



Methane to Markets (M2M) Conference

Advancing Project Development in India through Public Private Partnership

New Delhi

Reliance CBM Exploration in India

By

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OUTLINE



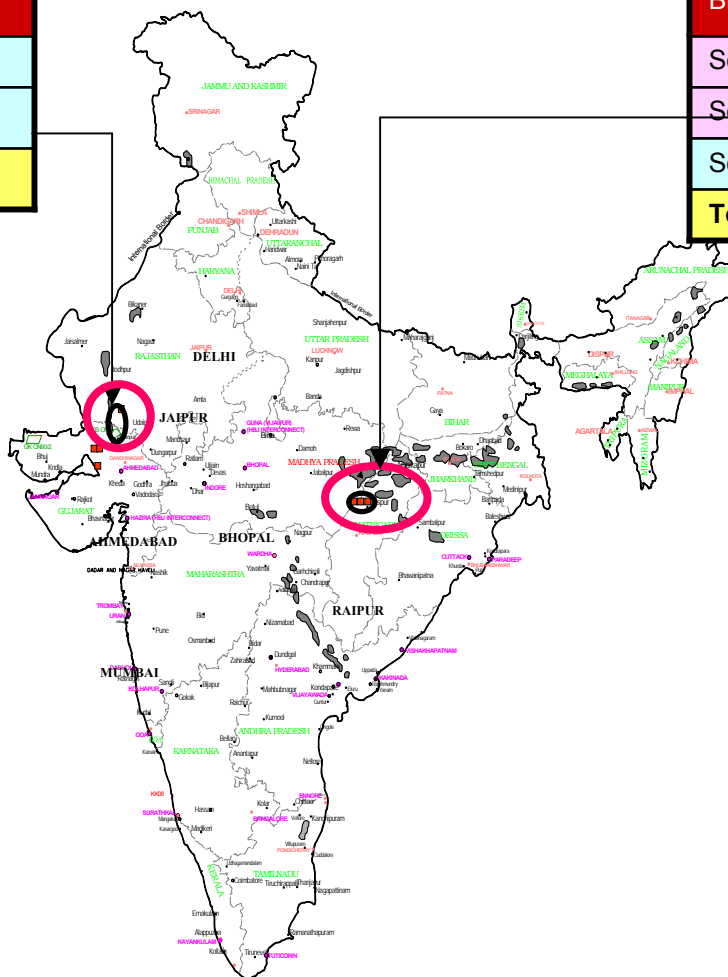
- **RIL's CBM blocks**
- **CBM exploration experience**
 - CBM prospect evaluation approach
 - Highlights & major achievements
 - Corehole program
 - Saturation conditions in coal beds
 - Permeability of coal reservoirs
 - CBM well drilling & completion
 - Emerging technologies
- **CBM gas usage options**

RIL's CBM BLOCKS



Block Name	(Area Sq. Km)
Rajasthan West	1045
Rajasthan East	1020
Total	2065

Block Name	(Area Sq. Km)
Sohagpur West	500
Sohagpur East	495
Sonhat	825
Total	1820

