



***OPTIMISATION OF THE RECOVERY and USE  
OF COAL MINE METHANE TO PROMOTE MINE  
SAFETY, GREENHOUSE GAS MITIGATION and  
SUSTAINABLE DEVELOPMENT***



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Leszek W.  
Lunarzewski  
Lunagas Pty Limited - Australia



## **Coal mine safety & productivity**

Methane emissions in coal mines adversely affects the efficiency of coal production and mine safety

The proper management, engineering tools, modern technology & the techniques could effectively improve those conditions



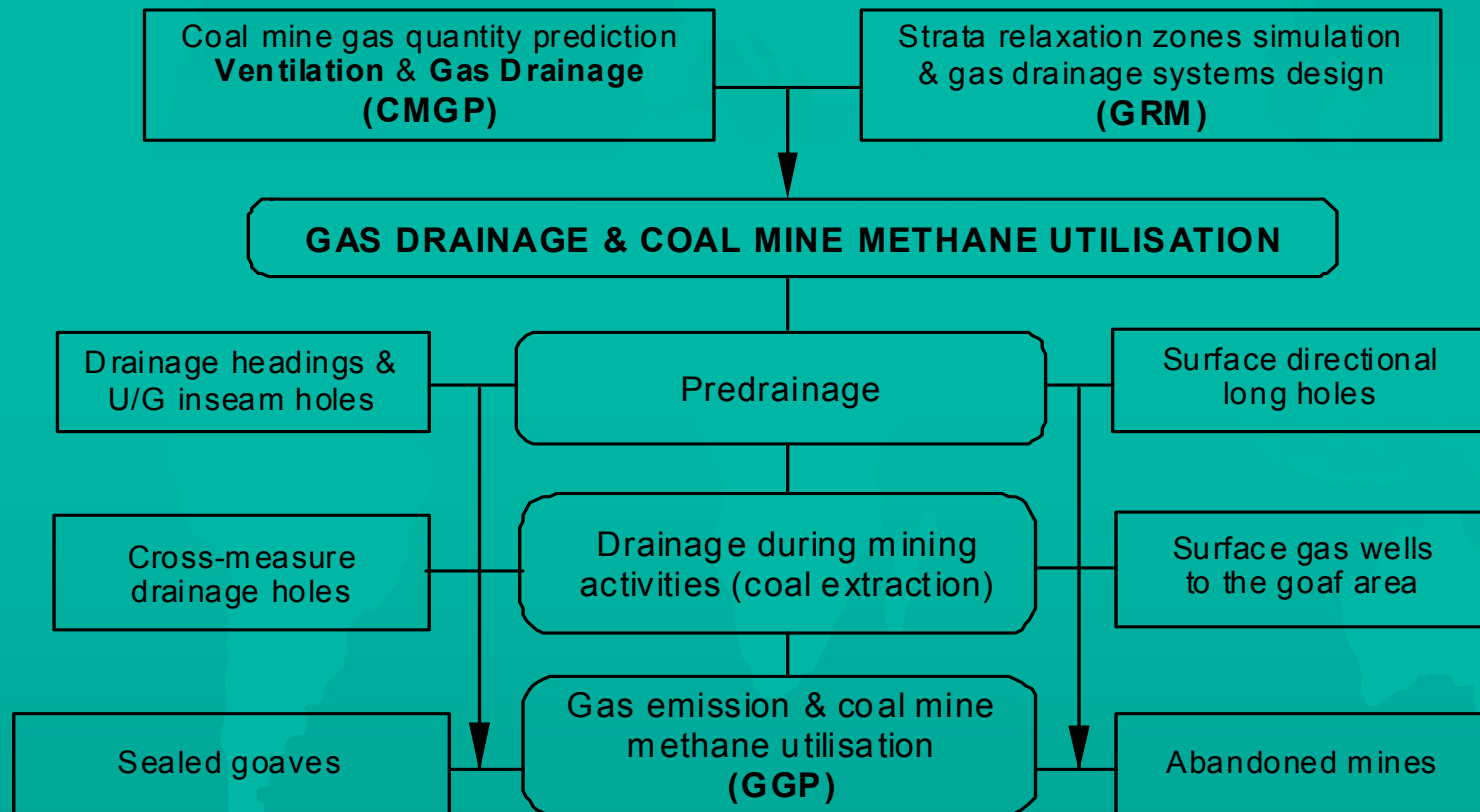
## **Engineering tools computer models - simulators**

Three specialised computer software developed in Australia allow for coal mine gas quantity prediction & design of optimum parameters for mine ventilation, gas recovery & methane utilisation

- I. Coal Mine Gas Predictor (CMGP)**
- II. Gas Release Model (GRM)**
- III. Goaf Gas Predictor (GGP)**



# Gas management chart when using specialised computer models





# 1. Coal Mine Gas Predictor (CMGP)

Prediction of coal mine gas quantity  
during mining activities

## Based on:

- local geology
- mining & gassy conditions
- coal production level

## Outputs :

- Coal mine gas quantity released underground
- Ventilation requirements



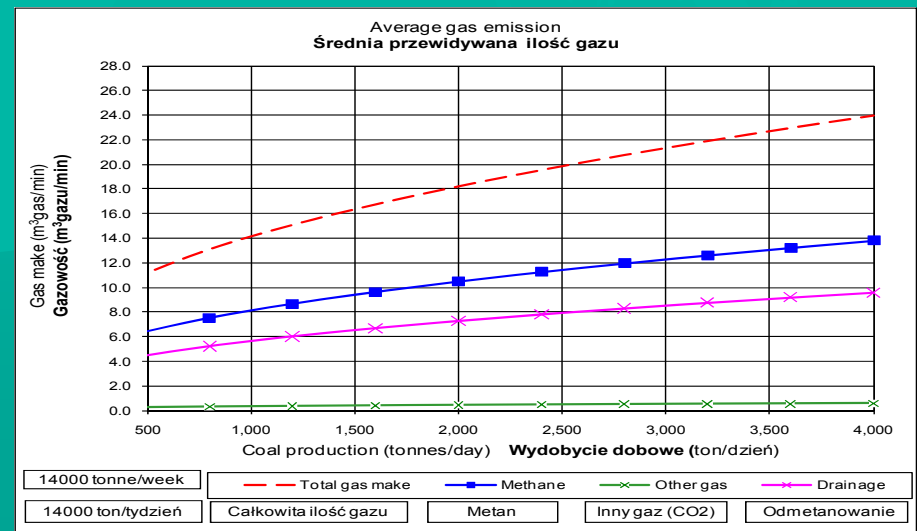
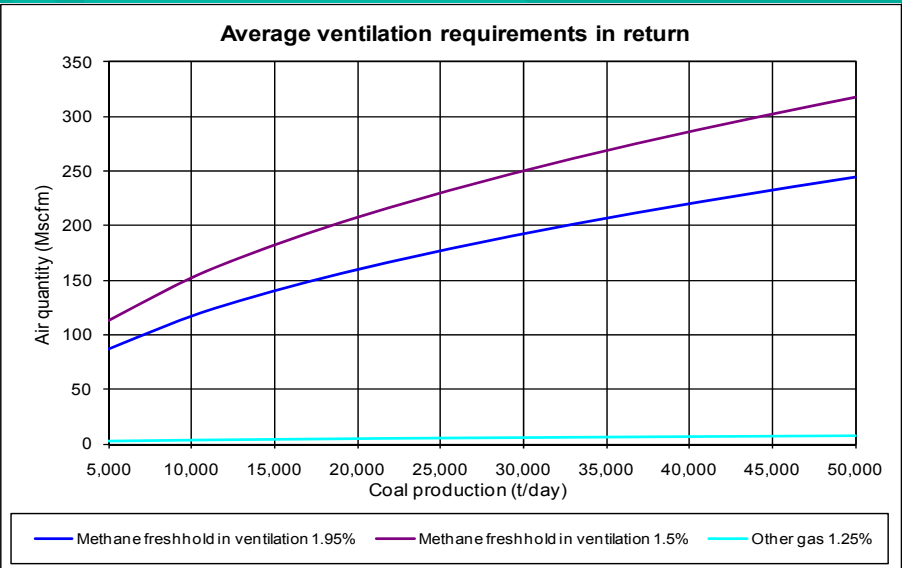
# CMGP case study China, USA, Poland

## Gas emission & ventilation requirements diagrams

### Gas sources & SGE simulation

Units	Coal seams description	In situ gas content	Coal seam thickness (coal only)	Distance from working seam	Strata relaxation range	Gas sources SGE when gas drainage is not used	
						未进行瓦斯抽放时的瓦斯释放量	
						Individual	Contribution to TOTAL
		煤层含气量	煤层厚度	到采掘工作面距离	地层松动范围	本煤层	占总量的百分率
		(m <sup>3</sup> gas/t)	(metres)	(metres)	%	(m <sup>3</sup> gas/t.mined)	(%)
煤层号	煤层描述	(立方米/吨)	(米)	(米)	(%)	立方米/开采1吨	(%)
4	#17	8.35	1.18	124.35	18.83	0.44	3.62
3	#16(?)	10.27	0.45	28.44	87.37	0.95	7.87
2	#15	10.34	0.60	24.80	92.61	1.36	11.21
1	#14	10.63	0.64	10.63	100.00	1.61	13.26
<b>Roof coal seams summary</b>		-	2.87	-	-	4.36	35.96
顶板煤层中瓦斯释放总量							
<b>Working coal seam</b>		7.59	4.23	-	43.50	3.30	27.22
#13-1							
1	#12	10.89	1.11	1.85	100.00	2.86	23.58
2	#11-1(?)	10.95	0.62	3.91	100.00	1.61	13.24
3	#11-2	12.55	1.32	58.98	0.00	0.00	0.00
<b>Floor coal seams summary</b>		-	3.05	-	-	4.46	36.82
底板煤层中瓦斯释放总量							
<b>TOTAL:</b>		-	10.15	-	-	12.13	100.00
总计							

SPECIFIC GAS EMISSION (SGE)	13.02	Coal mine gas
不同瓦斯释放量 (相对瓦斯涌出量 立方米)	12.63	煤矿瓦斯总量
(m <sup>3</sup> gas per tonne of mined coal)	0.39	甲烷释放量
(每采1吨煤排放瓦斯量)		其它气体



14000 tonne/week      14000 ton/tydzień

Całkowita ilość gazu      Metan      Inny gaz (CO2)      Odmetanowanie



## 2. Gas Release Model (GRM)

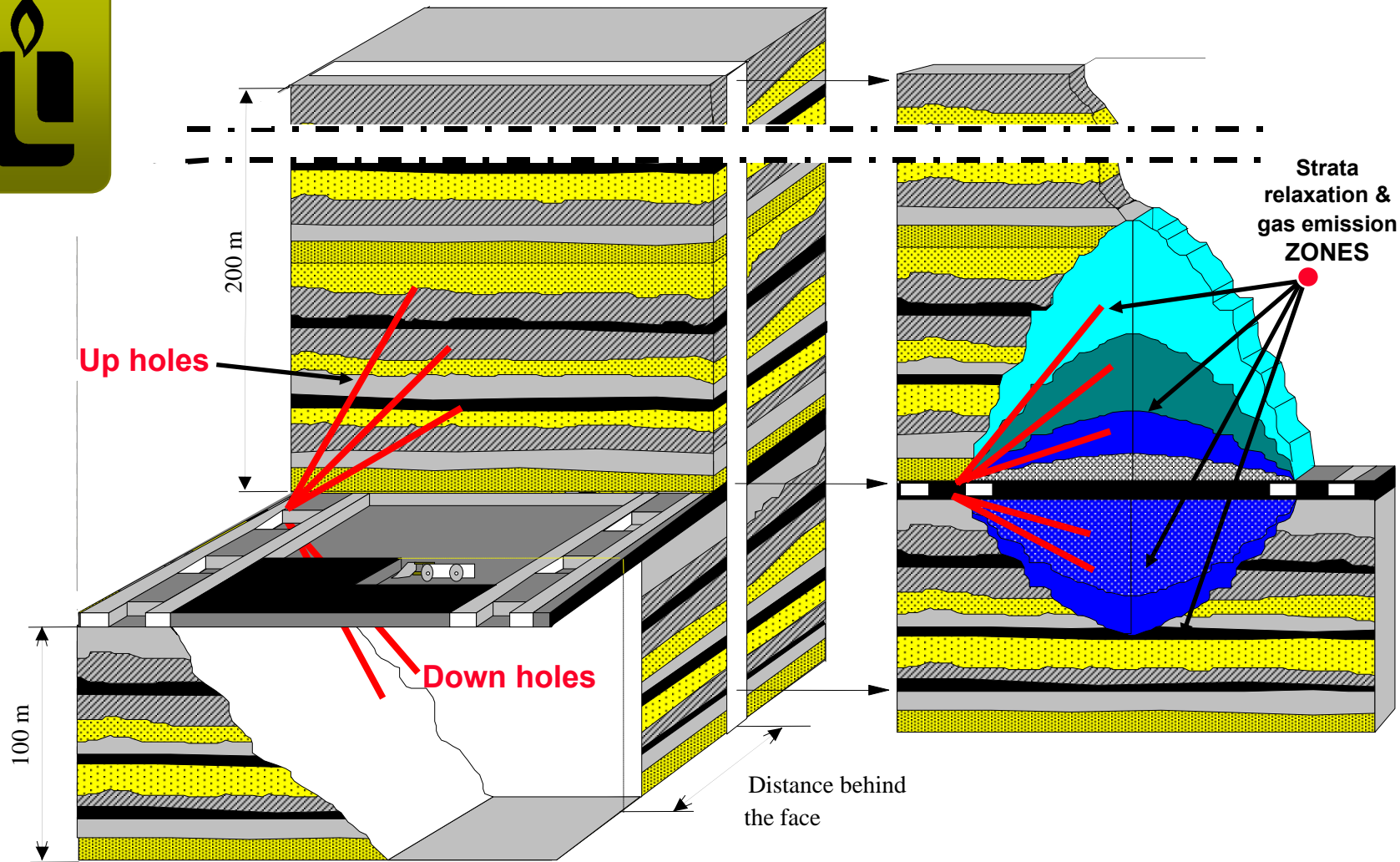
- **Roof simulator** generates a roof strata break-line as a boundary between continuous and discontinuous rock masses
- **Floor simulator** establishes the existing strata stress regime using Boundary Element Principles

