

# Hannanmetals

TSXV:HAN  
OTCPINK:HANNF

## **SEISMIC DECONSTRUCTION OF THE CLARE BASIN WITH IMPLICATIONS FOR BASE METAL PROSPECTIVITY**



**Lars Dahlenborg: VP Exploration**  
**Thursday, June 21, 2018**  
**Killeshin Hotel in Portlaoise**



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# Australia to Europe: Our Group

TSXV:HAN OTC:PINK:HANNF  
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# The Irish Team

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## ***Full time***

***Claire Duggan***  
Project Geologist

***Lars Dahlenborg***  
VP Exploration

***Graham Hartigan***  
Senior Geotechnician

## ***Part time***

***Don Brooks***  
Permitting and  
stakeholder relations

***Denise Roche Kelly***  
Core logging support

***Patrick Duggan***  
Geotechnical support

## ***Regular consultants***

***Majella O'Donnell***  
Accounting,  
Cuddihy & Co

***John Colthurst***  
Consulting Exploration  
geologist

***Mimi Crawford***  
Environmental Advisor  
brg

# Directors (Canada/Australia)

TSXV:HAN OTC:PINK:HANNF  
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**Michael Hudson (Chairman & CEO):** *B.Sc. (Hons), GDipAppFin, FAusIMM, MAIG*



**Nick DeMare (President):** *CPA, CA*



**David Henstridge:** *B.Sc. (Hons), FAusIMM, MAIG, MGSAust*



**Georgina Carnegie:** *B.Com, AM Harvard*



**Ciara Talbot:** *BSc. (Honours)*



**Mariana Bermudez - Corporate Secretary**

*Hannan is managed by a group with careers built in the zinc industry. In recent years, the group has raised more than US\$100M for European exploration and development. With a track record of success, and significant experience in gaining social licence to operate, Hannan is well placed for continued growth.*

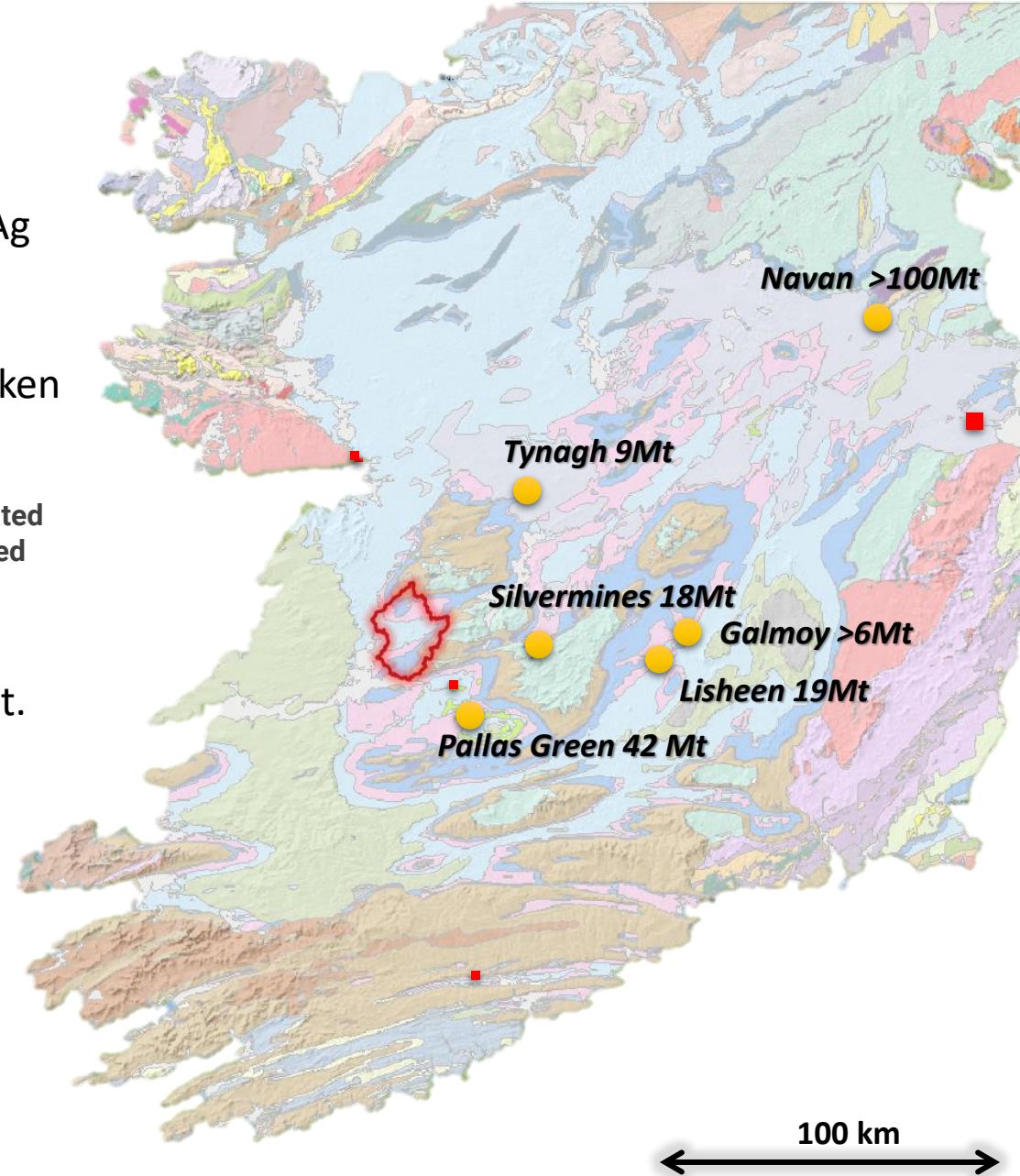


*The old Kilbricken Mine, a Victorian era Pb-Zn mine worked 1834-1854. A Cornish Engine House is still visible today.*

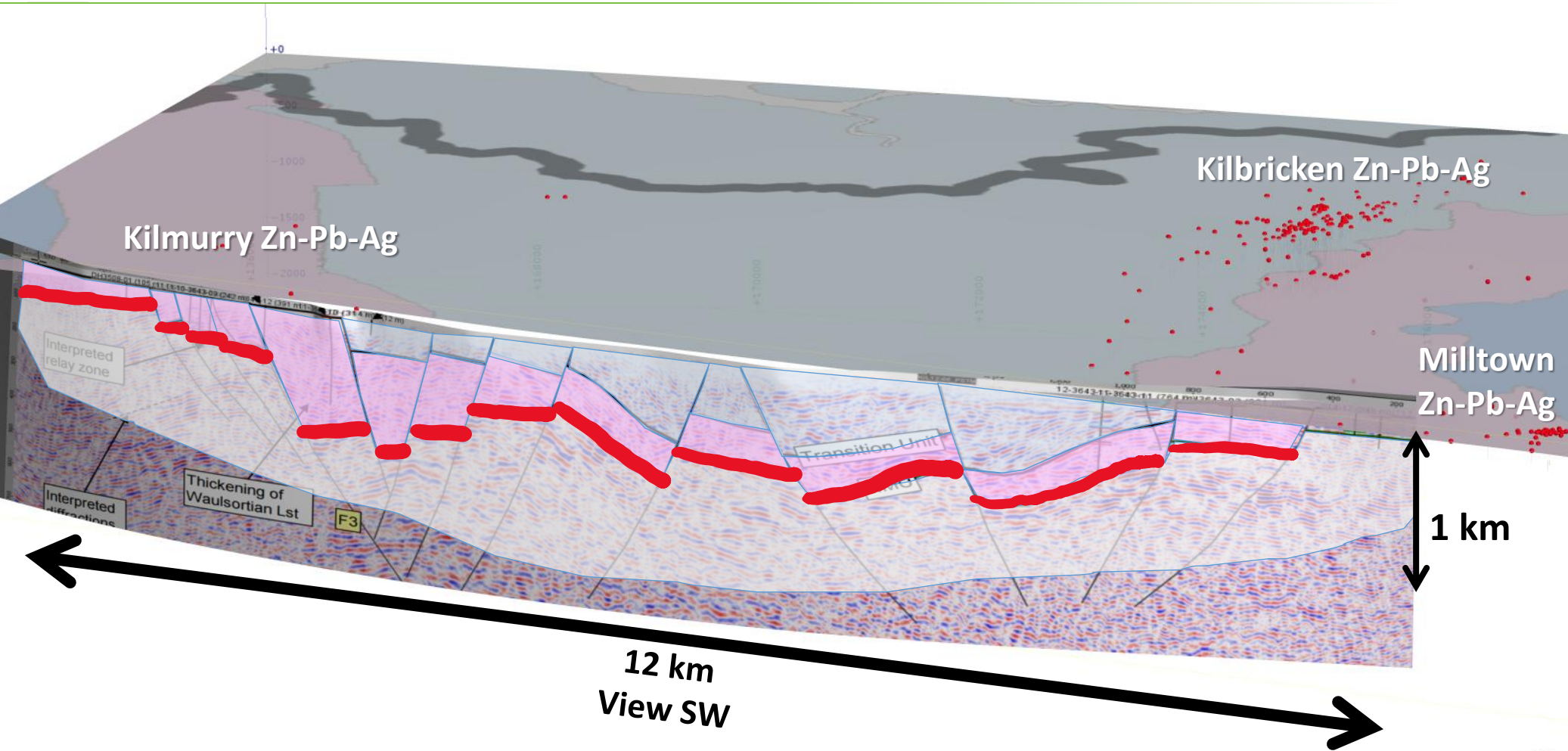


# The Clare Project

- 350 km<sup>2</sup> exploration block
- Targeting Waulsortian hosted Zn-Pb-Ag carbonate replacement deposits
- Flagship prospect 100% owned Kilbricken Zn-Pb-Ag discovery.
  - maiden resource
    - 2.7 million tonnes at 8.8% ZnEq indicated
    - 1.7 million tonnes at 8.2% ZnEq inferred
- > 85 km<sup>2</sup> Waulsortian subcropping in license block and >100km<sup>2</sup> blind target.
- Work ongoing :
  - Planning 5000 m drill program
  - Seismic interpretation
  - Soil sampling
  - Field mapping



# Geological Overview



> 85 km<sup>2</sup> Base of Wausortian reef subcropping in license block and >100km<sup>2</sup> blind target



# Project History - Phase 1

## Victorian Era

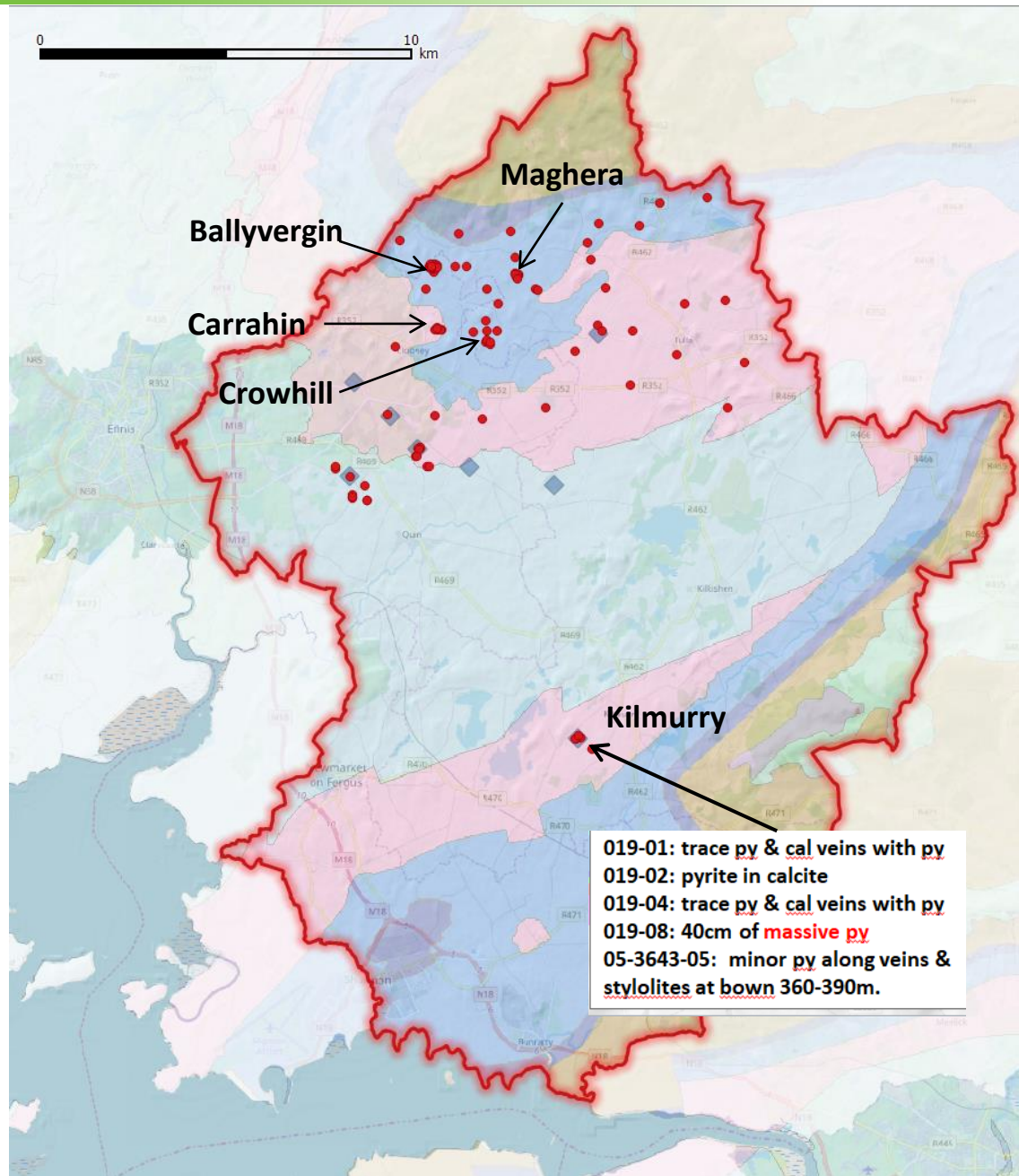
- Calcite, Pb-Ag mining from rich calcite pods and veins





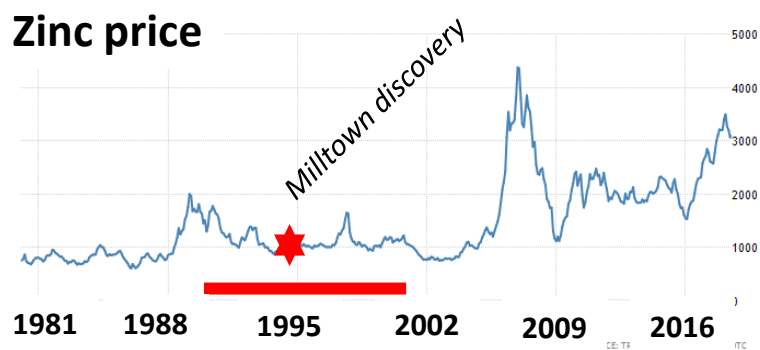
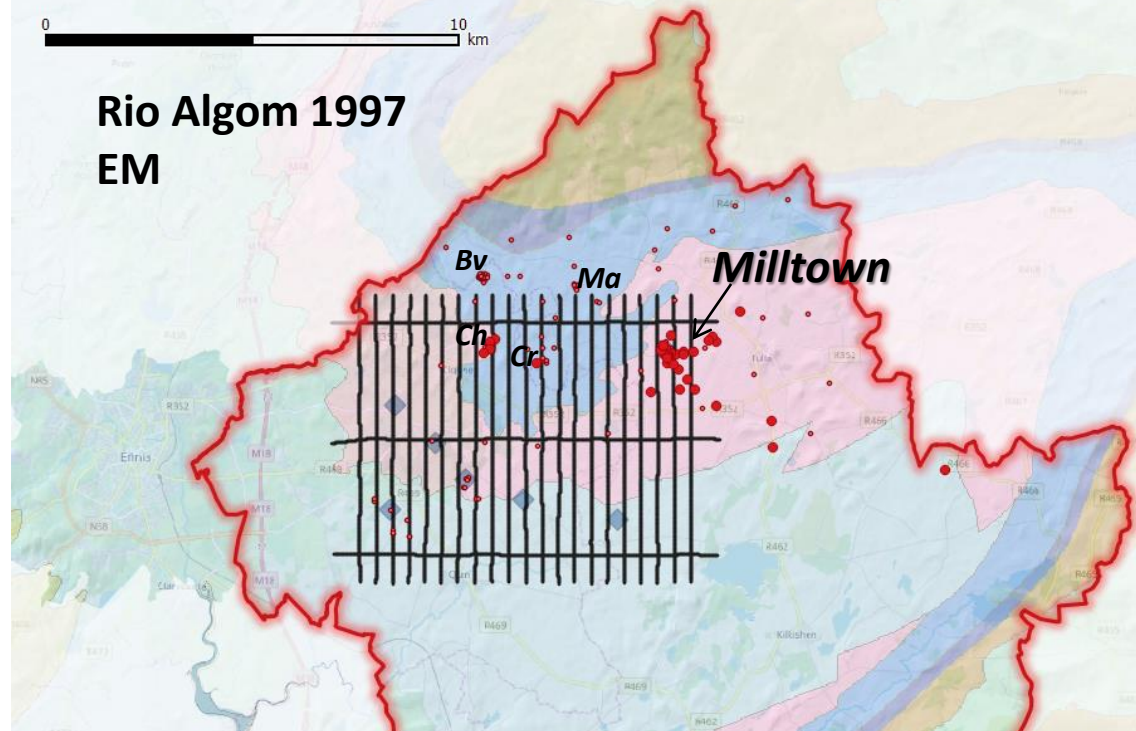
# Project History – Phase II

