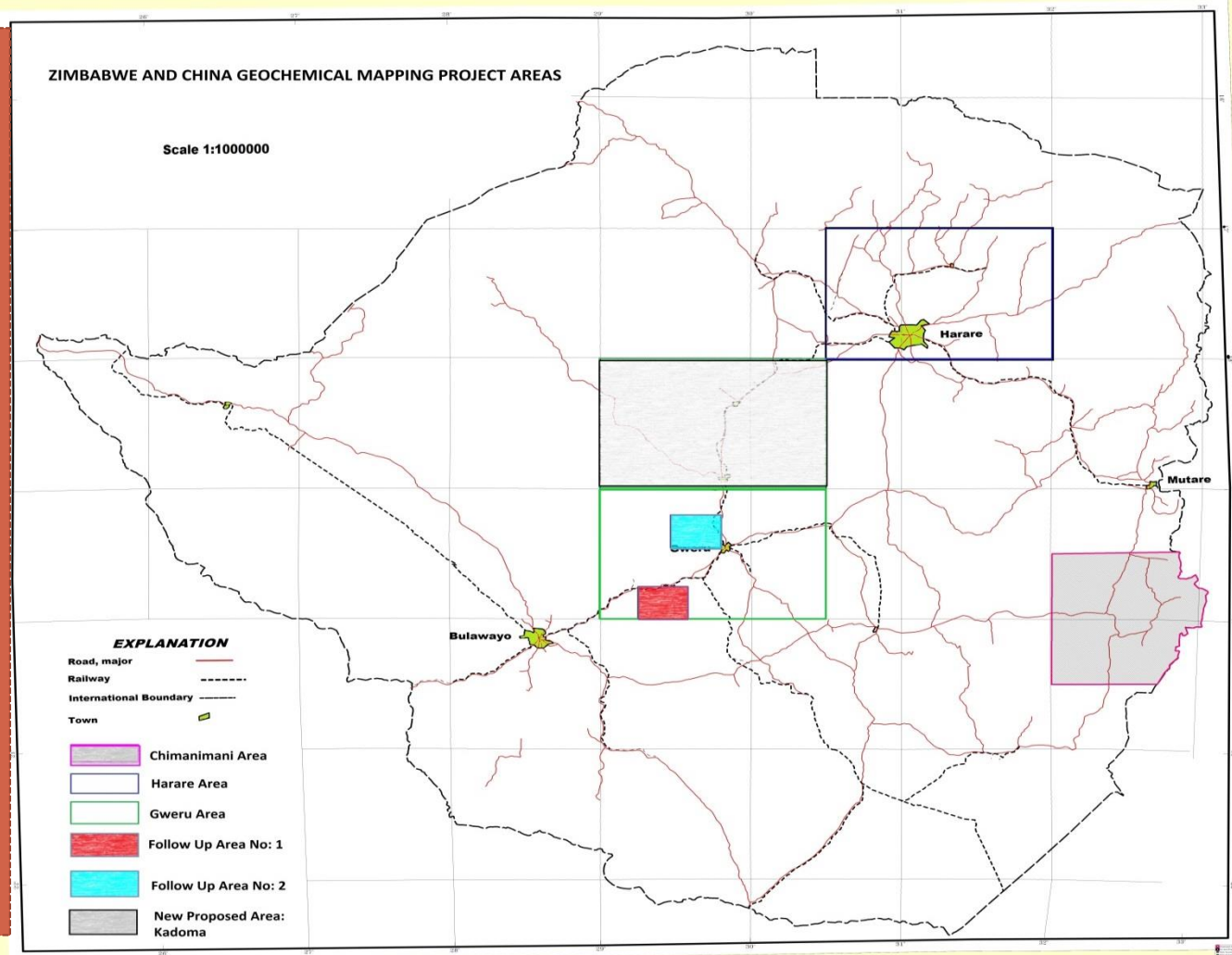


# STATUS OF BASELINE GEOLOGICAL DATA

## • GEOCHEMICAL MAPPING

Two Geochemical mapping levels  
National Scale:  
**Zimbabwe National Low Density Mapping Project.**

Cover whole country  
average sample density : 1 sample/ 2 000 km<sup>2</sup>  
sample media:  
floodplain/overbank sediment  
total sampling sites: 200  
chemical analysis: 41 elements;



# STATUS OF BASELINE GEOLOGICAL DATA

## • GEOCHEMICAL MAPPING

Regional Scale

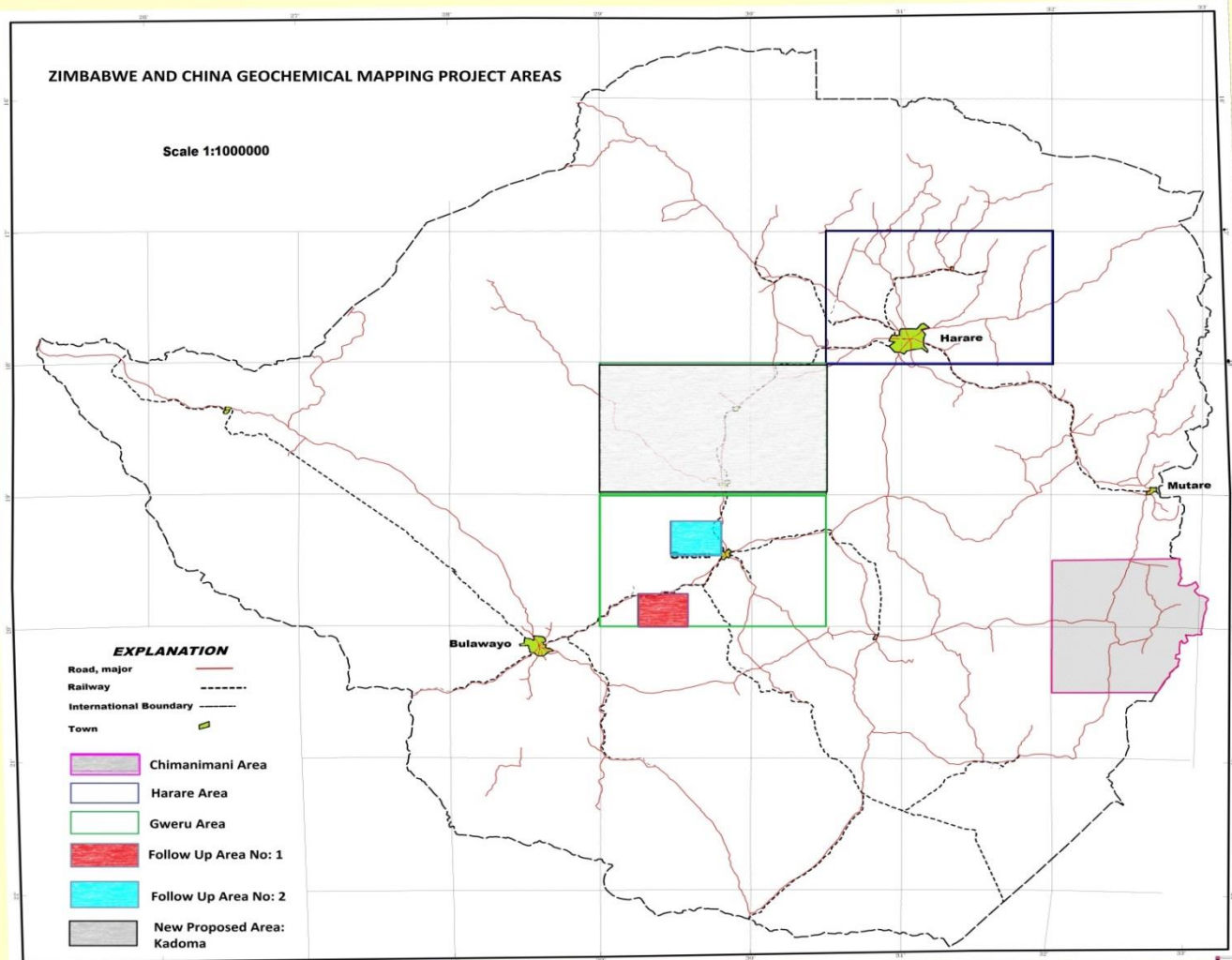
Regional Geochemical  
Mapping Project in  
Chimanimani Area,  
Harare and Gweru