### Outputs:

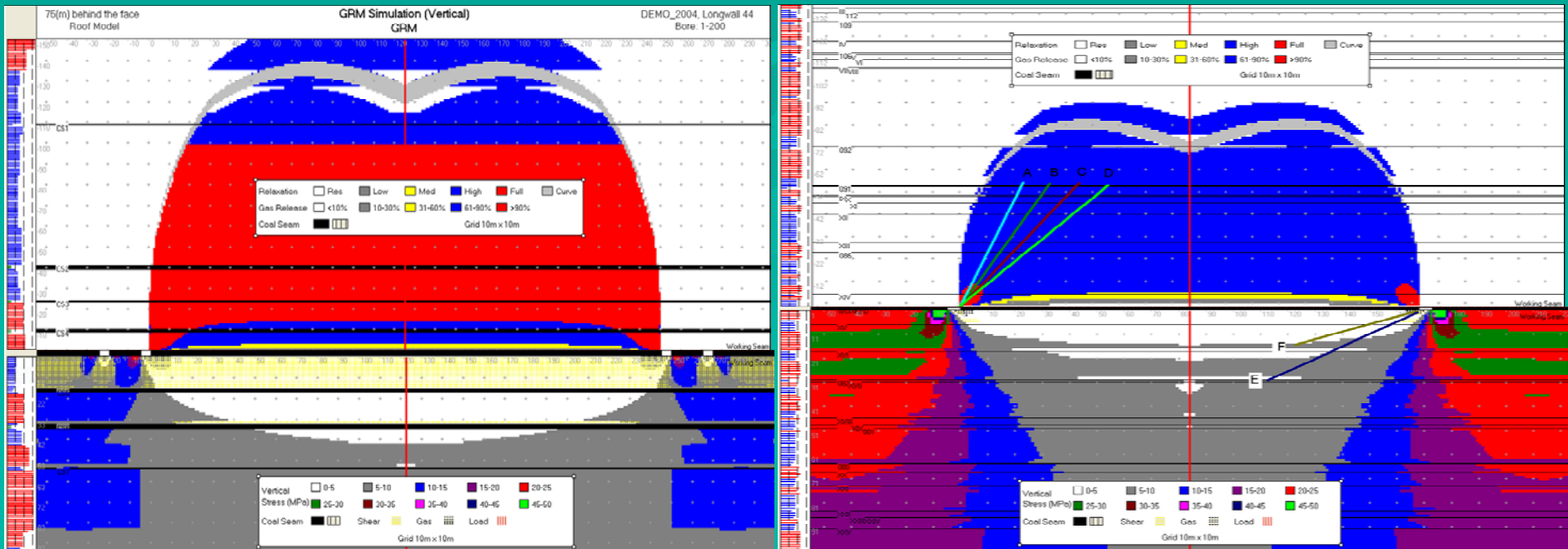
- Colour maps of strata relaxation & gas release zones
- Graphical design & optimisation of gas drainage systems

# GRM strata relaxation & gas release zones

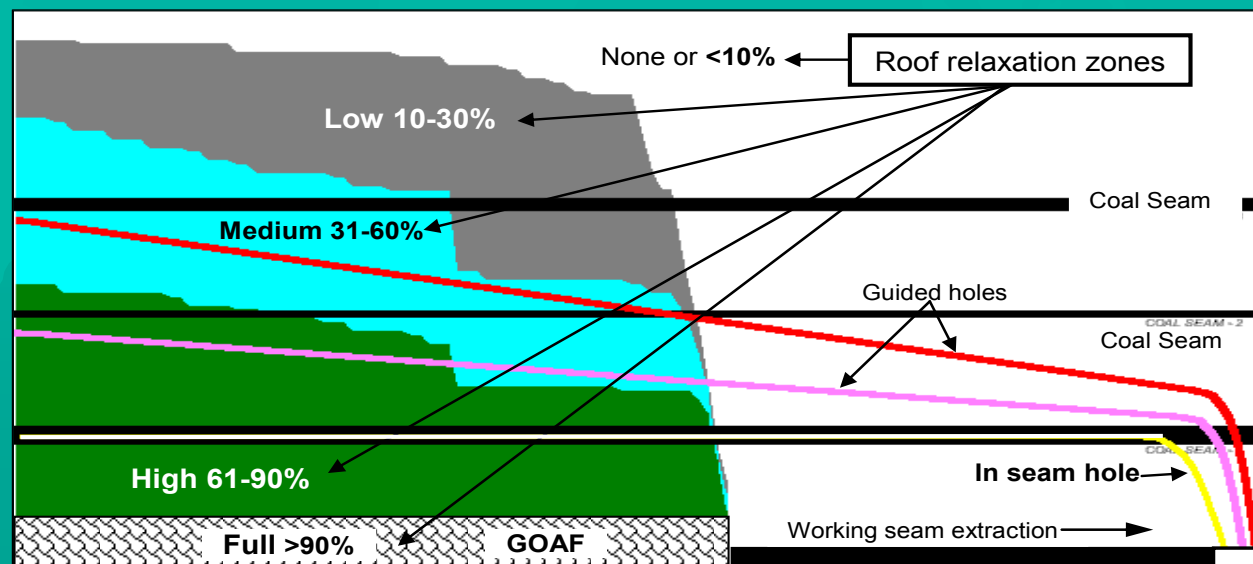
Simplified concept



# GRM-1 Combine roof/floor simulation outputs



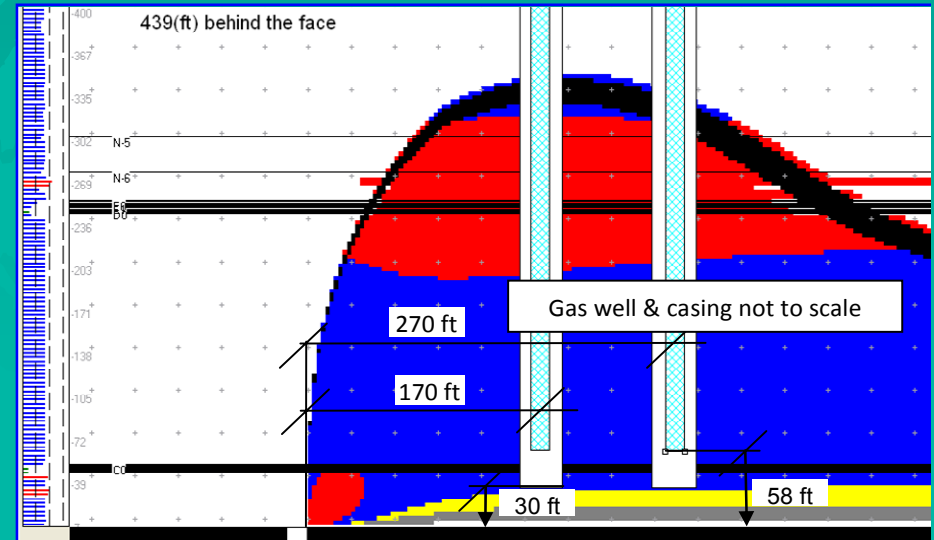
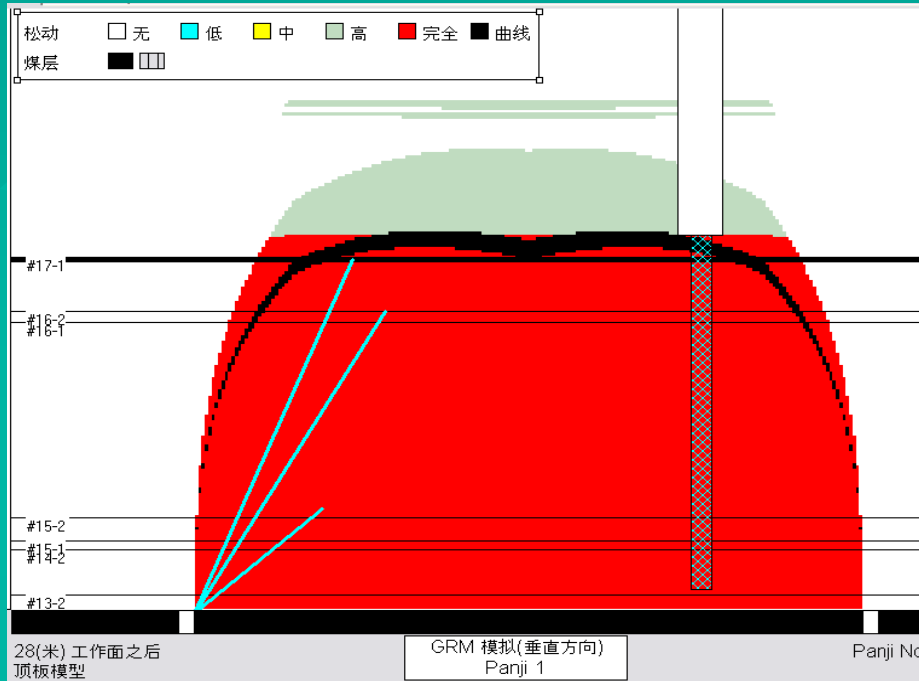
**GRM-2 roof vertical cross section along LW block output (U/G directional holes design)**



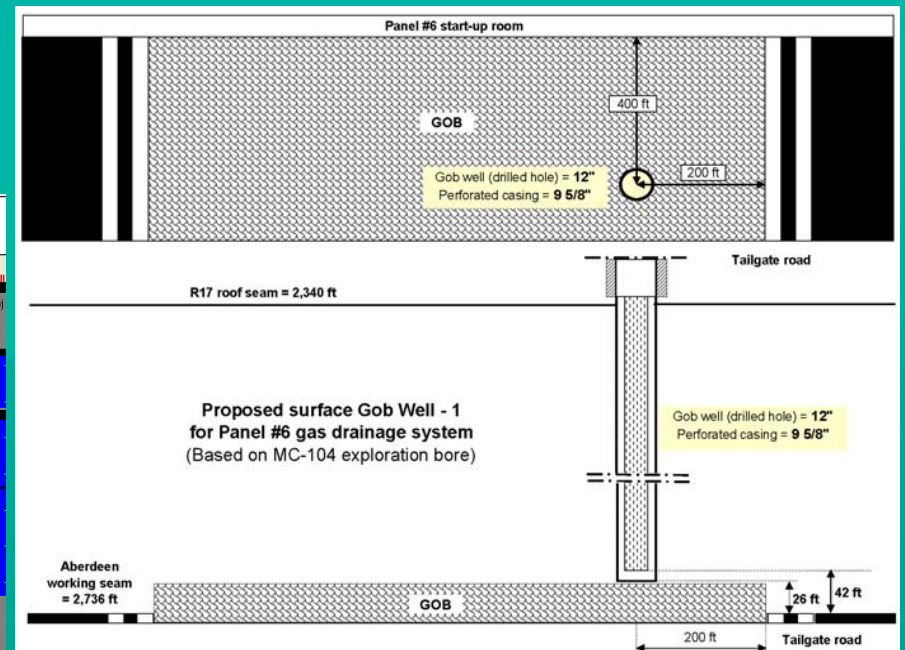
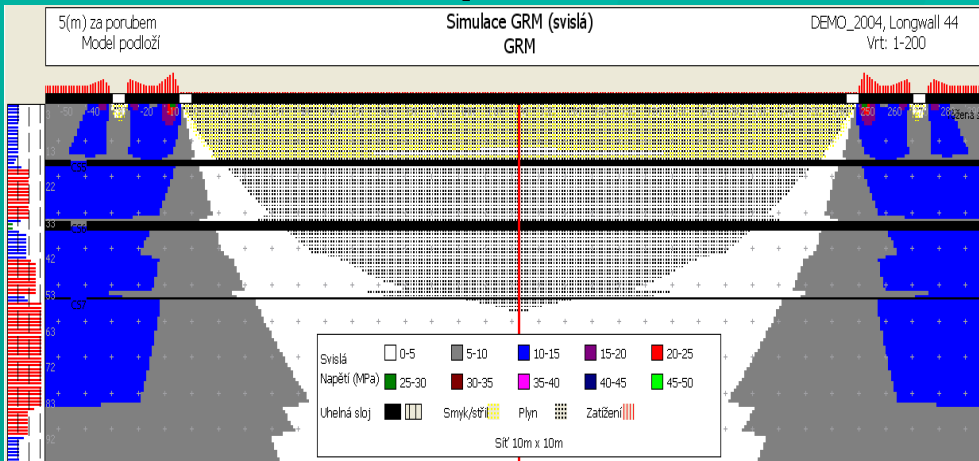
# GRM case studies