- 1960s- 1980s
- Exploration focus on shallow targets – sub-reef
- Discovery of Ballyvergin, Maghera, Carrahin and Crowhill
- First sign of mineralisation at Kilmurry



# Project History – Phase III

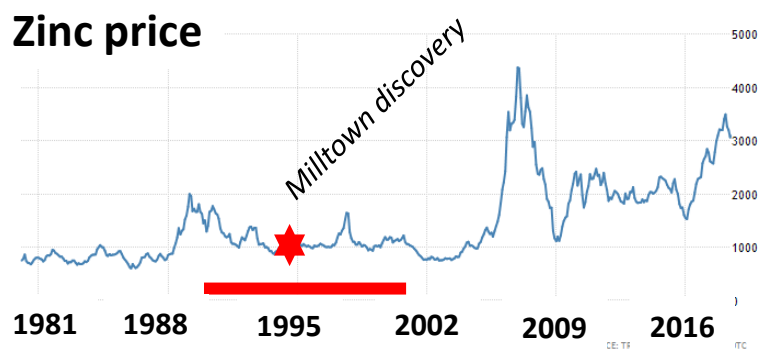
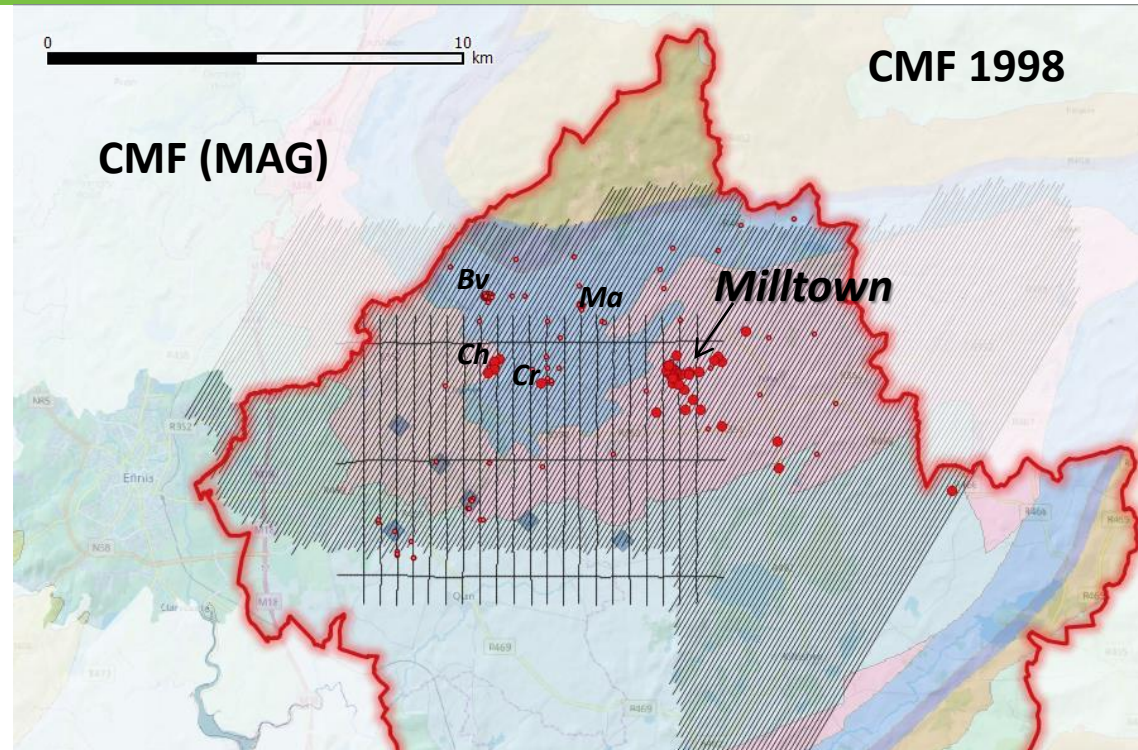
- 1990s
- **Discovery of Milltown**
  - 400,000t @ 12% ZnPb, 75g/t Ag (Historic resource)
- **Several airborne surveys within short timeframe**





# Project History – Phase III

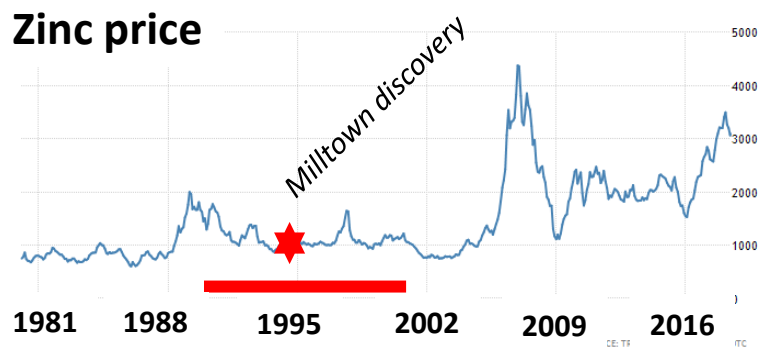
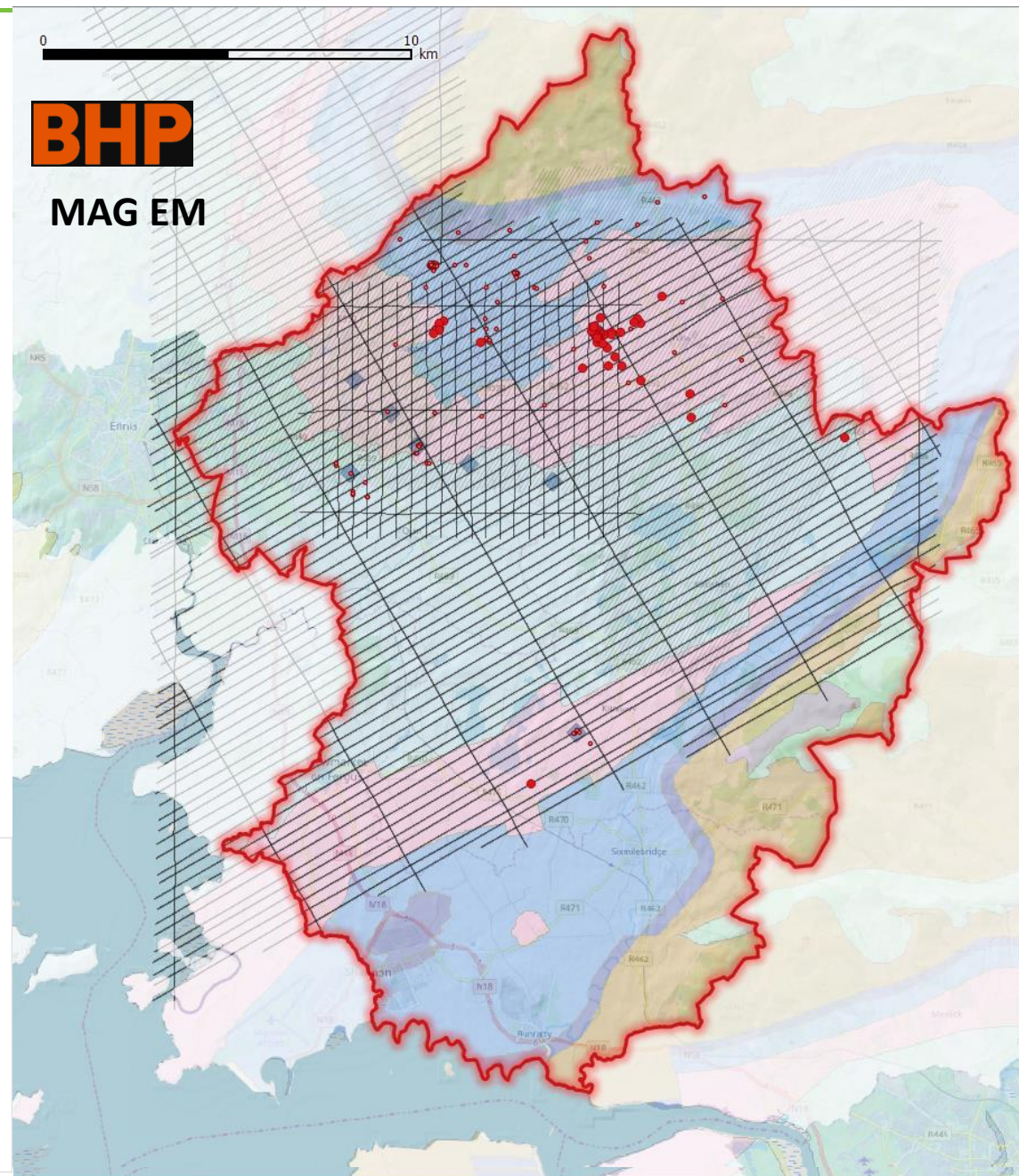
- 1990s
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  - 400,000t @ 12% ZnPb, 75g/t Ag (Historic resource)
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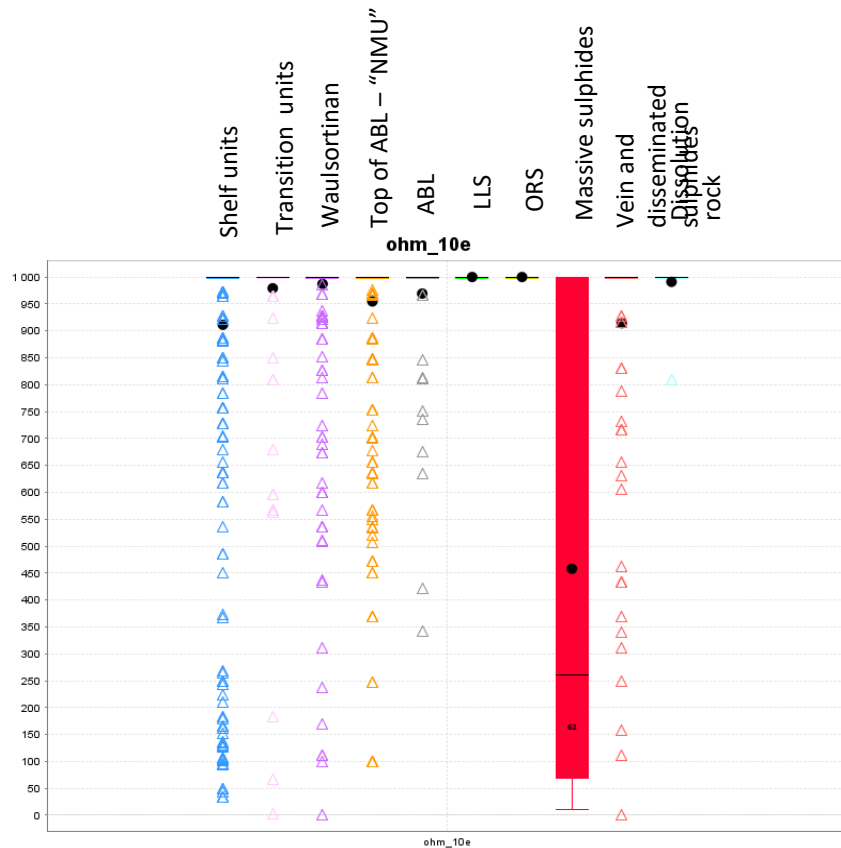


# Project History – Phase III

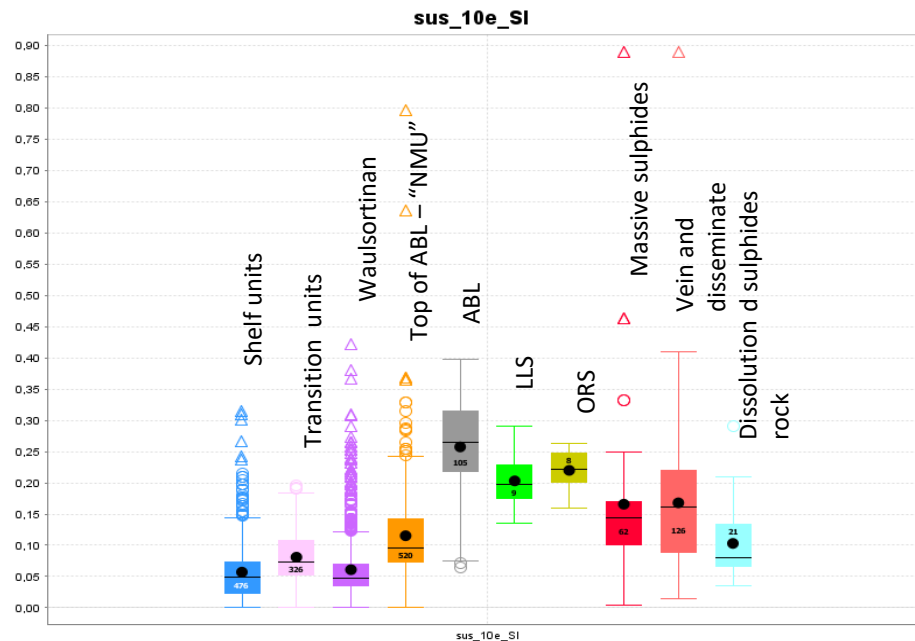
- 1990s
- **Discovery of Milltown**
  - 400,000t @ 12% ZnPb, 75g/t Ag (Historic resource)
- **Several airborne surveys within short timeframe**