Area: 10 400 km<sup>2</sup>

Mapping scale: 1:250  
000

Sampling density: 1  
sample/4 km<sup>2</sup>

Sampling media:  
stream sediments  
39 elements were  
analyzed



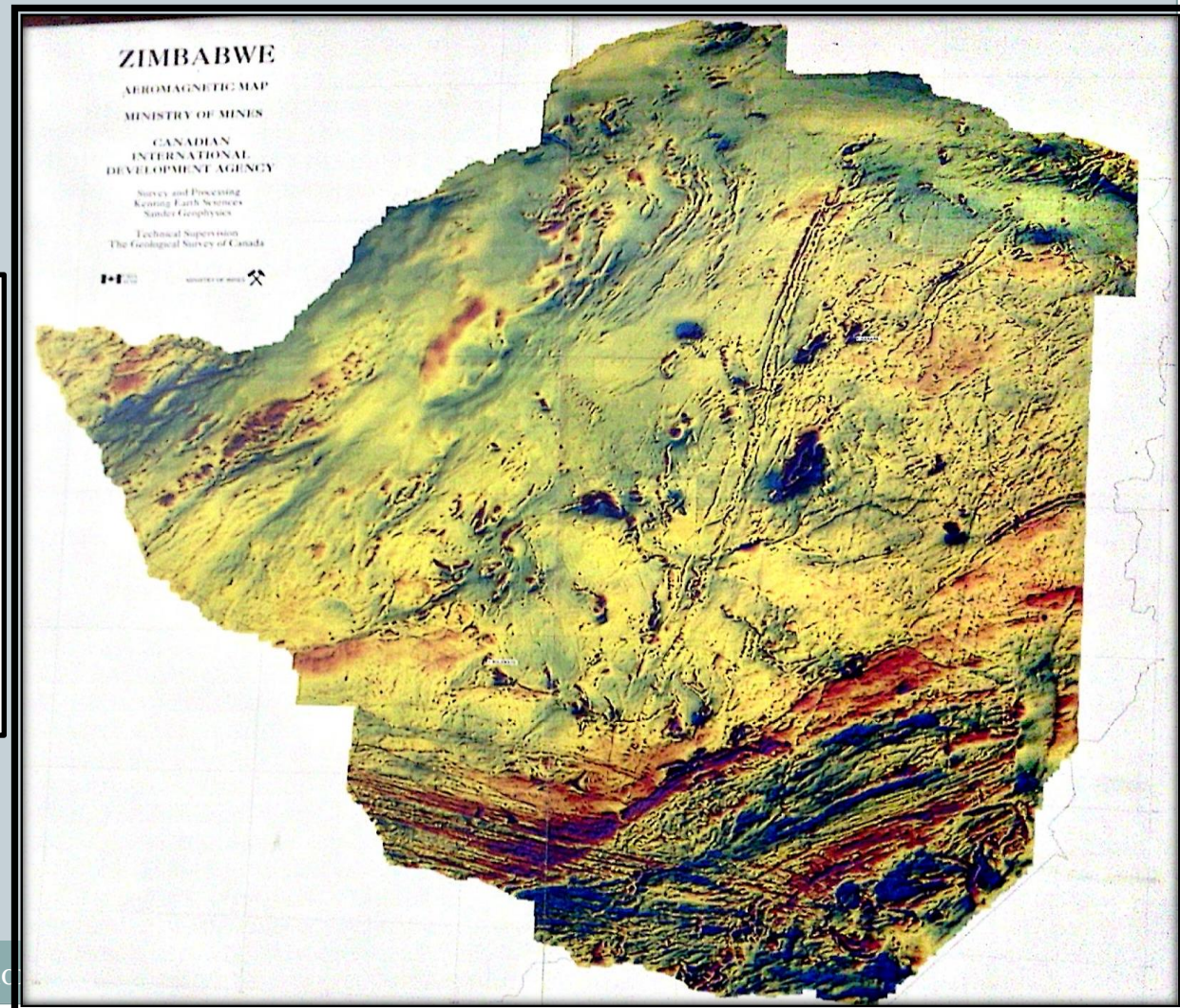


# STATUS OF BASELINE GEOLOGICAL DATA

## • GEOPHYSICAL MAPPING

### Aero-Magnetics

- At height of 305 m
- Line spacing of 1 km
- About 95% of the country covered





## ZIMBABWE

100 0 100 Kilometers

email: zgs@mweb.co.zw  
phone: 263-4-730314/5  
263-4-726342/4



- EPO areas where high resolution airborne geophysical surveys were conducted.  
(DB-De Beers, RT-Rio Tinto, CR- Canister Resources, 721 - other)
- JICA funded geophysical ground surveys.
- Special grants areas where high resolution airborne geophysical surveys were conducted.
- CIDA funded high resolution airborne surveys and ground geophysical follow-up projects.
- Phase1: CIDA Funded Aeromagnetic Project
- Phase2: CIDA Funded Aeromagnetic Project
- Phase3: CIDA Funded Aeromagnetic Project

#### DATA AVAILABILITY

A (d) - AVAILABLE AS DIGITAL DATA, A (rd) - AVAILABLE AS REDIGITISED DATA,  
A (h) - AVAILABLE AS HARD COPY, A(r) - AVAILABLE AS TECHNICAL REPORT ONLY,  
N/A - NOT AVAILABLE, CC - CLIENT CONFIDENTIALITY.