## China, Hainuan

## USA, Colorado

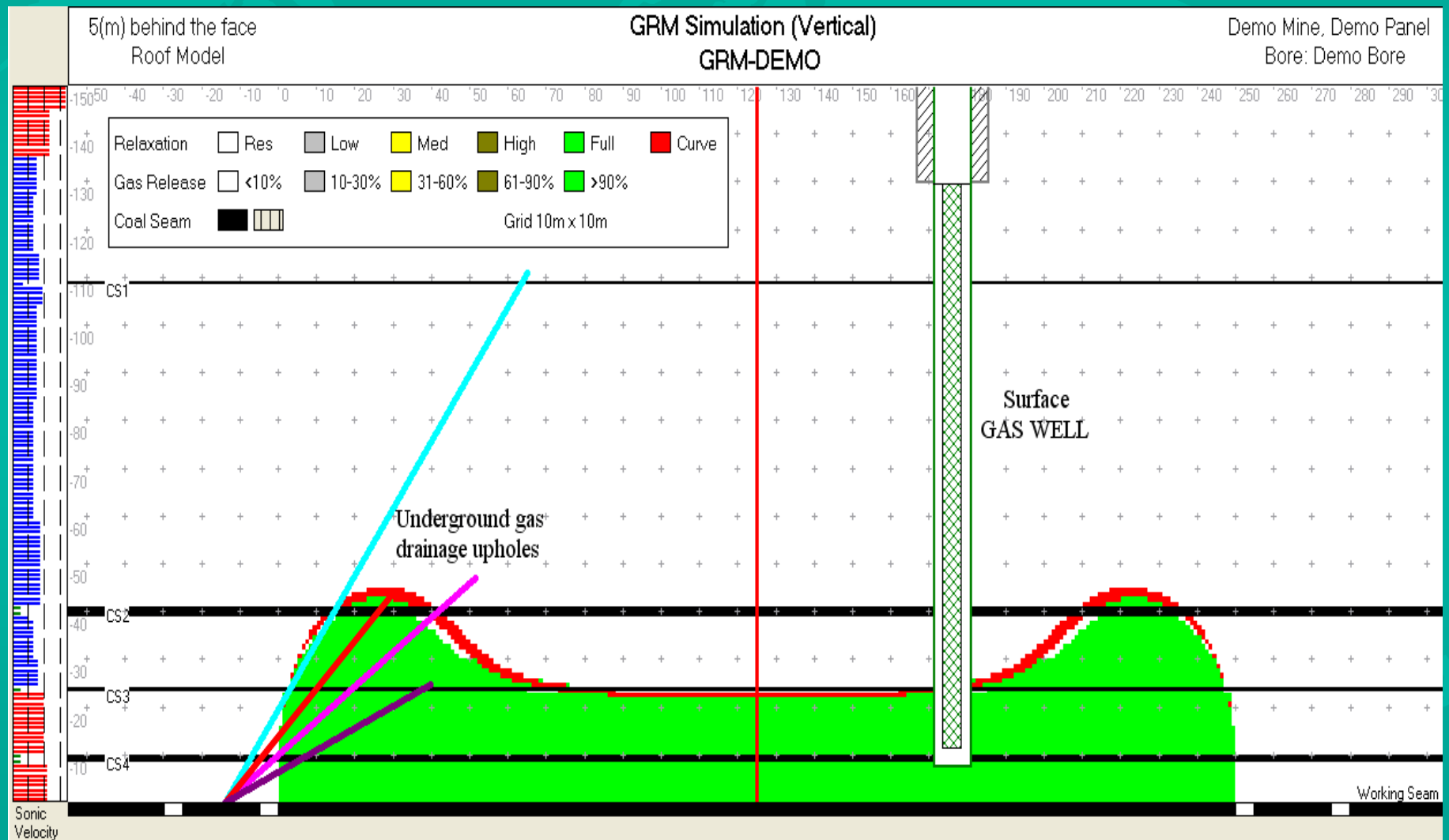


## Czech Republic, Ostrava



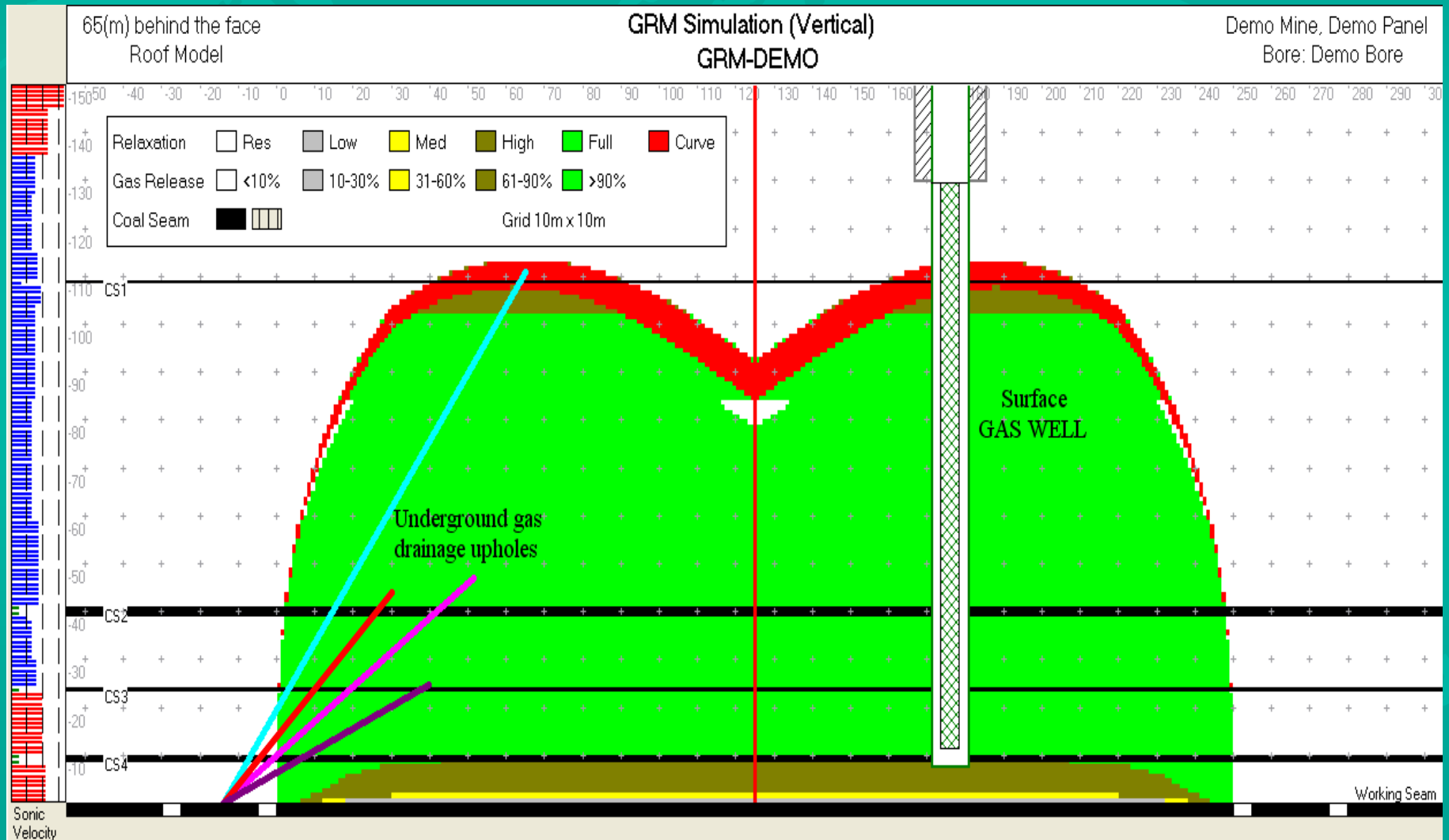


# GRM roof simulation 5m behind the face



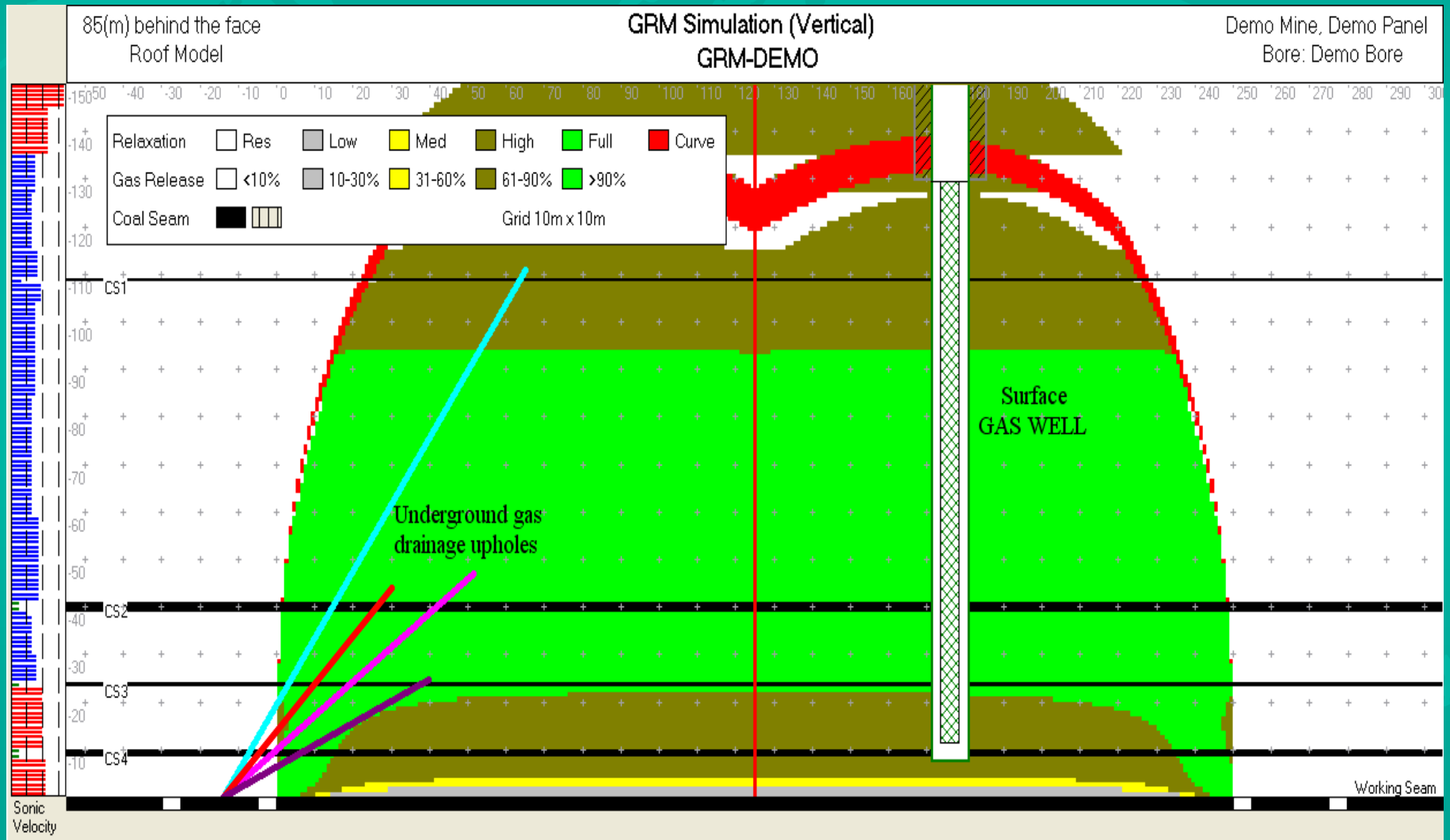


# GRM roof simulation 65m behind the face



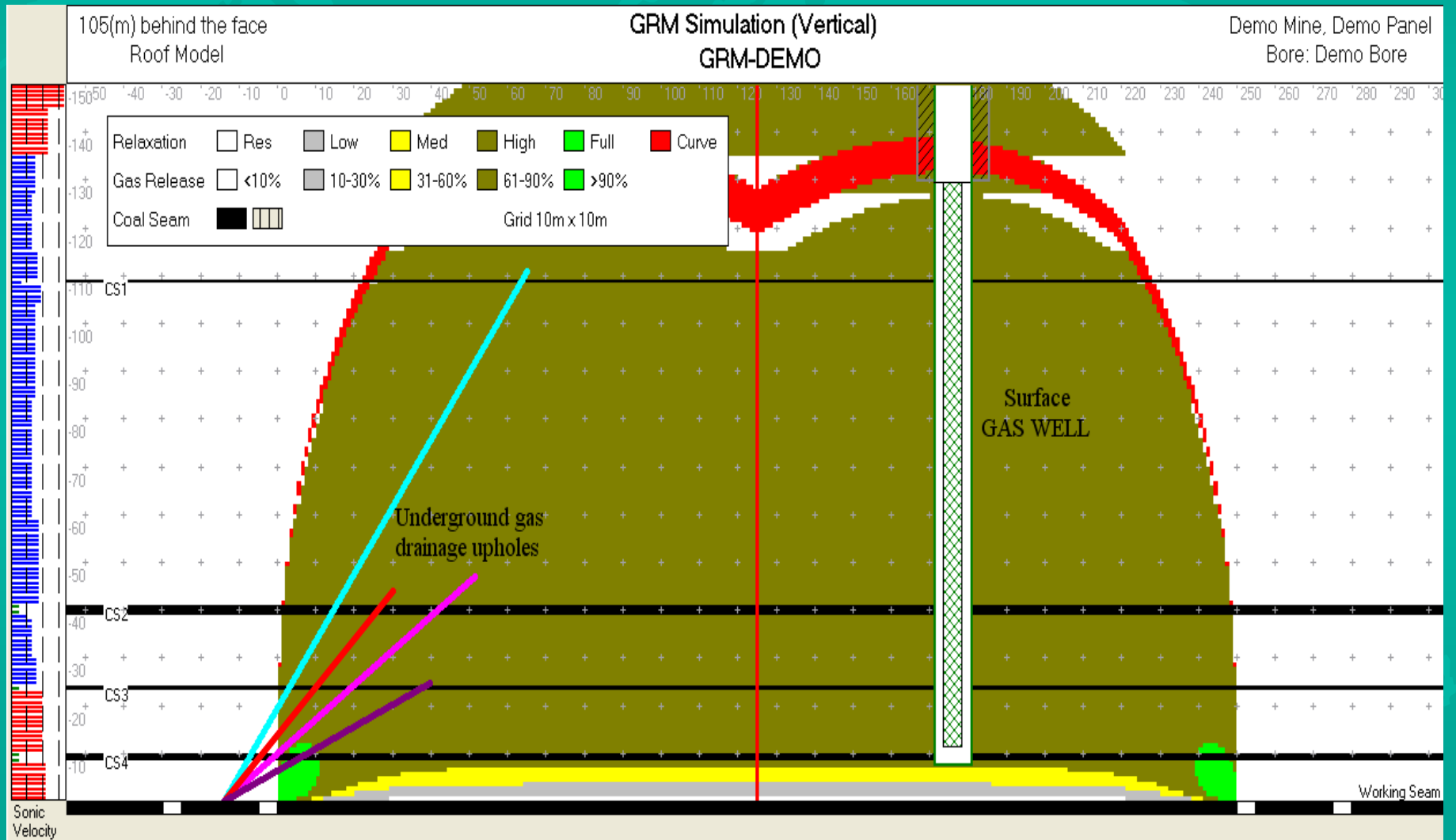