# Petrophysics from Drill Core



Resistivity



Magnetic susceptibility



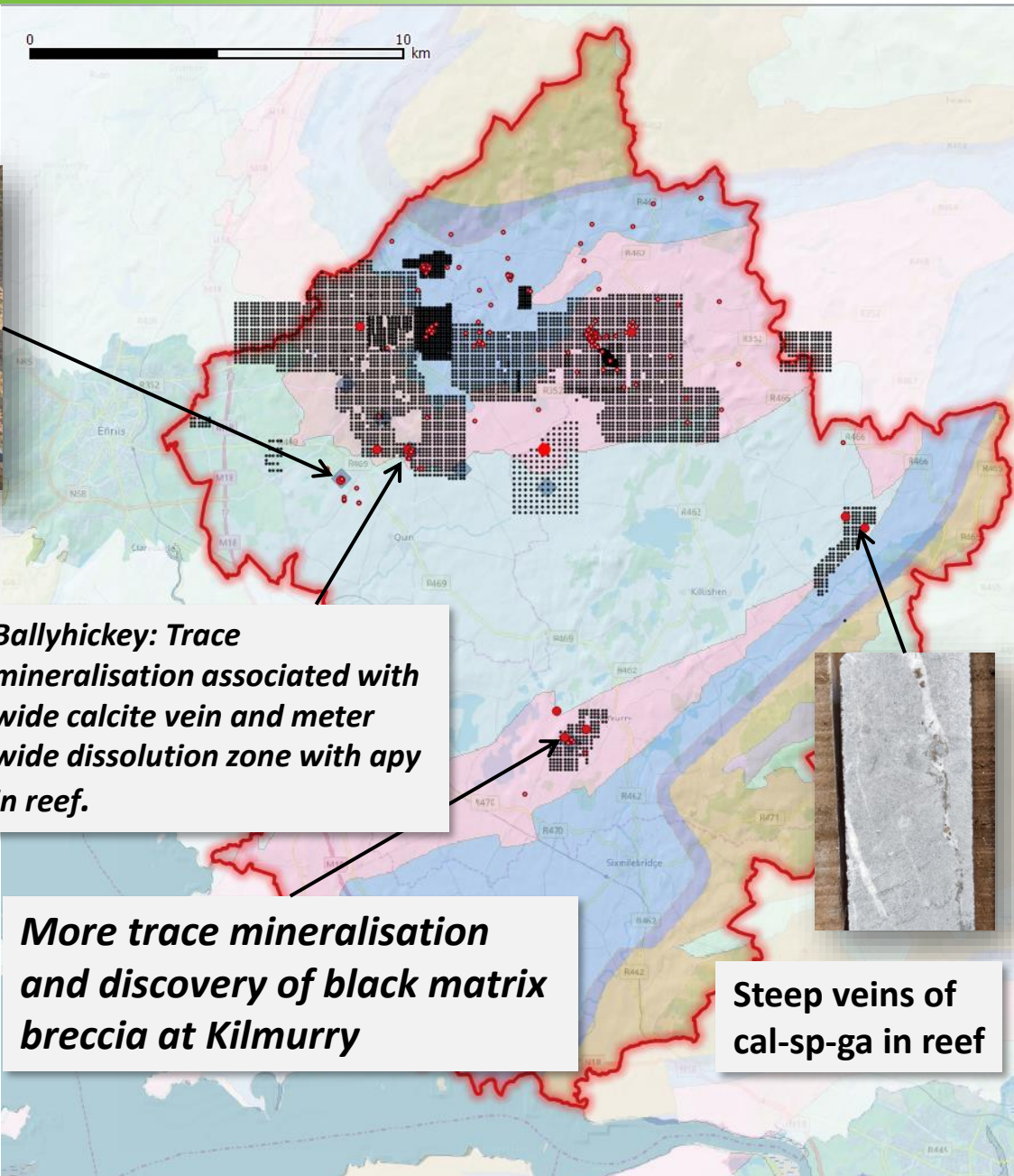
# Project History – Phase IV

## 2000-2007 Exploration by Belmore



**Kilbricken discovery DH 07-3679-04:  
14.4m @ 10.3% Zn, 4.1% Pb, 57 ppm Ag**

- ~5300 ah soil samples collected. Analyzed for Zn, Pb, Cu, (As)

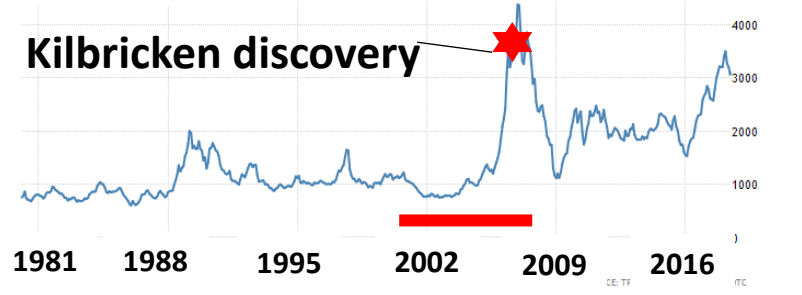


**Ballyhickey:** Trace mineralisation associated with wide calcite vein and meter wide dissolution zone with apy in reef.

**More trace mineralisation and discovery of black matrix breccia at Kilmurry**

**Steep veins of cal-sp-ga in reef**

### Zinc price





# Project History – Phase V

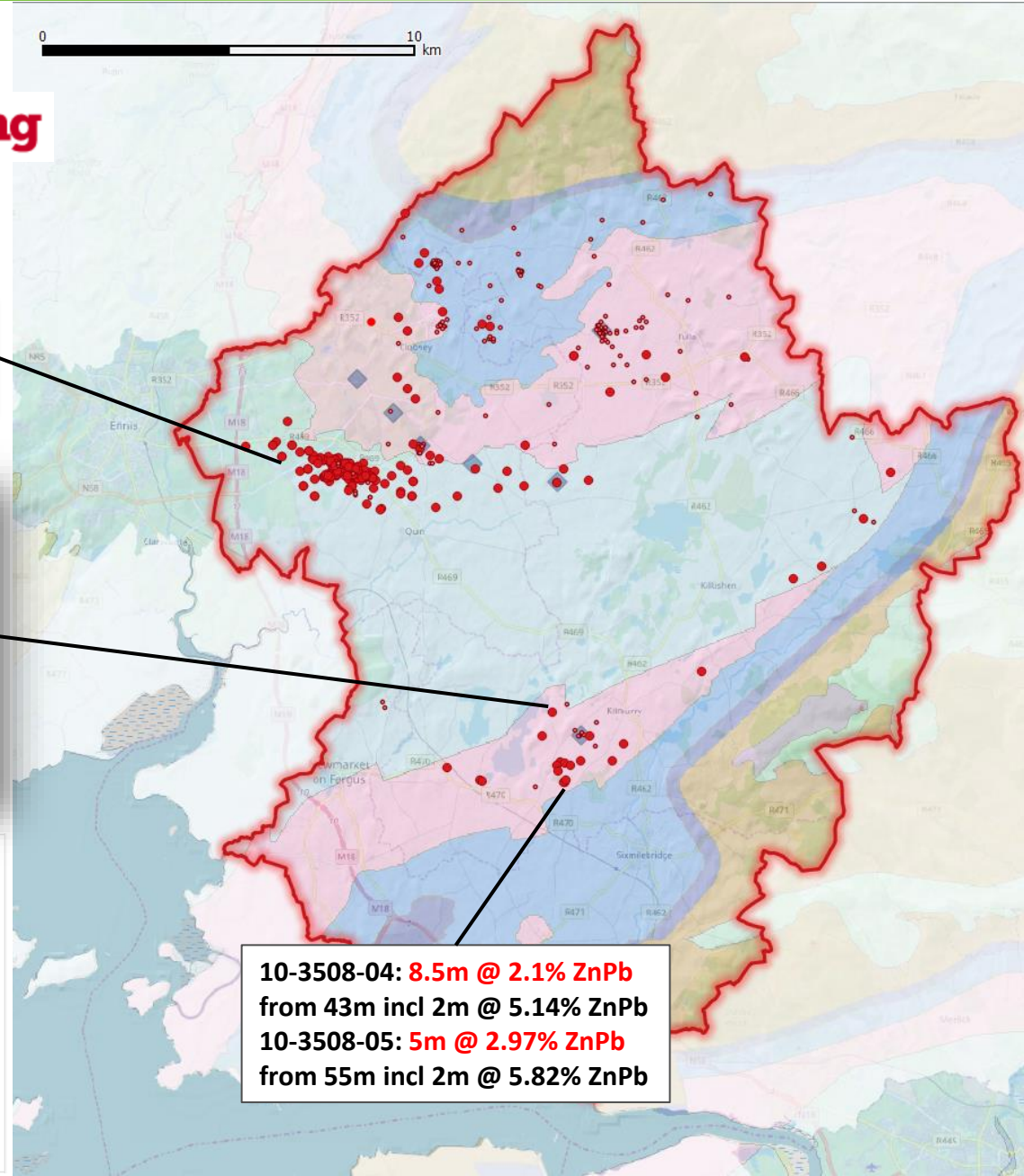
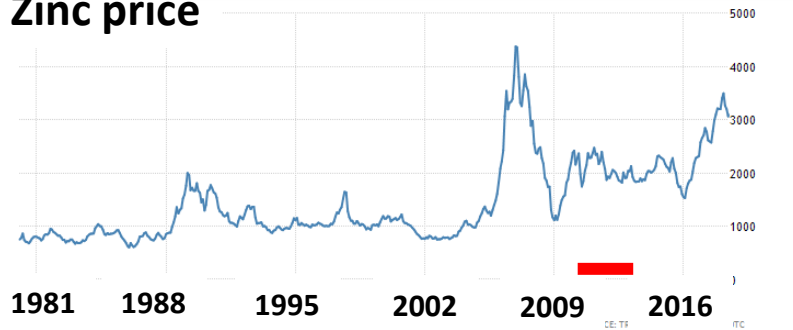
## 2010-2012 Exploration by **lundin mining**

➤ 134,000 m of drilling

*Discovery of two mineralized zones at Kilbricken*



Zinc price



## Two zones: Fort and Chimney

### Chimney (Stratabound and transgressive)

- 75 % hosted within dissolution breccia at base of reef
- 25% encrinites or Waulsortian lenses at the top of ABL (in the NMU).
- Roughly 2:1 Zn:Pb ratio (deposit average)

### Fort (Transgressive)

- Wedge shaped W dipping ore body with distinct geological and lithogeochemical zonation.
- Hosted by dissolution breccia
- Large basal footprint of disseminated chalcopyrite +/- bornite (0.05-0.3% Cu).

**Fort Zone Resource**  
Indicated 1,287,000 Tonnes @ 6.7% ZnEq  
Inferred 1,046,000 Tonnes @ 6.8 % ZnEq

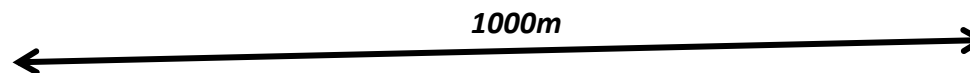
**Chimney Zone Resource**  
Indicated 1,369,000 tonnes @ 10.8 % ZnEq  
Inferred 635,000 Tonnes @ 10.4 % ZnEq

17-3679-217  
8m @ 4.1% Zn, 33.7% Pb and  
174 g/t Ag

26.6m @ 7.5% Zn, 0.9% Pb,  
15 g/t Ag and 0.35% Cu

17-3679-221  
6m @ 0.13% Cu

17-3679-220  
3.3m @ 10.4% ZnEq

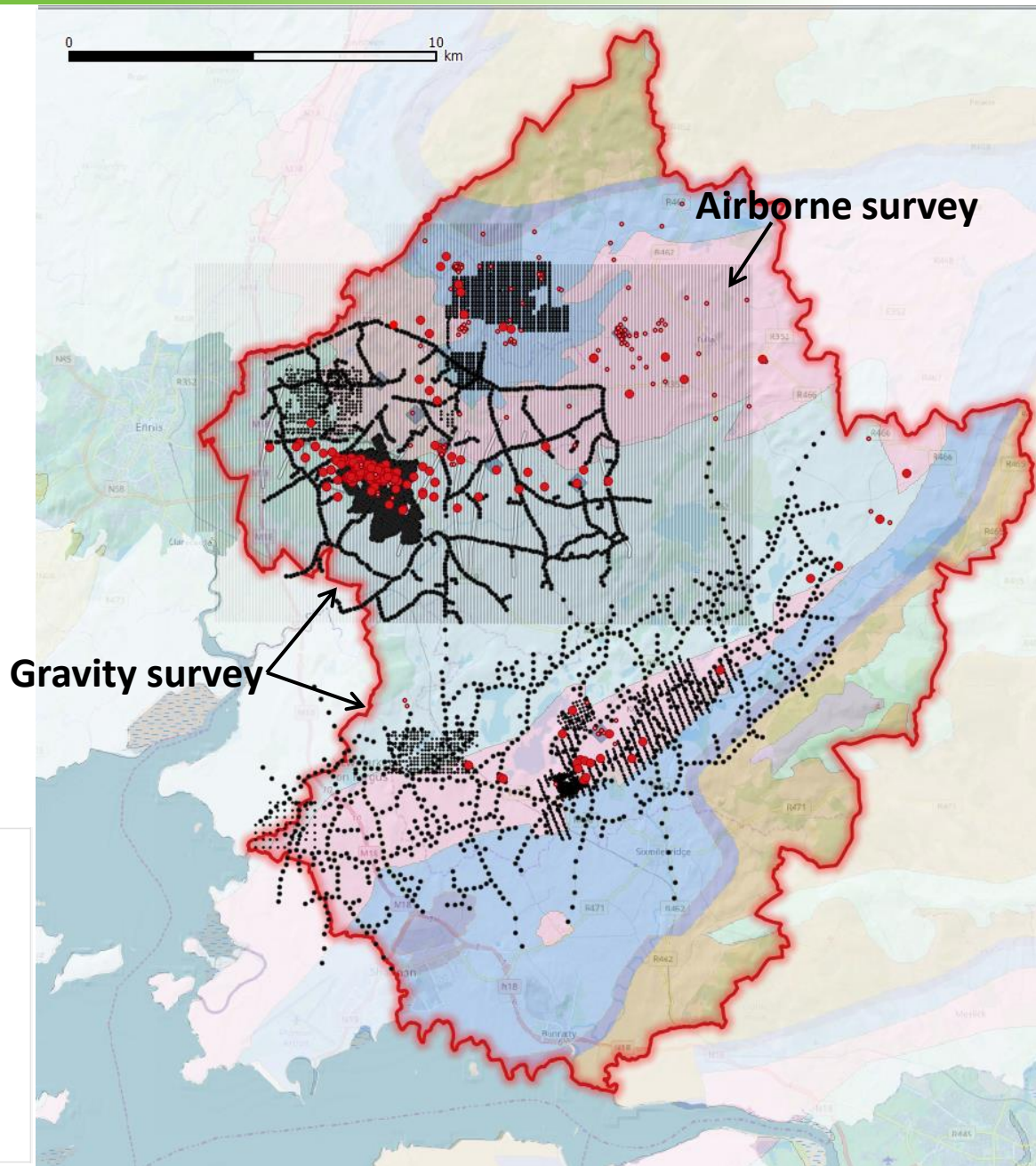




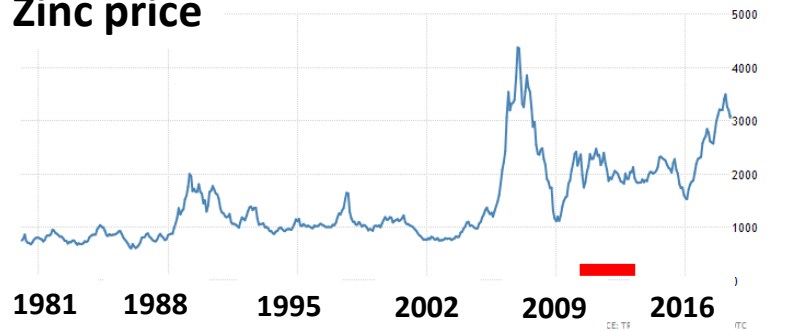
# Project History – Phase V

## 2010-2012 Exploration by Lundin

- 134,000 m of drilling
- 5 km<sup>2</sup> 3D seismic survey
- 28 km 2D seismic survey
- 2,700 ah soil samples
- Airborne survey
- 3,500 gravity stations



## Zinc price



# Project History

- Hannan purchases the license block from Lundin in December 2015.
- Drilling restarts in May 2017 after 5 year pause
- Project wide soil survey > 1,200 samples collected in 2017
- Seismic survey starts in October 2017

**Hannan's approach from day one: systematic review, collect data to beat the odds under cover at depth!**

**Deep geological understanding and persistence only way to succeed.**





# Opportunity in Big Data

- Starting from first principles - building up data confidence
- No shortcuts – geology first. We are still mapping outcrops to reconstruct a first class bedrock map.
- Experts involved
  - **John Colthurst** (consulting geologist with > 25 yrs experience in the Clare basin)
  - **Glenn Morgan** (Morgan Seismic Services)
  - **Leigh Rankin** (consulting structural geologist)
  - **iCRAG** (John Walsh, John Guven, John Coneally, Roisin Kyne, Koen Torremans)
  - **Barry Murphy** (consulting structural geologist and gravity expert)
  - **Kurt Forester** (Metallurgical testwork)
  - **Charles Hope** (consulting seismic expert)
  - **Dave Coller** (consulting structural geologist)
  - **Alastair Beach** (consulting structural geologist)
  - **Eric Adam** (consulting seismic expert)
  - **Ian Campell** (AMAG processing, de-culturing and spectral depth filtering)
  - **Hannan's team** (Michael Hudson, Claire Duggan, Graham Hartigan, Lars Dahlenborg)

(The **Lundin Team** and experts consultants involved with Lundin includes **Derek Rhodes, Murry Hitzman, John Walsh, Richard Unitt.** )