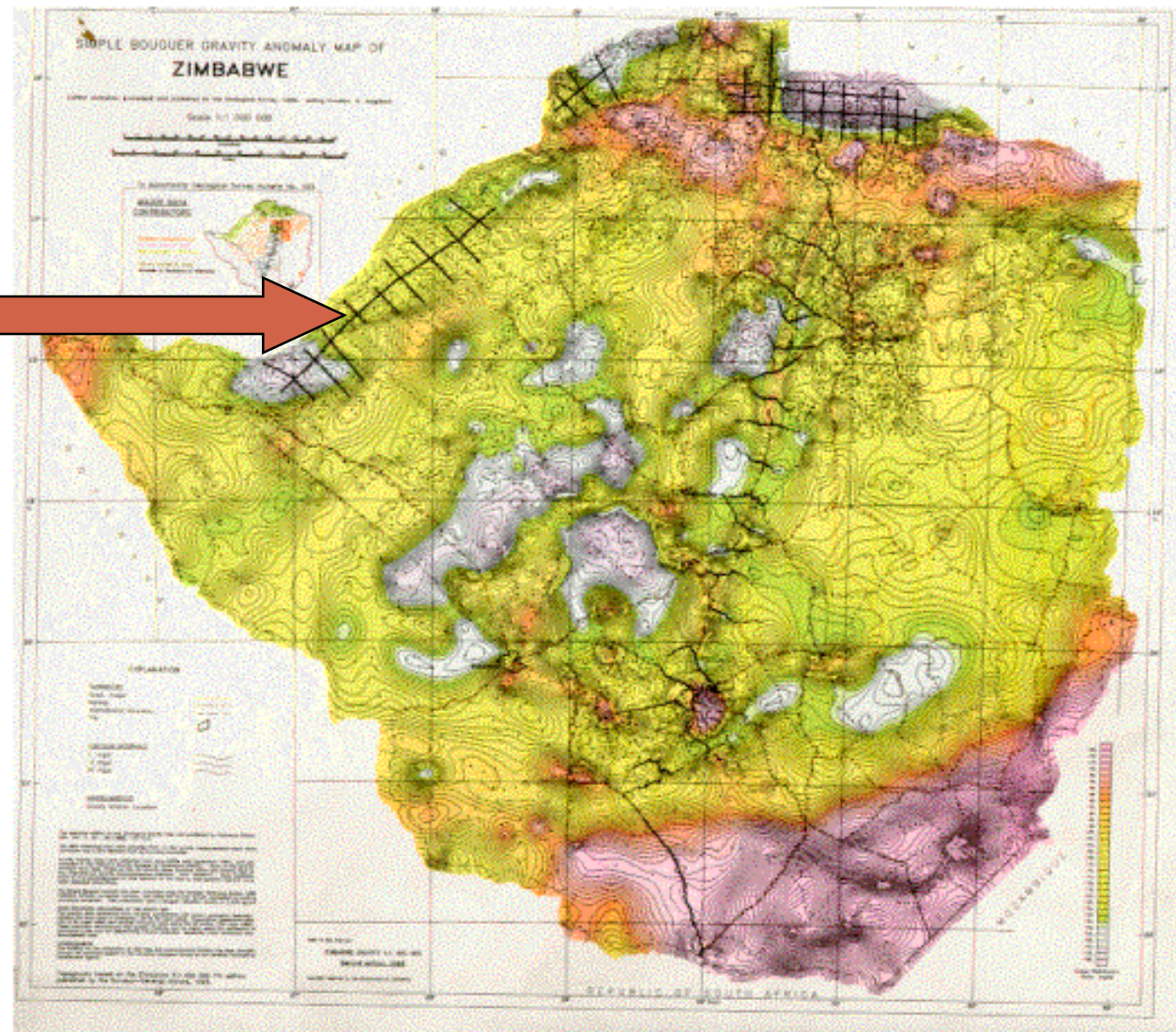


# STATUS OF BASELINE GEOLOGICAL DATA

- Gravity Survey

**SEISMIC LINES**  
done during Oil  
exploration


- *rock density contrasts*
- *Ground stations from 1 per km<sup>2</sup> to 1 per 100 km<sup>2</sup>*



# LEGISLATIVE FRAMEWORK FOR MINERAL EXPLORATION

- Large scale exploration carried out under licenses issued by the Head of State and administered by the Mining Affairs Board (MAB) as per the provisions of Mines and Minerals Act (ch.21:05)
- Large scale exploration licenses issued under two titles, depending on the mineral to be explored;
  - 1. Special Grant (SG) for energy minerals which include Coal, CBM, Natural Gas, Oil and Uranium.
  - 2) Exclusive Prospecting Order (EPO) for all other minerals including base metals, gold, diamond etc.
- Type of license introduced in 1947.
- Over 1600 large scale exploration licenses have been issued to date.

# LEGISLATIVE FRAMEWORK FOR MINERAL EXPLORATION

- 
- Preliminary exploration covering whole country done at one point or another.
  - History of exploration dates back to the 19th century.
  - Over 4000 Mineral deposits known from ancient workings.
  - Current exploration activities biased towards rediscovering ancient workings
  - Exploration led to discovery of several major mines some of which are still operating to date, e.g. Zimplats, Murowa Diamonds, Freda Rebecca, Hwange Colliery

# LEGISLATIVE FRAMEWORK FOR MINERAL EXPLORATION



## NON SYSTEMATIC EXPLORATION ACTIVITIES

- Exploration in claims which are mining titles – the results of this exploration which is usually meant for mine development is normally not reported.
- Special grants in reserved areas – the reporting is also non systematic in nature.

# STATUS OF EXPLORATION TITLES



## EXCLUSIVE PROSPECTING ORDERS (EPOs)

- Number current = 0
- Number pending applications = 34
- Number pending approval for renewal = 3

## SPECIAL GRANTS (Part XX) of MMA

- Number current = 18
- Number pending applications = 35
- Number pending approval for renewal = 20

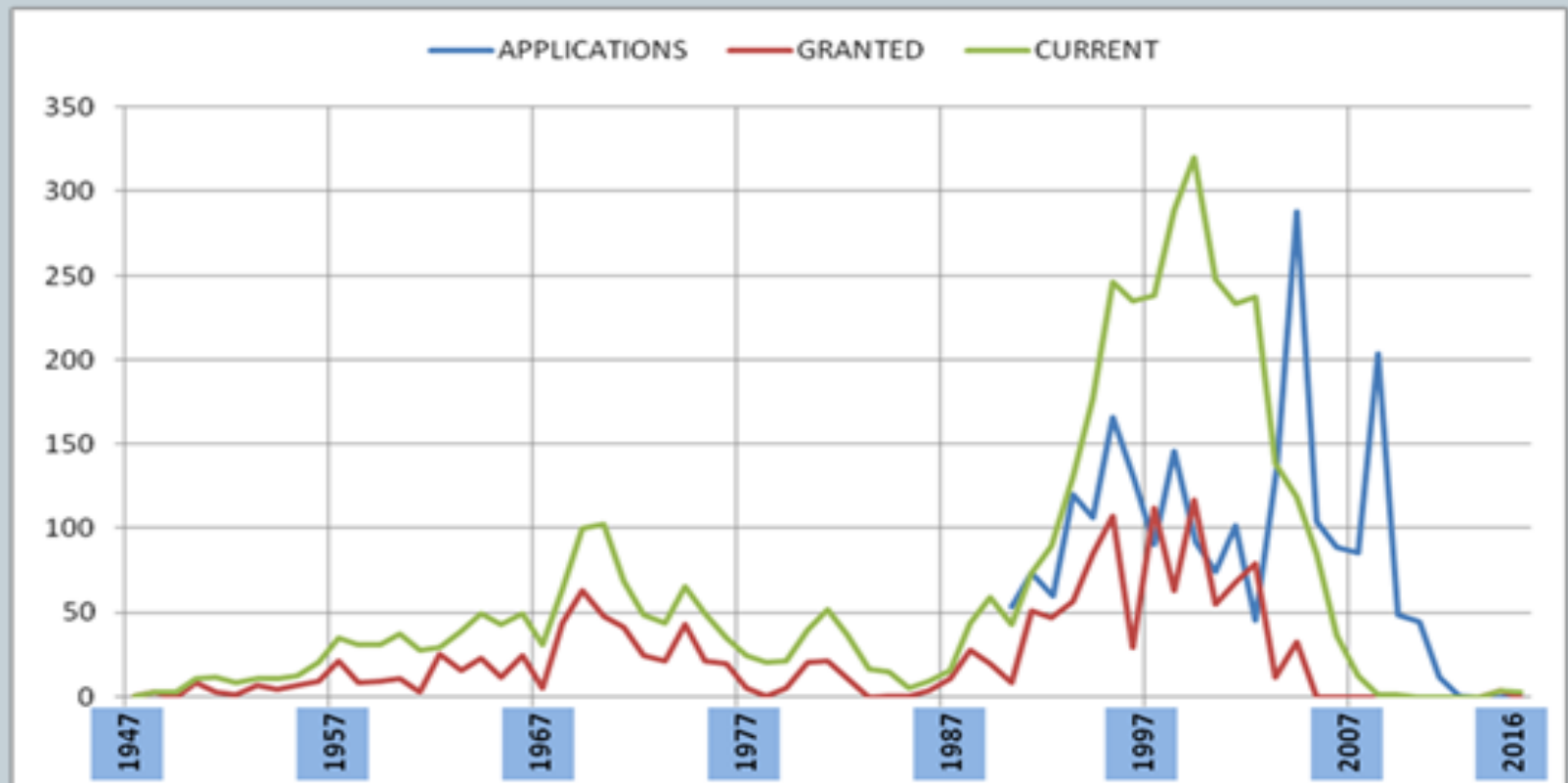


# STATUS OF EXPLORATION TITLES



## Exclusive Prospecting Orders

No. of EPOs



# HISTORICAL EXPLORATION TRENDS

- The past century commencing in 1910 coinciding with the establishment of the Zimbabwe Geological Survey was characterized by distinct phases of prospecting interest.
- There was a peak activity in the 1960s to early 1970s reflecting a world trend in increased exploration, notably for base metals.
- The years 1968-75 constituted the nickel boom with Ni/Cu by far the most popular target over that period in Zimbabwe.