# GRM roof simulation 85m behind the face



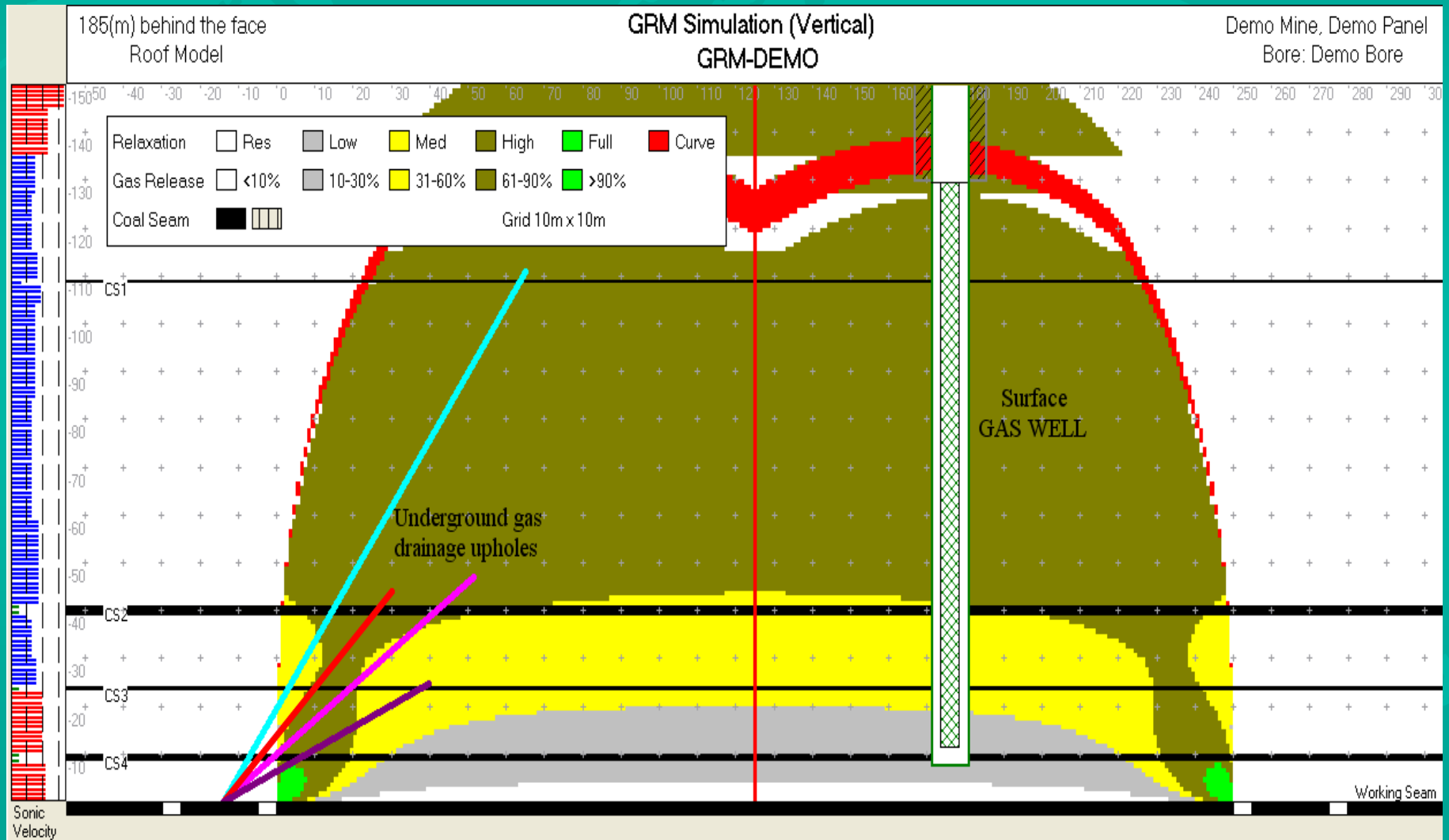


# GRM roof simulation 105m behind the face



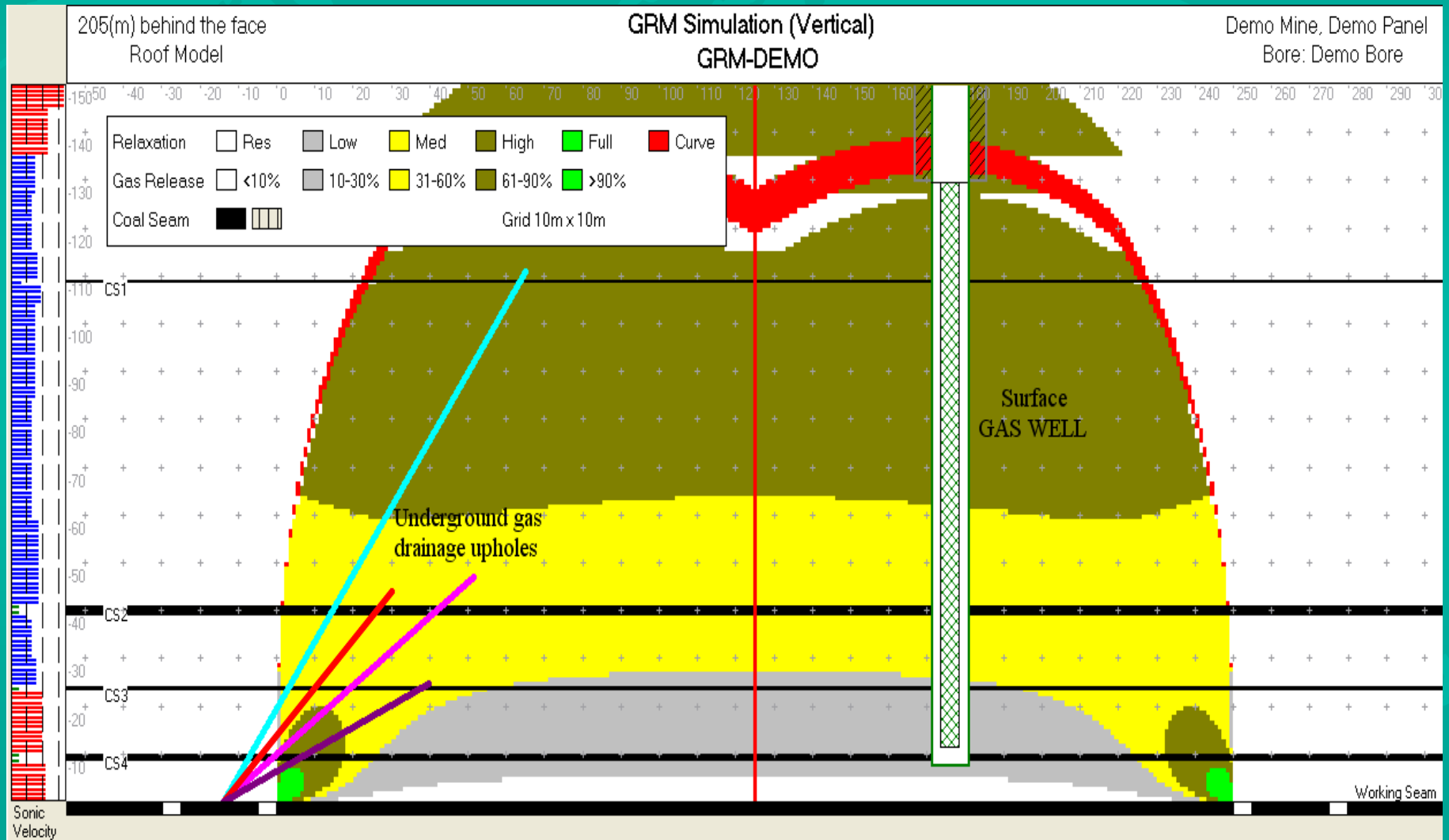


# GRM roof simulation 185m behind the face



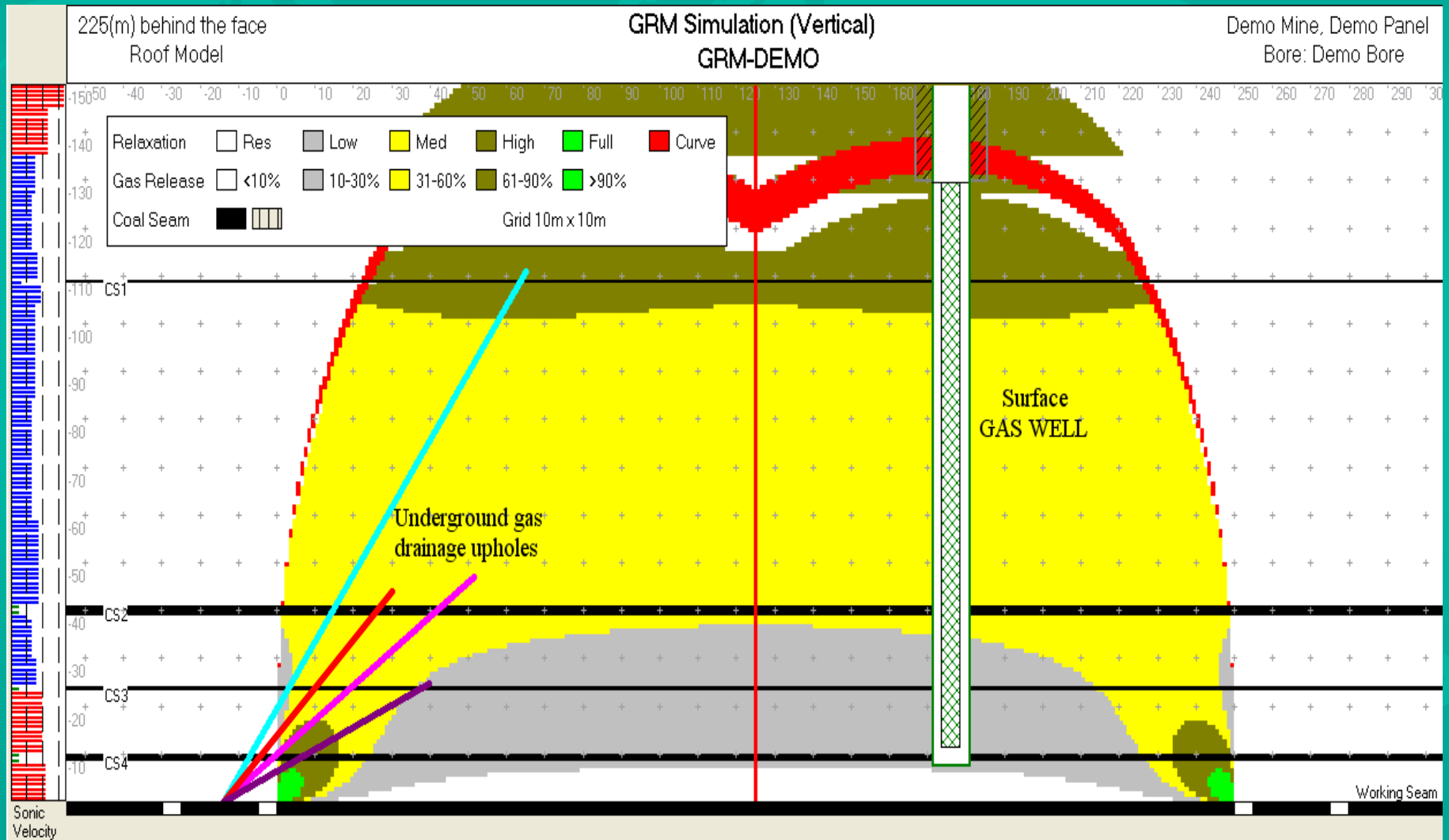


