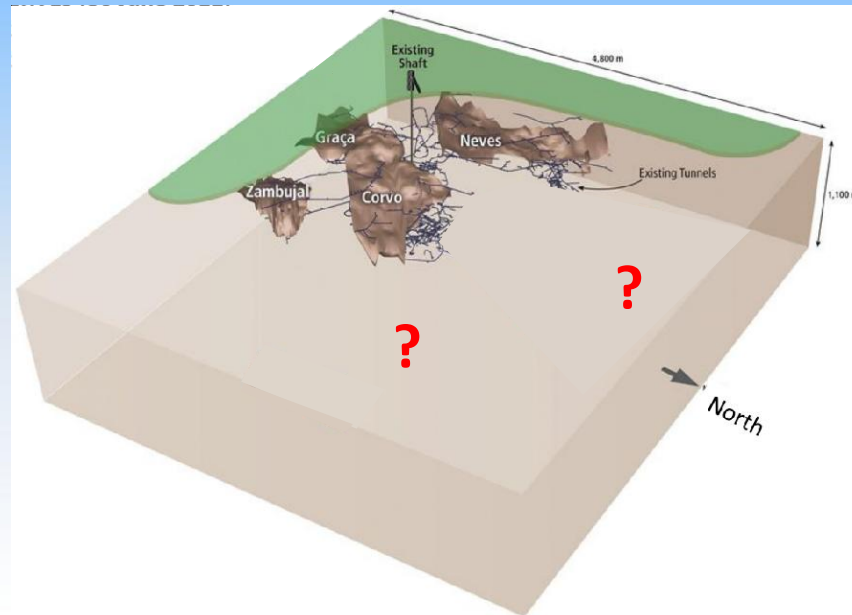


Capturing all of the value of the **Life of Mine Volume**, quickly and effectively. Can it be done?

Authors:

Peter K Williams
Greg Turner
Don Pridmore
Milovan Urosevic
Anton Kepic



Life of Mine Volume

Definition

Life of Mine Volume (LOMV):

Volume of earth, within which mineralisation of significant amounts can extend the life of the mining operation



Neves Corvo minesite and surrounds – *courtesy Lundin Mining*

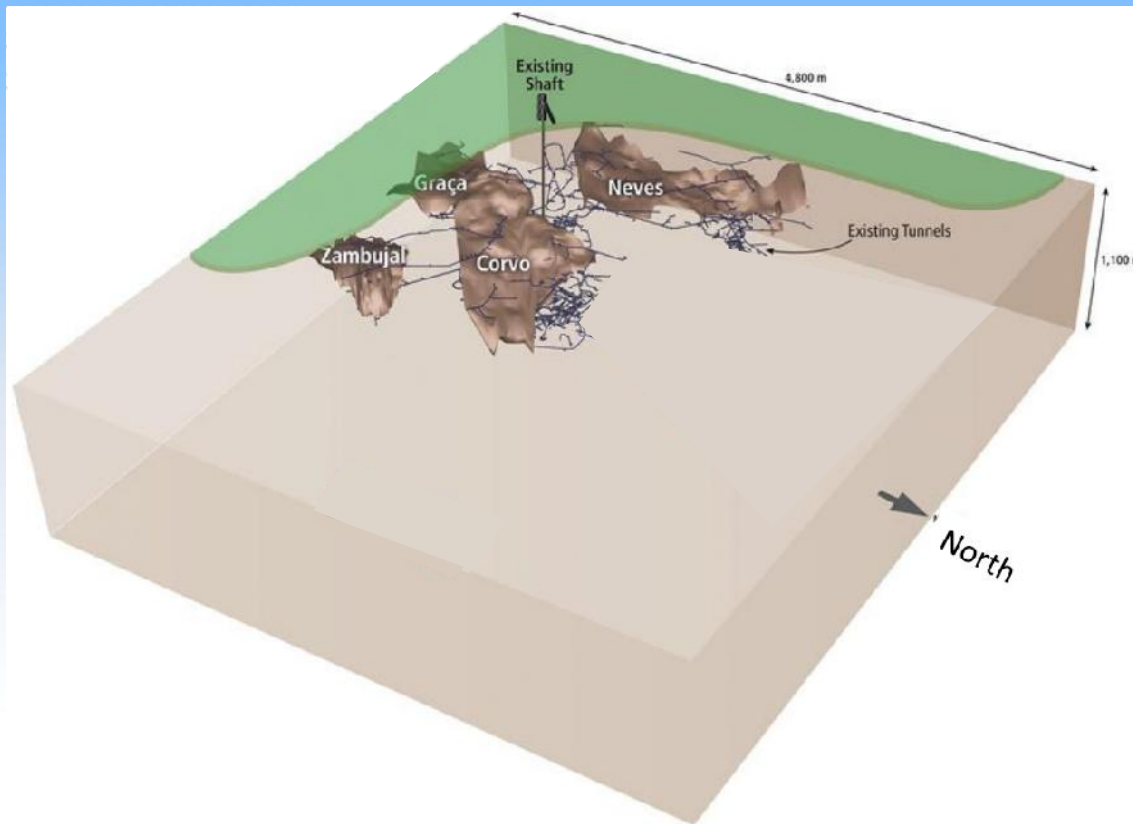
Benefits of earlier insight into Life of Mine Volume