# HISTORICAL EXPLORATION TRENDS



- The decade, coinciding with the first of ten years of the country's independence, has had its ups and downs in the exploration sphere.
- There was an initial rush in E.P.O applications and exploration activities in 1980 and 1981, much of this work being aimed at re-establishing previously suspended programmes as a result of insecurity caused by the war of independence.
- All mineral categories were targets, although Coal and Uranium were topping the list. The falling base mineral prices in the mid 1980s resulted in drastic drop in activity.

# HISTORICAL EXPLORATION TRENDS

- The fall in gold prices in the early 1988, resulted in a change of emphasis in 1989 with more than ten E.P.O holders specifically selecting Platinum as a target mineral.
- In the early 1990s there was a growing interest in diamond exploration encouraged by the opening of the River Ranch diamond mine near Beitbridge.
- There was also an interest in gas exploration in Zimbabwe in the early 1990s with major focus being on Coal Bed Methane (CBM).
- Significant CBM resource has since been established but development to critical stage of proving the commercial viability of the gas is still lagging behind.

# HISTORICAL EXPLORATION TRENDS

- An important event in the exploration history of the country was marked by the availability of the Canadian International Development Agency (CIDA) sponsored aeromagnetic data on Zimbabwe in the 1990s.
- The data attracted several exploration companies to venture into areas that had previously been ignored. This was especially for the western parts of the country covered by Kalahari sands.
- The data also triggered diamond exploration.

# SYSTEMATIC EXPLORATION EXPENDITURES

YEAR	NO. CURRENT EPOS BY END OF YEAR	NO. CURRENT SGS BY END OF YEAR	TOTAL NO. OF EXPLORATION TITLES	ANNUAL EXPLORATION EXPENDITURE (US\$)
<b>2009</b>	2	31	33	107 731+
<b>2010</b>	0	16	16	2 066 172+
<b>2011</b>	0	23	23	19 901 285+
<b>2012</b>	0	27	27	11 850 368+
<b>2013</b>	0	11	11	29 323 969+
<b>2014</b>	4	18	22	1 017 593+
<b>2015</b>	3	21	24	112 182+
<b>2016 (August)</b>	3	24	27	46 645+



# ACHIEVEMENTS OF EXPLORATION

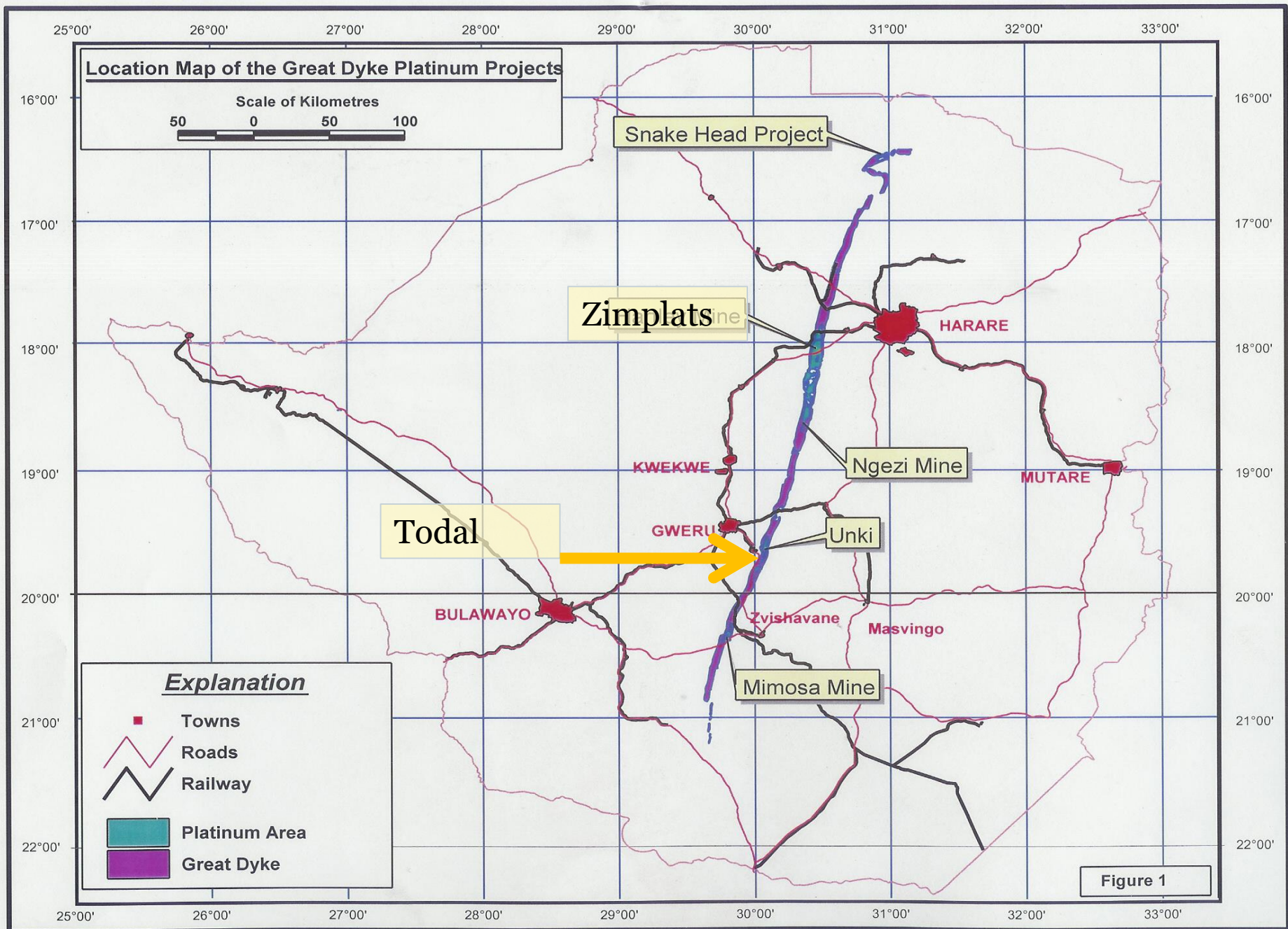
- Work carried out during the tenure of EPOs has over the years been translated into numerous successful mining ventures (**Next Slide**).
- Mines brought into production fall into two categories;  
(a) those where mineralization was not known prior to the granting of the order,  
(b) and those where it was known to be present, and in which the order enabled the deposit, and the surrounding country, to be thoroughly prospected and delimited without hinderance by speculators.

The success rate for exploration in Zimbabwe was at 3.9% by 1984 which is quite high by global standards.