# GRM roof simulation 205m behind the face



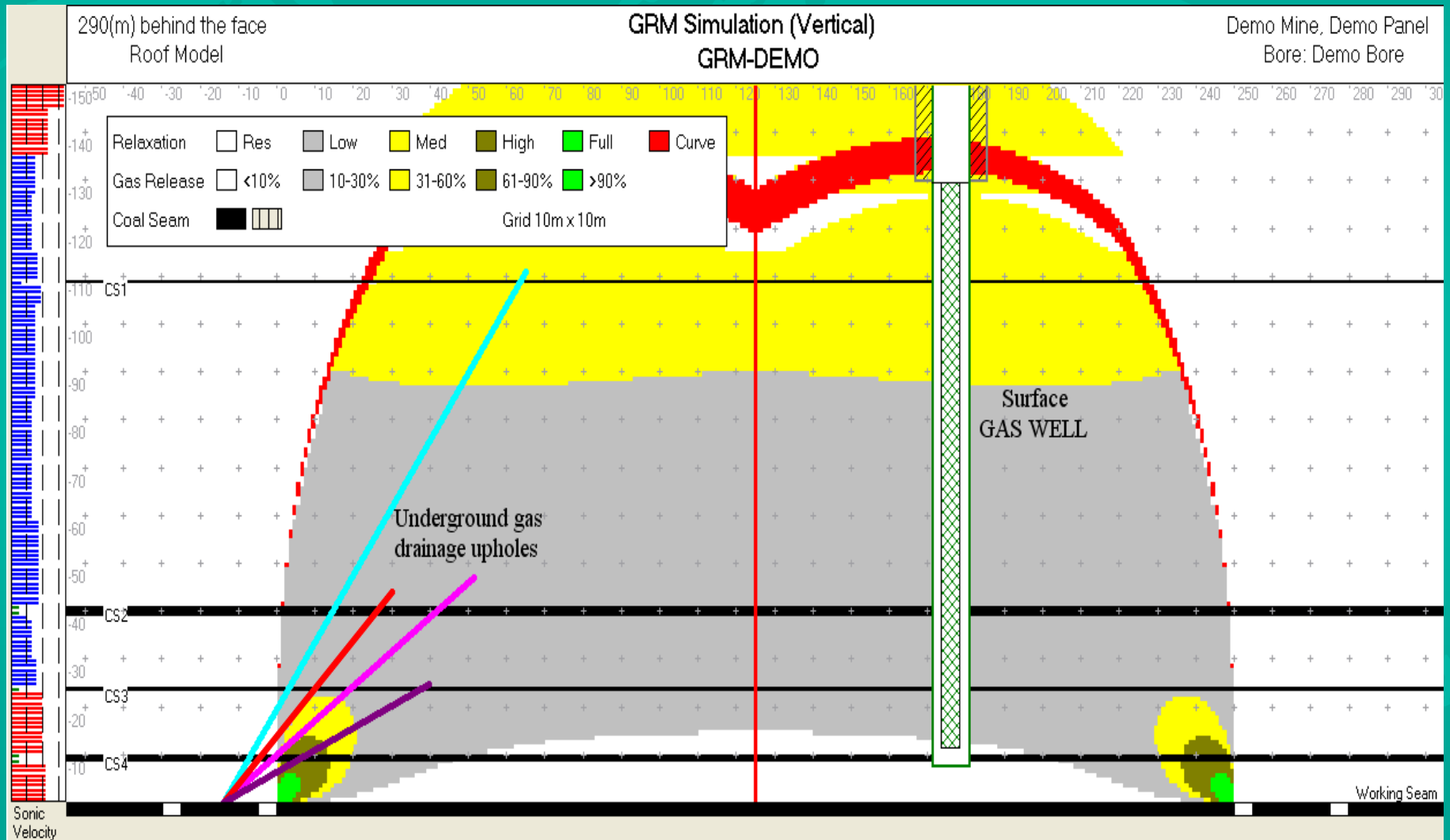


# GRM roof simulation 225m behind the face



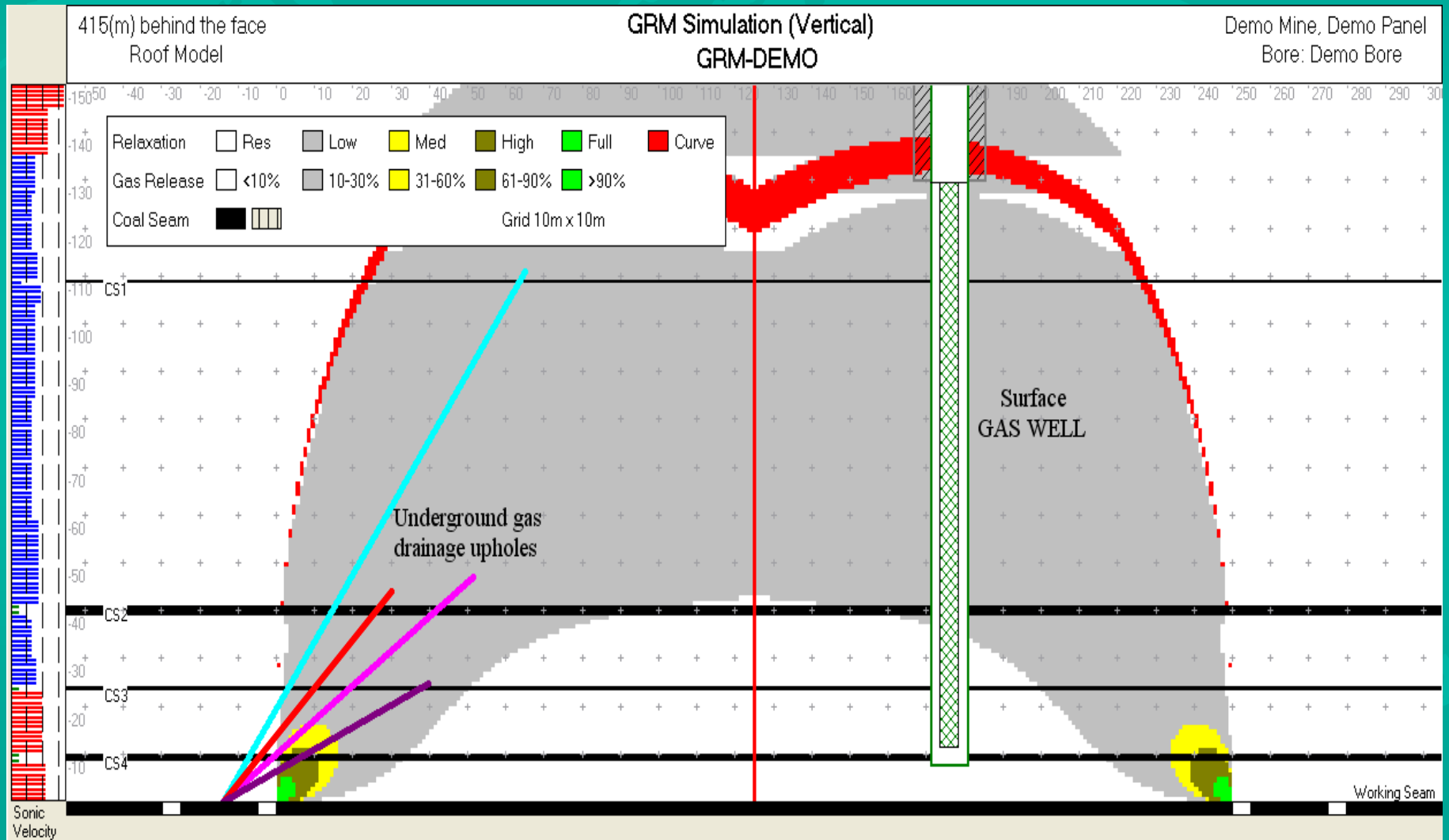


# GRM roof simulation 290m behind the face



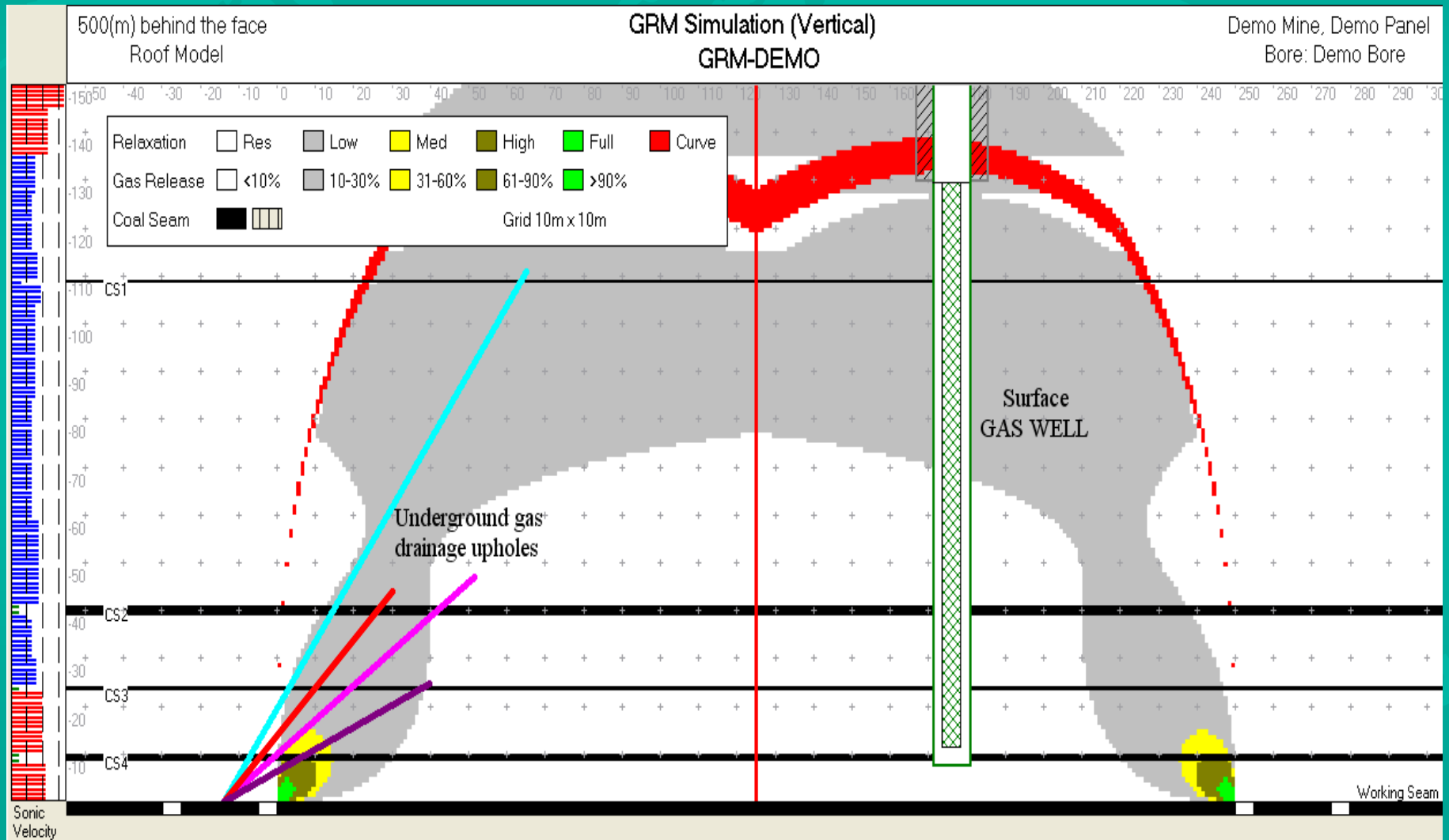


# GRM roof simulation 415m behind the face



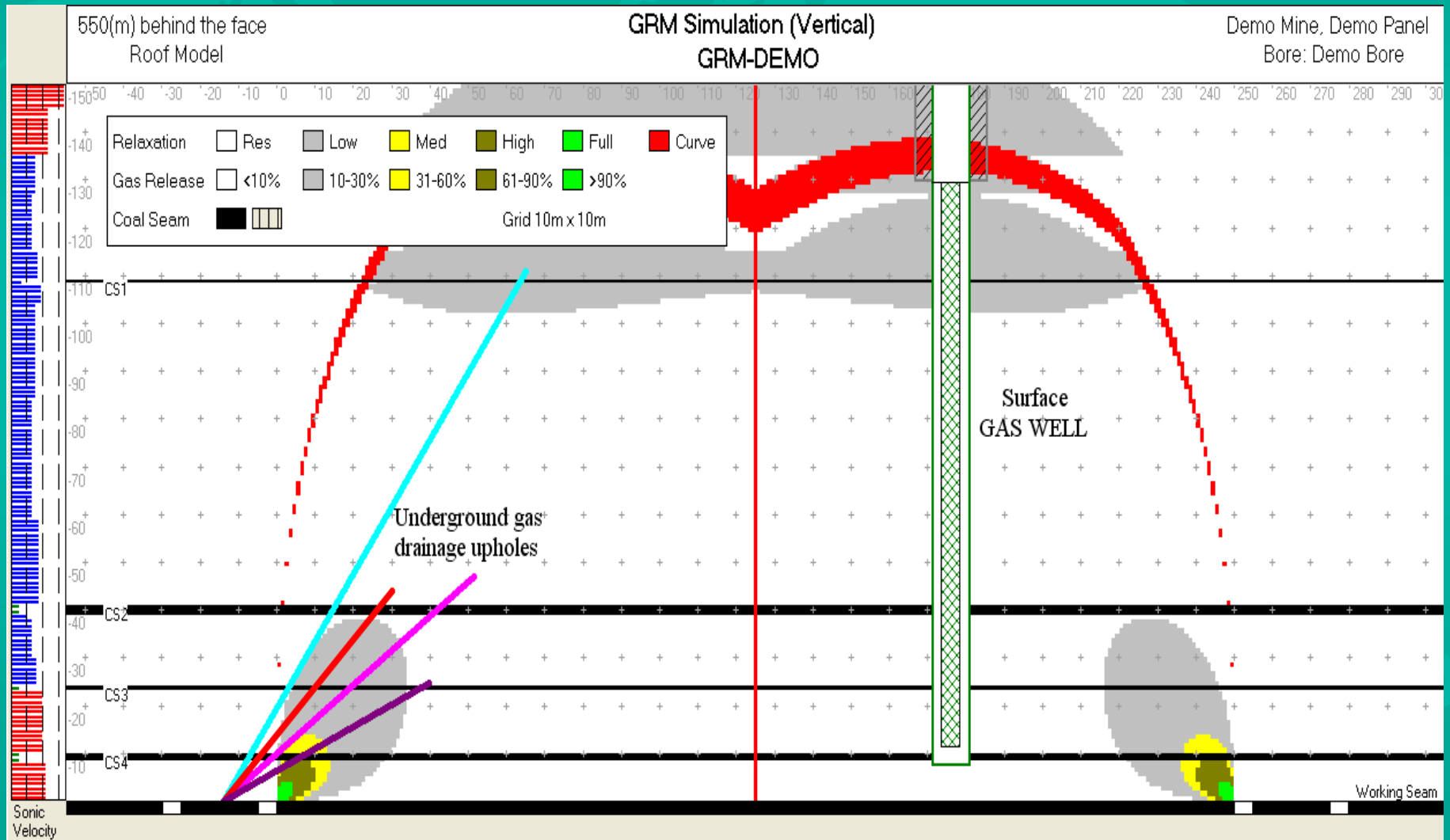