- Better decisions on initial capital investment
 - Processing Plant
 - Mining methods
- Better placement of infrastructure
- **Create value for shareholders faster**

Value ~ Project NPV + Resources + Exploration potential (LOMV)

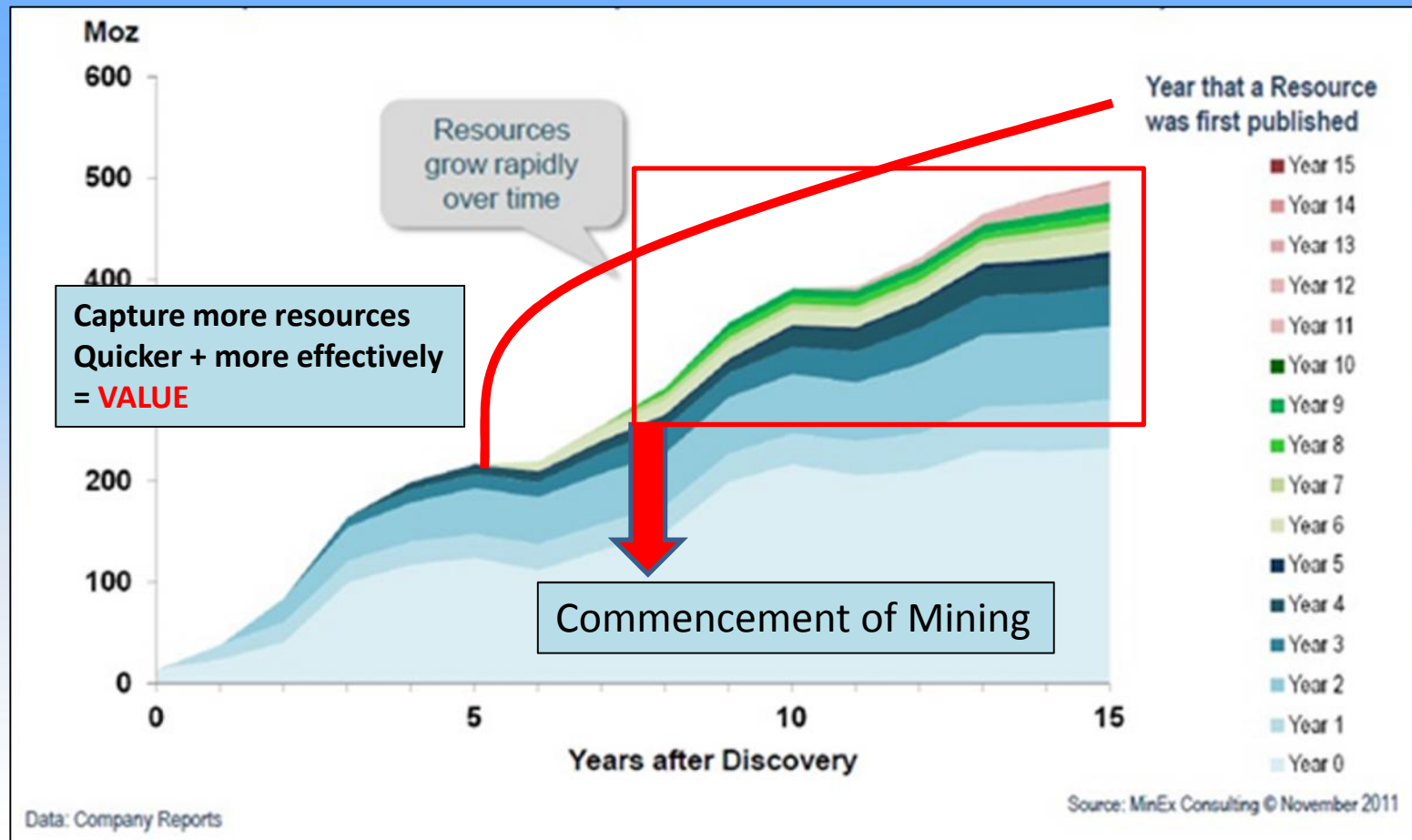
Exploration Potential

- How much ore is within trucking limits to processing plant?



*Neves Corvo
Cu Zn Mine
Portugal*

Resources expand with time



Resources expand with time

Longshaft Nickel Mine, Kambalda
Mining Stopped in 1999 by WMC/BHP
30 years after discovery
= WHAT VALUE LEFT???

2002-2012 (Independence Group)

Production of 94,000 Ni tonnes

Net increase in Resource of 90,000 Ni tonnes

Total Value ~ \$3 Billion

(purchased for \$15 Million + offtake)

Can we create value for shareholders quicker?