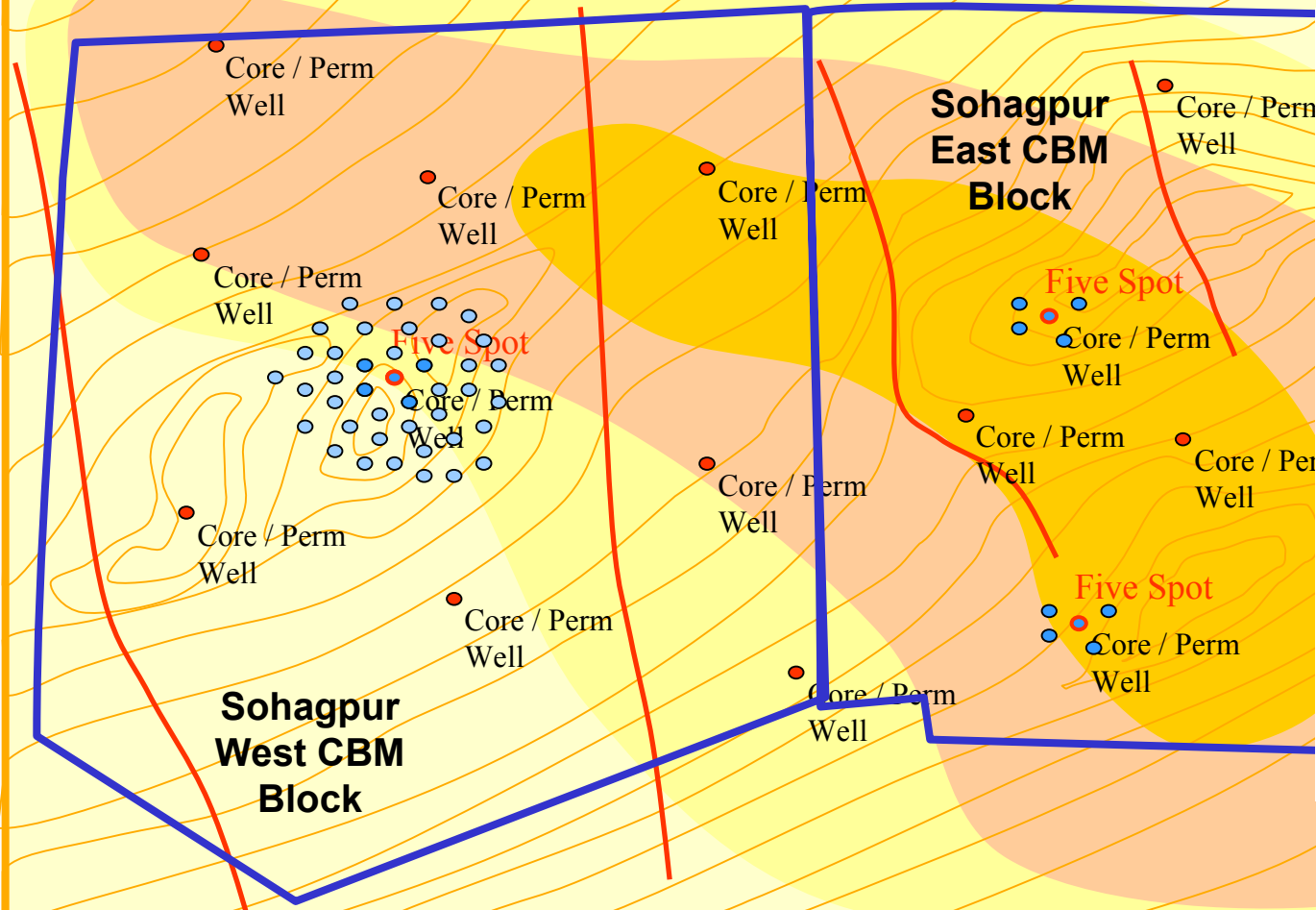


- 1ST CBM ROUND BLOCKS
- 2ND CBM ROUND BLOCKS

CBM EXPLORATION EXPERIENCE



CBM PROSPECT EVALUATION APPROACH



Pre-drilling Assessment

Geological evaluation, based on available information
Remote sensing studies
Lineaments, natural fracturing studies

Core Program

Core & Log
Gas Content, Adsorption Isotherm
Injection/ Falloff Permeability Test

Production Test (5-Spot Pilot)

Production Test
Completion Effectiveness
Relative Permeability

Reservoir Simulation

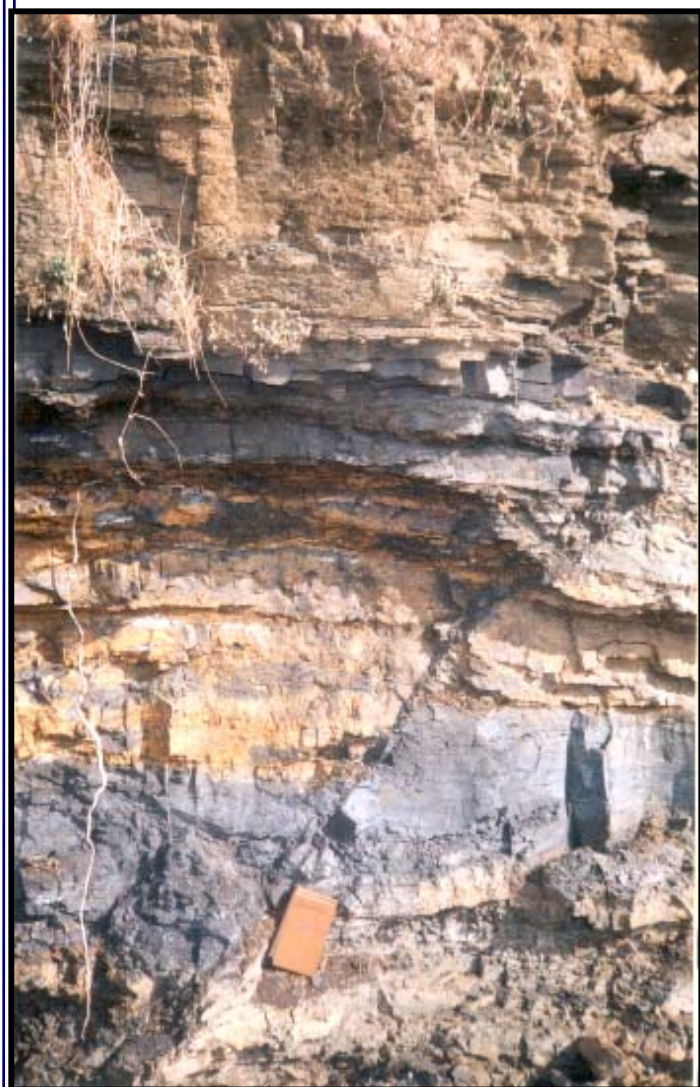
Spacing & Pattern
Field / Area Production Potential
Field / Area Development Program

Commercial Pilot

Step out wells
Larger Spacing
Completion optimization

Exploration Objectives

- Fixing CBM Gas-in-place and identification of CBM fairway by corehole drilling
- Fixing well producibility numbers from 5-spot cluster wells further refined by commercial pilots



Minor fault in Raniganj coal and shale interbands, north of Kanchanpur

TECTONIC AND STRUCTURAL SETTING FAULT DEVELOPMENT



Steeply dipping micaceous sandstone abutting against massive sandstone along E-W fault, Kaser nala