# GRM roof simulation 500m behind the face



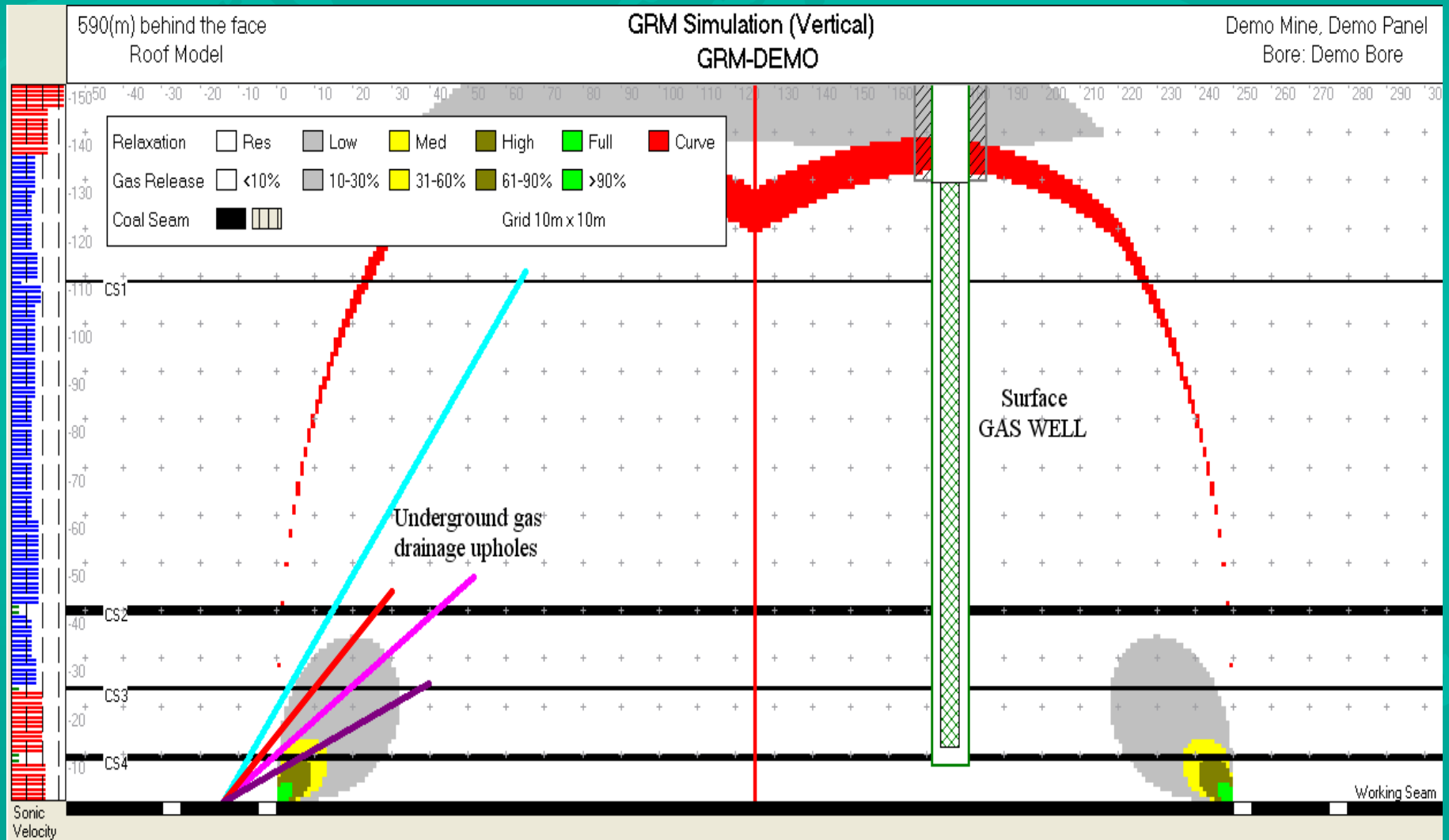


# GRM roof simulation 550m behind the face



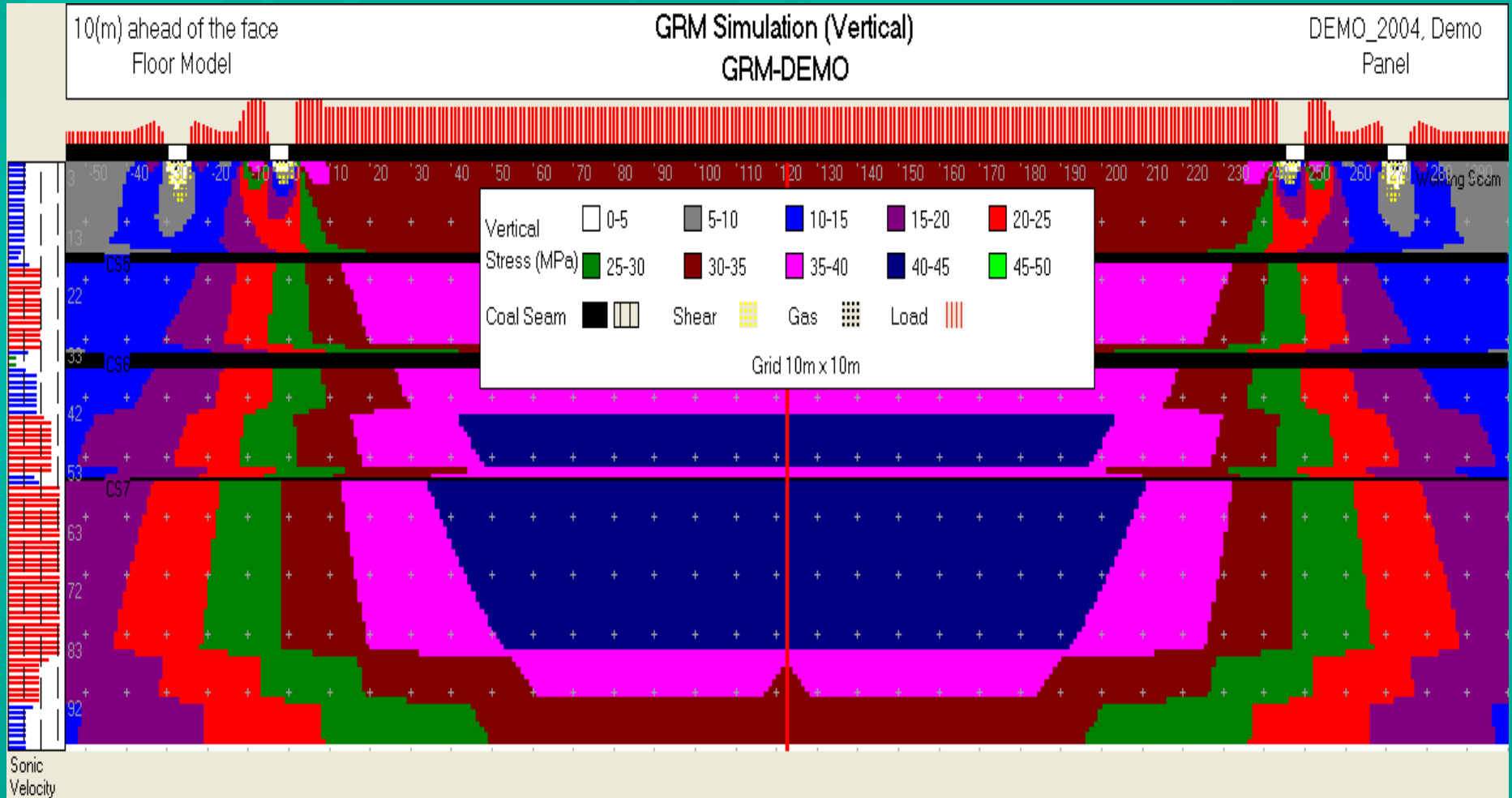


# GRM roof simulation 590m behind the face





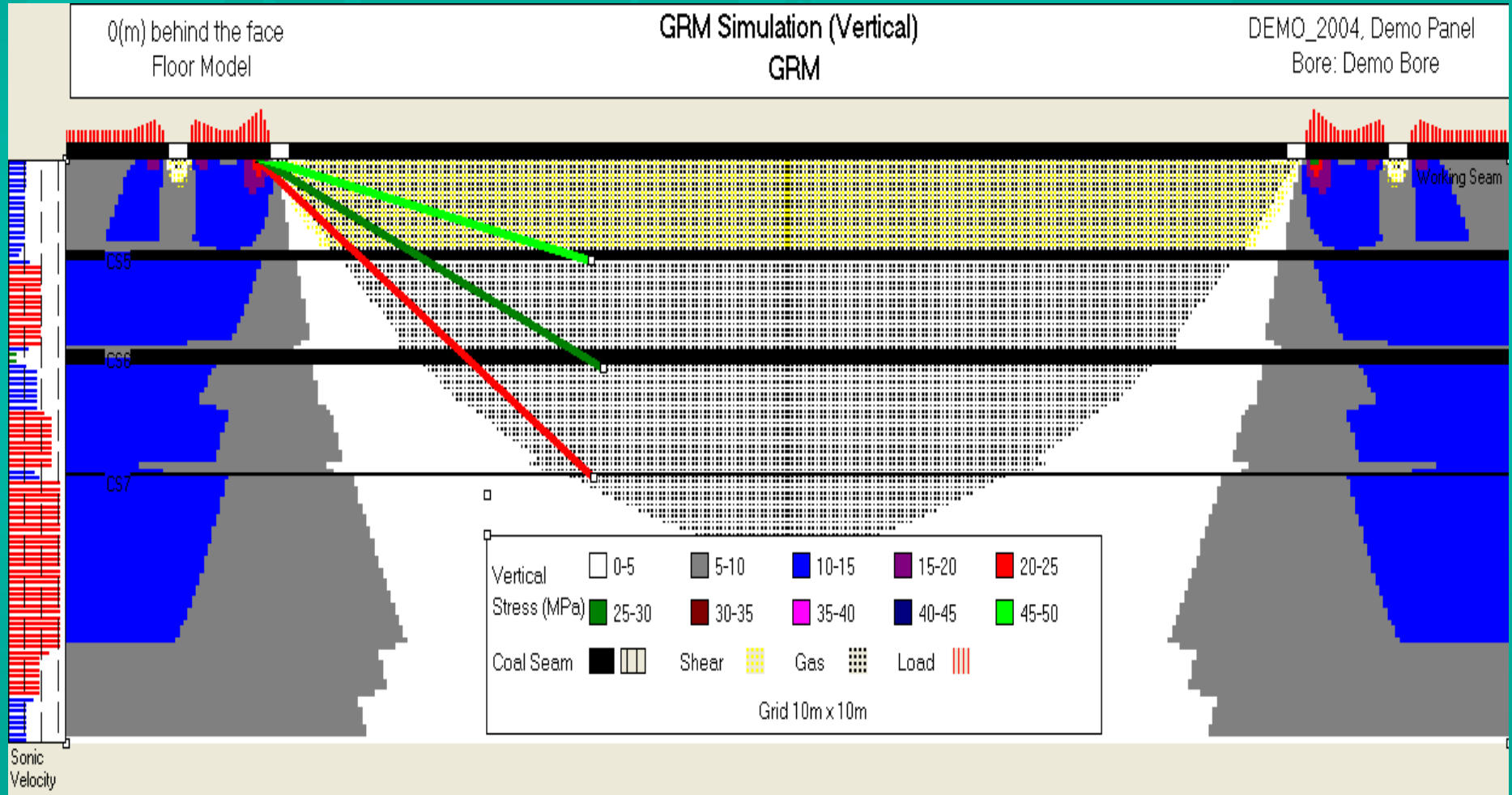
# GRM floor simulation 10m ahead of the face