Conventional approach to investigate LOMV – drilling

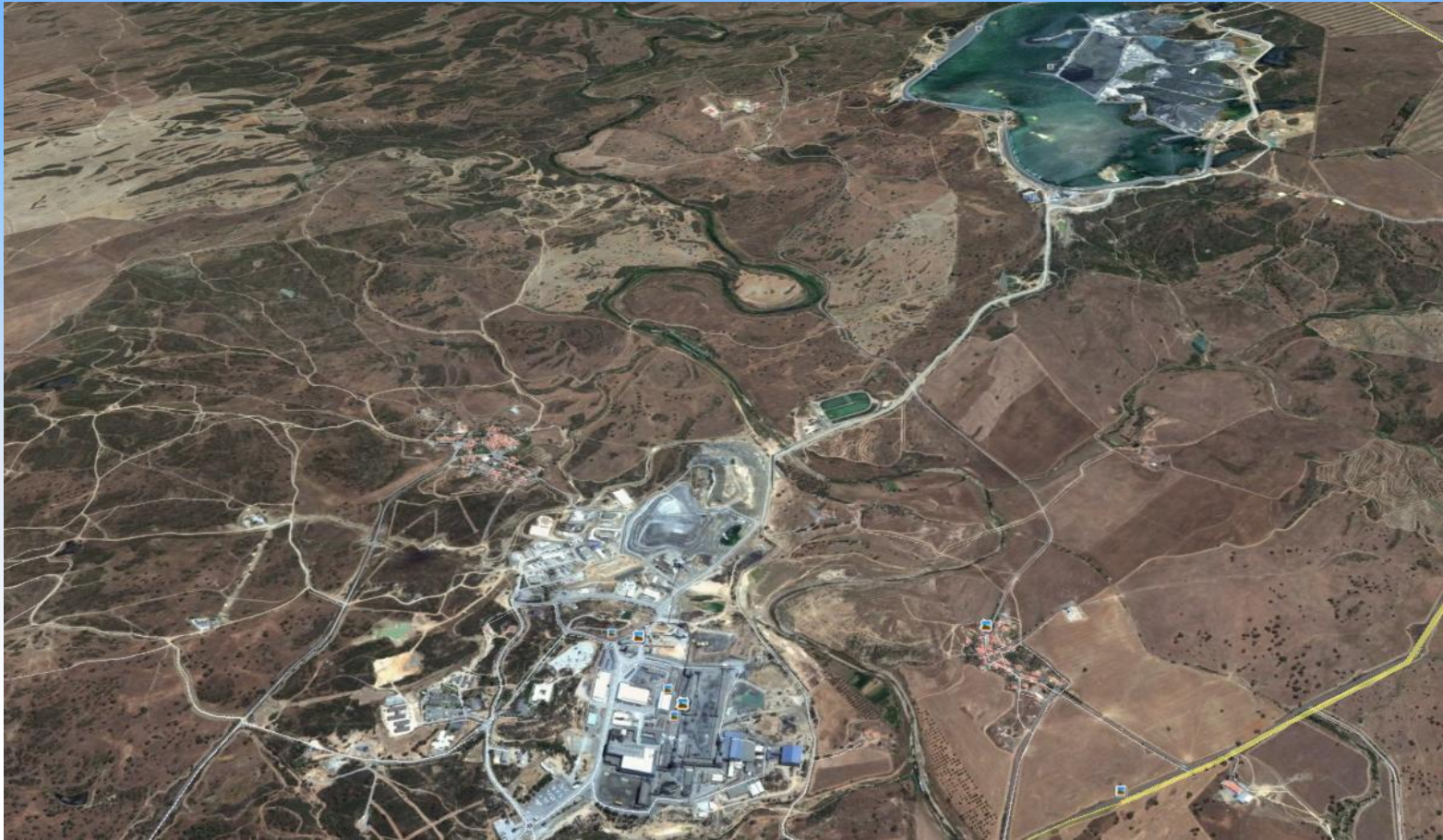
- Time consuming

Pressures of developing a mine