## Why seismic?

- Proven success in Ireland (Tara: Boliden)
- Project was already de-risked
- Only way to map lithology and structure undercover

*“While Kilbricken is an attractive prospect, it is by no means clear that this is the best target on the block or that Kilbricken sits astride the major structures in the area“*

*Murry Hitzman, Lundin site visit 2010, internal report*



Three phases :

**Acquisition**

**Processing**

**Interpretation**



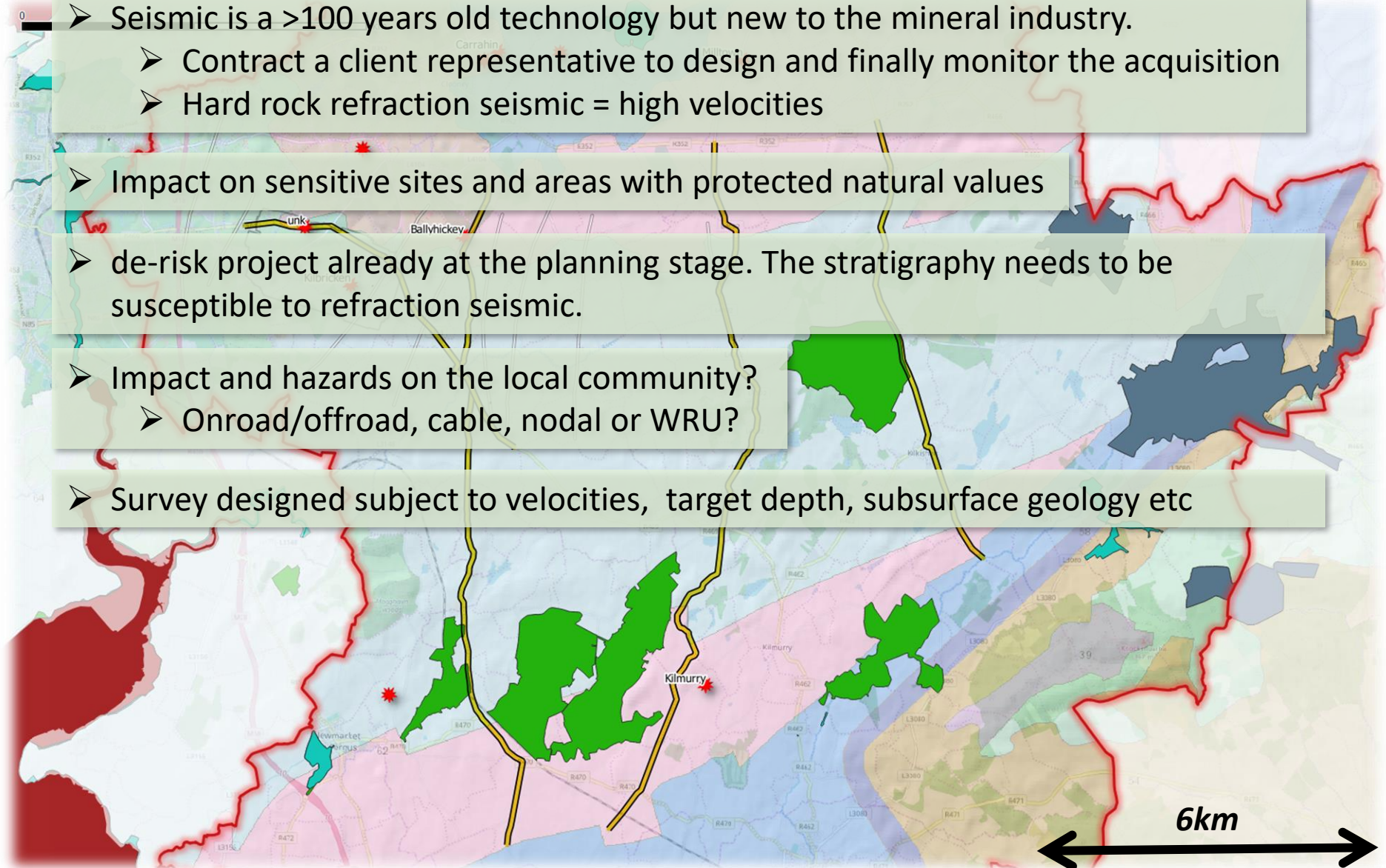
- Seismic is a >100 years old technology but new to the mineral industry.
  - Contract a client representative to design and finally monitor the acquisition
  - Hard rock refraction seismic = high velocities

- Impact on sensitive sites and areas with protected natural values

- de-risk project already at the planning stage. The stratigraphy needs to be susceptible to refraction seismic.

- Impact and hazards on the local community?
  - Onroad/offroad, cable, nodal or WRU?

- Survey designed subject to velocities, target depth, subsurface geology etc



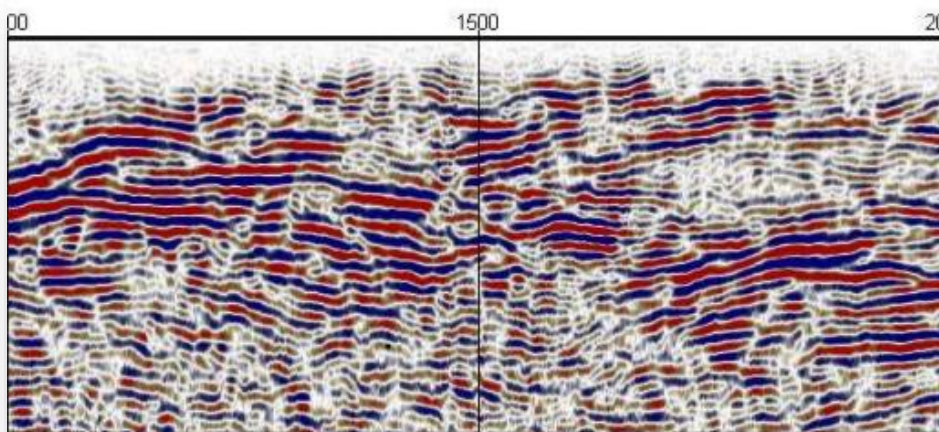


# Processing

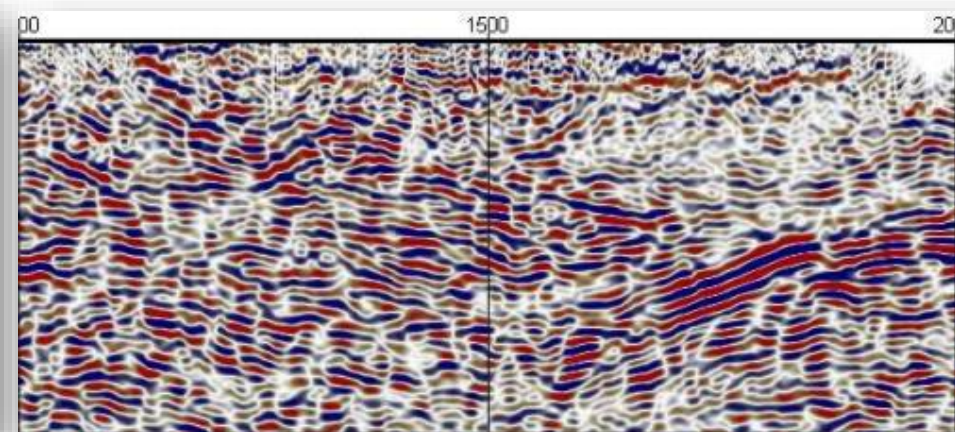
## Interpretation

- A processing job from the mineral industry is “small potatoes” for the petroleum industry
- Processing trails will show you who has the interest and if it fits budget
- Get experienced seismic interpreter involved
- Drill hole constraints are key in a high velocity world

*Same data processed by two different groups*



**17HAN04\_post STM**



**17HAN04\_post STM**

- Two staged:
  - I. data driven
  - II. model driven

➤ Interpretation was conducted by Glenn Morgan, (Morgan Seismic Services), with input from John Colthurst, Hannan's team and John Conneally (iCRAG).

➤ The mapping was conducted over the Kilbricken 3D, KIL11 2D, KIL12 2D and 17-HAN 2D seismic surveys.

- The aim of the mapping was to determine the structural geometry across the Kilbricken area in order to:
  - Understand the known mineralization at the Chimney Zone and Fort Zone.
  - Identify potential exploration targets across the area covered by 2D data.



## ➤ Seismic mapping:

- The stratigraphy was grouped into 9 units.
  - Top Transition Unit (good acoustic impedance boundary)
  - Top Nodular Micrite Unit (NMU) – corresponds with reasonable seismic reflectors.

Age	Hannan stratigraphy Clare Project	Thickness
Brigantian	Aylecotty Chert Mbr, Burren Fm	>30m
Asbian	Burren Formation Caherscooby Oolite Mbr, Burren Fm	85m
Holkerian - Asbian	Upper Silty Calcarenite	>45m
Holkerian - Asbian	Doora Argillite	15 - 35m
Holkerian - Asbian	Upper fine Calcarenite	30m+
Holkerian - Asbian	Upper Clean Grainstone	10-20m
Holkerian	Argillaceous Calcarenite	22m
Holkerian	Middle Fine Grainstone	25m
Holkerian	Main Chert	15m
Holkerian	Middle Burrowed Unit	27m
Arundian	Lower Crinoidal Marker	8m
Chadian - Arundian	Lower Pale Grainstone	45m
Chadian - Arundian	Dark Fine Calcarenite	50m
Chadian	Transition (CHT)	40-70m
Courseyan - Chadian	Waulsortian Lst (WAL)	170-400m
Courseyan	NMU - Nodular Micrite Unit	20-35m
Courseyan	ABL-Argillaceous bioclastic limestones	80-140m
Courseyan	Ballymartin Fm	15-30
Courseyan	Ballyvergin Shale	3-9m
Courseyan	Ringmoyle Shale	20-30m
Courseyan	Mellon House Beds	12-25m
U Dev-L.Carb	Old Red Sandstone (ORS)	>100m
	unconformity	
Silurian-Devonian	Basement	>>1km

**STRATIGRAPHIC UNITS**

- Holkerian-Asbian
- Holkerian
- Arundian
- Chadian-Arundian
- Transition Unit
- Waulsortian Limestone
- NMU
- Courseyan
- Dev-Carb

**Zn-Pb-Ag**



## ➤ The seismic database

- 68km 2D data
- 5 km<sup>2</sup> 3D data

## ➤ The data quality is generally poor to locally fair:

- Significant noise in places.
- Individual seismic reflectors can not be used to determine horizon positions.
- Horizon mapping relies on drill-hole data and trends in reflector packages.
- Fault planes not imaged but reflector discontinuities are observed and used to determine likely fault locations.

## ➤ Dominant frequency of the upper target section ~25-30 Hz.

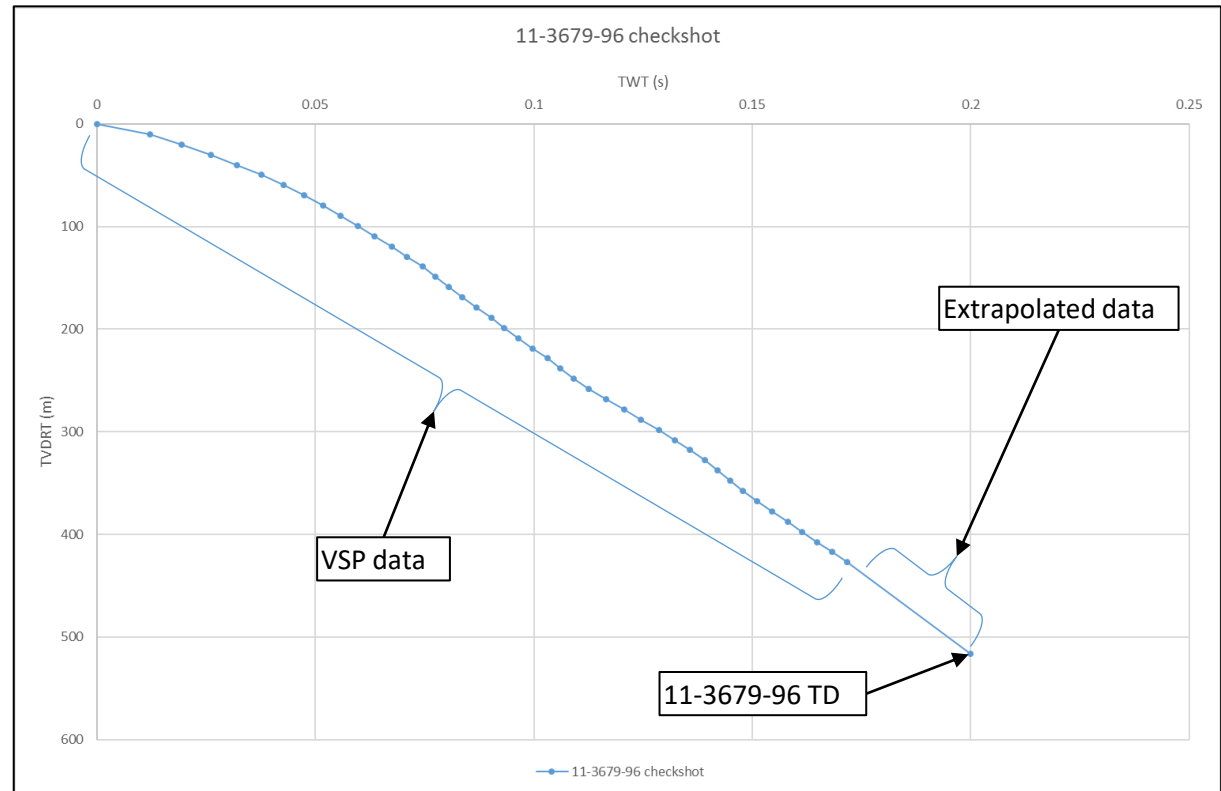
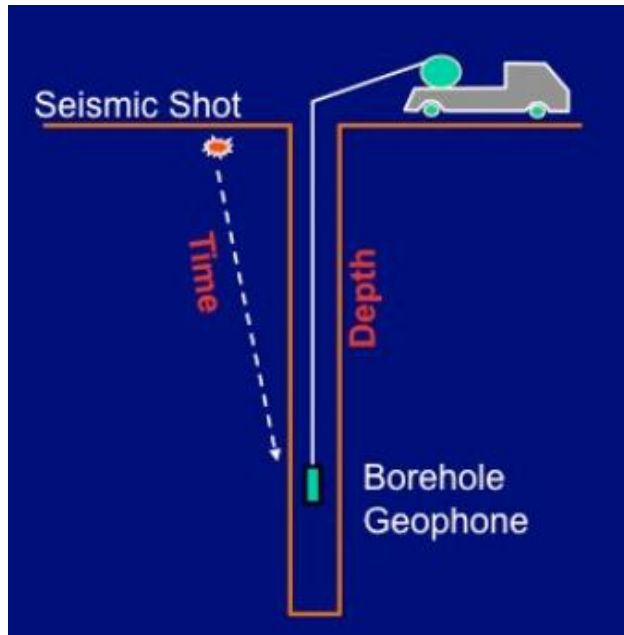
- 30-50m vertical resolution