<b>Exclusive Prospecting Order (EPO) no.</b>	<b>Mine Opened/Discoveries</b>
85	Perseverance nickel mine, Delcia gold mine
137	Shackleton Copper Mine, Avondale copper
92-3, 97-8 and 113-7	Sandawana Emerald Mine
4,42 and 82	Mhangura and Nora copper mines
3 and 16	Silverside Copper Mine
15	Umkondo Copper Mine
24 and 28	Buchwa Iron ore mine
11	Orpheus iron ore deposit
35	Alaska copper mine
39	Empress nickel Mine
57	Inyala chrome mine
79	Chegutu Limestone deposit
80	Shamrocke copper mine
55,72 and 178	Trojan Nickel Mine
104 and 184	Madziwa nickel Mine
169 and 231	Shamva-Cymric Mine
171	Jannasch gold mine
181 and 195	Gwaai River Copper mine
204	Inyati Copper mine (headlands)
239	Epoch Nickel deposit
233 and 352	Shangani Nickel deposit
22,27,77 and 78	Copper Queen and Copper King mines
13	Lubimbi coalfield
19	Tuli coalfield
50 and 112	Bubye Coalfield
127,128,130,188,189,194,203 and 260	Great Dyke Platinum-nickel-copper deposits
391 and 406	Zinc mineralization in the eastern portion of the Zambezi Metamorphic Belt
446	Sengwa Coal deposit (Sengwa coal mine)
578	Kanyemba Uranium Deposit
601	Royal family gold mine
613	Freda Rebecca mine
628	Expansion of golden Kopje gold mine
629	Expansion of Blanket gold mine
654	Platinum resources in the Snakes Head (Great Dyke)
689	Considerable gold resources in the Dindi Greenstone belt were discovered.
692	Development One Step gold deposit
721	Maligreen gold mine
745	Development of Peach Tree mine
753	Ipanema and Hungwe gold discoveries
831	Discovery and establishment of the Bubi Mine Prospect
847	Renco Gold mine

# HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS

- **Platinum Group Metals (PGMs):** The Great Dyke hosts world's second largest reserves of PGM after the Bushveld Igneous Complex of RSA.
- 2.8 billion tonnes PGM ore @ 4g/t 4e on the Great Dyke
- Two PGM-bearing horizons are the Main Sulphide Zone (MSZ) and the Lower Sulphide Zone (LSZ)
- Current mining is focused on the MSZ while LSZ is still to be investigated in greater detail.
- Potential of other layered igneous complexes not been explored.



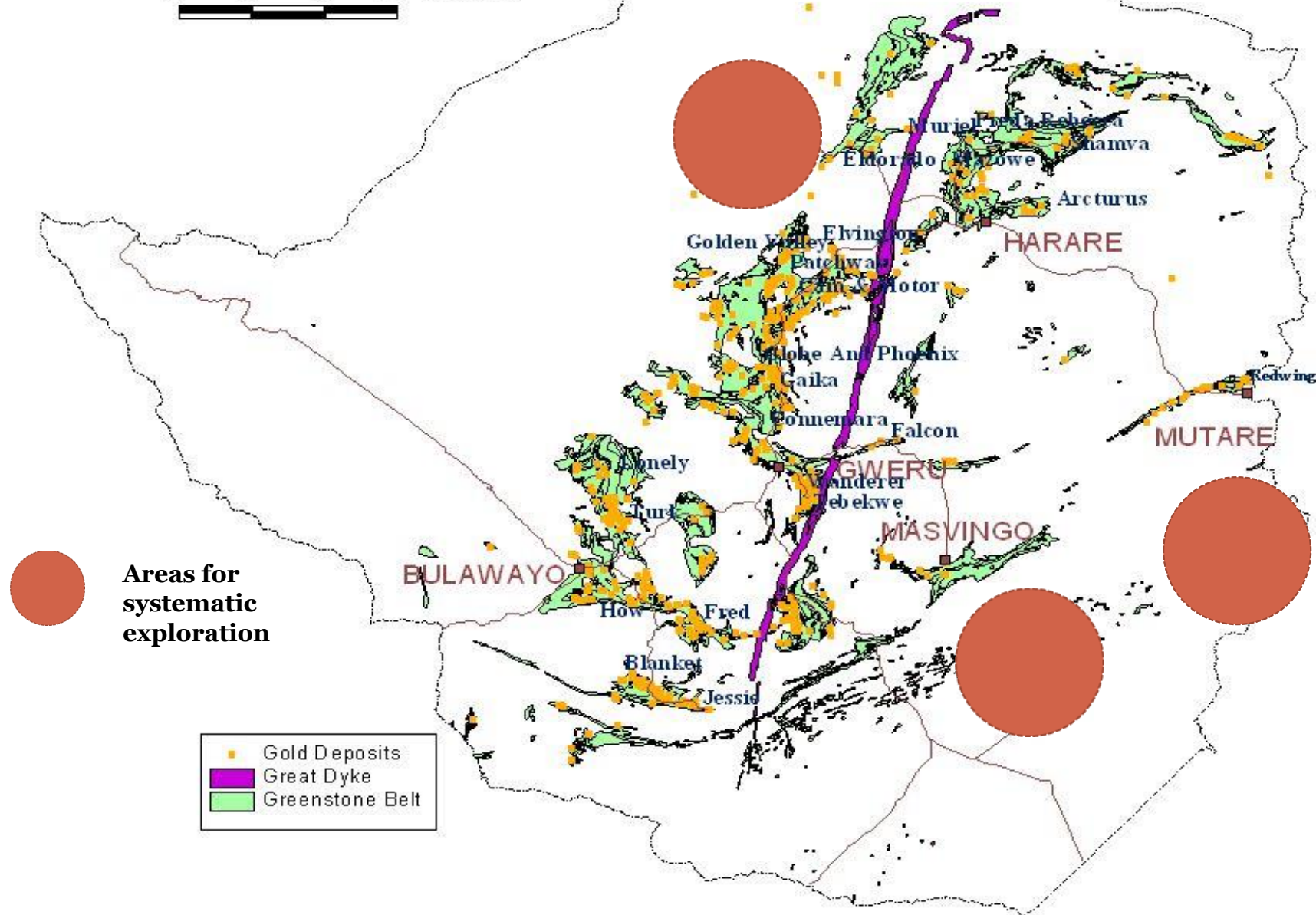
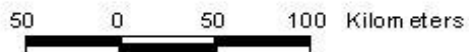
# HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS

## • GOLD

- > 4 000 recorded gold deposits, nearly all of them located on ancient workings.
- The country remains under-explored to discover deposits away from these ancient workings.
- Other gold deposits occur in the Limpopo mobile Belt in the south of the country and Proterozoic Piriwiri rocks in the North western part of the country.
- The Umkondo Group - Chimanimani is a new gold province that requires systematic exploration
- Rivers such as Mutare, Angwa and Mazowe also requires exploration for alluvial gold.