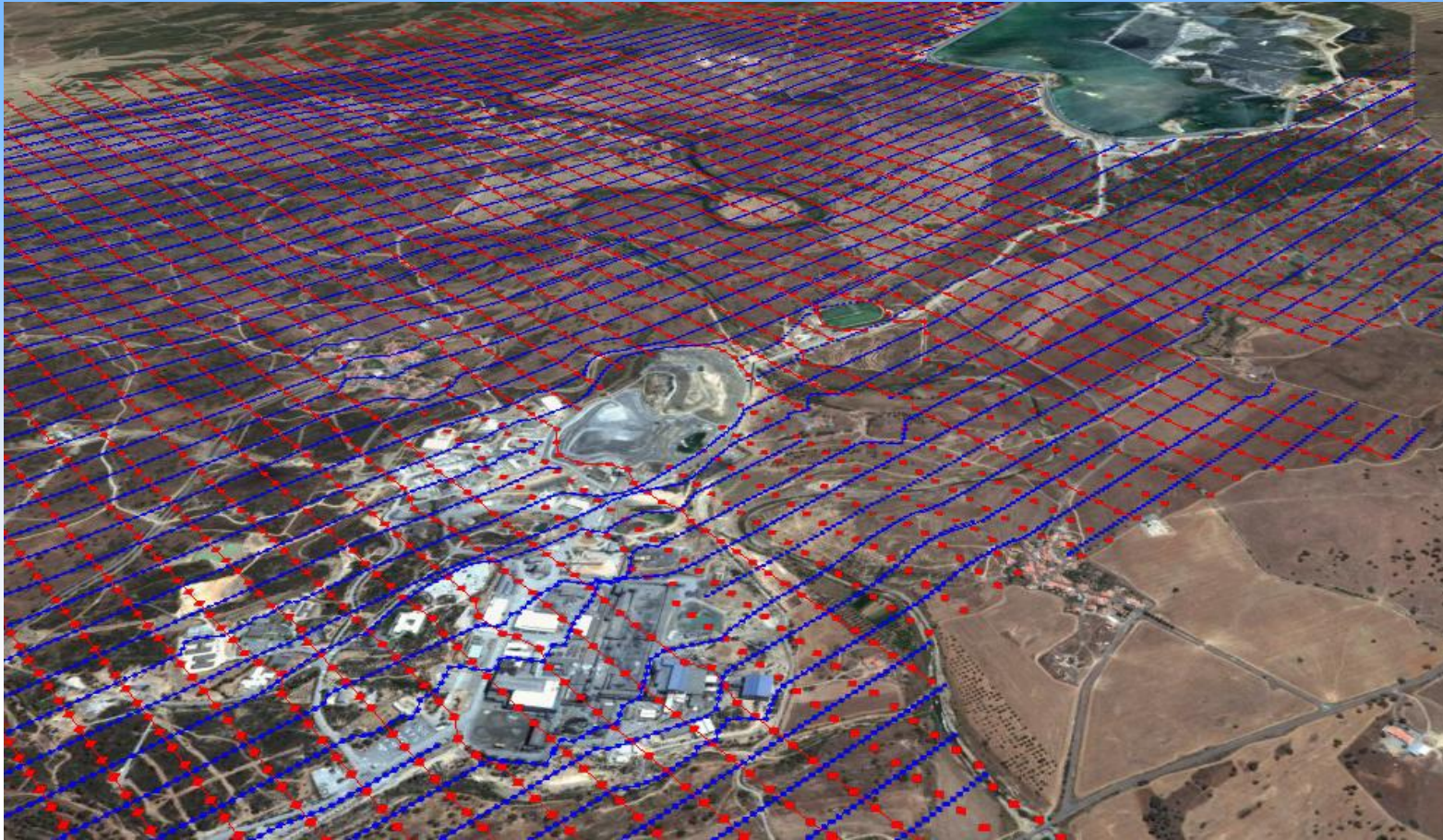
1. Discovery
2. Inferred resource (JORC)
3. Measured and Indicated resource (JORC)
4. Reserve (JORC)
5. BFS
6. Mining

