MINING

TRANSFORMING MINING

CRCMINING
TRANSFORMING MINING

WORLD-CLASS SOLUTIONS FOR INDUSTRY

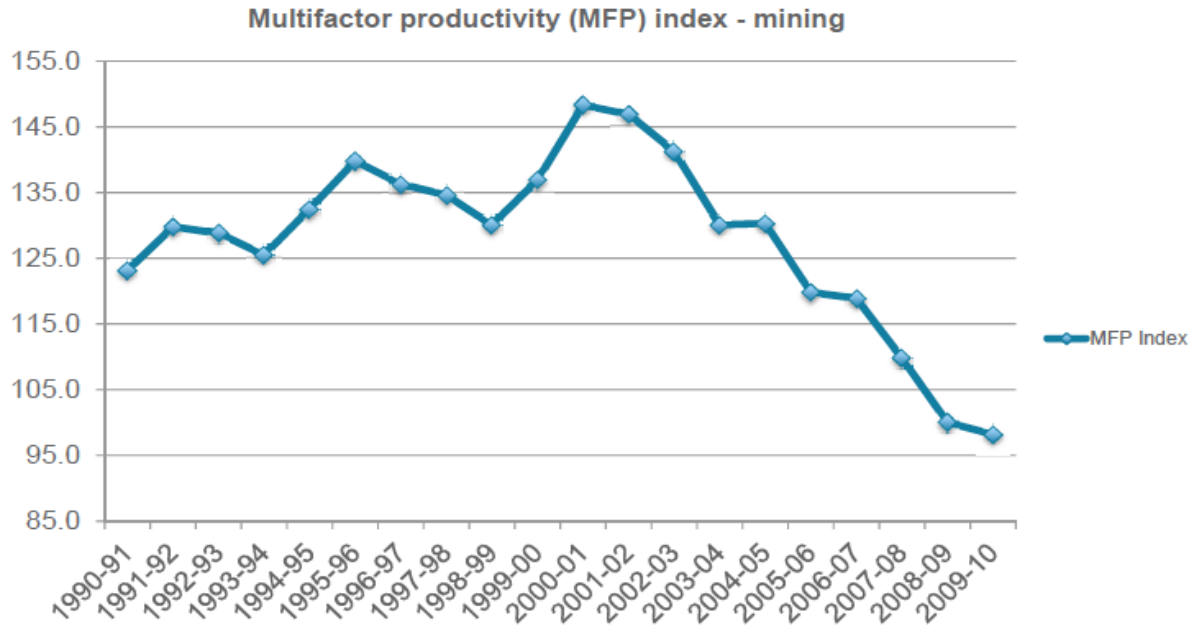
CRCMINING – TRANSFORMING MINING

CRCMining is the **pre-eminent**, industry-driven centre for global mining research and innovation.

We deliver deliver transformational research and innovations that **maximise mining productivity** and enhance resource utilisation and sustainability.

We develop **highly-skilled leaders** to drive the adoption of new mining processes and technologies.

THE MINING INDUSTRY CHALLENGE



Source: Australian Bureau of Statistics (ABS) (2011), 5260.0.55.002 – Experimental estimates of industry multifactor productivity, 2010-11

Addressing these issues will require **investment** in a significant and focused long-term R&D program, sustained programs that build capacity (people, products, services, and infrastructure) and develop implementable solutions for the mining industry.

Drivers for research vision – mining grand industry challenges

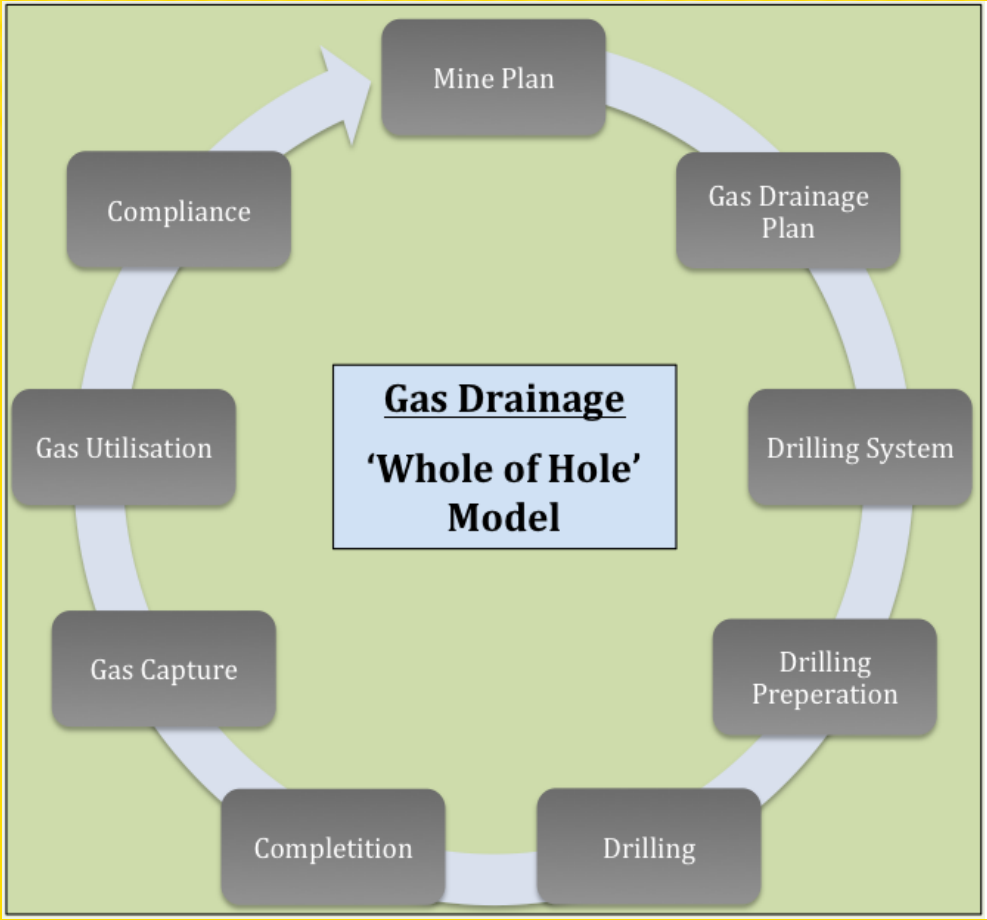
- Exponential growth in demand
- Reduced effective commodity prices
- The decreasing quality and increasing complexity of ores
- Declining productivity trend across worldwide mining industry
- Increased rate of rising costs
- An increasing need to go deeper – both underground and surface
- The need to mine in less accessible areas and more challenging environments
- The carbon economy and the need for greater energy efficiency, decreased GHG emissions and the move to renewable energy sources
- Good corporate citizenship: a move to greater OH&S, ecology, and environmental responsibilities
- Skilled labour shortages
- Higher energy and water costs (both financial and environmental)

OUR RESEARCH VISION

- A research vision with a **20 year timeframe**
- Developing major outcomes over **8 year periods**
- Delivering **ongoing incremental outcomes**