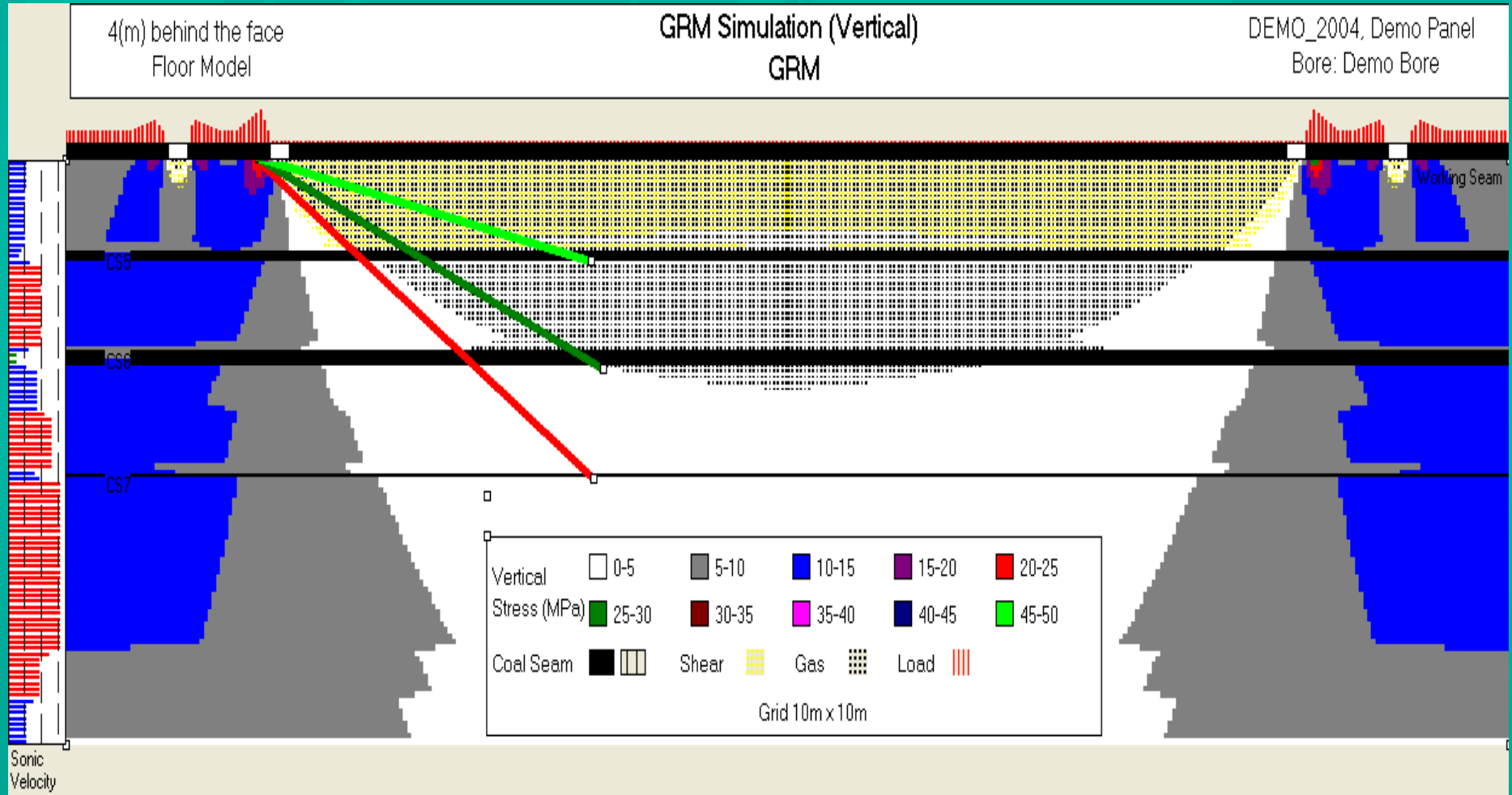
# GRM floor simulation

## 0m behind the face



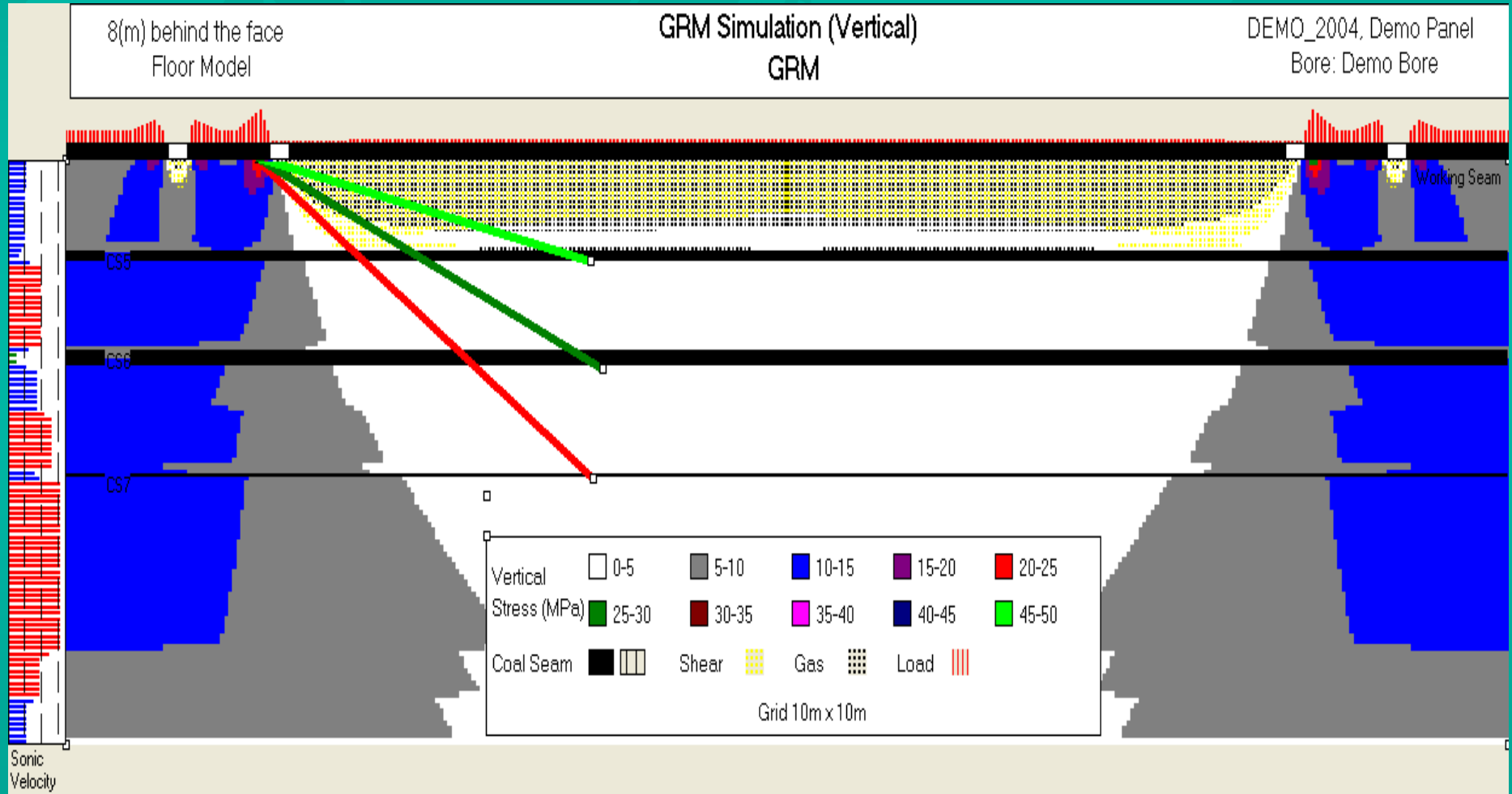


# GRM floor simulation 4m behind the face



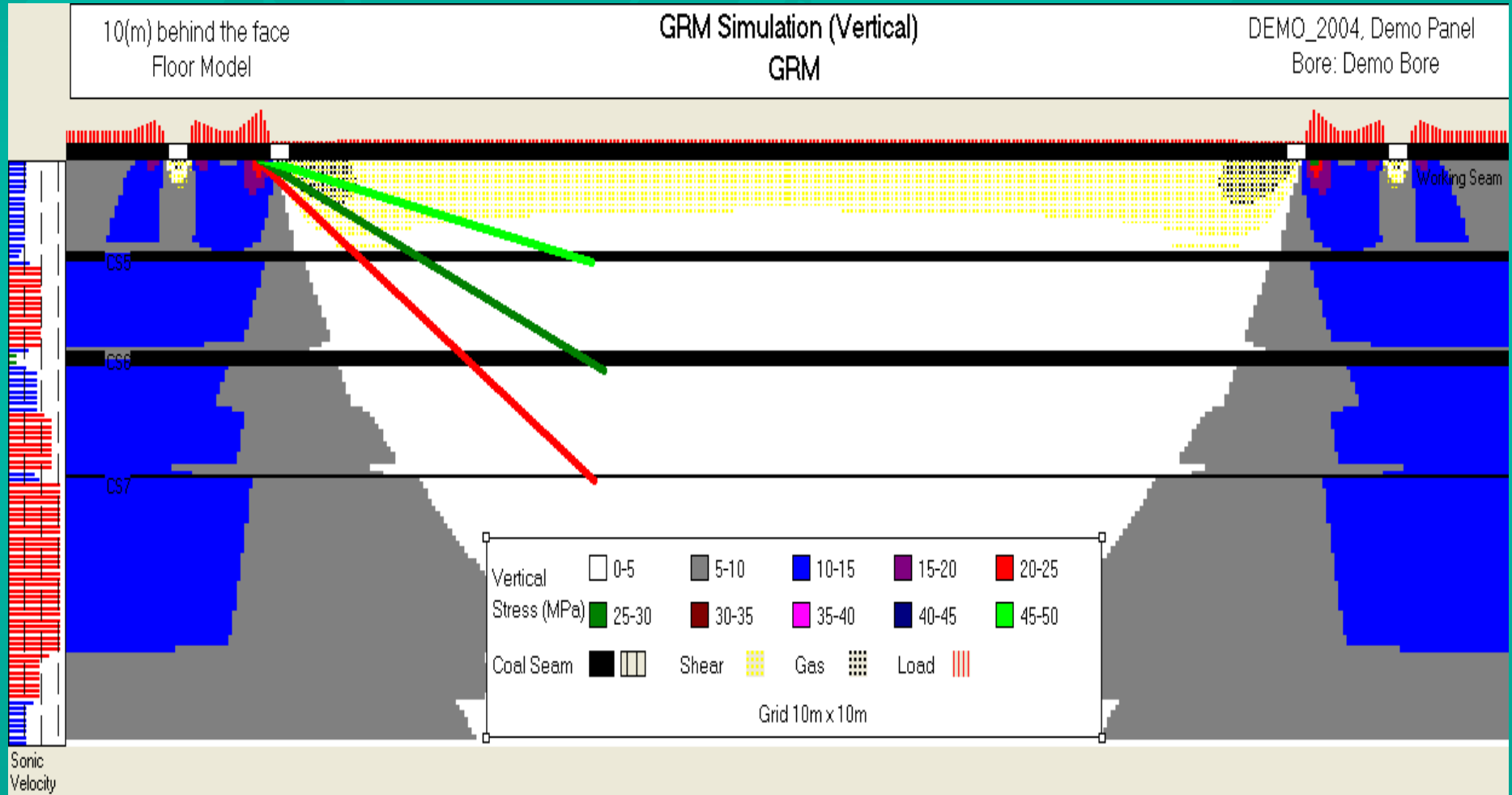


# GRM floor simulation 8m behind the face





# GRM floor simulation 10m behind the face





### **3. Goaf Gas Predictor (GGP)**

**Prediction of coal mine gas quantity from sealed goaves & abandoned coal mines**

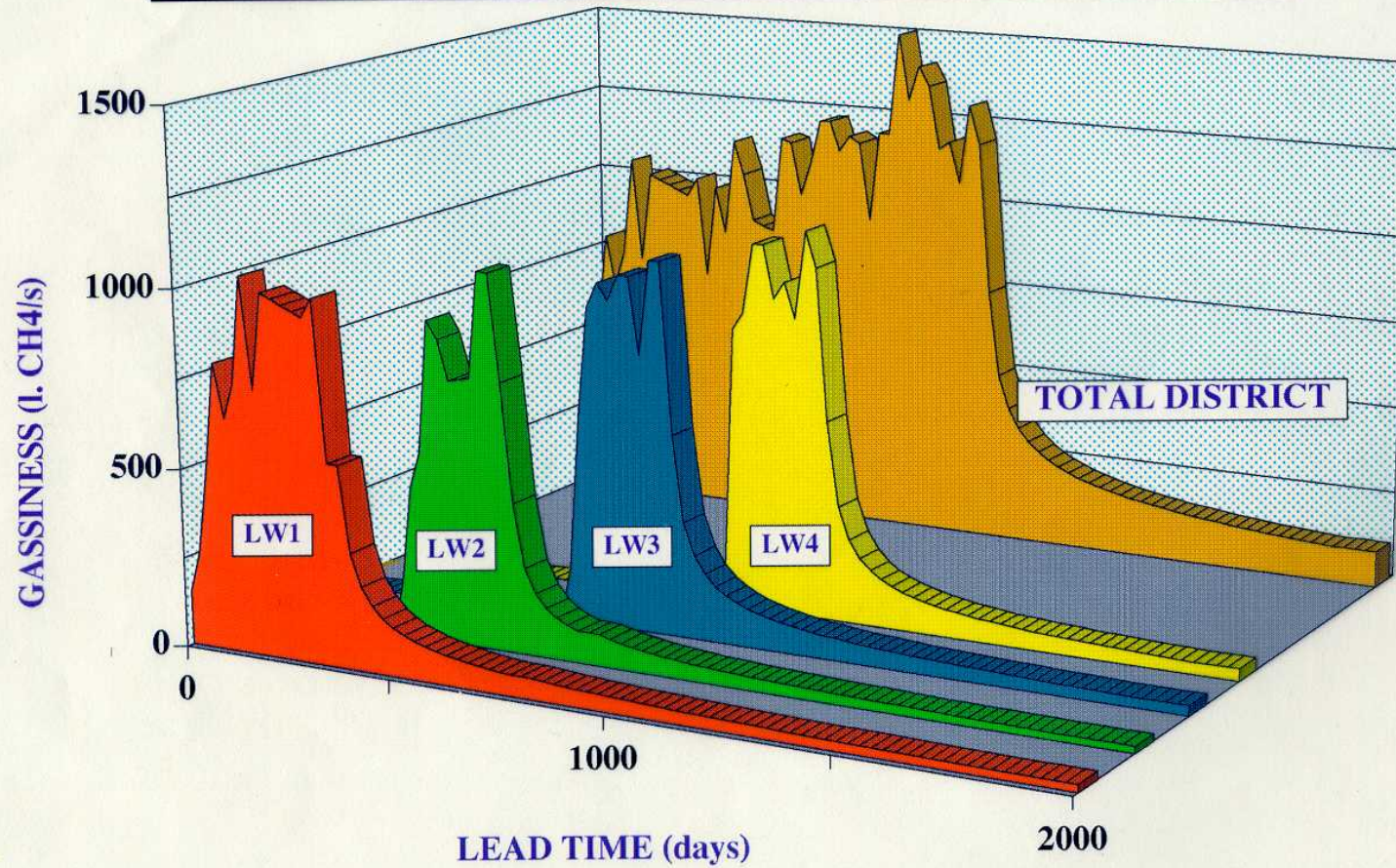
- 1. *PRODUCTION GAS* - rapid decline phase**
- 2. *BACKGROUND GAS* - long term decline phase**

#### **Outputs:**

- Dry & flooded mine gas decline rate versus time**
- Methane available in underground gas reservoir**