Is there an alternative ?

'Life of Mine' Study – Neves Corvo, Portugal (Lundin Mining)



'Life of Mine' Study – Neves Corvo, Portugal (Lundin Mining)



3D seismic

'Life of Mine' Study

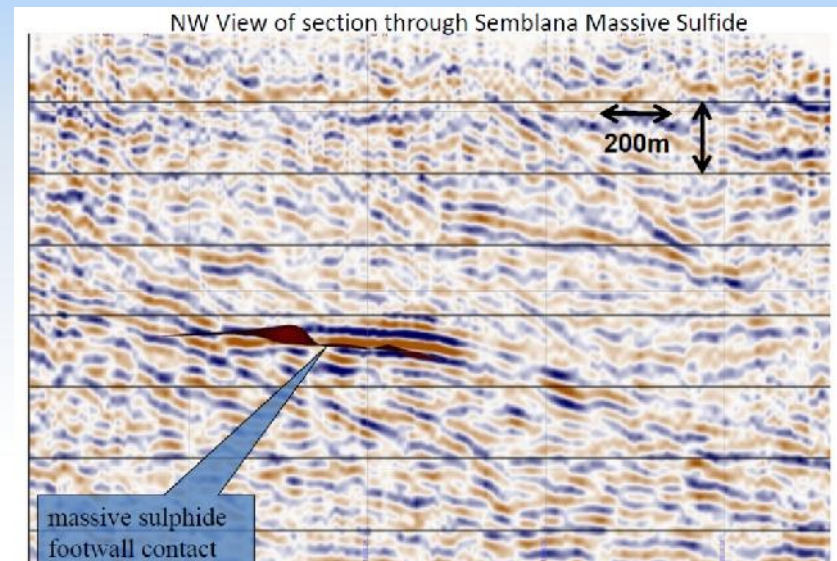
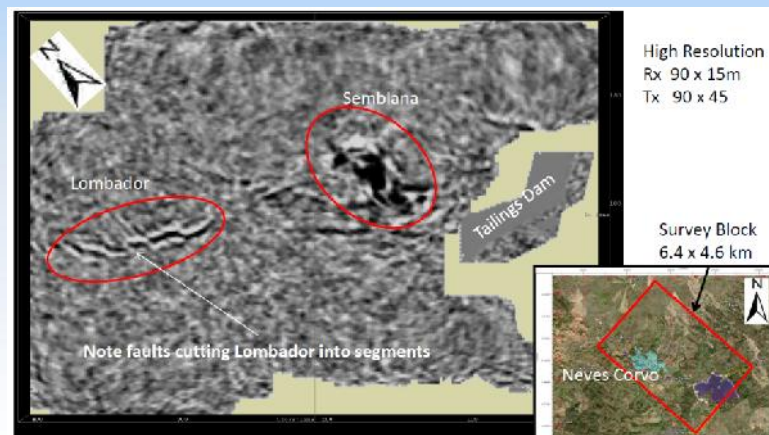
– Neves Corvo, Portugal (Lundin Mining)