50 0 50 100 Kilometers

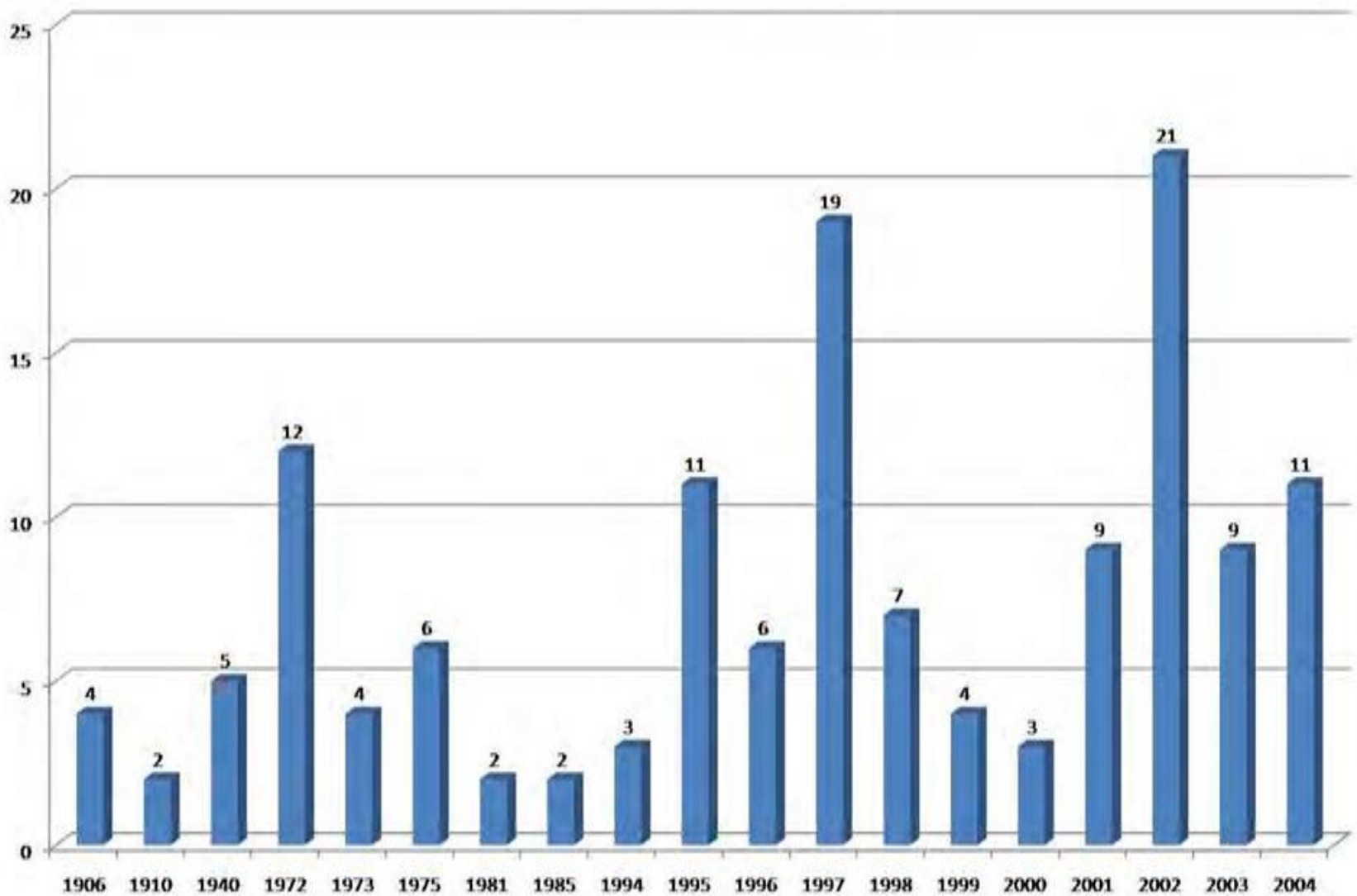


# HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS

## • DIAMONDS

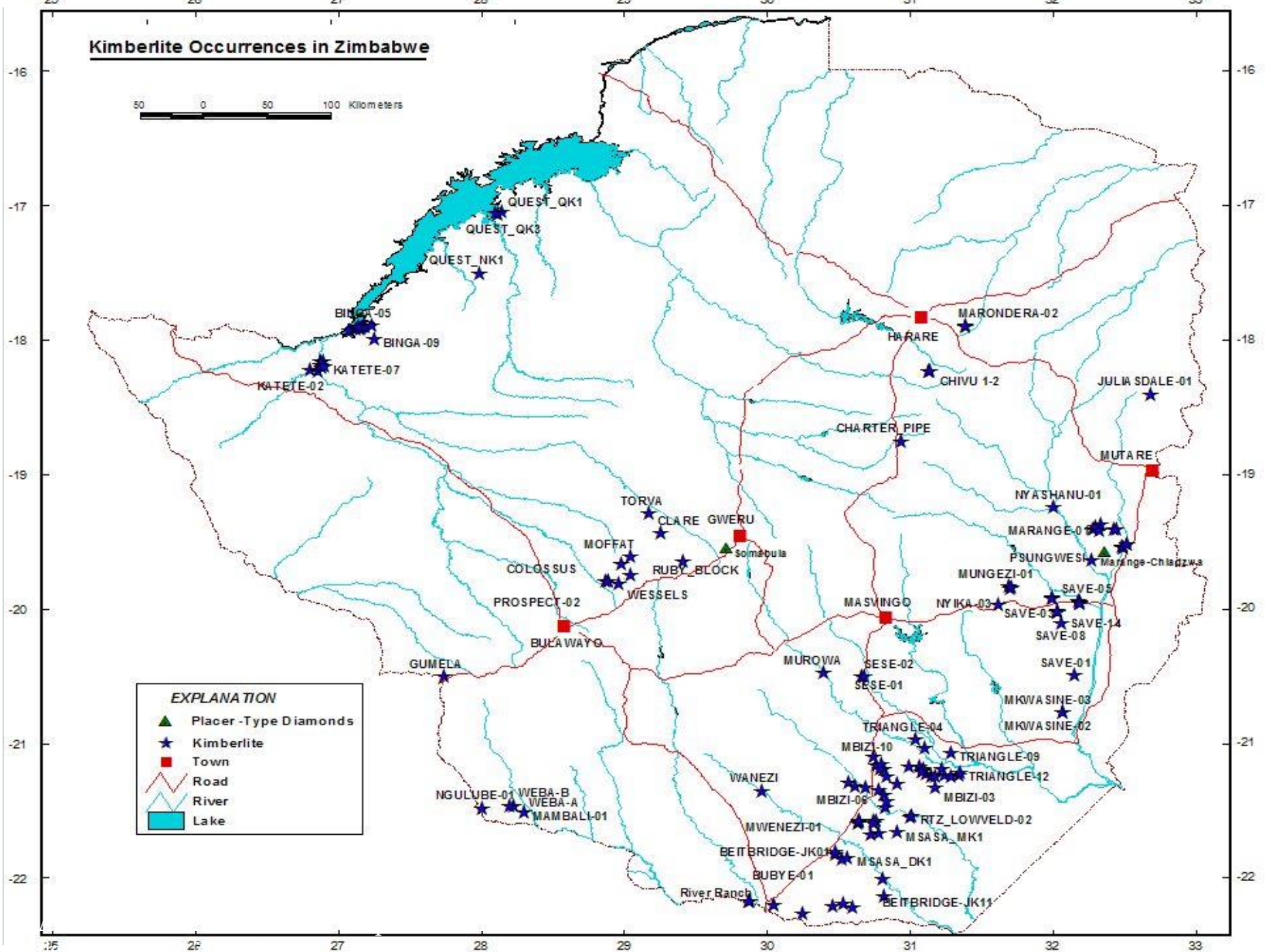
- Diamonds are a gemstone of enormous potential in Zimbabwe.
- Globally economic kimberlites are commonly found in ancient cratons such as the Kaapvaal, the Siberia and the Congo cratons.
- With similar geology to these areas, the well exposed Zimbabwe craton presents vast opportunities for kimberlitic diamond discoveries.
- Over 150 kimberlites have been discovered to date whose economic and commercial viability is yet to be ascertained.
- The discovery of a world class placer diamond deposit in 2006 points to significant potential in ancient basins on the edges of the craton.