TECTONIC AND STRUCTURAL SETTING - JOINTS/FRACTURES



E-W major joint cut across by N-S joint,
Kaser nala section

CBM EXPLORATION EXPERIENCE



HIGHLIGHTS

- CBM Discovery : 3.65 TCF, validated by the Directorate General of Hydrocarbons (DGH)
- Technology used for drilling : Air Drilling
(First ever used in India for CBM Drilling)
- Gas Production Potential : 3 - 5 MMCMD in a Frontier Area
- Water Production Potential : 50,000 – 70,000 BPD of good quality water
- Investment Potential
 - CBM Production : Over Rs.3000 crores
- Employment Generation
 - Direct employment : In thousands
 - Indirect employment : In thousands
- Infrastructure Development : Roads, Ancillary Industries, Support Industries
- CSR Scope : Health, Education, Environmental conservation. Agricultural Support
- **USTDA Funding** - Considering positive viability, funding of 0.5 million USD approved for project Techno-economic feasibility study. Contract signed with TDA in May this year



MAJOR ACHIEVEMENTS

- The CBM key reservoir parameters acquired:
 - Compleatable Coal thickness and coal seam continuity
 - Gas content and gas saturation
 - Permeability and its variability
- Corehole drilling:
 - Faster completion of corehole in 15 days average as against about 60 days by others.
 - Faster drilling of dolerite rocks (80-170 m) in 2-3 days as against 1 month by others
 - 100% core recovery
 - Many open hole Injection / fall off tests have been carried out first time in the country for determination of permeability of the coal seams



COREHOLE PROGRAM

- Critical parameters essential to determine gas in place resource and fairway areas of high gas production
 - Coal thickness
 - Gas content
 - Permeability: a key CBM production parameter, may vary drastically over short distances

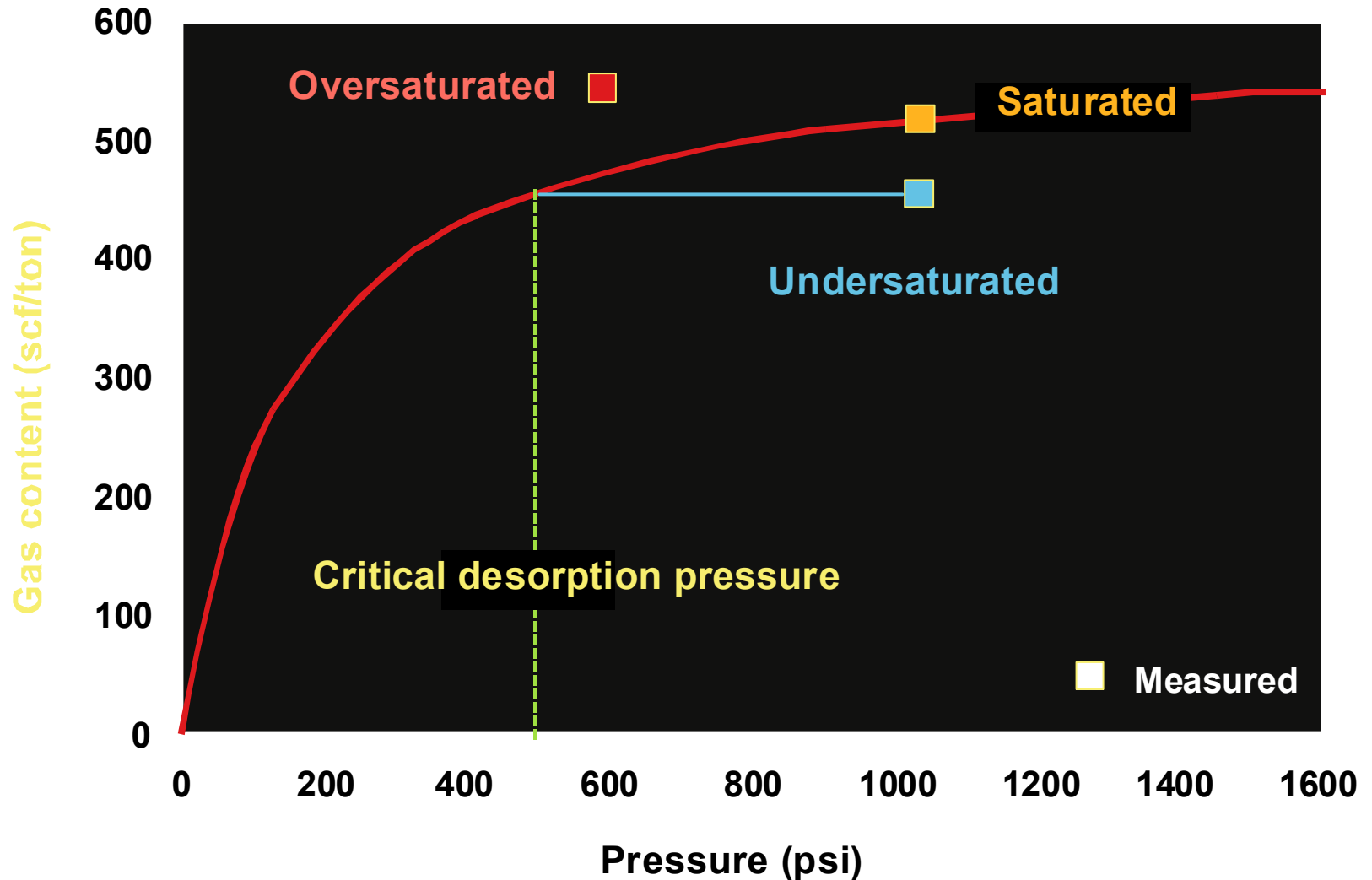
There is a paucity of data on gas content and permeability for Indian coal basins