VMS belt.... (2000 years after discovery?)

3D seismic surveys completed over 70km² (Initial 20km² + 50km² extension)

(Coverage beneath mine infrastructure, large tailings dam and small villages)

Survey mapped both extensions to existing mineralisation and new mineralisation



(Data provides location, depth, approximate size, structural integrity...)

3D seismic program over 70 sq km surrounding the asset **can:**

- Characterise the geology and structure to a depth of ~2km+ in cubes of 15m
- At an indicative cost of \$7-8M
- In a period of 13 months from design to final interpretation
- FIND more ore quickly
- FIND ore depositional environments

3D seismic program over the Neves Corvo LOMV **did....**

"A high-resolution 3D seismic survey has now been completed over a 21 square kilometre area surrounding the Neves-Corvo mine. Preliminary results have clearly imaged the major Semblana deposit, verifying the effectiveness of this new tool in the search for blind massive sulphide deposits"

Lundin Mining
news release to the
Toronto stock exchange. July 21, 2011

3D seismic in the Petroleum Industry

Success Rate Summary 1990-97

Percent

Overall success rate 2D:3D

13:47

Gas-well success rate 2D:3D

24:54

Oilwell success rate 2D:3D

3:37

Drilled wells covered by 3D Seismic

1990:1997

5:97

Annual drilled success rate

1990:1997

10:47

(Reference : Aylor, W.K. Jr 1999)

3D seismic in the Minerals Industry

Slow to Adopt and Adapt - Why?

1. Lack of Effectiveness

- Complex 3D geology
- **10 years of applied research - much progress made**

2. Lack of Need

- Drilling effective at shallow depth
- **Increasing requirement to explore deeper**

3. Cost

- More expensive than other geophysical methods
- **Equipment costs have reduced massively**

Comparative costs in exploring in 3D

<i>Sampling activity</i>	<i>cost</i>	<i>Sample geometry</i>	<i>time</i>
Drilling program to 400m:	\$80K/hole	(line)	~10 days/hole
Drilling program to 1000m:	\$300K/hole	(line)	~2 months/hole
3D seismic cost:	\$300K per sq km	(Voxel)	13 months for 140km ³ (Initial interp after 60 days)

Seismic becomes more cost effective as exploration and development is required at increasing depths

What does 3D seismic look like in the field ?