**Zimbabwe Kimberlite Discoveries by Year**



# Kimberlite Occurrences in Zimbabwe

50 0 50 100 Kilometers





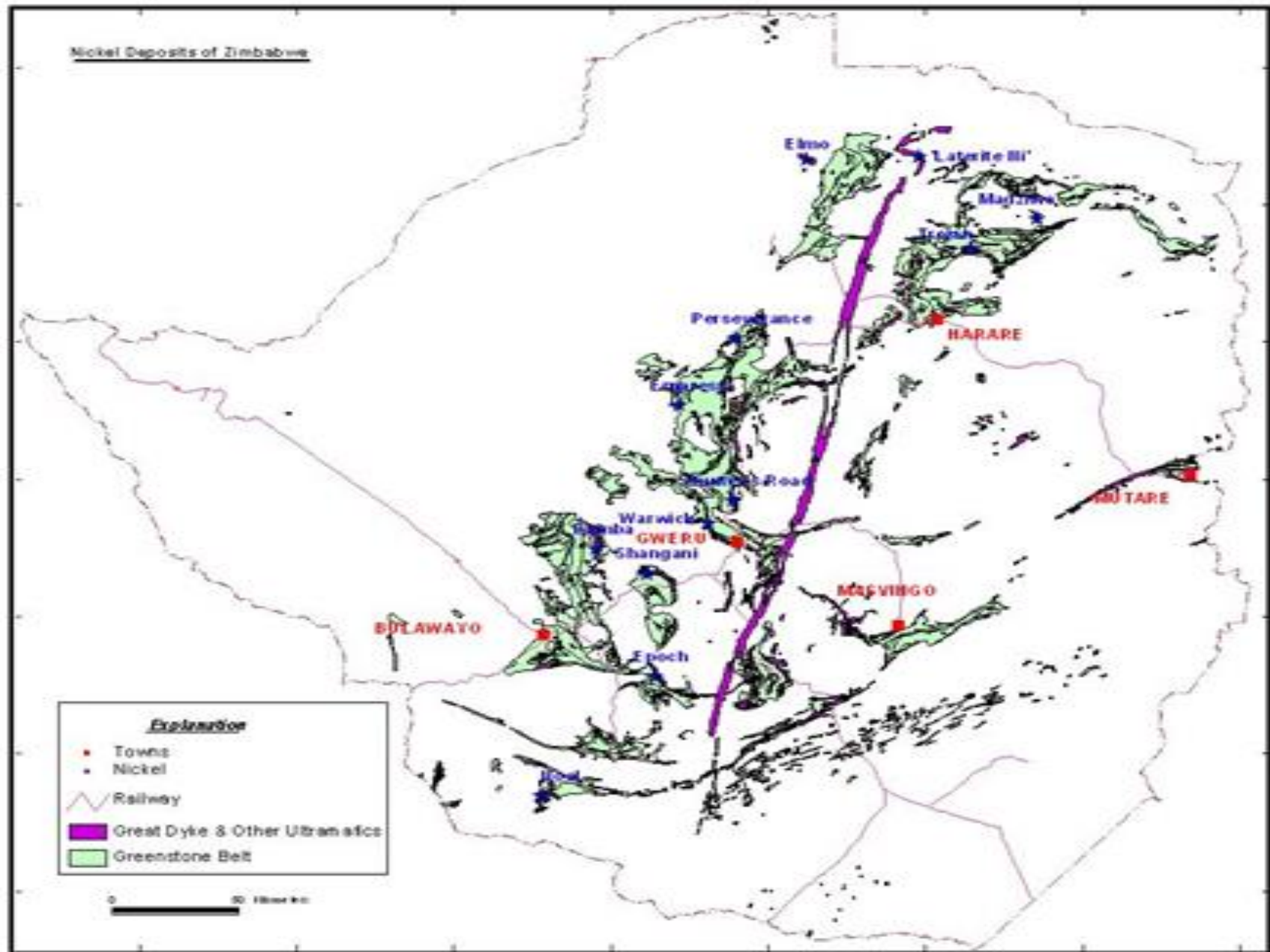
# HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS



- **NICKEL**
- The geology of Zimbabwe is highly favourable for nickel occurrences.
- The country's nickel sulphide endowment includes a variety of komatiite and mafic intrusion-hosted deposits.
- Other sources of nickel are the huge laterite deposits on the northern part of the Great Dyke.
- Explored deposits include Hunter's Road & Perseverance.



# Nickel Deposits of Zimbabwe

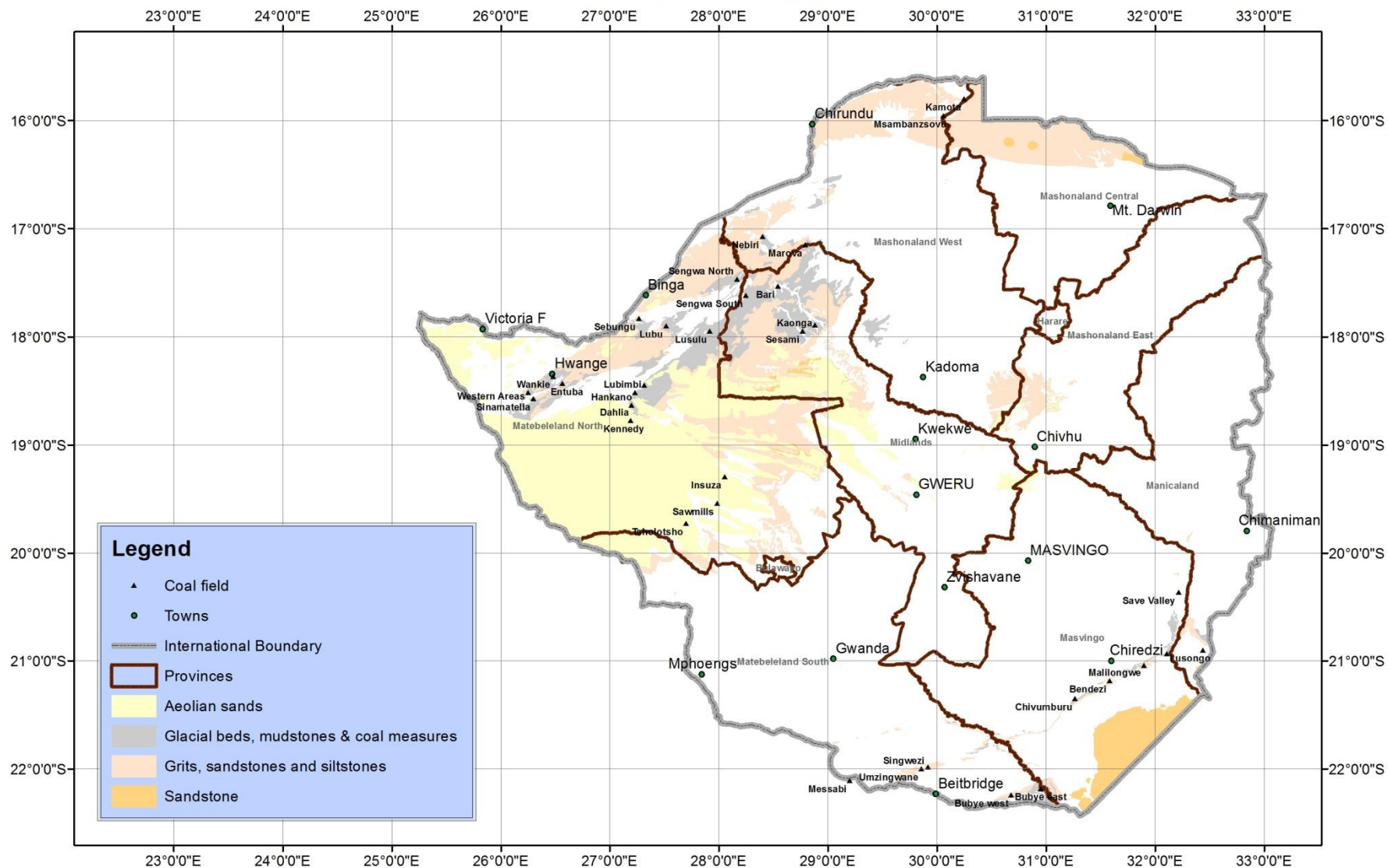


# HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS



- **COAL**
- Large in- situ reserves in Lower Karoo of the mid Zambezi & the Save-Limpopo basins.
- Estimated resources of >26 billion tonnes
- The Hwange area hosts large reserves of both coking and thermal coal.
- Despite the widespread occurrence, development and production has so far been confined to Hwange.
- There has recently been some small production from the Tuli and Mkwesine coalfields.