- **Exploration Campaign in any frontier basin should aim at getting fix on these 3 parameters**

CBM EXPLORATION EXPERIENCE



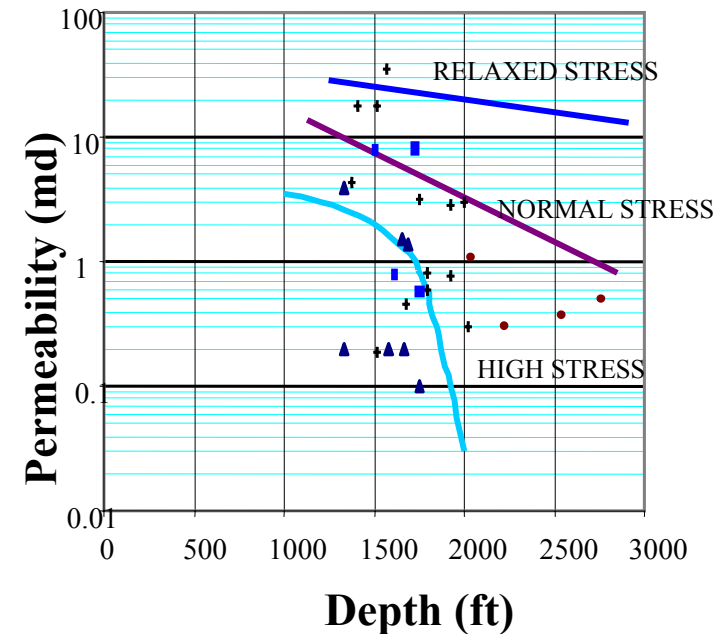
SATURATION CONDITIONS IN COAL BEDS





PERMEABILITY OF COAL RESERVOIRS

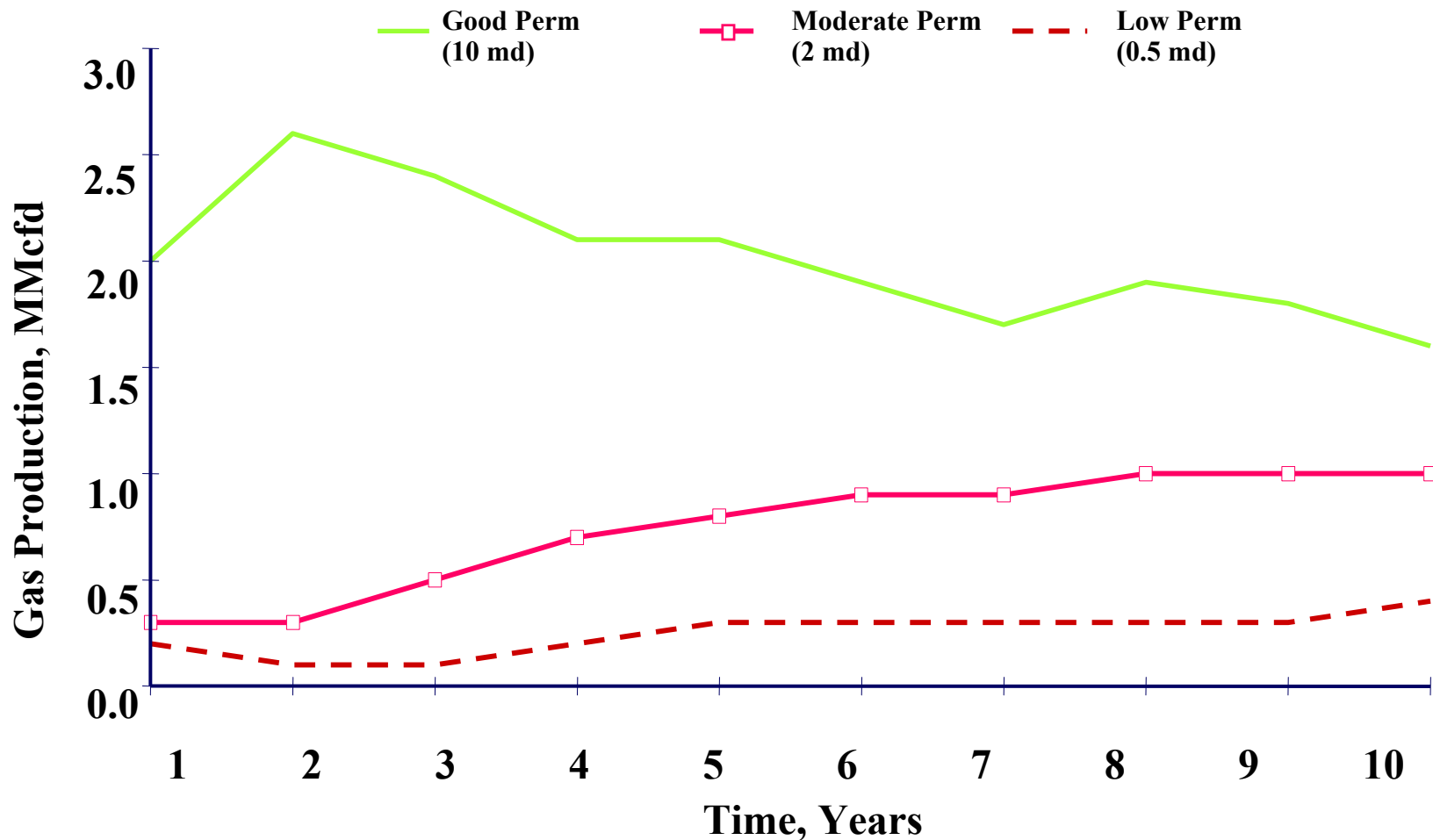
- Permeability, the key parameter of coal for commercial CBM production can be low and vary drastically over short distances. Therefore, almost all CBM wells are routinely stimulated
- Coals at deeper depths with high stress conditions, usually have insufficient permeability to allow flow of CBM gas into the well.
- Generally speaking, such adverse conditions are less evident in US, Australian and Indian coals. That is why USA & Australia have many CBM producing fields, whereas drilling in Europe has drawn a blank so far.