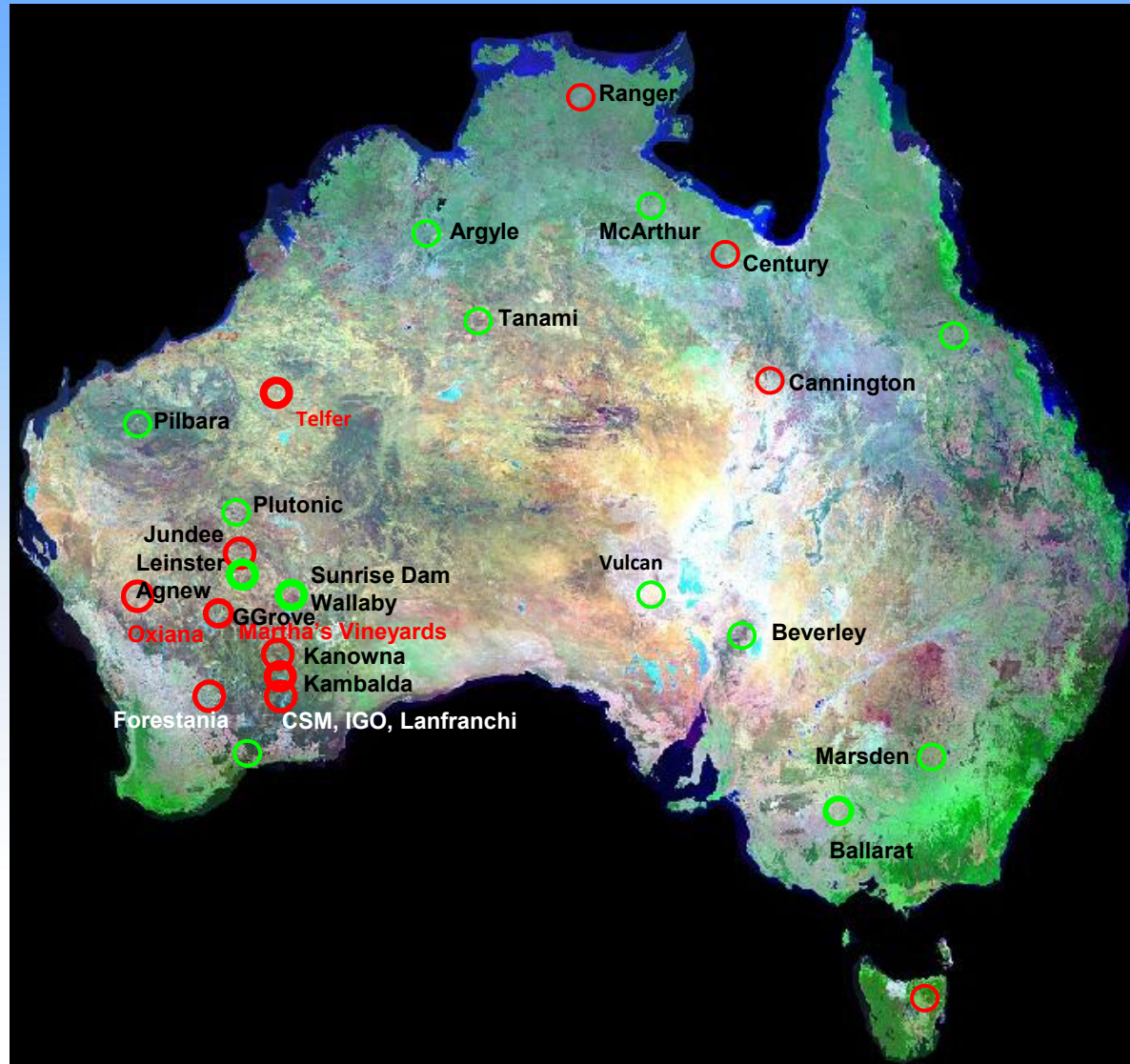


Seismic sources are a case of horses for courses



Low environmental footprint

Mineral exploration and mining seismic surveys



- 2D Survey
- 3D Survey

Capturing all of the value of the Life of Mine Volume, quickly and effectively. Can it be done?

Answer?

Yes ... demonstrated for

Lundin Mining – Neves Corvo, Portugal **(Zn-Cu)**: additional targets and extensions verified by drilling

Keveitsa Mining – Keveitsa, Finland **(Cu-Ni-PGE)**: structural bounds of ore system mapped

Consolidated Minerals – Kambalda, WA **(Ni)**: 3 drill verified exploration targets under Lake Lefroy.

Barrick Gold – Gold Strike, Nevada **(Au)**: Verified gold system at 850 m depth

ERA Resources – Ranger, NT **(U)**: Mapping key controls on the ore deposition, and ore environment

Acknowledgements:

Thanks to Lundin Mining, HiSeis staff, Curtin University (Centre for High Definition Geophysics)