- New and modified mining methods and processes
- New mining technology and equipment
- Improved operational control of mining value chain
- Highly skilled people to drive adoption of new processes, technology and equipment

WHOLE OF HOLE



Whole of Hole Elements	Activities
1. Gas Management Plan	*Mine Plan*
	Resource Management
	Legal Requirements
	Quality, Time and Cost
2. Drilling System	*Surface to In-Seam Drilling*
	Underground In-Seam Drilling – Drill Rig
	Goaf – Surface to Top of Coal Drilling
3. Site Preparation	*Transport*
	Location
	Infrastructure – Ventilation, Air, Water, Power & Waste
	Equipment Set-Up
4. Drilling	*Standpipe*
	Pre-Drainage Drilling
	Compliance Drilling – Coring and Redrilling
	Exploration Drilling
	Compliance Drilling
	Drilling Performance
	Surveying
	Geological Mapping
	Reporting
5. Completion	*Borehole Dewatering*
	Borehole Lining
	Infrastructure – Gas, Water and Waste
6. Gas Capture	*Ventilation*
	Gas Flow Measurement
	Infrastructure Maintenance
7. Gas Utilisation	*Vent*
	Flare
	Energy Production
8. Compliance	*Coring*
	Testing
	Redrilling
	Road Way Development

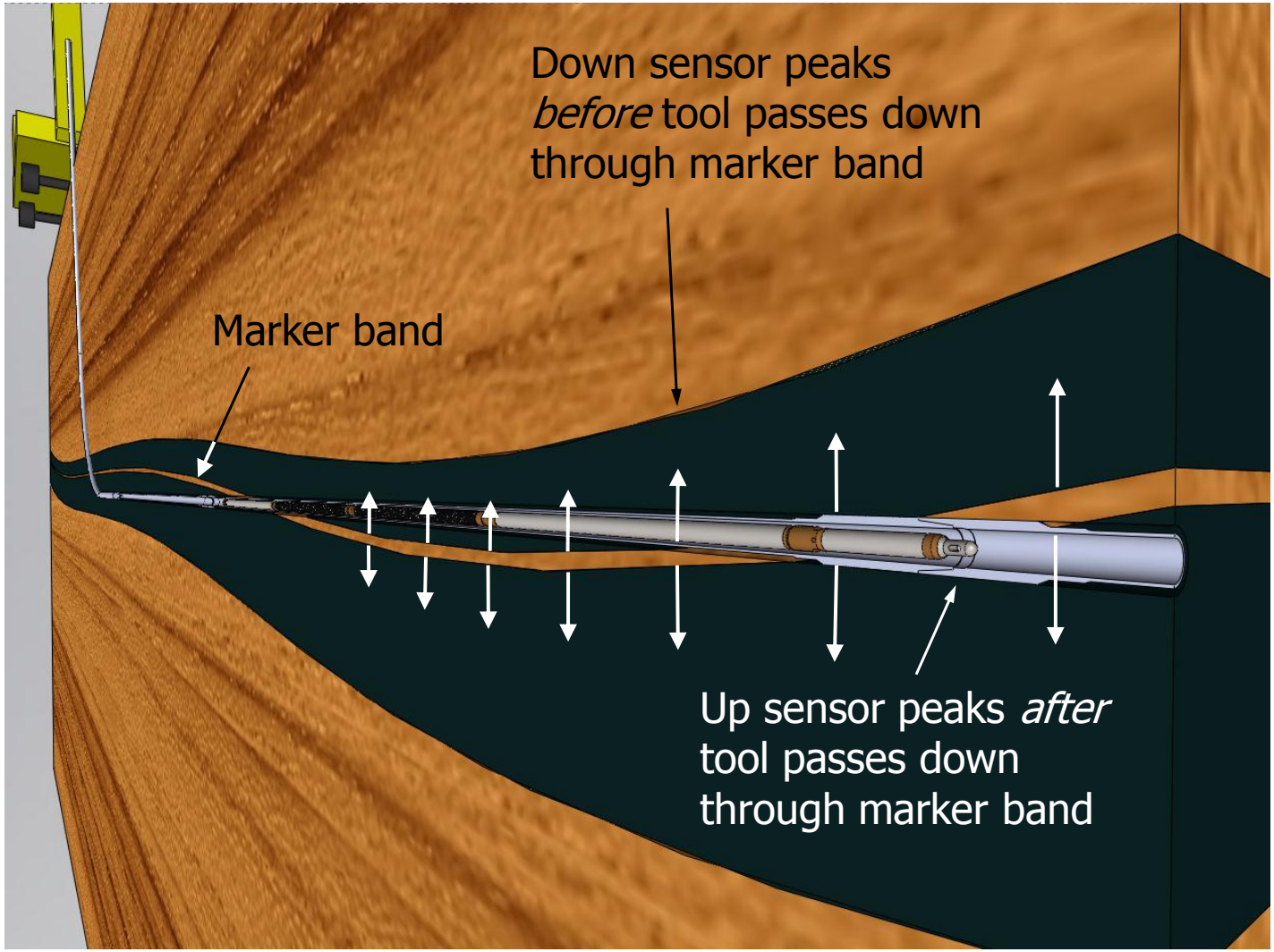
SUPERLOGGER STAGE 1 & 2
DELIVERING LOWER RISK U/G COAL MINING

SUPERLOGGER

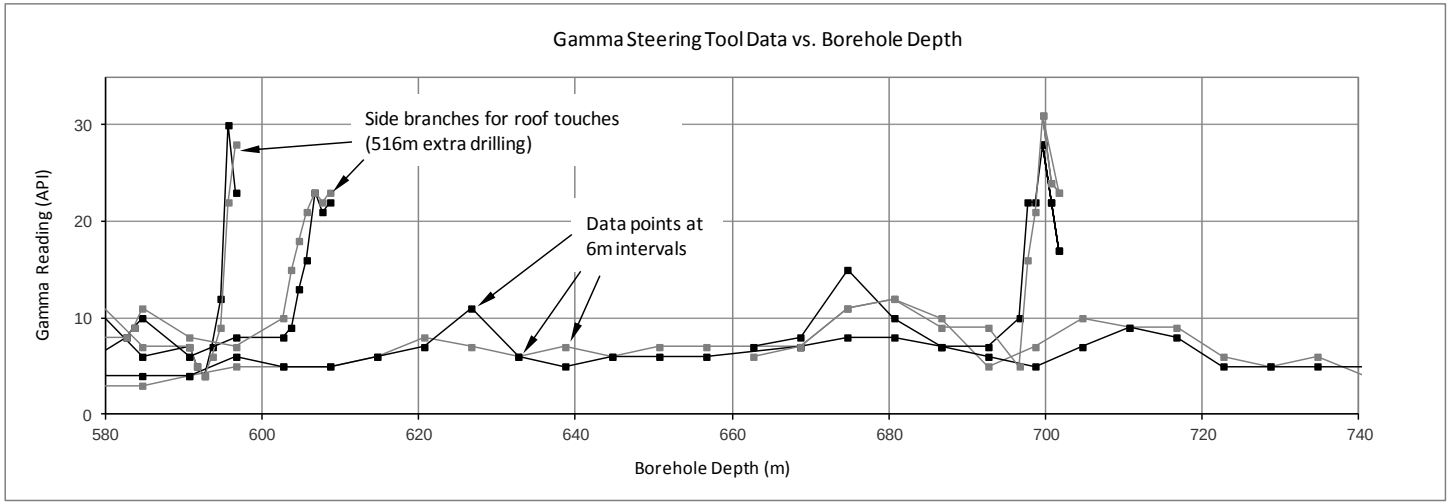
Stage 1:

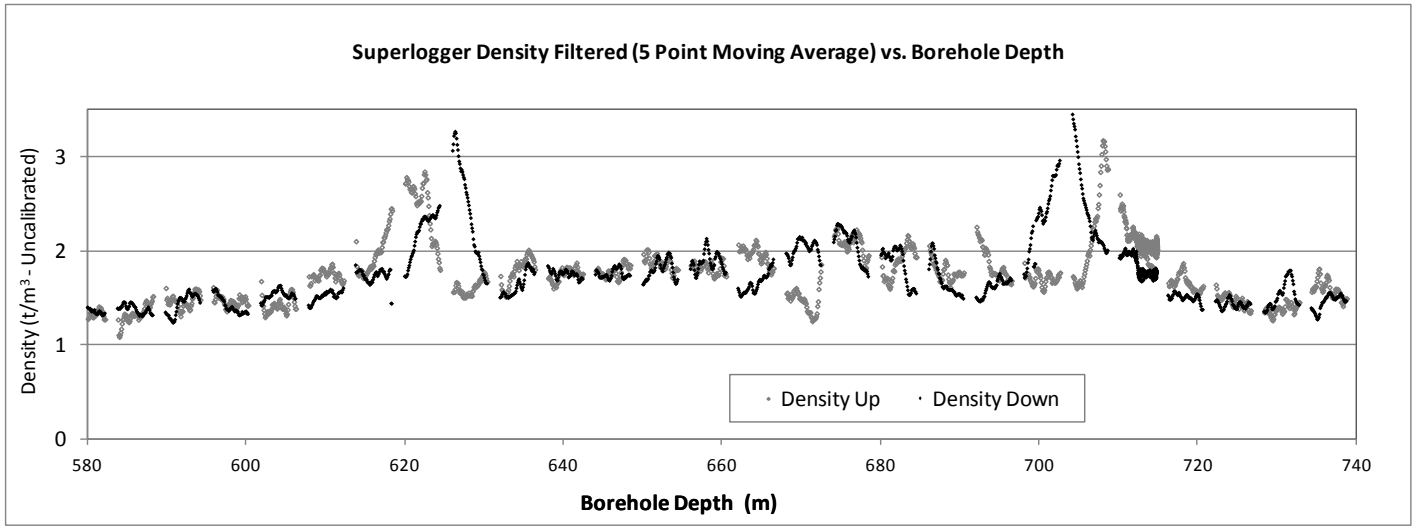
- Surface to In-Seam
- Deployed on wireline
- Deployed *inside* drill string
- Directional gamma
- Directional density

SUPERLOGGER OPERATION

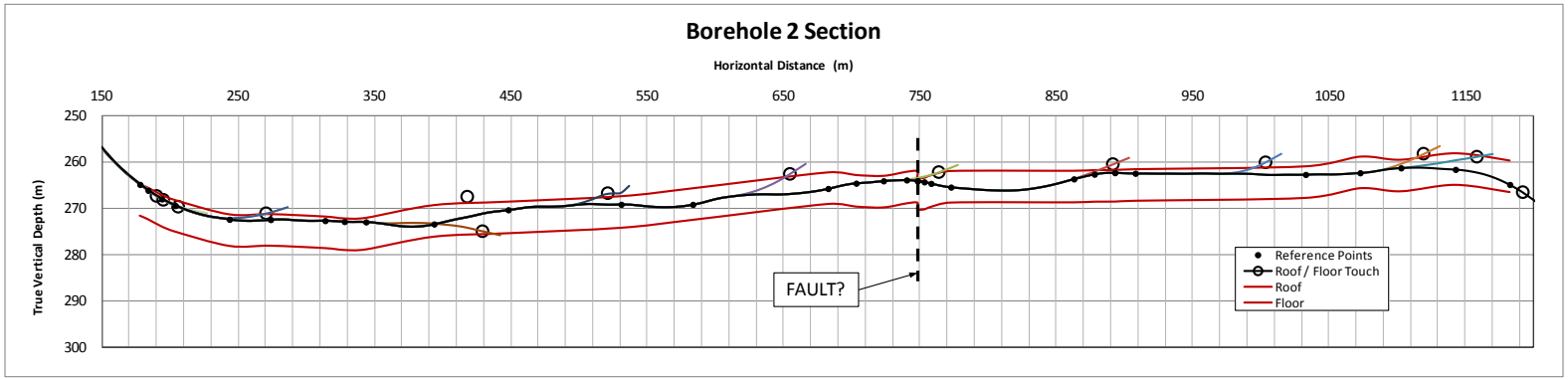


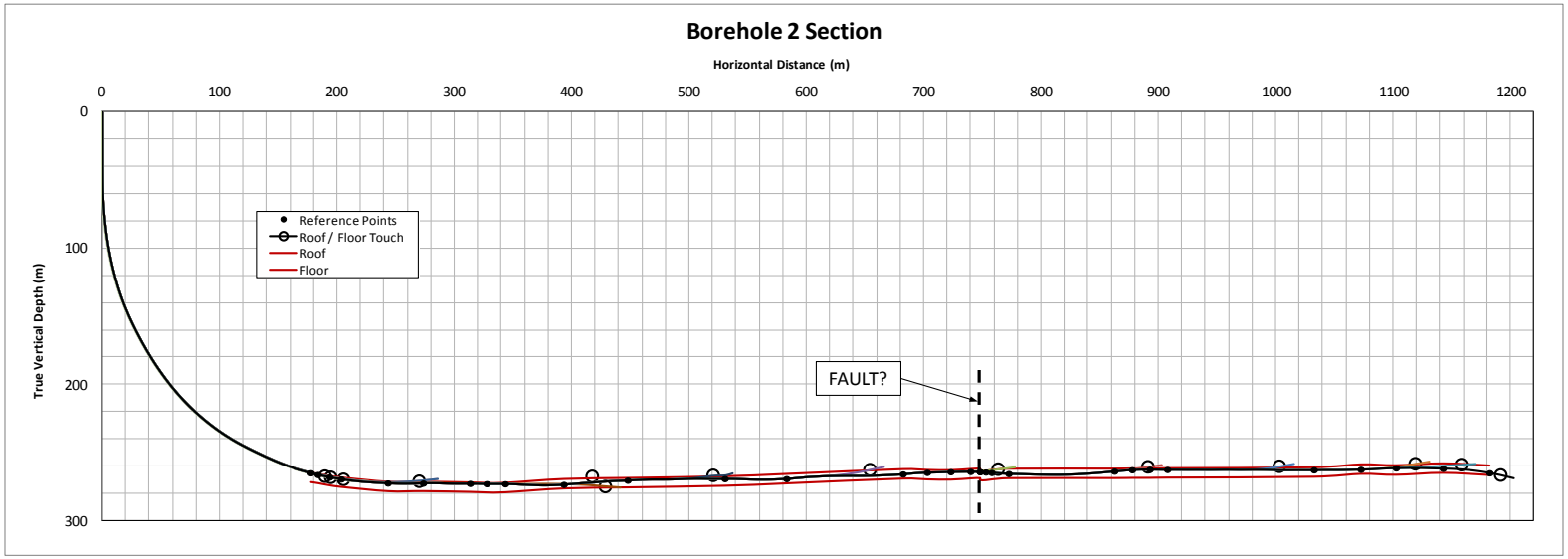
SUPERLOGGER DATA VS. EXISTING DATA





SUPERLOGGER COAL SEAM GEOLOGICAL MODEL





SUPERLOGGER STAGE 2

Further improvements:

- New resistivity module for greater depth of investigation

Future concepts:

- Spectral Gamma for absolute position in seam
- Calliper sub for correction of Gamma data

UIS WIRELESS DRILL STRING COMMUNICATION

A PLATFORM FOR INNOVATION AND FLEXIBILITY IN UIS

BACKGROUND

The need for enhanced geo-sensing and ***real-time telemetry*** to improve drilling quality and accuracy exists in Underground In Seam (UIS) and Surface to In Seam (SIS) drilling.

The lack of real-time data has resulted in a standard practice developing that involves routine stoppages in drilling. This reduces the quality of metres drilled by 20% to 50%.

The existing art for UIS drilling also has two other main drawbacks;

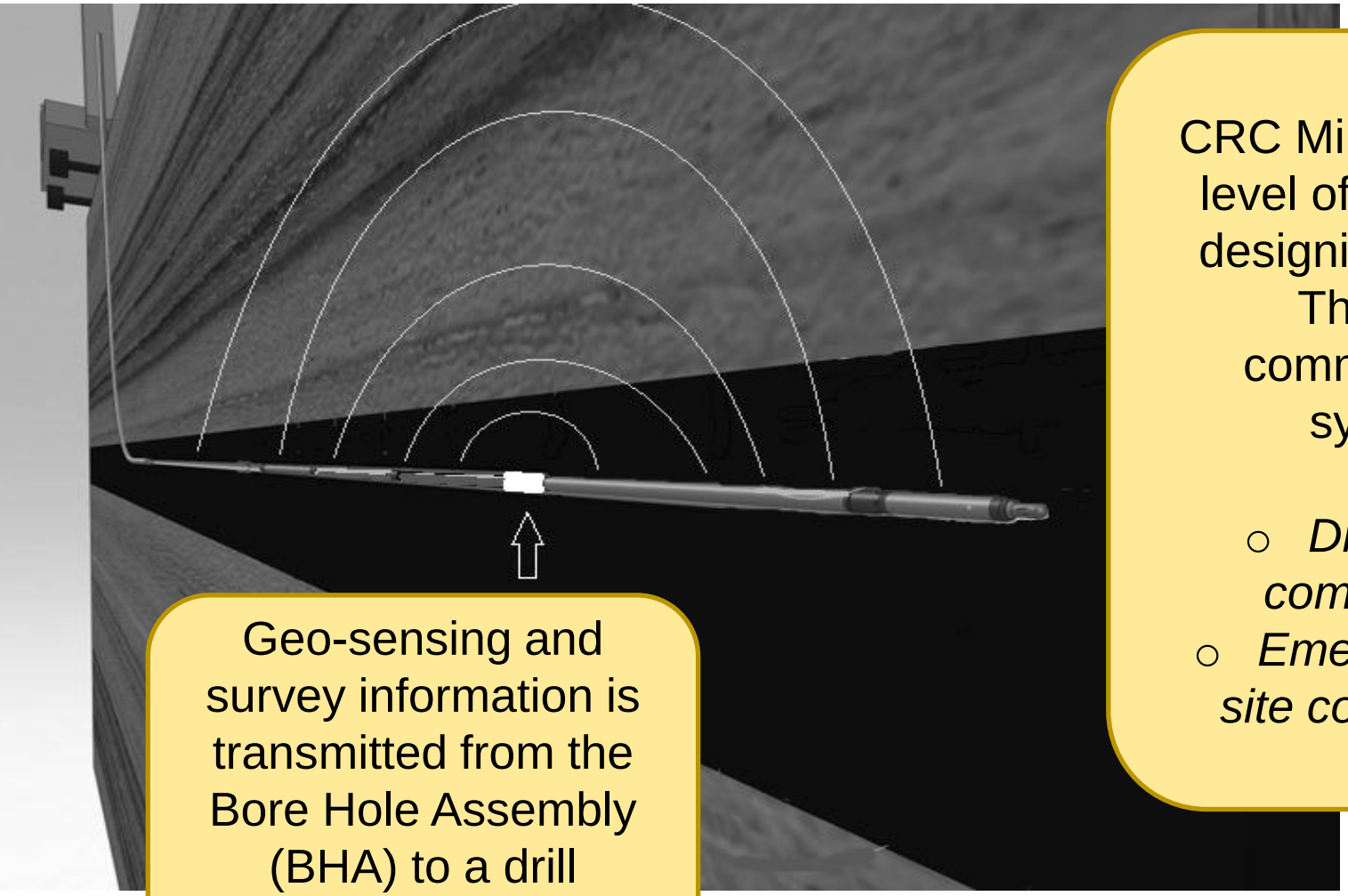
- high capital costs.
- Non-retrievable

AIM

- Develop a communication platform for fast, real-time geo-sensing and survey measurements from the Bottom Hole Assembly (BHA).
- Design the system to fit different sized subs so that it can be adaptable to any standard drill rod configuration.
- Develop an open architecture, to enable integration with all off-the-shelf survey and geo-sensing units.
- Enable retrievable BHA's

- ❑ REDUCE DRILLING COST & TIME
- ❑ IMPROVE BOREHOLE QUALITY
- ❑ CHANGE DRILLING PRACTICES

OVERVIEW



Geo-sensing and survey information is transmitted from the Bore Hole Assembly (BHA) to a drill operator unit.

CRC Mining has high level of expertise in designing Through-The-Earth communication systems.