CBM EXPLORATION EXPERIENCE



PERMEABILITY vs. PRODUCTION



- Gas productivity from low stress naturally fractured coal seams is high

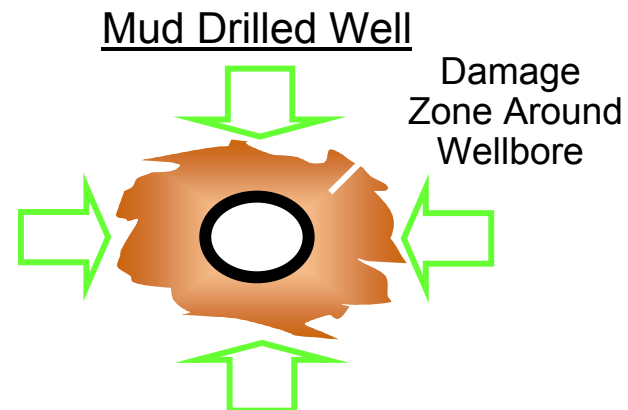
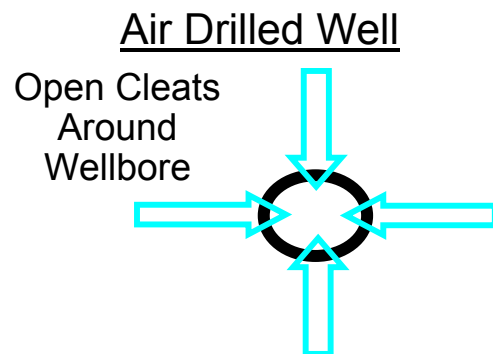


CBM WELL DRILLING

- In general, coals are susceptible to damage from drilling, cementation and frac fluids
 - Air / Air mist drilling
 - Light weight cement slurries and compatible fluids
 - Careful selection of frac fluids

DRILLING

Underbalanced or Air Drilling helps reduce Formation Damage in CBM Wells and results in faster rates of drilling



CBM EXPLORATION EXPERIENCE



Photo – 04.05.05

CBM Flow Computers – Sohagpur west 5 spot



West 5 – Spot CBM Gas / Water Separation

CBM EXPLORATION EXPERIENCE



CBM Gas Flare – Sohagpur west 5 spot



Photo – 04.05.05



Water Quality

TDS Limits For Water Usage

TDS Content	Tolerance [mg/ l]
<500	Drinking Water
<2,500	Cattle
<3,000	Crop irrigation
<5,000	Sheep



Initial water analysis for Sohagpur water shows that TDS is less than 1000 mg/l

P.S. : Rajasthan Barmer district drinking water bore wells : 5000 + mg /l

CBM EXPLORATION EXPERIENCE



CBM WELL COMPLETION

High-Perm Completions in other CBM Basins

Field	San Juan (USA)	Arkoma (USA)	Fairview (Australia)	Moranbah (Australia)
Perm range (md)	5-100	10-30	10-1000	1-300
Completion	Cavity for high k; HF for low k; Recent horizontals	Single horizontals	More cavity Some HF	SIS