## Time-Depth Relationship

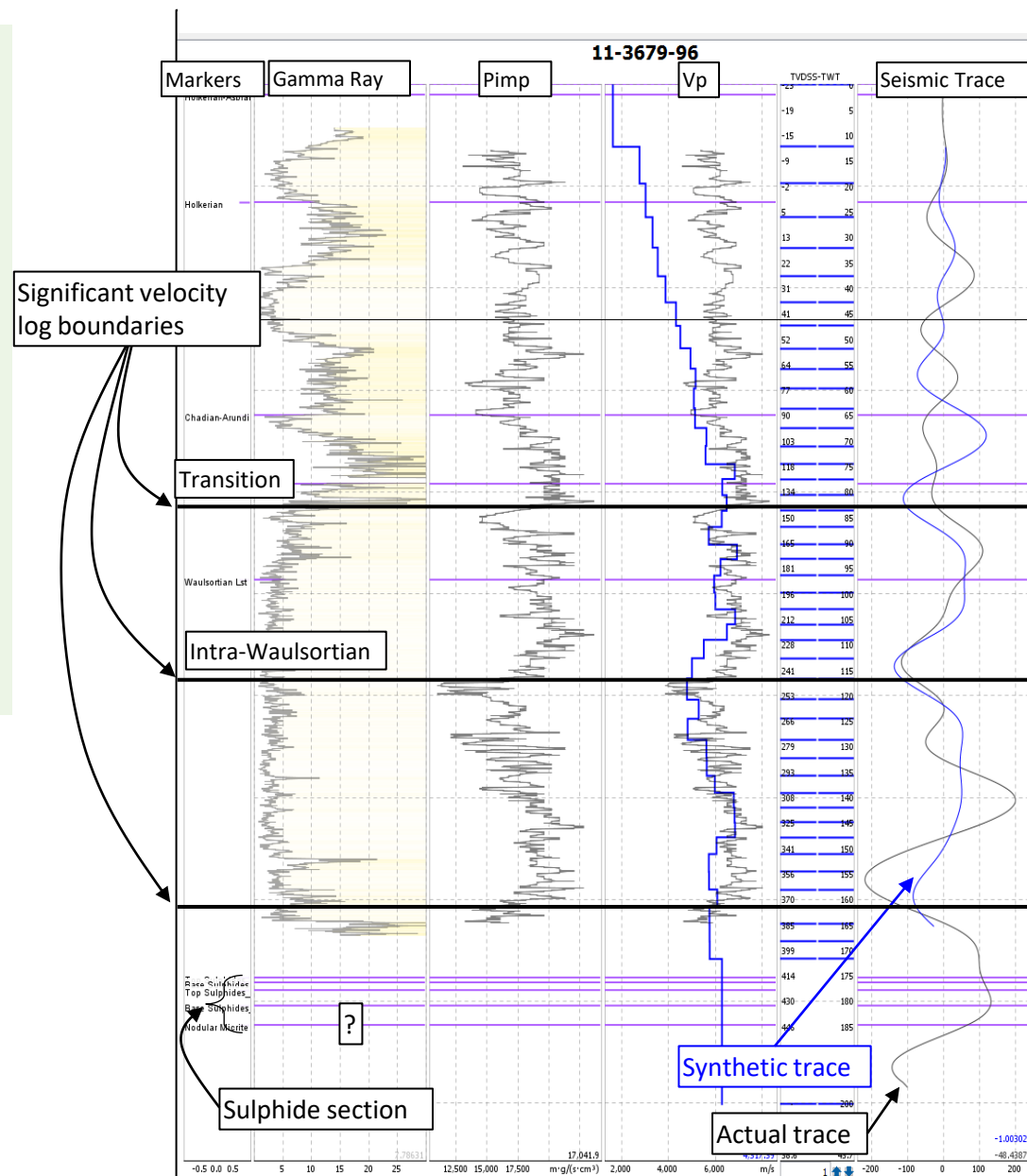


- Time-depth relationship determined from Vertical Seismic Profile (VSP) in 11-3679-96.



- Why VSP is so useful?
- True correlation between depth and time
- The synthetic seismogram shows:
  - Significant seismic events are expected at near Top Transition Unit and Intra-Waulsortian Limestone levels.

## Synthetic Seismogram (11-3679-96)





# NMU: TWT Structure Map

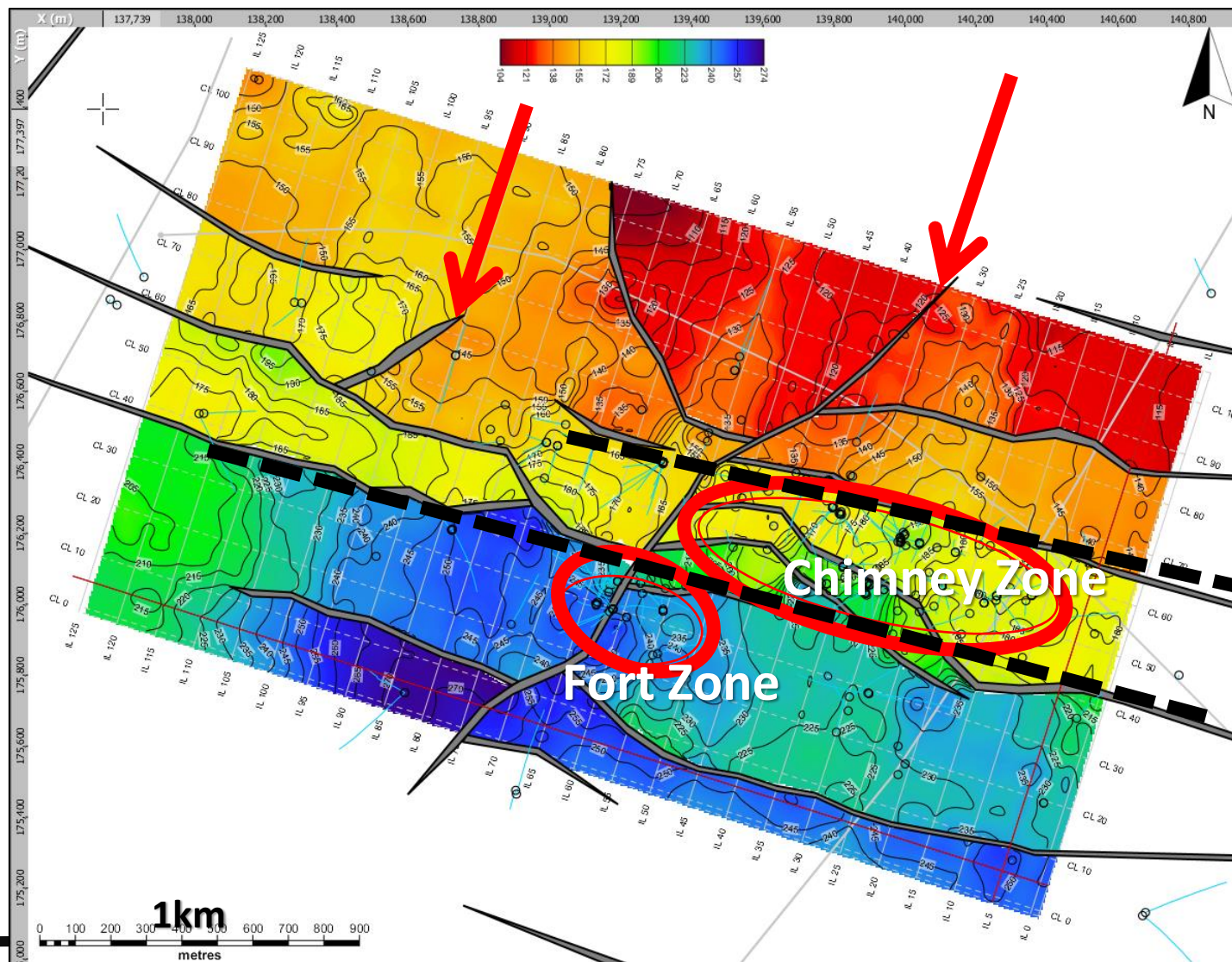
## Kilbricken 3D area

### ➤ Kilbricken 3D:

- Mapping difficult due to poor data quality

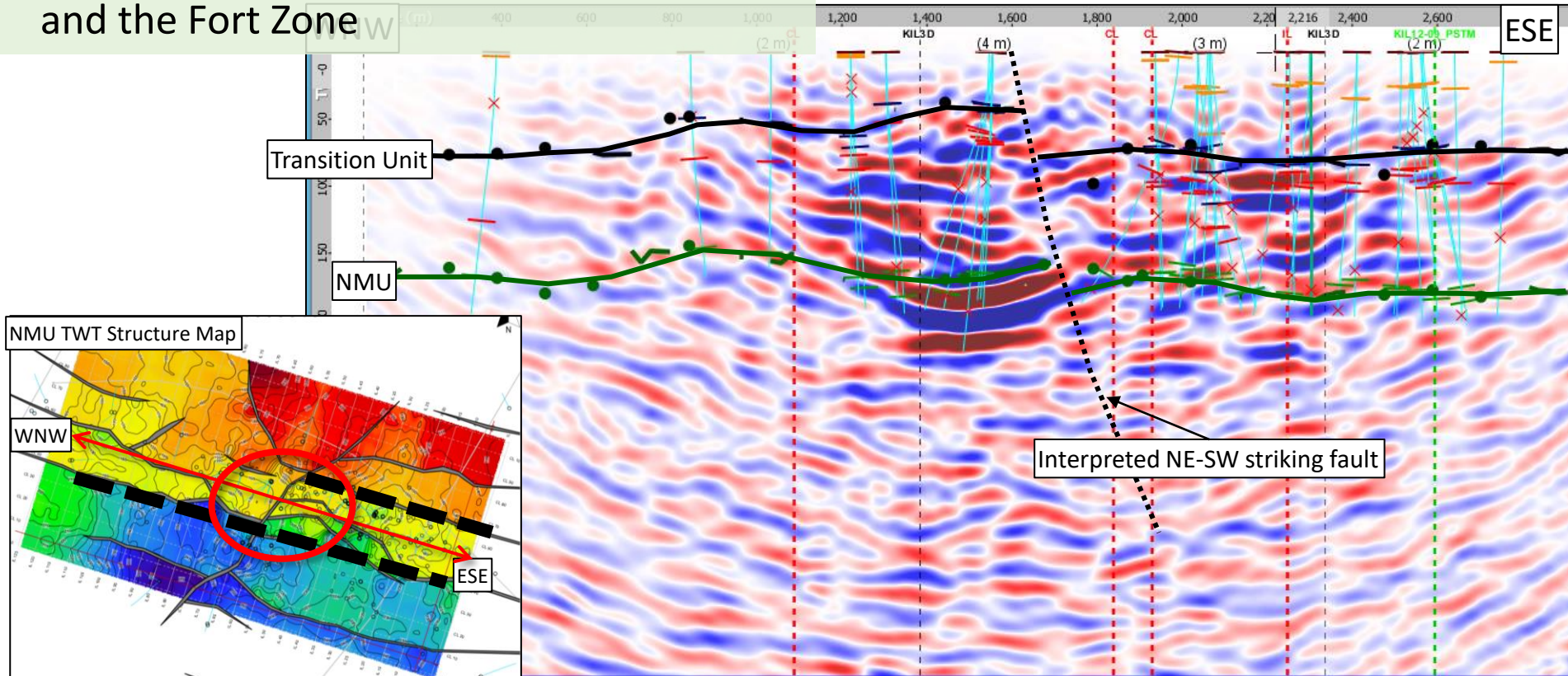
➤ Drill holes helped constrain the model

➤ Significant outcome is the NE-SW structures



# NE-SW Faults

- NE-SW fault based on:
  - Significant thickening of the supra-Waulsortian section to the east and reflector offsets.
- Majority of thickening and reflector offsets suggest a SE-dipping fault with net normal displacement.
- Coincides with relay zone of the Chimney and the Fort Zone



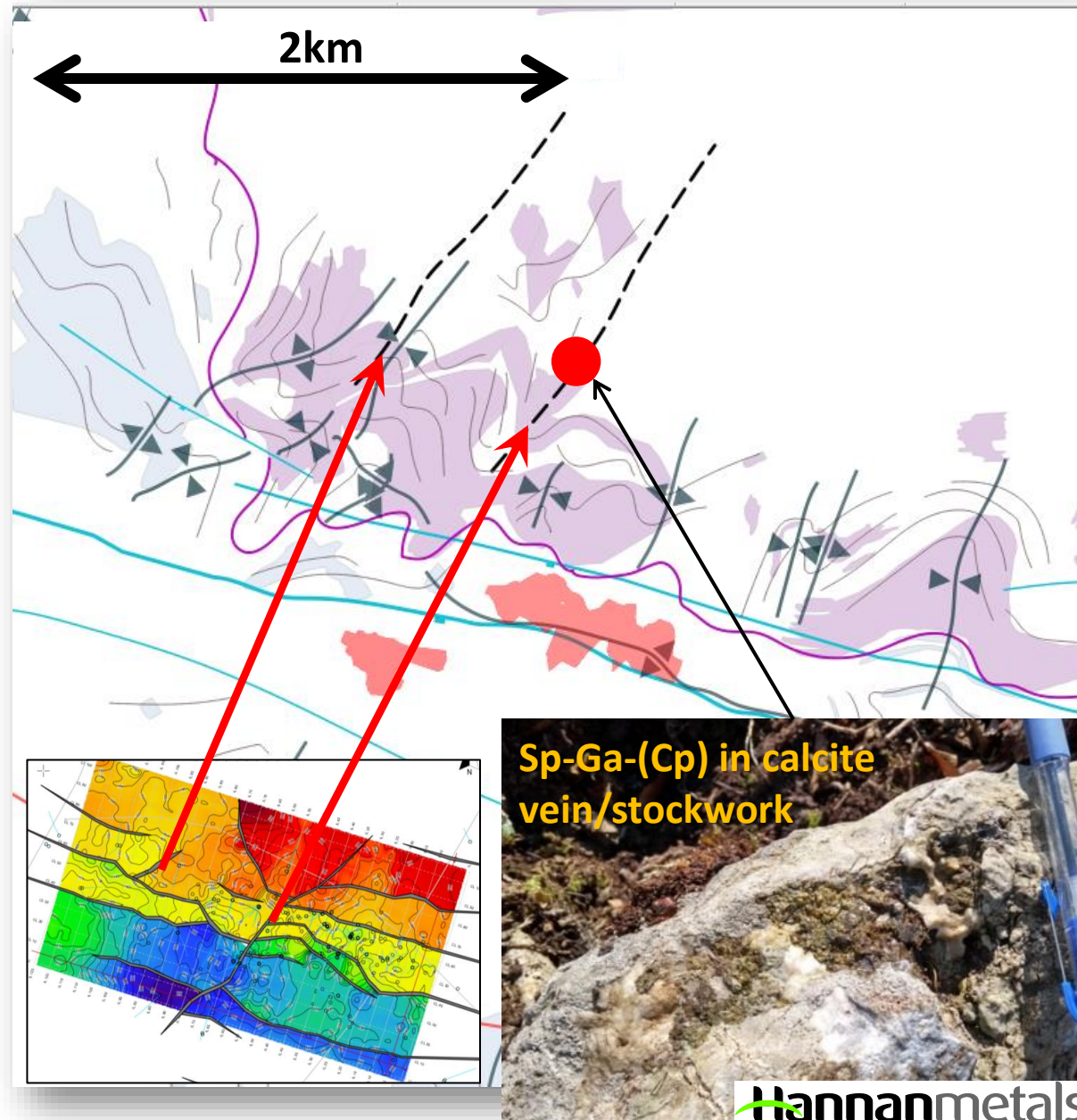


# NE-SW Faults

➤ Strong support in detailed surface mapping

➤ Deformation is Variscan. The N-S orientation is an interference pattern related to strain bend around pre-existing structures.