- *Drilling BHA communications*
- *Emergency mine site communications*

BENEFITS

- Wireless real-time data means continuous drilling and steering.
- An improvement of 10% in drilling quality equates to an annual reduction in operating costs of approximately $500K-$800K per mine.
- Reduced capital costs of $200K - $400K for a set of rods and survey equipment.
- Improved borehole quality means
  - longer borehole life
  - more effective drainage
  - Longer drill rod & rig mean time to failure (MTTF)

MINING

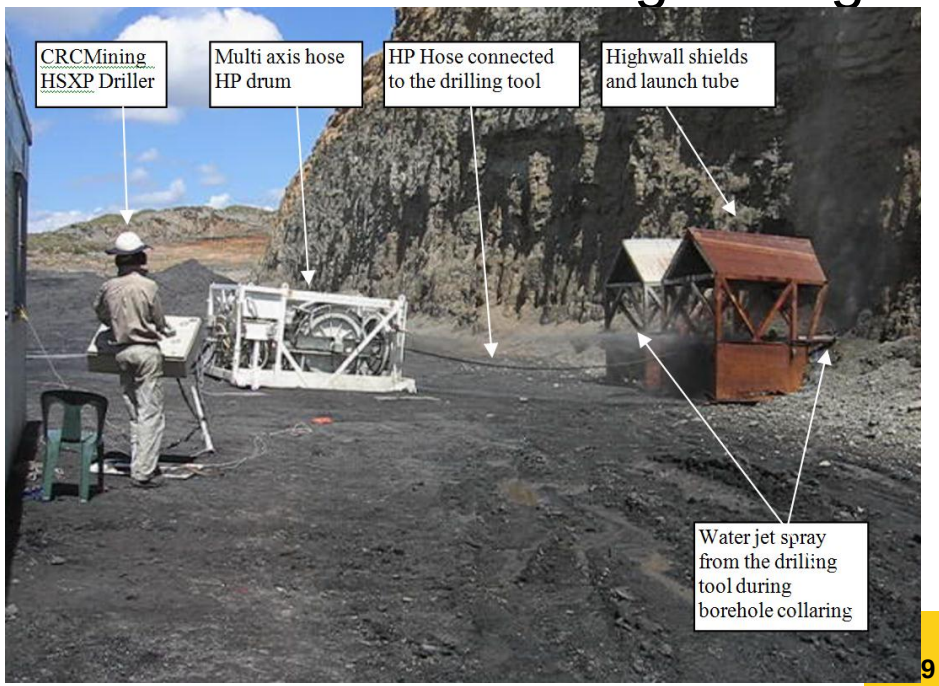
TRANSFORMING MINING

CONTINUOUS HIGH SPEED UIS DRILLING

TRANSFORMING GAS DRAINAGE

A STEP CHANGE IS REQUIRED – HIGH SPEED CROSS PANEL

- Safe by design - Hands off, Supervisory/Remote Controlled
- High Productivity – 2 to 5m/min continuous drilling rate
- Controllable – Steer laterals in Seam, monitor with Gamma
- Flexible – Drill out a fan pattern without relocating the rig



HSXP SYSTEM COMPONENTS - DRILLING SYSTEM

- Features:
  - Hose Drum – Stores 500m of hose
  - Remote Operator panel
  - Compact lightweight design – easily transported
  - Can be configured on track base
  - Air or hydraulic control
  - Single positioning to drill out a fan pattern

HIGH PRESSURE PUMP

- Features:
  - Configured for underground use
  - Electric driven high pressure water pump delivers 250lpm @ 800 Bar
  - Can be positioned once, remote from multiple drilling locations

SPIN TEST ON RIG

COIL TUBE DRILLING
NEW HORIZONS FOR AN ESTABLISHED TECHNOLOGY

WHAT IS COIL TUBE TECHNOLOGY??

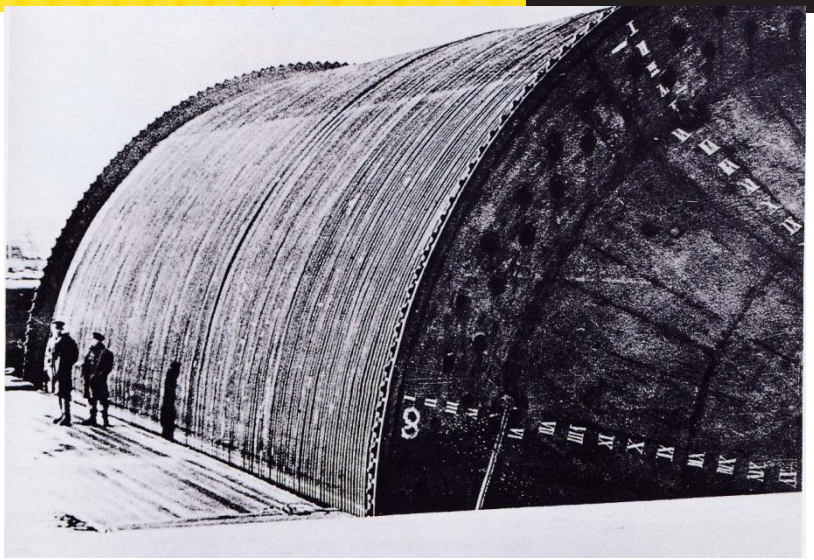
First rolled out in WWII;

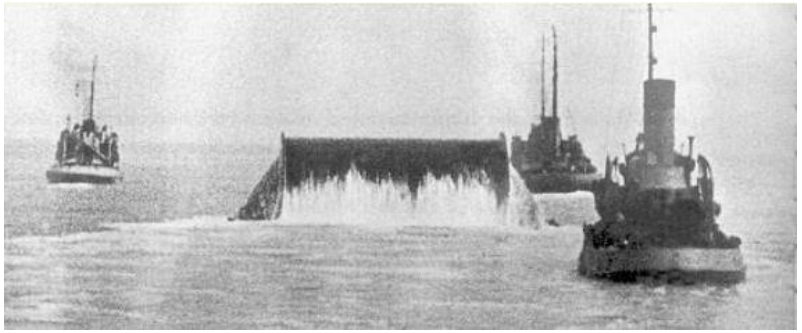
Operation PLUTO (Pipe Laying Under The Ocean) rolled 100km of 75mm steel tube from England to France to support the D Day invasion.

1,000,000 gallons of fuel a day was delivered through 6 pipes.

Pumping stations disguised as Ice Cream Factory and Houses.

Concept, R&D, Prototyping, Full scale in 2 Years !!!!!





WHAT IS COIL TUBE TECHNOLOGY?

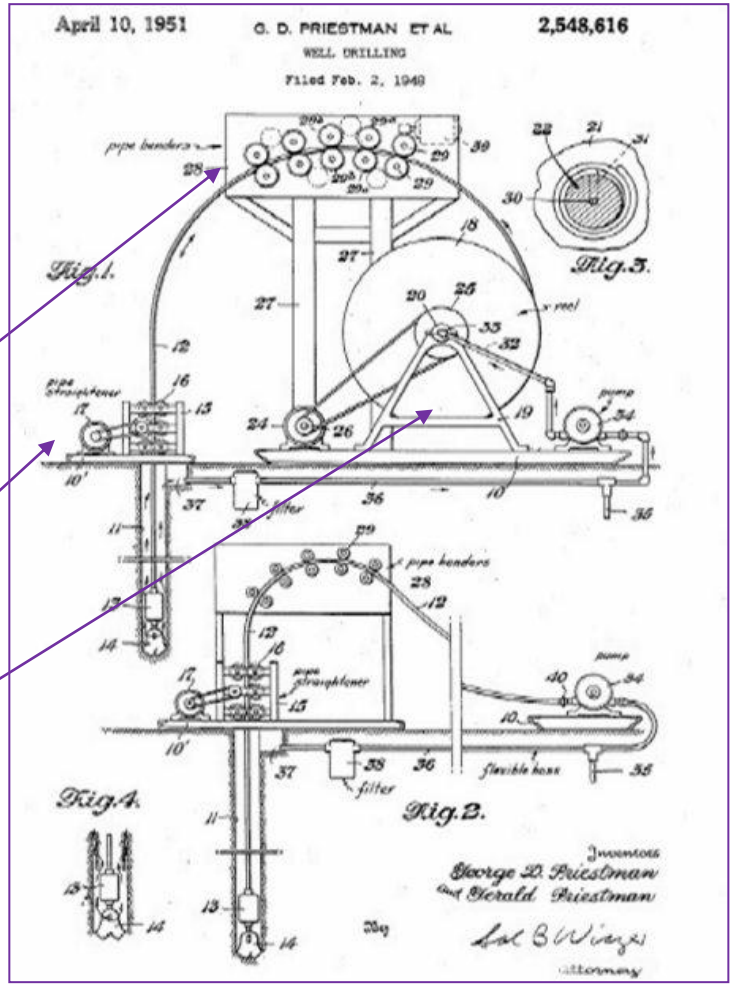
First drilling application patent followed a few years later;