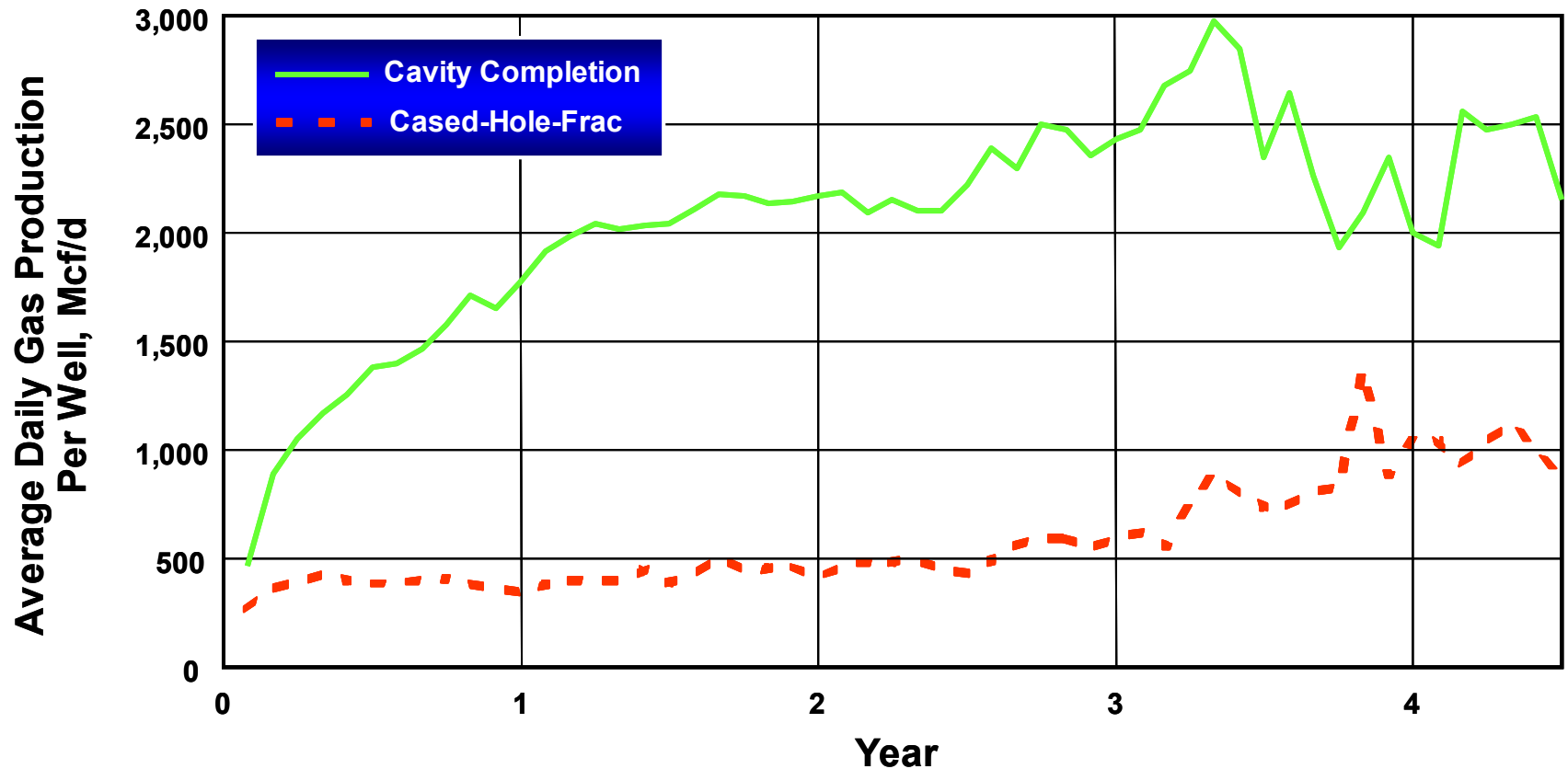
CBM EXPLORATION EXPERIENCE



AVERAGE WELL PERFORMANCE-CAVITY VS CASED HOLE IN SAN JUAN BASIN

Number of Wells:

Open -Hole	598	477	366	263	185	117	75	38	19	17
Cased-Hole	230	207	169	140	114	74	57	24	12	8



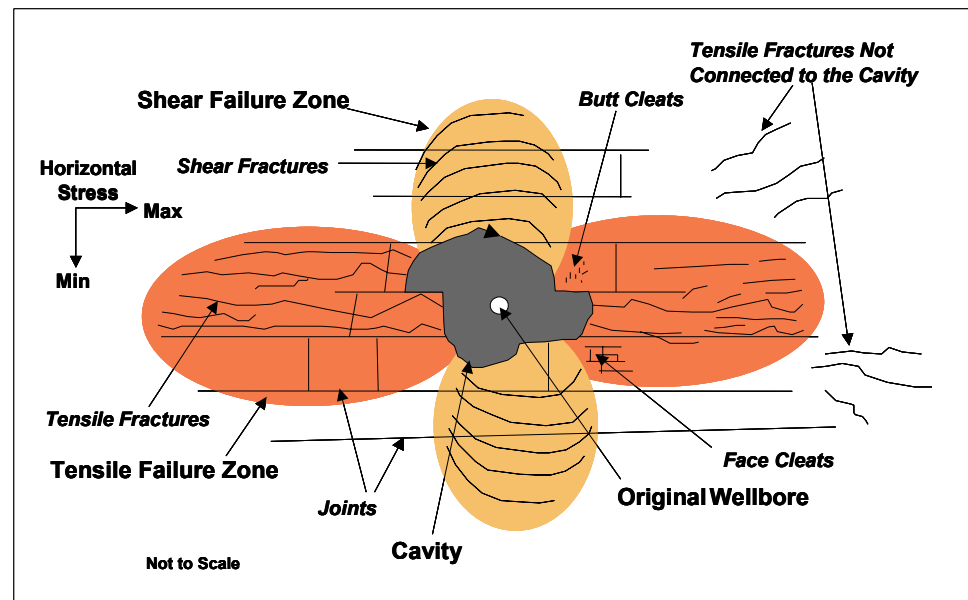
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EMERGING TECHNOLOGIES – CAVITY COMPLETION

Ideal Targets

- High rank, Low to medium volatile bituminous Coals
- Fragile coals
- Moderate to good permeability, 10⁺ mD
- Over pressured coal reservoirs
- Costs about 1.5 times more than normal vertical wells but produce 4 to 6 times more
- *Many Parts of Sohagpur CBM blocks having the above characteristics are good for Cavity Completion*