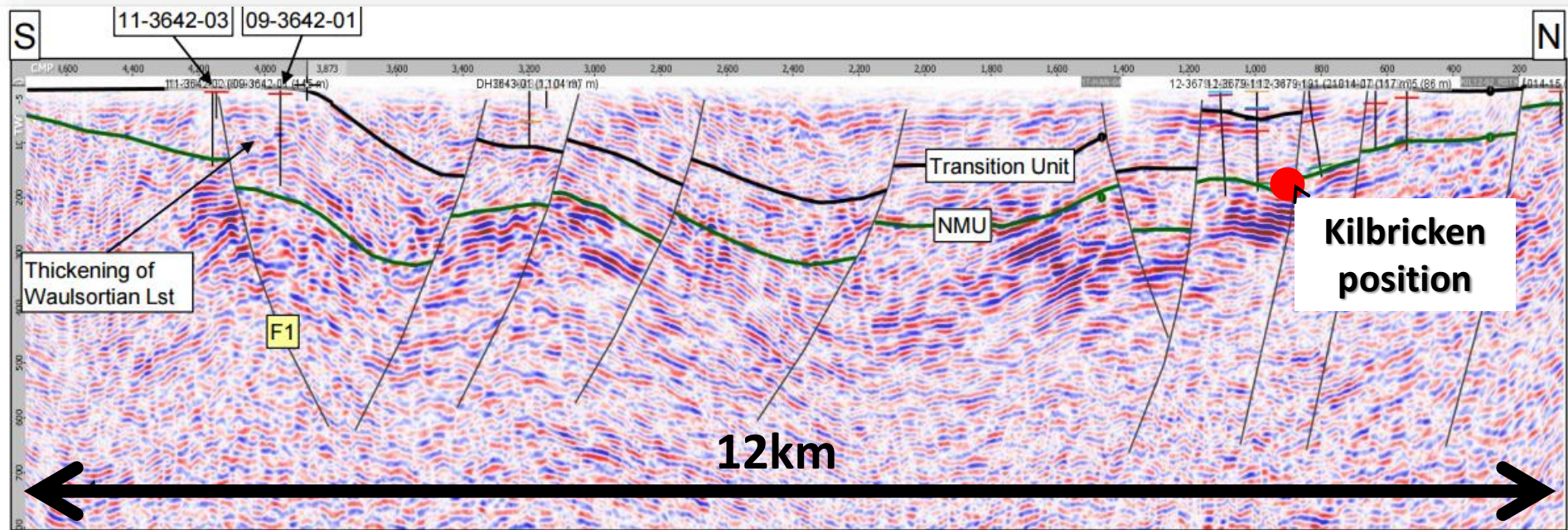
➤ Hannan's latest outcrop discovery correlates with one zone





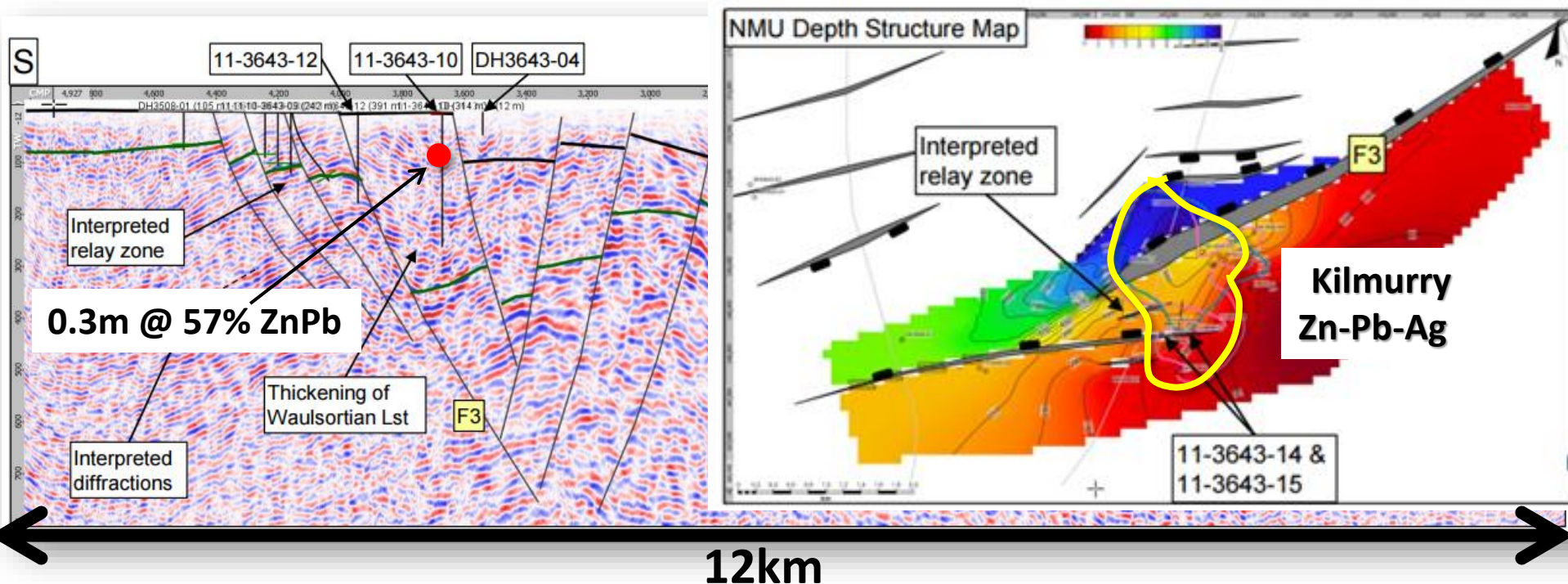
# Interpretation 17HAN01

- Key markers for mapping is the high amplitude package and the “bland zone”
- Interpretation in North and South is constrained by drill holes
- DDH 09-3642-01 (proj. 145m W intersected +450m Waulsortian from surface
- F1 is a significant N dipping fault with ~200m vertical offset



# Interpretation 17HAN02

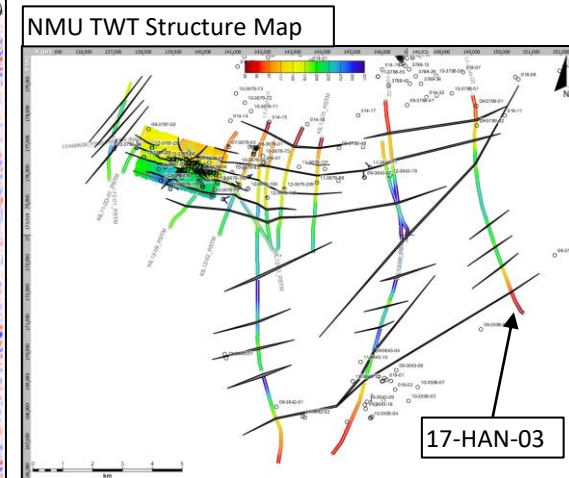
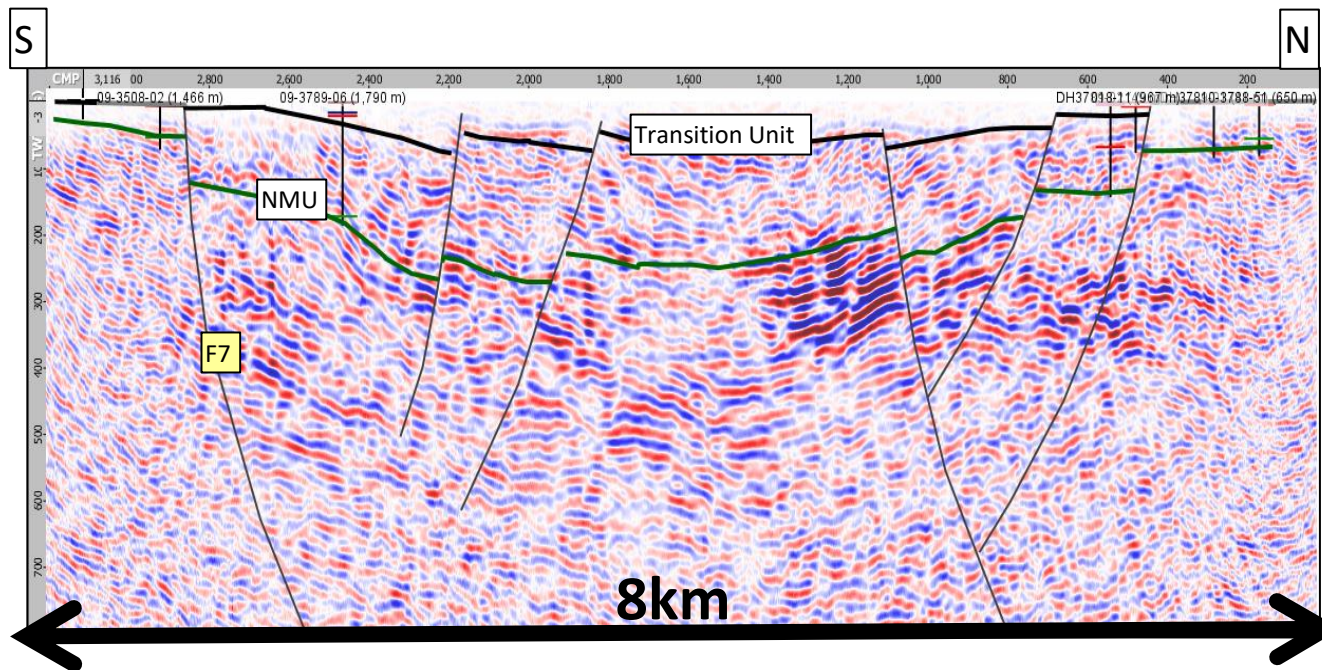
- Northern and Southern end is constrained by drill holes
- F3 is a major fault with >750m vertical displacement. It is interpreted to be the northern bounding fault of a major relay zone
- Drill hole 11-3643-10 intersected >750m of Waulsortian.
- Kilmurry sits in the FW of the major relay zone.





# Interpretation 17HAN03

- Interpretation is partly constrained by drill holes in the North and South
- 09-3789-06 (proj. 1790 m W) intersected 428 m Waulsortian from near surface.
- F7 is a significant N-dipping fault with 300m vertical offset





- **Model driven** interpretation was conducted by Leigh Rankin, with input from Glenn Morgan, John Colthurst, iCRAG and Hannan's team.
- The purpose with this assessment is to identify the most prospective parts of the project.
- The key is to constrain the interpretation with good exploratory data

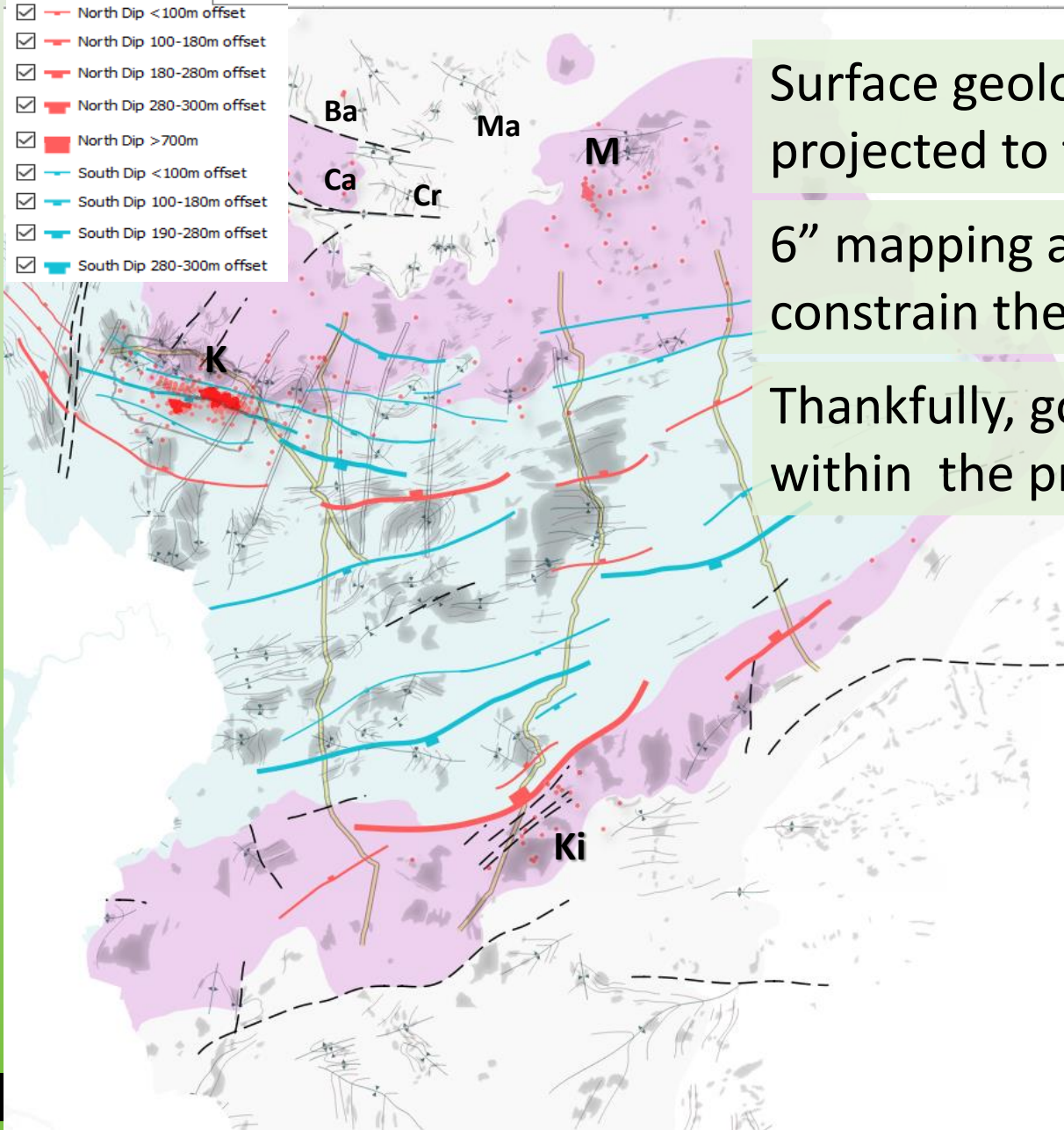
*"In Ireland where the maps are on a scale of six inches to the mile, very great precision may be obtained, both as regards the lines of mineral veins, and the outcrop of coal beds...."*

*Instructions for the Local Directors of the Geological Survey of Great Britain and Ireland.  
Henry de la Beche  
22nd May 1845*

**Kilbricken**

# Constraining the model

- North Dip < 100m offset
- North Dip 100-180m offset
- North Dip 180-280m offset
- North Dip 280-300m offset
- North Dip > 700m
- South Dip < 100m offset
- South Dip 100-180m offset
- South Dip 190-280m offset
- South Dip 280-300m offset



Surface geology with seismic faults projected to the surface

6" mapping and drilling has been key to constrain the cross line geology

Thankfully, good outcrops were found within the project area



# Proposed basin controls

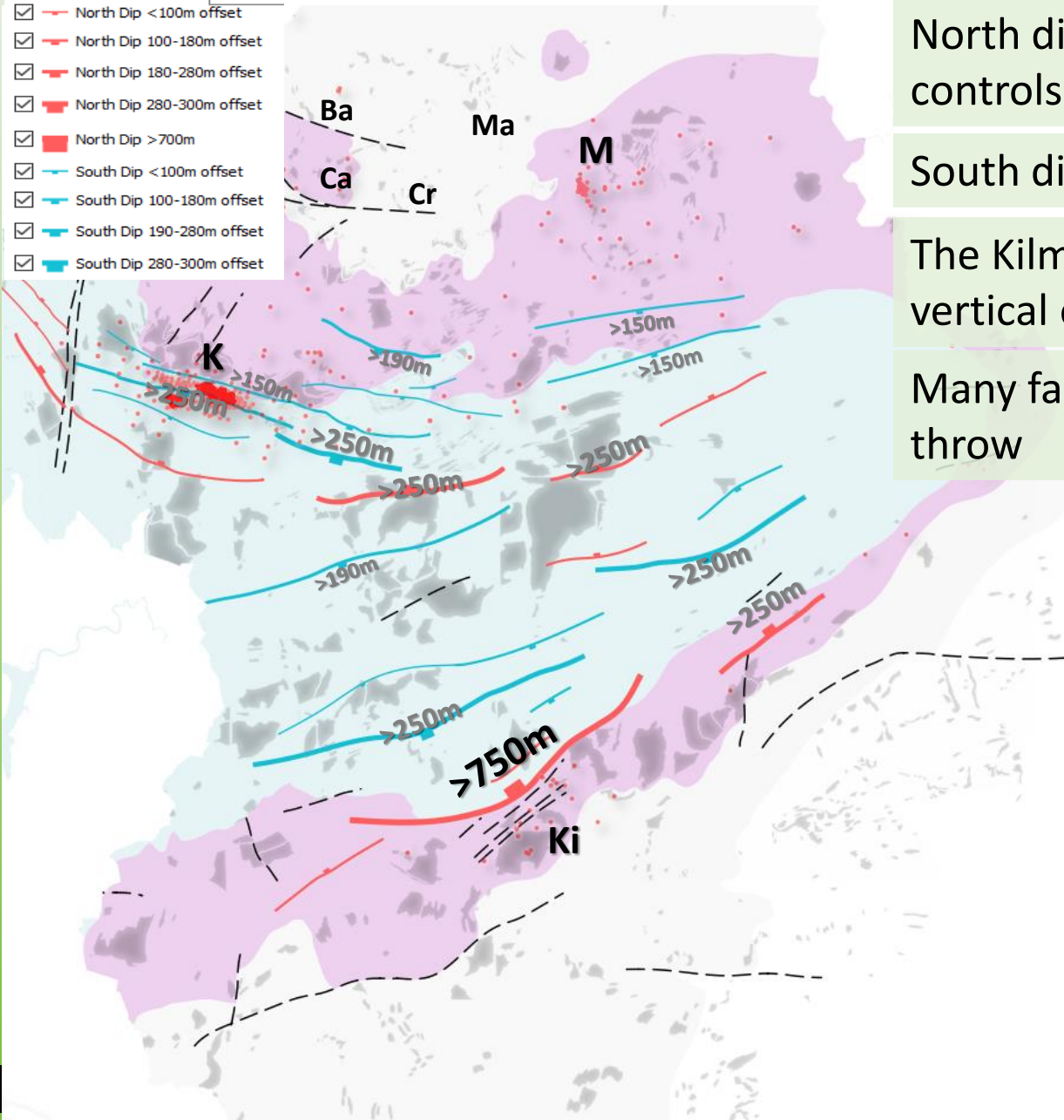
- ☑ North Dip <100m offset
- ☑ North Dip 100-180m offset
- ☑ North Dip 180-280m offset
- ☑ North Dip 280-300m offset
- ☑ North Dip >700m
- ☑ South Dip <100m offset
- ☑ South Dip 100-180m offset
- ☑ South Dip 190-280m offset
- ☑ South Dip 280-300m offset

North dipping faults are first order and controls the basin margins

South dipping faults are 2<sup>nd</sup> order.