Major components already identified;

Arch Rollers

Injector

Reel & Drive



WHAT IS COIL TUBE TECHNOLOGY??

Modern Rigs have not changed a great deal;

Major components still there;

Arch Rollers

Injector

Reel & Drive

WHAT'S AN UNDERGROUND CT RIG LOOK LIKE??

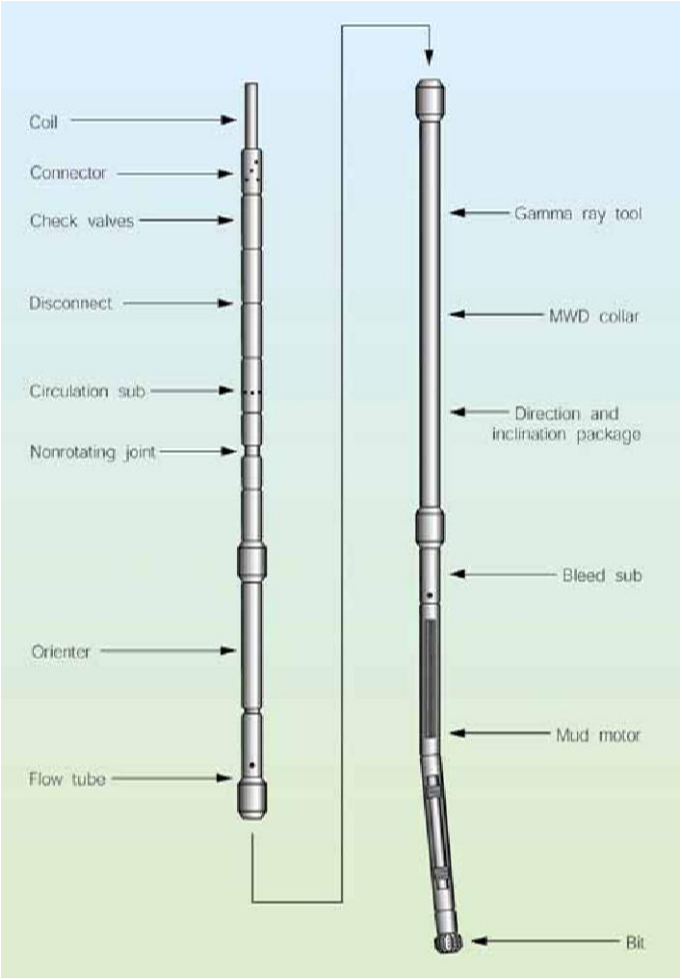
They come in all sizes;

HOW TO STEER A COIL BHA? (2009)

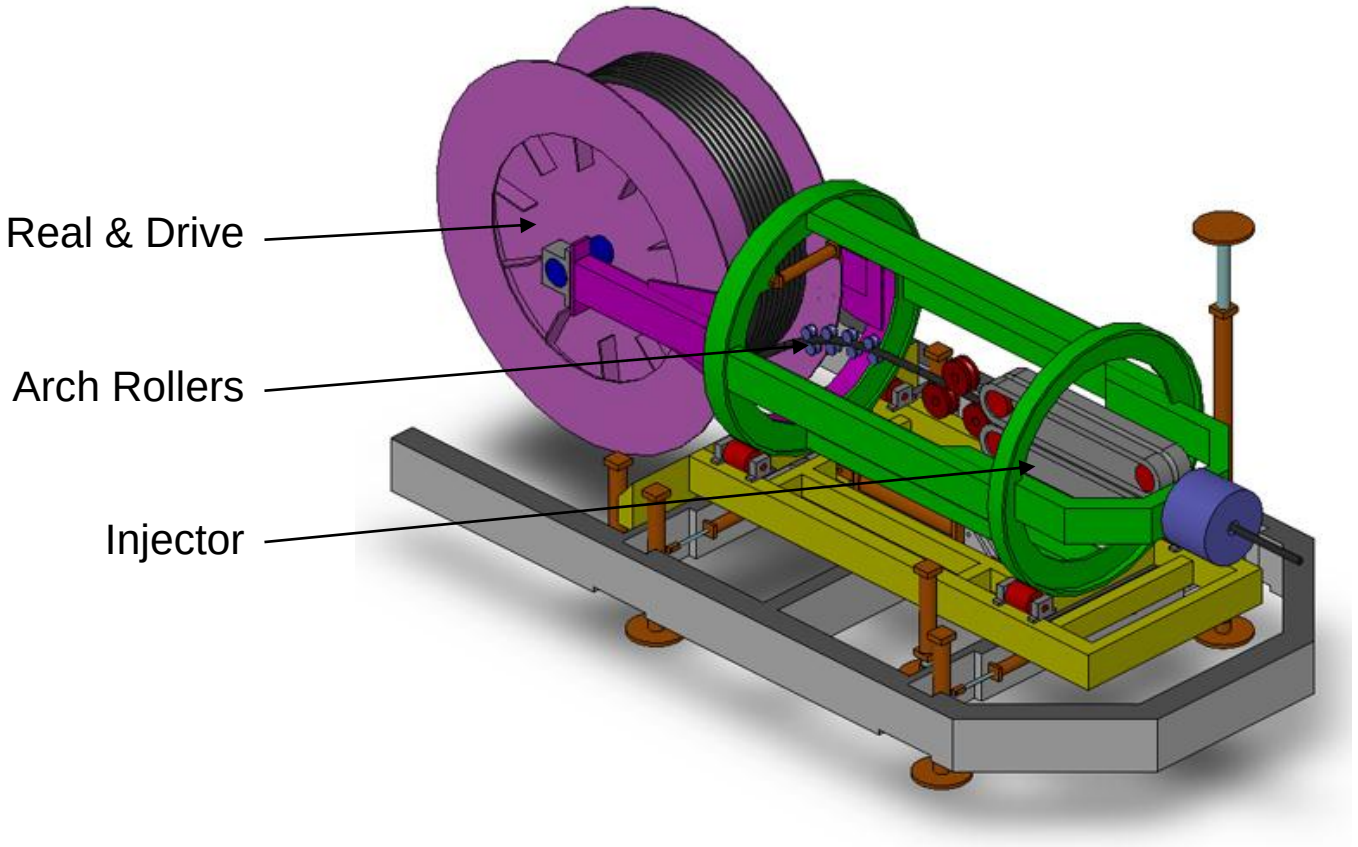
2009:

•All use bent subs with orientors – Tier 1 technology

•Subs not available for purchase – can be rented for $60k per week – Tier one pricing

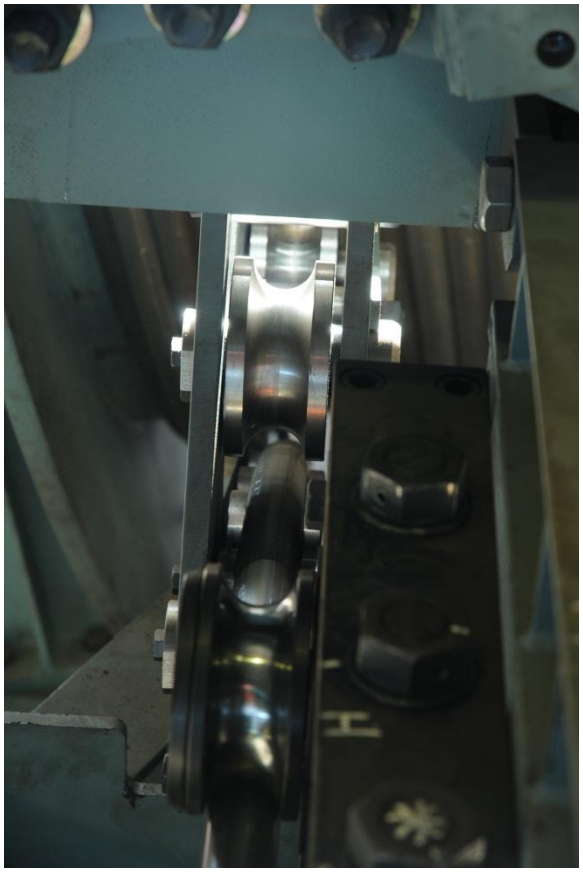


WHAT (WAS) IT GOING TO LOOK LIKE?



FATIGUE TRIALS OF COMPACT REEL

TUBE STRAIGHTENING DEMONSTRATION

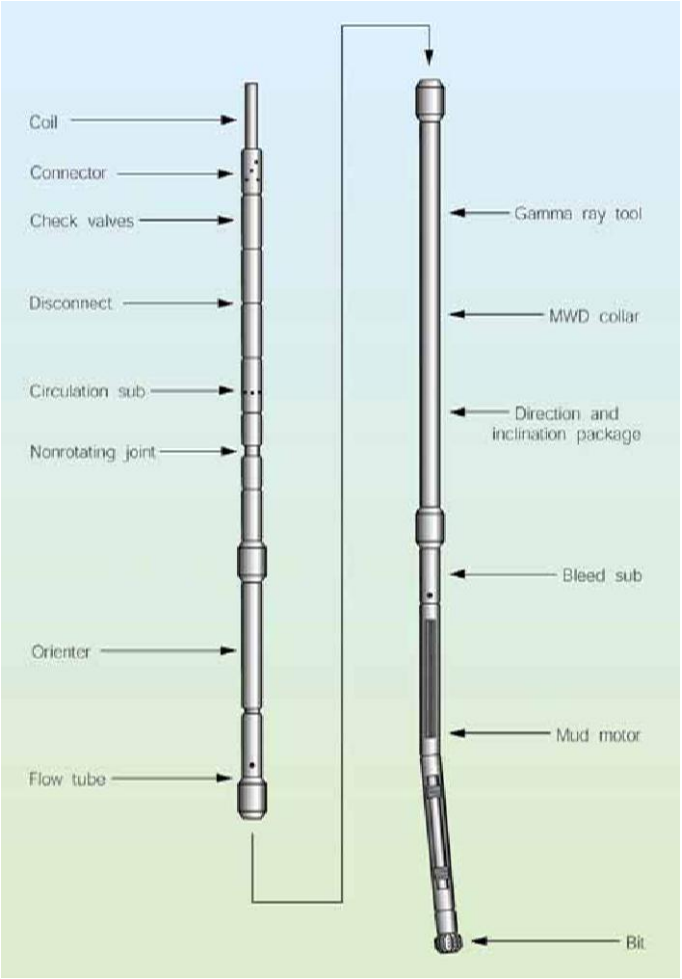


HOW TO STEER A COIL BHA? (2013)

2013:

•Rotary Steerable is here – Tier one technology

•Orienter subs – Tier 2 technology – can purchase for $8k.



WHAT DOES THIS MEAN?

Orienter sub in the BHA means…

A conventional rig concept can be used

- Larger diameter coil
- Longer reach
- Double tubing fatigue life
- ~200cycles

BOREHOLE GAS FLOW EVENT DETECTION

UNDERSTANDING GAS DRAINAGE PRODUCTION

BACKGROUND

The monitoring of gas flow in gas drainage holes at coal mines is usually carried out by measuring the flow at the borehole collar, or seldom monitored at all.

The current method does not provide any information on where the gas flow originated and how effective the gas drainage was throughout a region.

This can result in extra costs of $100Ks to ameliorate the problem, and $Millions in losses per day due to production down time.

AIM

CRC Mining is developing a system for gas monitoring inside boreholes that will detect gas flow & other events to determine the distribution of gas release from the coal seam along the entire length of the borehole.

The system works on the principle of Distributed Temperature Measurement.