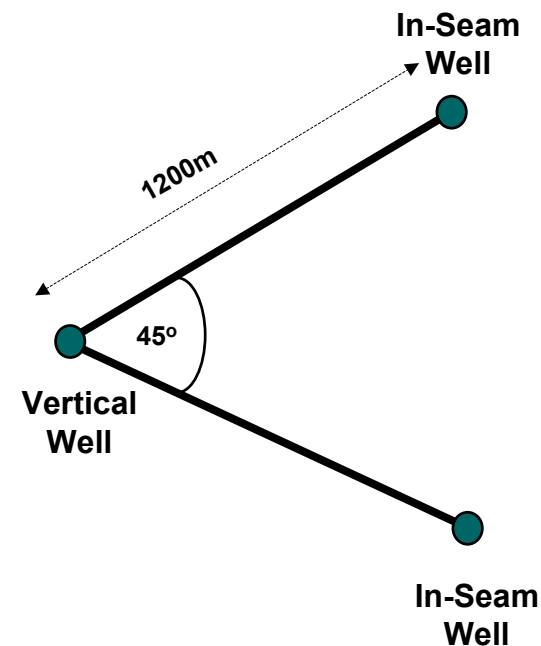
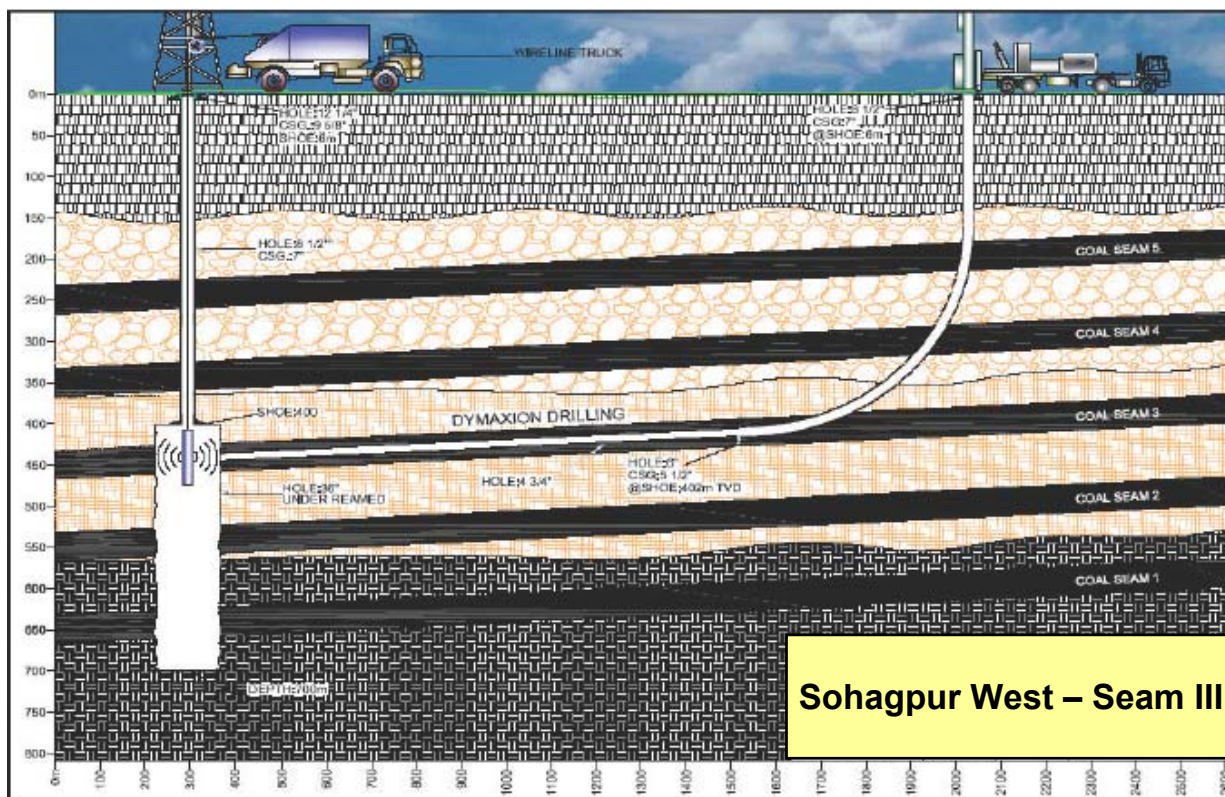
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EMERGING TECHNOLOGIES IN CBM - IN SEAM DRILLING

Plan for Sohagpur West Block, Seam-III

Drilling in seam – directional well from a distance of 1200 m.