## MULTI-LONGWALL GOAF GASSINESS DECAY





# GGP - Coal mine gas emission decline curves equations

Stage 1      3 - 12 months

*The logarithmic approximation curve*

$$Q = -A * \text{Ln}(\text{Time}) + B$$

Stage 2      15 - 30 years

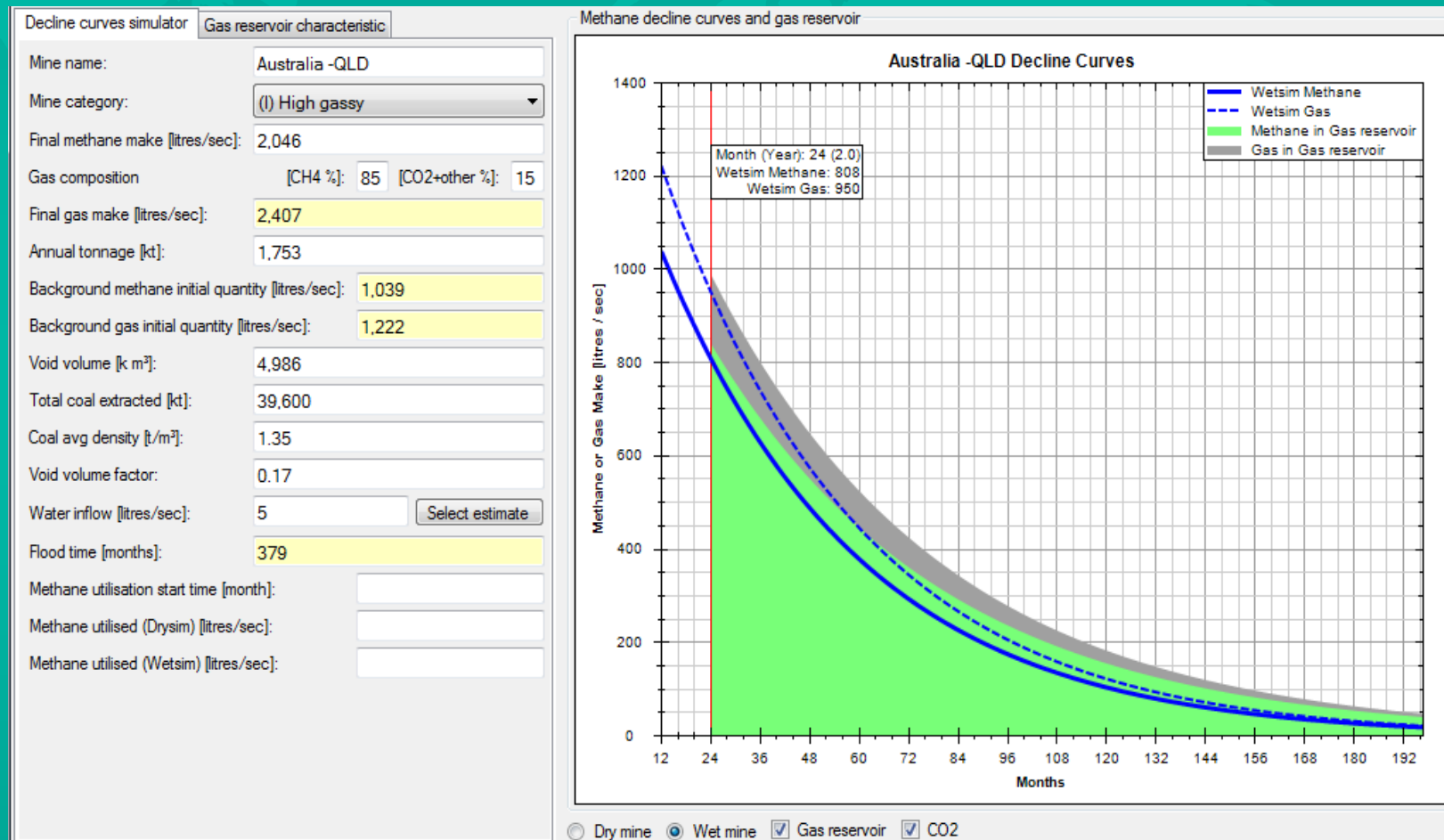
*The exponential approximation curve*

$$Q = C * e^{-D * (\text{Time})}$$



# GGP - case study

## Australia, QLD

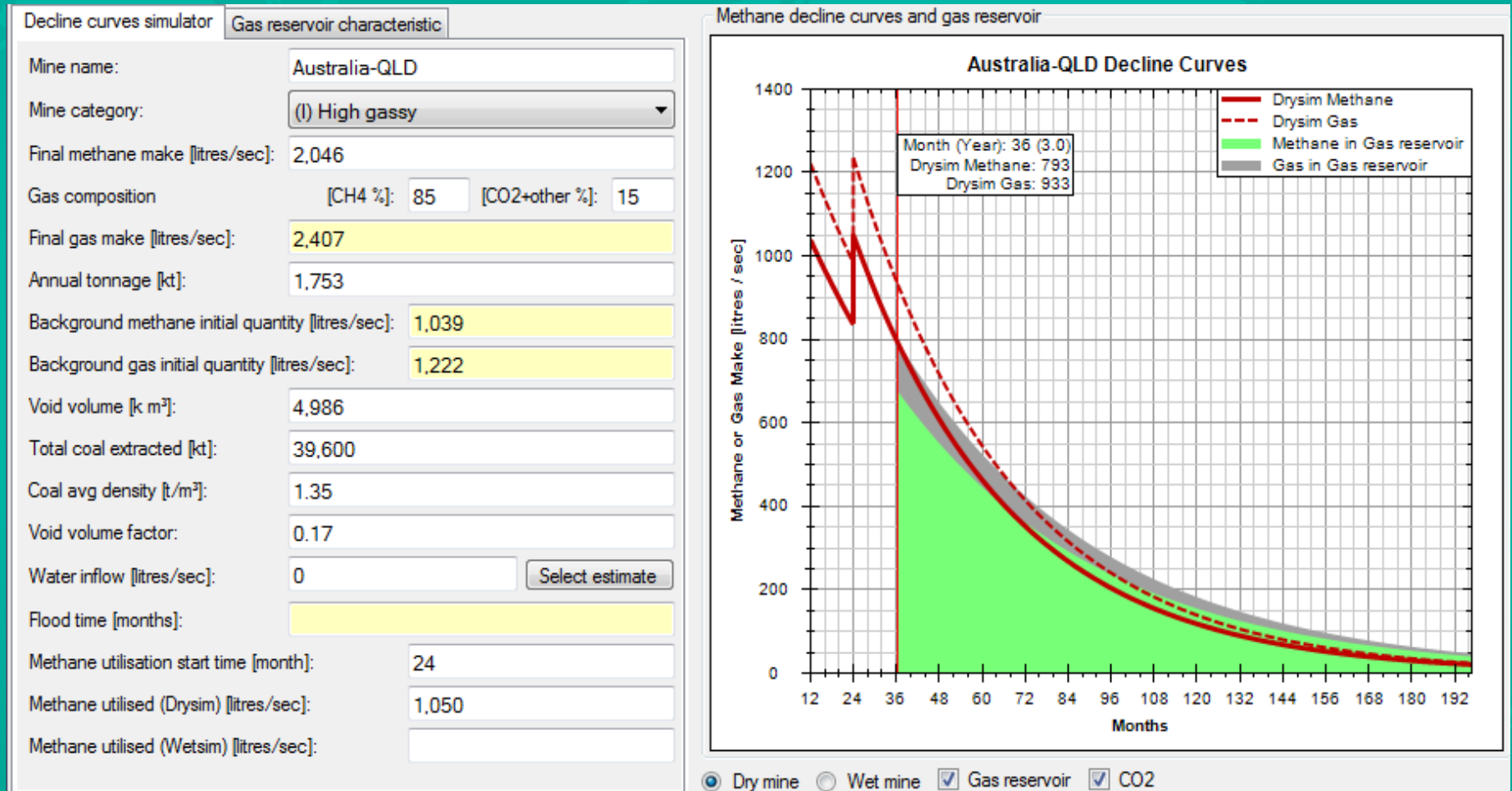


Closed mine parameters, gas decline curves and gas reservoir area graphs for high gassy flooded mine



# GGP - case study

## Australia, QLD

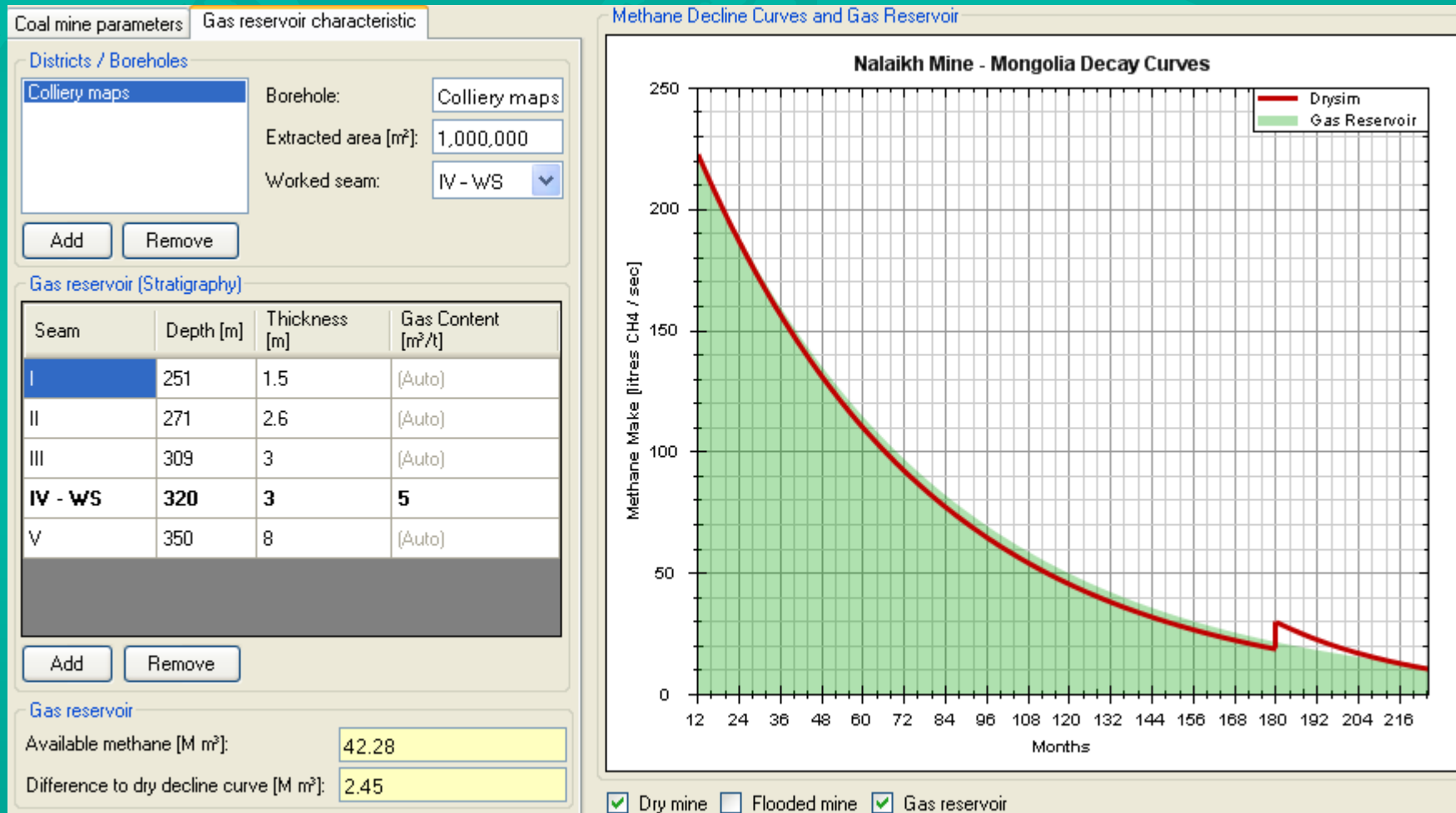


Closed mine parameters, gas decline curves and gas reservoir area graphs for high gassy dry mine



# GGP - case study

## Mongolia, Nalaikh



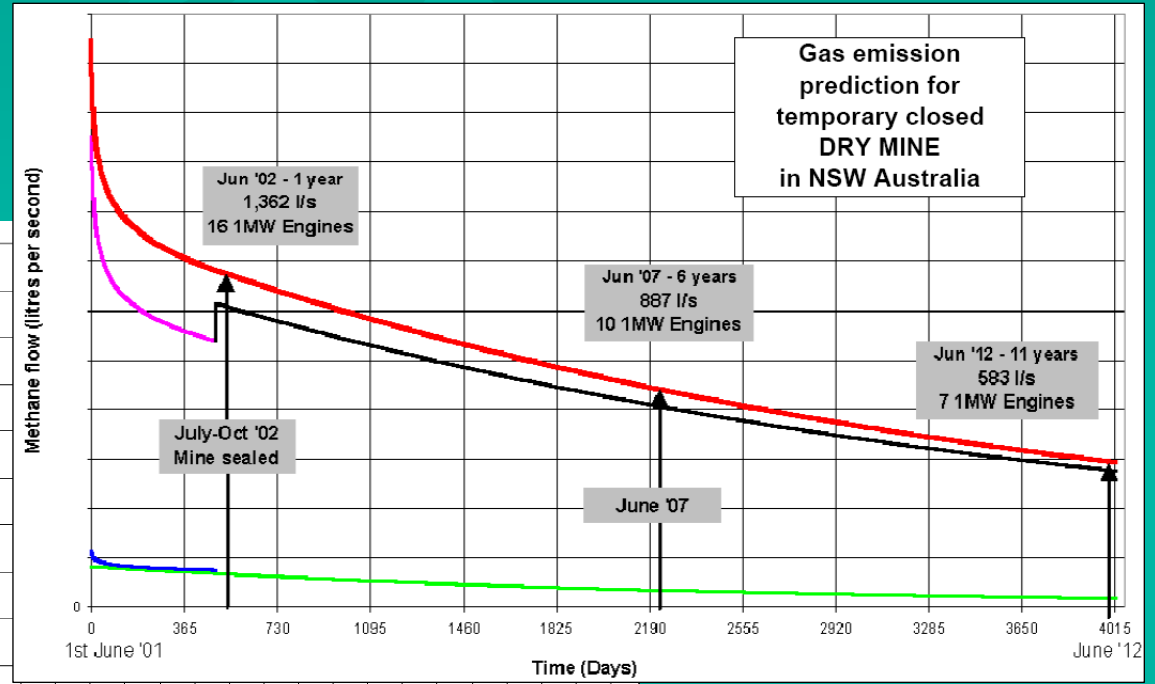
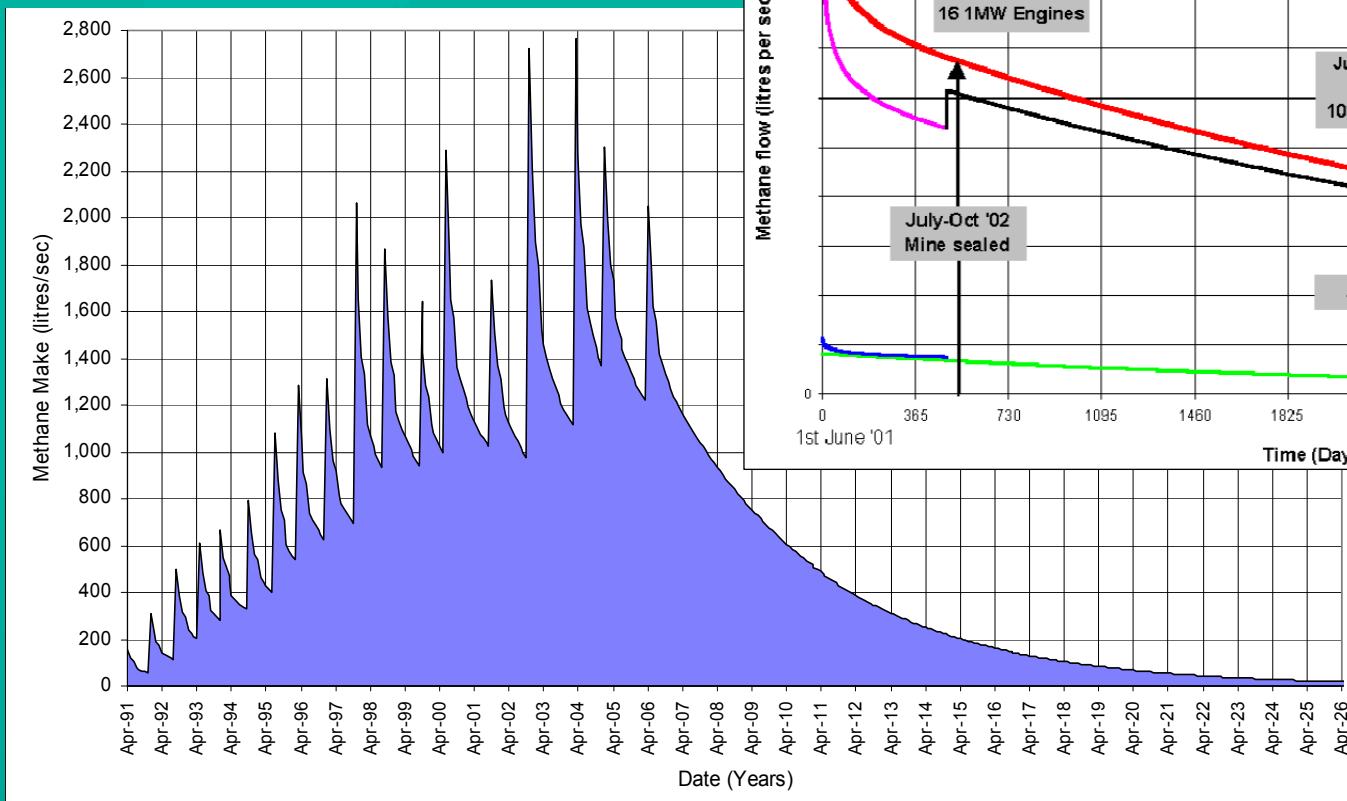
Gas reservoir available methane calculation and decline curve projection for abandoned dry coal mine



# GGP - case studies

## Australia - NSW

## Australia - QLD



Decline curves  
projection (2001-2012)  
after mine was  
temporarily closed

Coal mine gas emission during coal production (21 LWs)  
and projection (2006-2026) after mine was closed



[lunagas@ozemail.com.au](mailto:lunagas@ozemail.com.au)  
Australia