# COAL FIELDS OF ZIMBABWE



Date: 31/03/2017

# HIGHLIGHTS OF SOME EXPLORATION AND DEVELOPMENT PROJECTS



- **Coal Bed Methane :**
- Potential resource areas have been identified but commercial viability of the gas is still to be assessed.
- Quality of CBM is good. About 95% methane, 4% Nitrogen and 1% shared by Ethane, Carbon Dioxide and Oxygen.
- CBM resource is estimated at > 20 Trillion Cubic Feet (TCF).
- Pilot Production wells have been drilled and currently being tested in Lupane.



**LEGEND**

ERA	AGES (Ma)	TECTOGENESIS (Deformation)		BASIN DEVELOPMENT (Sediment)
			Orogenic Period	
PALEOZOIC	Cambrian			Basin
	Ordovician			Basin
	Silurian			Basin
	Devonian			Basin
	Carboniferous			Basin
MESOZOIC	Triassic			Basin
	Jurassic			Basin
	Cretaceous			Basin
	Tertiary			Basin
	Quaternary			Basin
CENOZOIC	Quaternary			Basin
	Tertiary			Basin
	Cretaceous			Basin
	Jurassic			Basin
	Triassic			Basin

**TECTOGENESIS (Deformation)**

ERA	AGES (Ma)	TECTOGENESIS (Deformation)	BASIN DEVELOPMENT (Sediment)
PALEOZOIC	Cambrian		Basin
	Ordovician		Basin
	Silurian		Basin
	Devonian		Basin
	Carboniferous		Basin
MESOZOIC	Triassic		Basin
	Jurassic		Basin
	Cretaceous		Basin
	Tertiary		Basin
	Quaternary		Basin
CENOZOIC	Quaternary		Basin
	Tertiary		Basin
	Cretaceous		Basin
	Jurassic		Basin
	Triassic		Basin

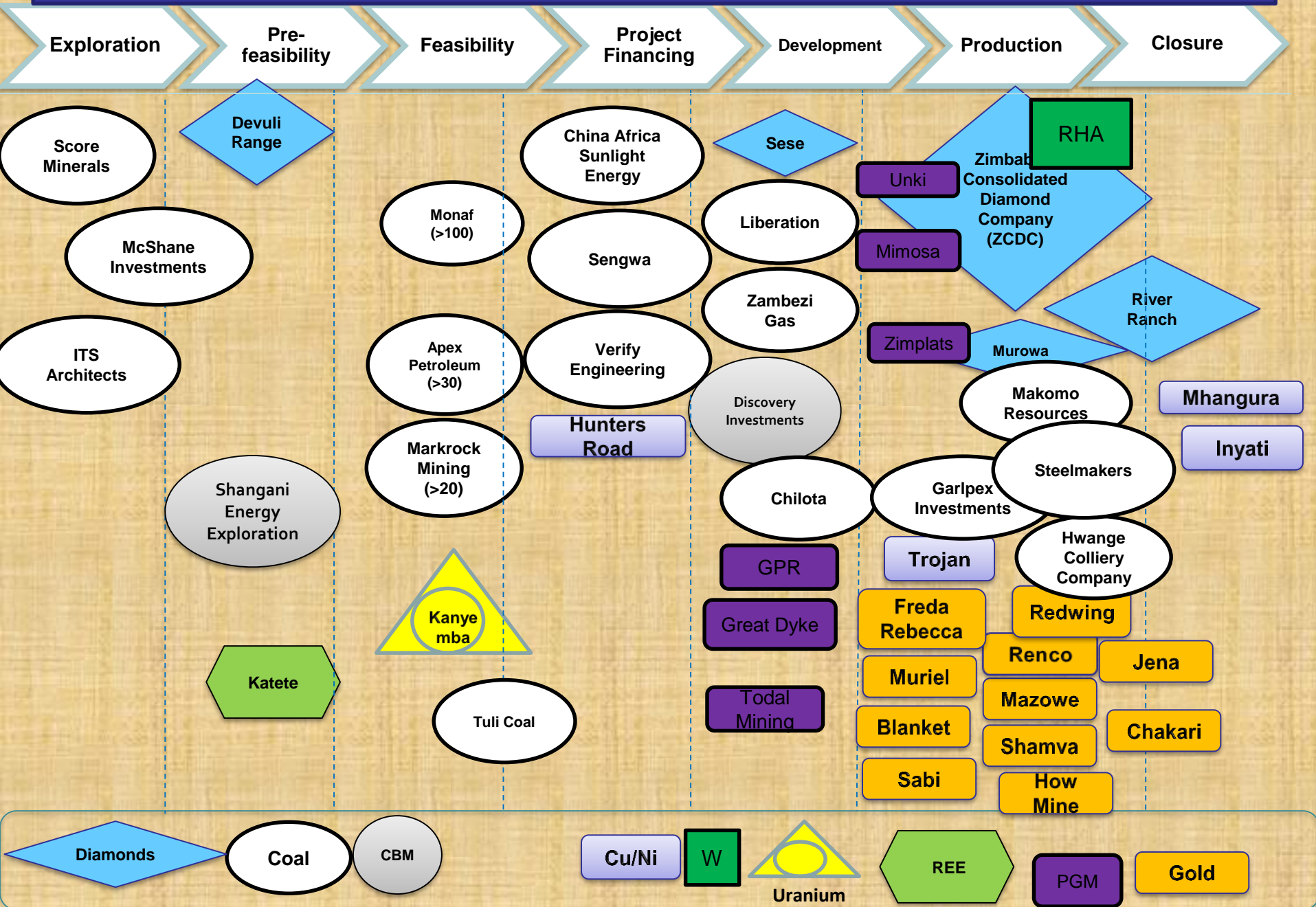
**BASIN DEVELOPMENT (Sediment)**

ERA	AGES (Ma)	TECTOGENESIS (Deformation)	BASIN DEVELOPMENT (Sediment)
PALEOZOIC	Cambrian		Basin
	Ordovician		Basin
	Silurian		Basin
	Devonian		Basin
	Carboniferous		Basin
MESOZOIC	Triassic		Basin
	Jurassic		Basin
	Cretaceous		Basin
	Tertiary		Basin
	Quaternary		Basin
CENOZOIC	Quaternary		Basin
	Tertiary		Basin
	Cretaceous		Basin
	Jurassic		Basin
	Triassic		Basin

ERA	AGE (Ma)	TECTOGENESIS (Information)	Basin Development (Information)
PALEOZOIC	9	Imperial Period	
	88		Halahan
	180		Post Karoo
	280		Upper Karoo
	300		Lower Karoo
	360		
Mesozoic	50	Post-African	
	50	East African	
	50		
	50		
	100		
TERTIARY	100	Irondale	
	100		
	100		



# ZIMBABWE'S MINING DEVELOPMENT SITUATION AS OF JULY 2017



# FUTURE EXPLORATION OUTLOOK



## GRASSROOTS EXPLORATION

- Existence of so many known mineral deposits made exploration in virgin areas unnecessary for a number of minerals.
- Exploration biased at re-discovering old workings.
- All known mineral deposits are potential areas for detailed grassroots exploration in respect of larger deposits.
- We usually find economic mineral deposits in a new place with old ideas. Sometimes, we find economic mineral deposits in an old place with a new idea, **but we seldom find much economic mineral deposits in an old place with an old idea.**

# CONCLUSION



- Country conducive to discovery of world-class mineral deposits.
- There has been little exploration outside known deposits
- With huge historical data on mineral occurrences, and usage of modern exploration techniques, the full potential is still to be realized.
- The future of exploration in Zimbabwe is very bright if we invest in modern ideas of exploration.

# Thank You