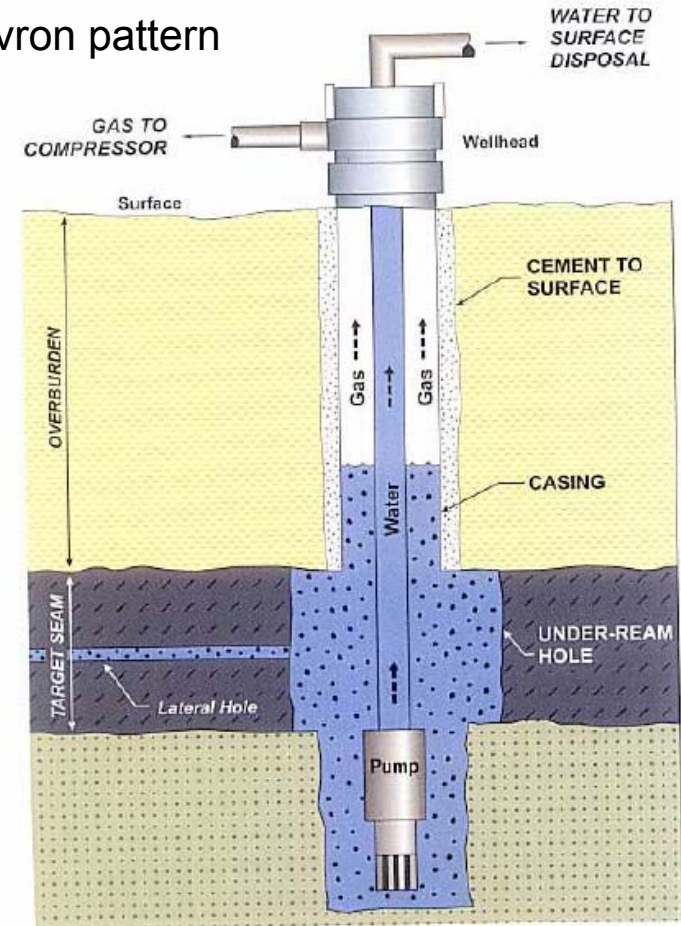
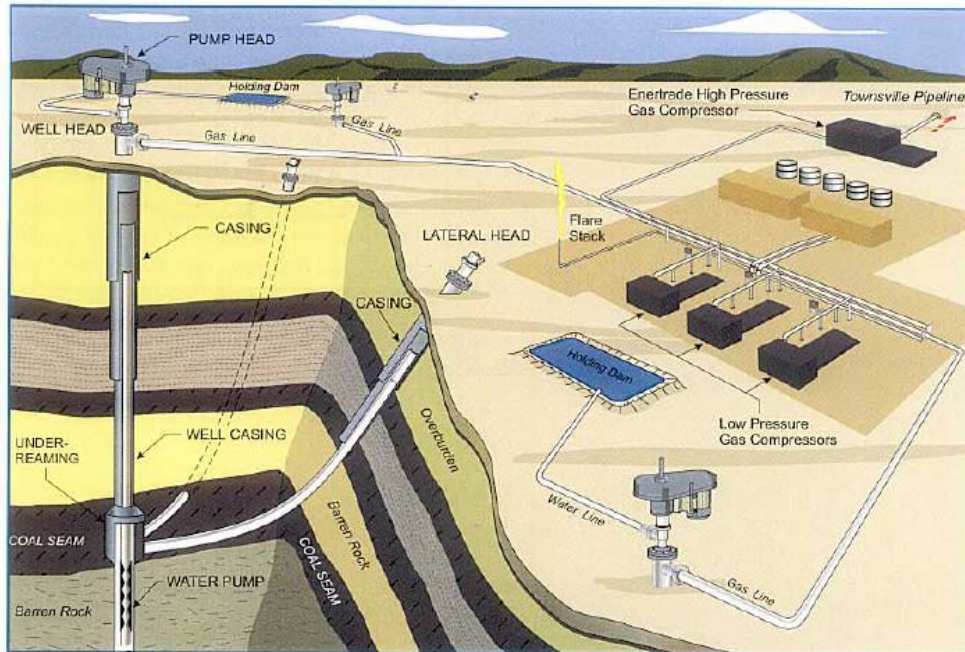
Estimated production potential – 1.5 to 2.0 MMSCFD per well

CBM EXPLORATION EXPERIENCE



EMERGING TECHNOLOGIES IN CBM - IN SEAM DRILLING

Surface to in-seam horizontal directional drilling in chevron pattern



CH₄, Australia drilled over 100 sets of chevron wells producing 1-2 million cubic feet per day of CBM Gas

CBM EXPLORATION EXPERIENCE



Advanced technology implementation – Potential Impact

Technology	Potential
Horizontal and in-seam drilling	Increase ultimate recovery by up to 50%
Multilateral drilling	Increase ultimate recovery by up to 50%
Air drilling	Cut drilling time and cost by up to 50%
Optimizing stimulation	Increase ultimate recovery by 20-50%
Better well spacing	Could double NPV
Continuously variable pump controller	Save workovers, boost ultimate recovery By 5-10%
Foam cement	Increase ultimate recovery by 5-10%
Coiled Tubing Frac	Increase ultimate recovery by 15-30%
Down hole gas compression	Increase ultimate recovery by 20-40%
Smaller rigs	Save \$ 15,000 per location
Closed loop air drilling	Save \$ 20,000-30,000/well
Casing drilling	Save \$ 10,000/well
Jet slotting	Save \$ 10,000/well, increase ultimate recovery by 20-50%

 Implemented in Phase-I

 Being implemented in Phase-II



Possible CBM Based Industries

- Fertilizers, chemicals & petrochemicals
- Town Gas & Industrial fuel supply
- Power generation
- Cement
- Paper and paper products
- Sponge iron & steel
- Ceramics
- Glass
- Textiles

Steel, Glass, Ceramics and Paper manufacturing companies are showing keen interest to put up their plants in the region

CBM GAS USAGE OPTIONS



Gas demand in the region

Location	Industry	Distance from CBM blocks in Km	Gas Demand Potential in MMSCMD
Shahdol	Chemicals, Paper, Power, Fuel, City gas	25	0.35
Katni	Cement, Fuel, City gas	135	2.92
Maihar	Cement, Fuel, City gas	153	0.40
Rewa	Cement, Fuel, City gas	200	1.12
Satna	Cement, Fuel, City gas	200	0.65
Allahabad	Fertilizer complex	350	4.50
TOTAL			9.99

With availability of CBM gas, accelerated industrial development is a good prospect in and around Shahdol apart from above demand



Thank You