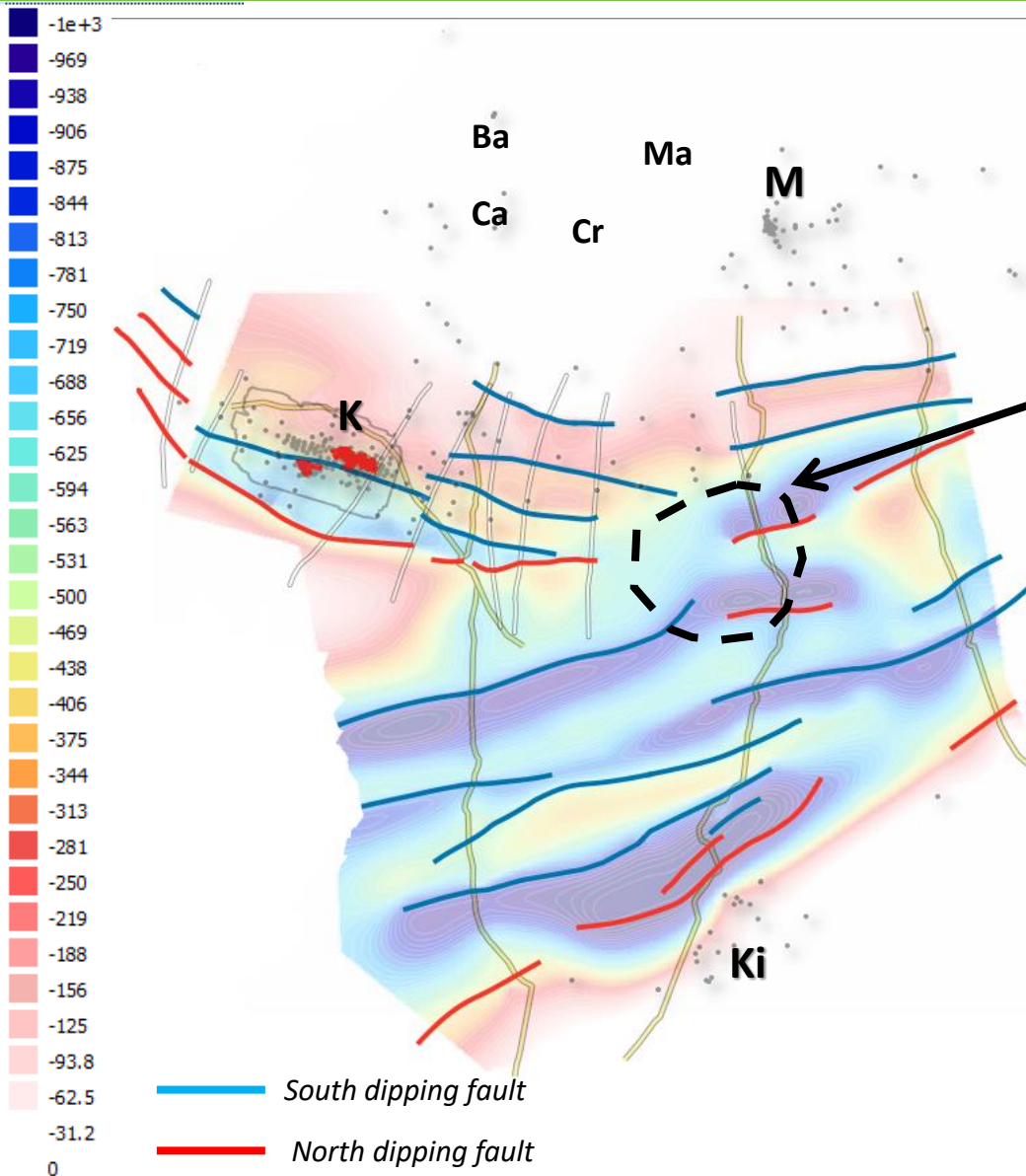
The Kilmurry fault shows more >750m vertical offset

