In-Seam Directional Drilling and Gas Drainage Demonstration Project – Baijigou, PR China

Frank Hungerford
Valley Longwall Drilling
Baijigou Service Project

- CAMDA – AMSI hold contract to gas drain Baijigou longwall blocks
- GeoGAS consulted for gas content and drainage characteristics
- Drilling Project in 2 components
- VLD to complete the underground component
- Mitchell Drilling to complete the SIS component
Location - Ningxia
Mine Audits

- Mine Safety - safe to operate in?
- Seam conditions – is the coal drillable?
- Drilling applications
- Services – air, water, power – fittings
- Access, transport, dimensions
- Surface facilities
- Accommodation
- Location, access to mine site
Initial Audit Results

• Cross-measure drilling from under the seam
• Stone strength apparently $f_2$ (20 MPa)
  – Revised to $f_7$-$f_{12}$ (70-120 MPa)
• Angled drilling would require rig with vertical adjustment – Modular
• Mono-rail requirement for each site
• Design straight stone sections to allow for rotary roller-cone drilling if required
Baijigou Rotary Gas Drainage

Baijigou Rotary Cross-Section

Vertical Displacement (m)

Seam

66 deg

55 deg

67 deg

40 deg

1640 Roadway

Baijigou Rotary Cross-Section

-150 -100 -50 0 50 100 150
Initial Borehole Layout - Baijigou Mine
Modular Rig – Feed Frame
Modular Rig – Operators Console
Site Preparations

INITIAL STUB TO BE 6 METRES WIDE X 11.5 METRES DEEP - REVIEW AFTER FIRST SITE

VENT TUBE

FAN

GAS PIPELINE

MANIFOLD/Dewater

MONORAIL - PLACED CENTRALLY

BOLTS IN ROOF ACROSS FACE TO HANG HOSES FROM STANDPIPES

BOLTS ALONG RIB TO PULL EQUIPMENT INTO POSITION
Site Layout - Baijigou Mine
Drill Site – Side View
Gas Manifold – Drill Site
Drill Site – Rig Alignment

Rig aligned parallel to 280.0 deg line in position to suit site layout

Vertical angle as close to 29 deg as manageable
Drilling Design

- Rotary roller-cone 150mm x 3m - standpipe
- Rotary roller-cone 98mm to coal
- Directional drill up into seam roof
- Branch from coal intersect and follow 8m line below roof
- 1.5 deg/6m lateral curve and 1.0 deg/6m vertical curve (combined 1.8 deg/6m)
- Regular sharp roof intersections for profile definition – unstable upper seam coal
Profile Design

Baijigou B1 - Borehole Depth (m) vs. Vertical Displacement (m)

Road
Lateral Design

Target Azimuth 305.0 deg

Roadway - borehole has to be outside 100m Left

Entry Heading 280.0 deg

Baijigou B1 - Down Track (m)

Lateral Deviation (m)
Lateral Design – multiple legs

Target Azimuth 305.0 deg

Entry Heading 287.0 deg
Profile Design

Baijigou B2,B3 - Borehole Depth (m)
Vertical Displacement (m)

Right-hand Leg 3m Lower
Drilling – Site A

- Directional drill with 98mm roller-cone to coal for directional control
- Tungsten tip rollers for better performance
- Seam intersected 26m up at 85m hole depth
- Upper section of seam boggy
- Drilled 2677m to maximum depth of 1023m at 89.9 m/shift
- Terminated 1st branch covered with 2nd branch
Lateral Deviation

Target Azimuth 215.5 deg
Lateral Plot - Borehole B1

Target Azimuth 305.0 deg

Roadway - borehole has to be outside 100m Left

Entry Heading 284.2 deg (280.0 deg)
## Baijigou Project Time Analysis

### VALLEY LONGWALL DRILLING

#### PROJECT DRILLING PERFORMANCE

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<th>Activity</th>
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<th>Time (mins)</th>
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#### Activity Group

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![Pie chart showing percentage of drilling, activities, and other delays]
Drilling Performance
to 20 October

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Surface to In-Seam

- Extremely rough surface environment
- Influences from previously excavated seams above the target Yanan #2 seam.
- Low pore pressure of the coal
- Bogged and could not recover a drill string
- Under-balanced drilling required to succeed but expensive
- Discontinued – to be replaced with underground boreholes
Conclusions

- Baijigou project has demonstrated a successful provision of gas drainage drilling services
- A project managing company (CAMDA) is crucial to providing management and interface between drillers and mine.
- The audit process is critical to the successful planning and implementation of each project
- VLD drillers offer the most extensive experience due to wide exposure in China