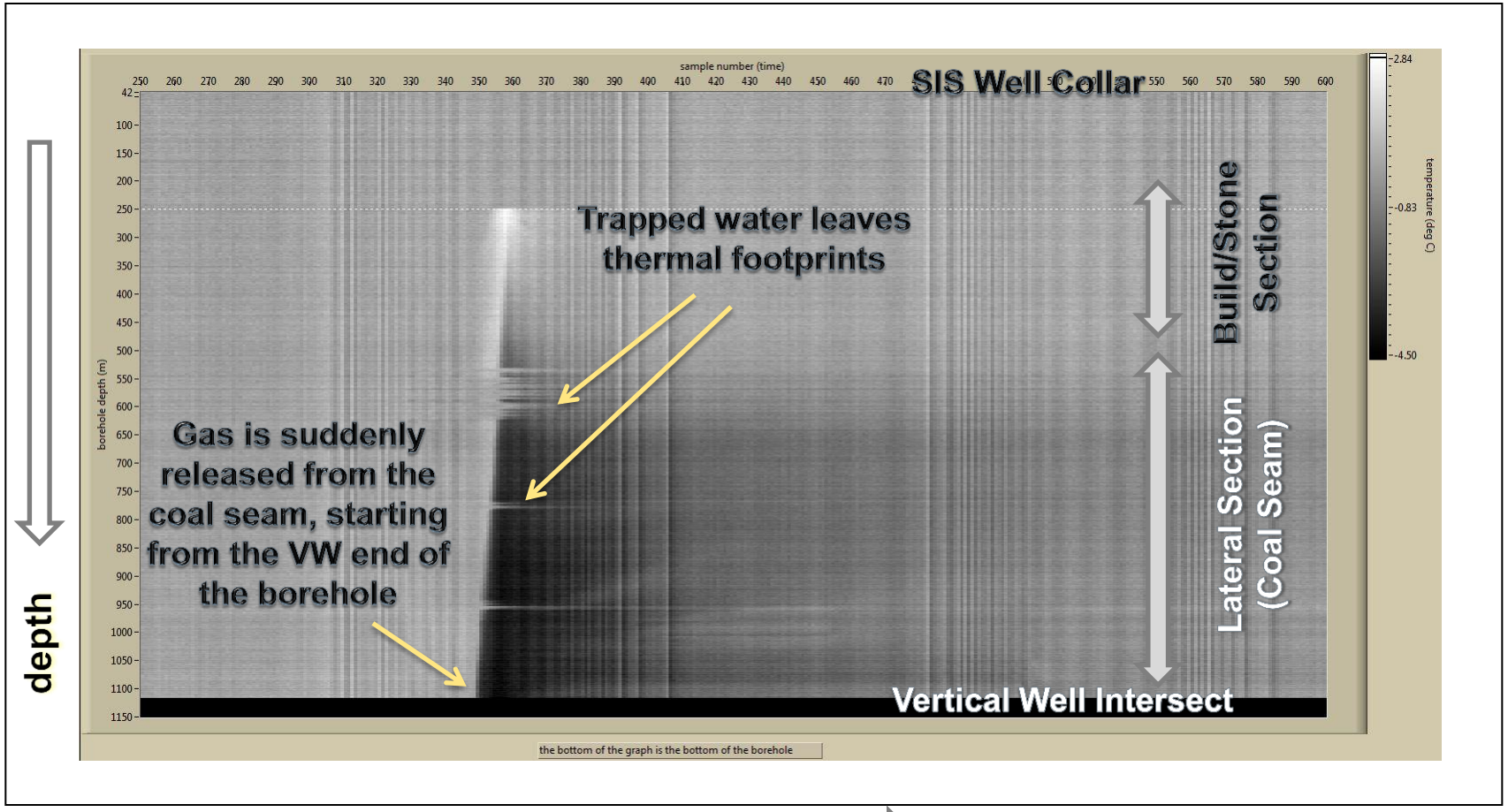
Gas flow events inside the borehole produce temperature footprints that can be utilised to identify the locations where gas flow originates.

EQUIPMENT – DTS

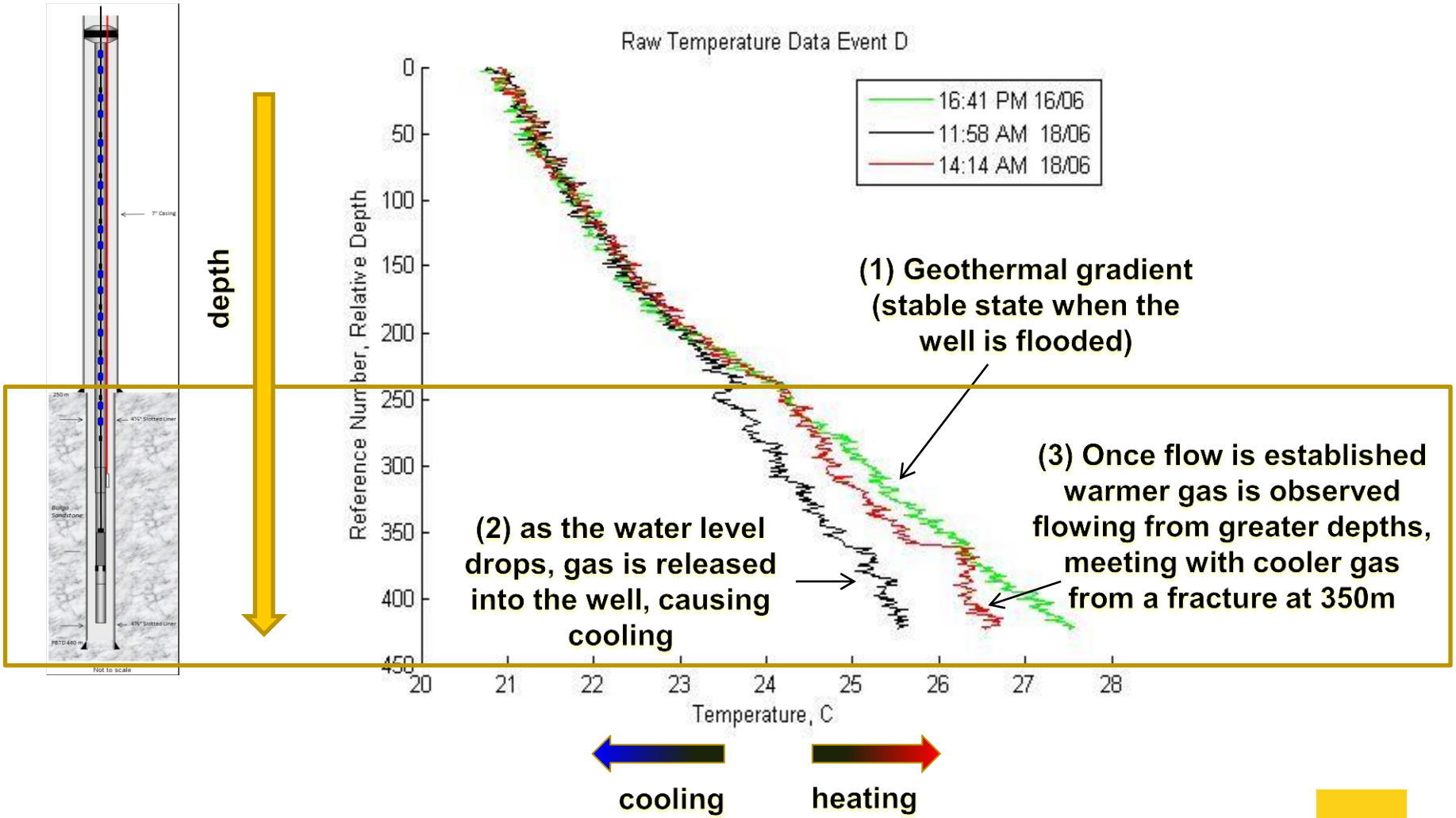
High Precision DTS Computer

Low Power Monitoring System

RESULTS – CARBOROUGH DOWNS



RESULTS – BULGO SANDSTONE



CURRENT OUTCOMES

The work conducted so far has been successful in identifying gas flow events inside the boreholes, and developing software tools that provide novel ways of visualising static and dynamic flow events inside the borehole.

Future work will continue building more advanced event detection algorithms and writing software that can be run at a mine.

More extensive field trials will be conducted to improve the existing dataset and monitor boreholes under different phases of gas drainage.

CRCMINING

TRANSFORMING MINING