Many faults have more than >250m throw





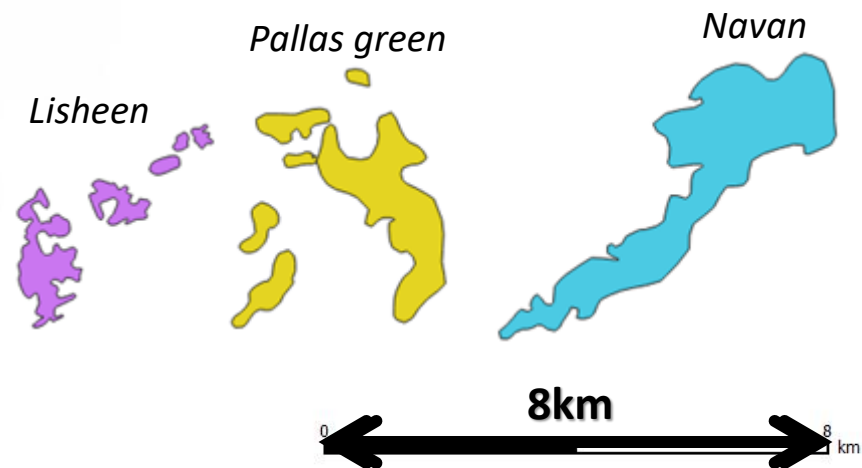
# Structures at target depth

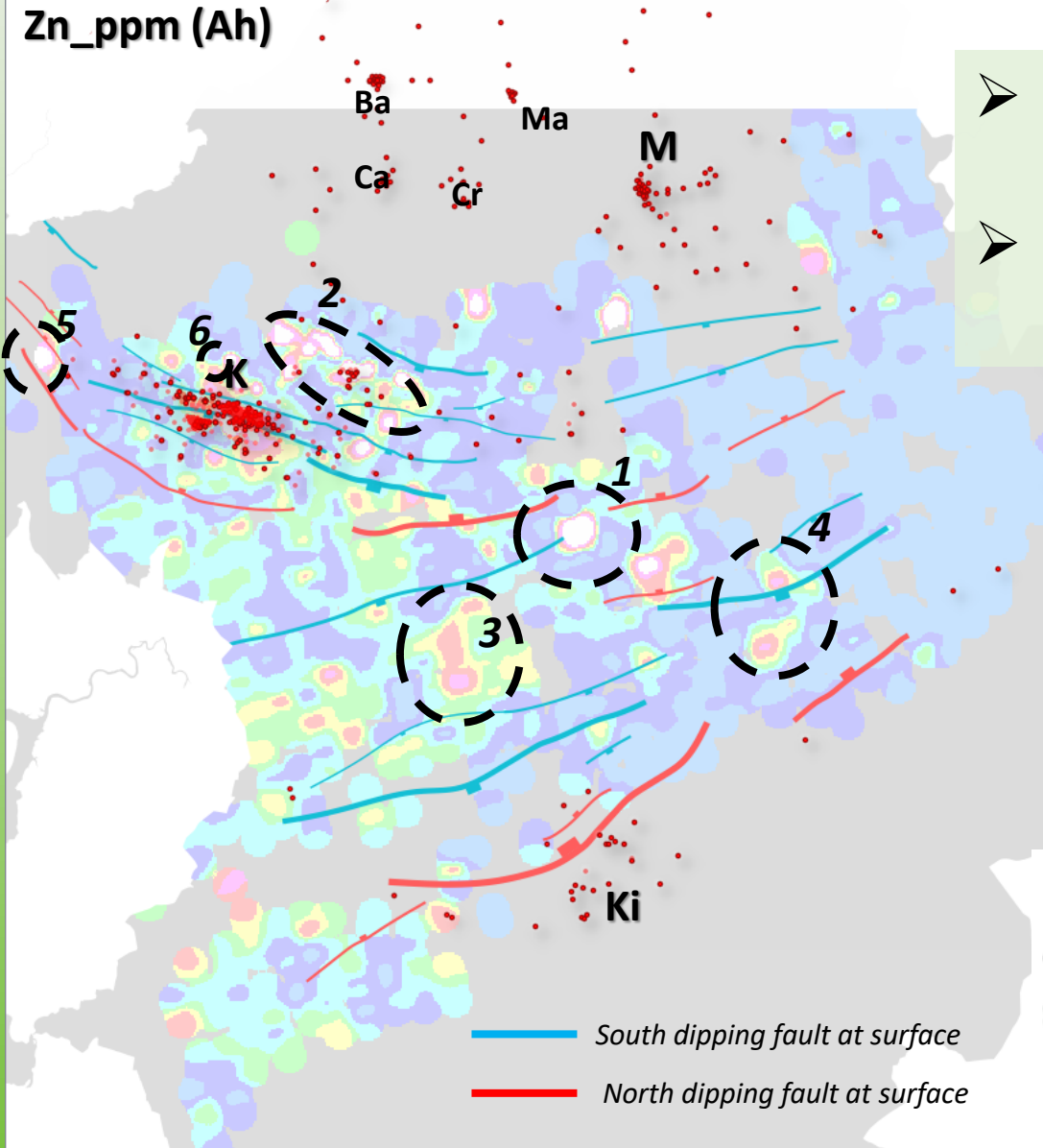


Target depth varies between 200-1000m

Converging fault trends and polarity change

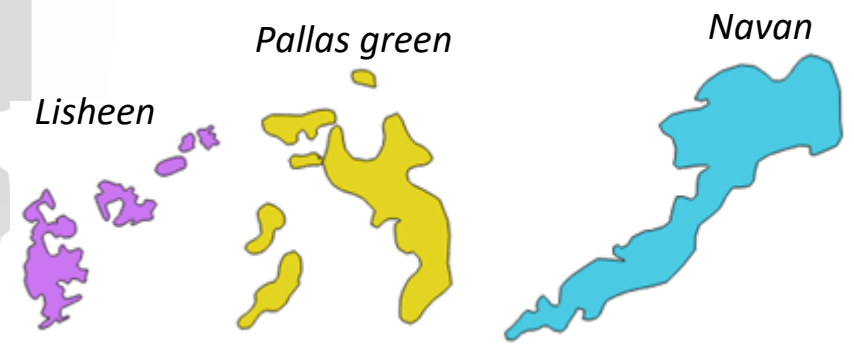
Irish deposits at the same scale



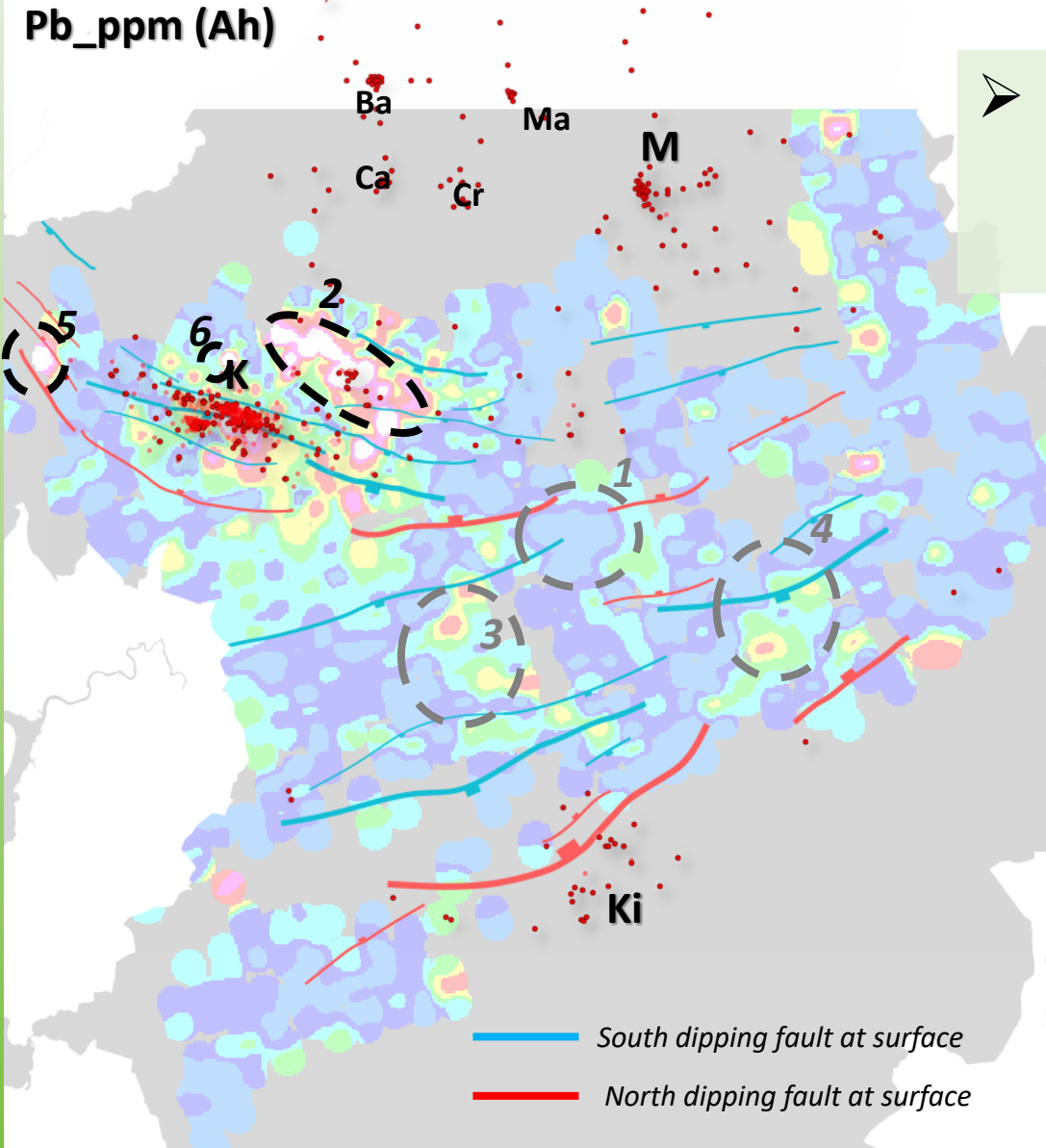


- 6 multipoint Zn anomalies
- Only Ballyhickey has been partially drill tested

Irish deposits at the same scale

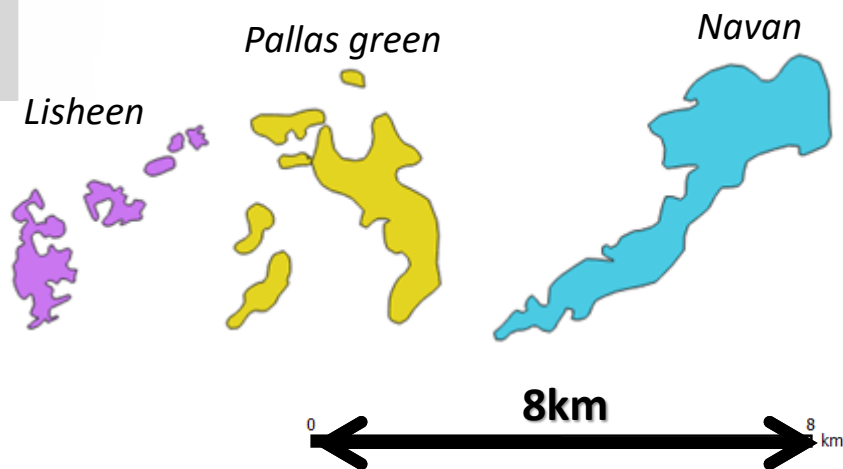


— South dipping fault at surface  
— North dipping fault at surface



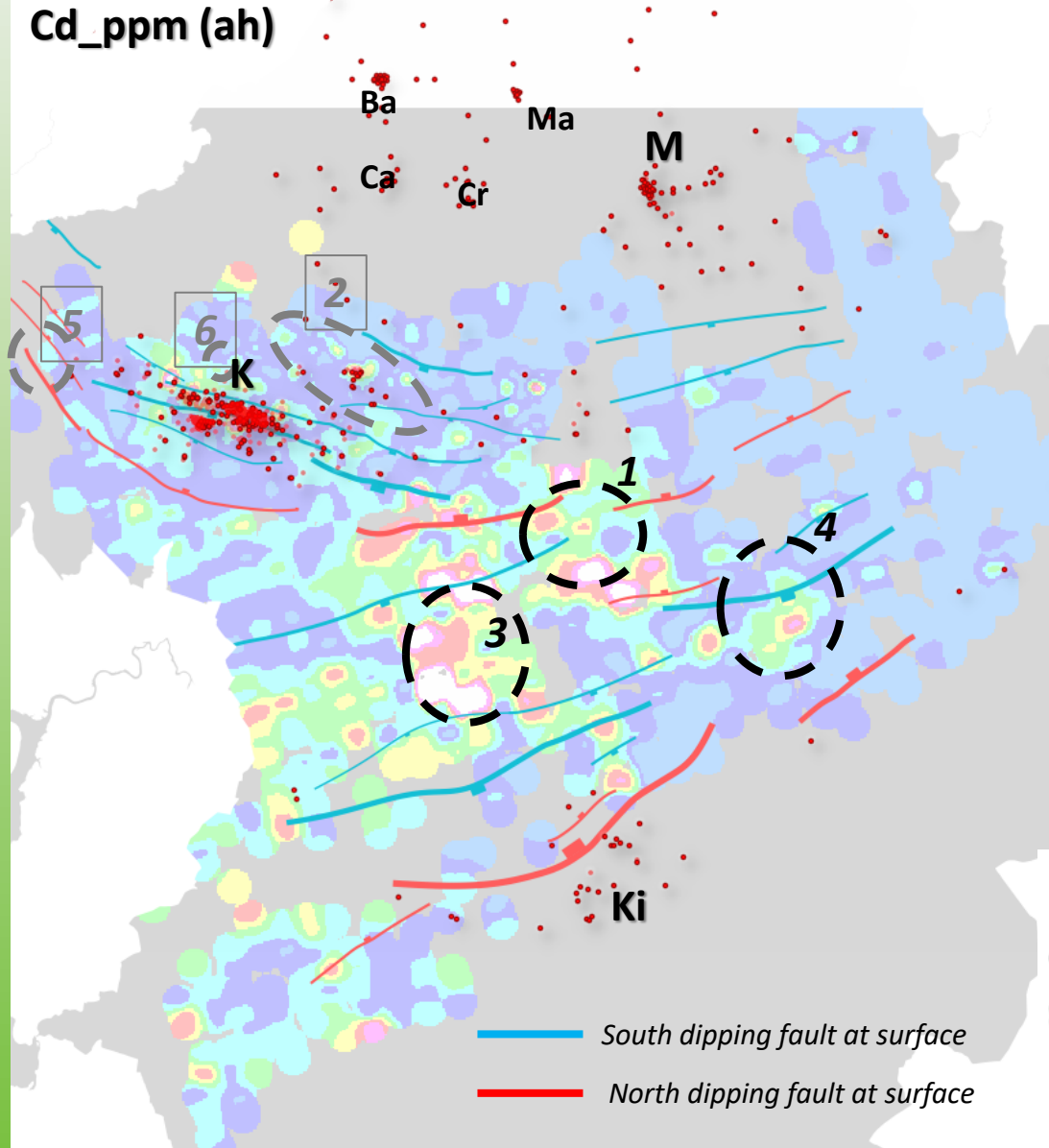
➤ Pb is strongly anomalous in the Kilbricken-Ballyhickey area

Irish deposits at the same scale



— South dipping fault at surface  
— North dipping fault at surface

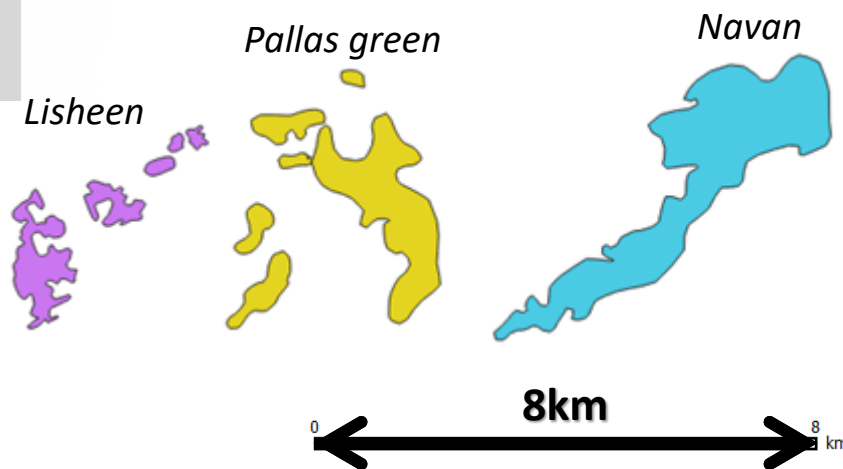




➤ Cd is anomalous in the “center” of the basin and at Kilmurry

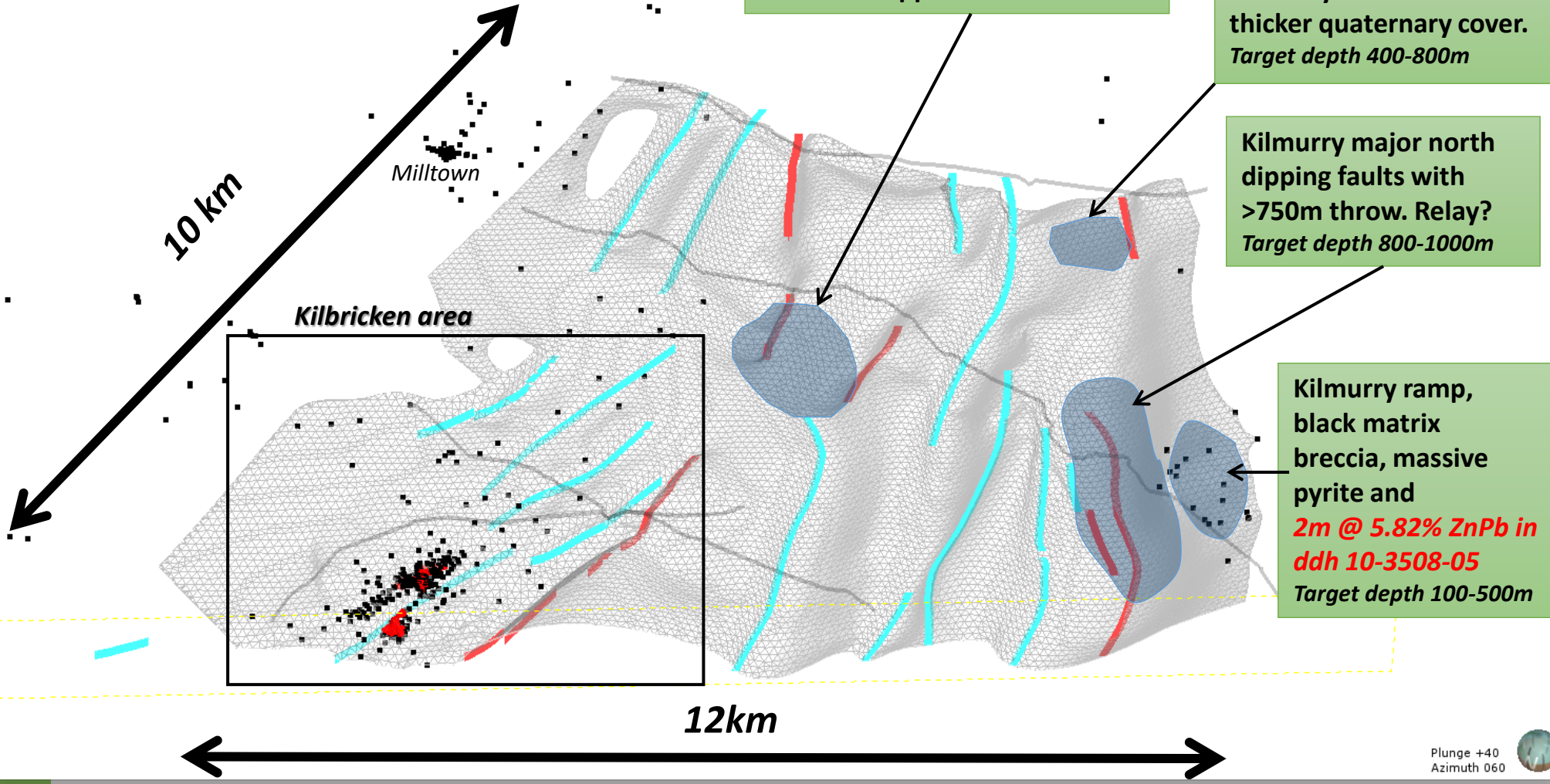
➤ Note that these Cd anomalies coincide with Zn anomalies

Irish deposits at the same scale



# Summary of new targets

- South dipping fault at surface
- North dipping fault at surface
- Drill hole at target depth

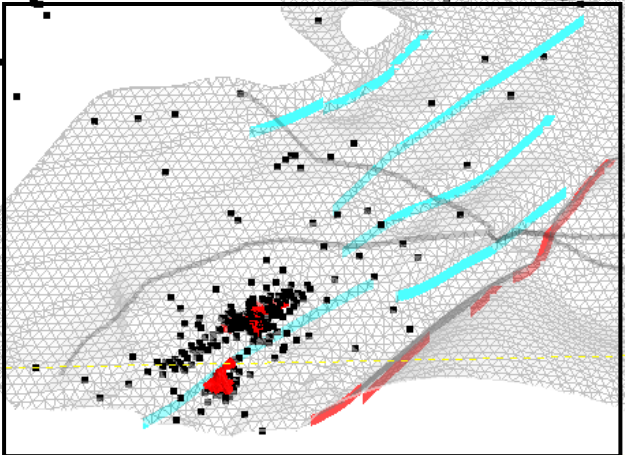


Converging fault trends with polarity change coinciding with multpoint Zn-Cd anomaly with 300-600 Zn ppm in soil.

Multpoint Zn-Cd anomaly in area with thicker quaternary cover. Target depth 400-800m

Kilmurphy major north dipping faults with >750m throw. Relay? Target depth 800-1000m

Kilmurphy ramp, black matrix breccia, massive pyrite and **2m @ 5.82% ZnPb in ddh 10-3508-05** Target depth 100-500m



VIEW NE

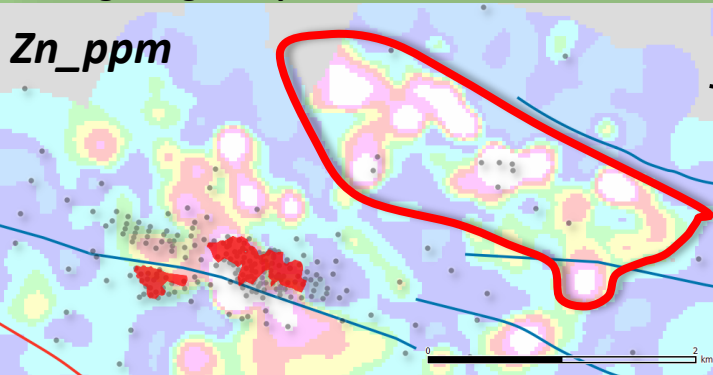
Plunge +40  
Azimuth 060



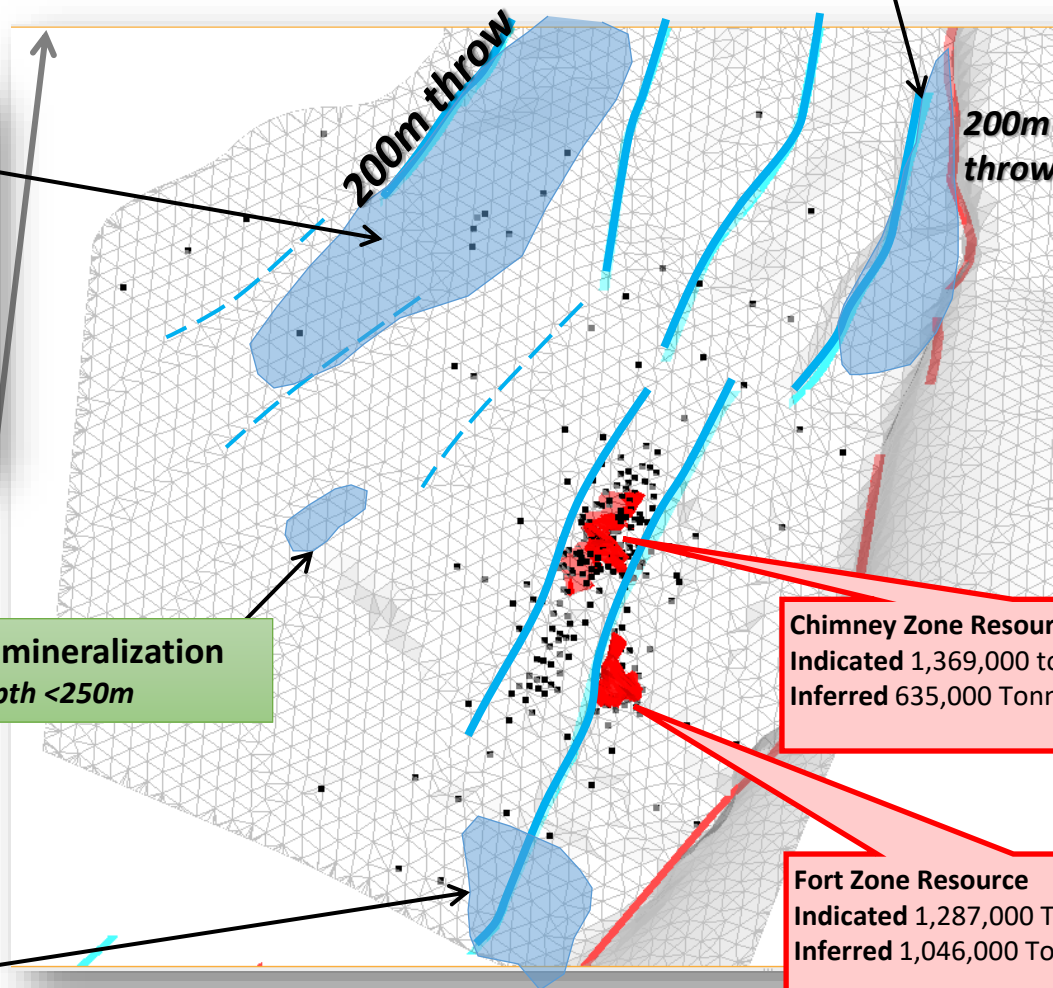
# First order targets at Kilbricken

Ballyhickey fault panel 2.5 km x 600 m, strong surface geochemistry and dissolution and trace Zn-Pb mineralization in historic drilling. Target depth <250m

Zn\_ppm



VIEW NE



Converging fault trends and strong surface geochemistry with multipoint Zn-Cd anomaly  
Target depth 650-850m

Outcrop mineralization  
Target depth <250m

**Chimney Zone Resource**  
Indicated 1,369,000 tonnes @ 10.8 % ZnEq  
Inferred 635,000 Tonnes @ 10.4 % ZnEq

**Fort Zone Resource**  
Indicated 1,287,000 Tonnes @ 6.7% ZnEq  
Inferred 1,046,000 Tonnes @ 6.8 % ZnEq

- South dipping fault at surface
- North dipping fault at surface
- Drill hole at target depth

>100m Complex collapse breccia. Converging fault trends.  
Target depth 550-650m

Thank you