Unconventional Gas in Italy: the Ribolla Basin*

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Abstract

CBM and Shale Gas production is growing fast and is becoming an important energy source in many countries.

CBM is methane produced directly from coal seams. Methane is found adsorbed into the coal matrix and it is produced at low pressure by pumping away any water from the coal seam and stimulating the methane flow through the coal cleats to the well bore. Similarly, Shale Gas is natural gas that is produced by desorption from organic rich clay at low pressure, after multistage stimulation of long horizontal boreholes, often from formations that are less permeable than coal.

Independent Resources plc is developing the first unconventional gas project in Italy, at the 100% owned "Fiume Bruna" and "Casoni" exploration licences (Central Italy), where some 300 BCF of natural gas are calculated to be in place, of which 160 BCF are interpreted to be primarily recoverable from the two blocks. The gas is interpreted to be producible from both the coal and the organic rich shale that is associated with the coal seam, at an average depth of approximately 1000 m.

Results to date include knowledge that the Miocene age organic rich sequence:

- consists of one laterally continuous 9-11 meter thick seam of coal and black shale,
- is saturated with thermogenic gas,
- is dry,
- is able to produce excellent quality natural gas by desorption after stimulation,
- has a permeability of 1-2 mD,
- responds more like a gas shale than a classic high permeability coal.

Additionally, there are indications that the 70 meter thick laminated marl and clay sequence immediately above the main seam may be prospective for shale gas as well.

The initial challenges of the project are:

- characterization of the coal and of the organic rich shale, including its mineralogy and gas content, gas composition and gas productivity, and any associated water;
- identification of the best formation stimulation technique;
- technology transfer from areas where CBM and Shale Gas production is mastered with economic success;
- procurement of suitable equipment and services in a safe and value-for-money manner.

ECBM (Enhanced Coal Bed Methane) is one way to implement CO_2 geological storage, by injecting CO_2 in unmineable coal seams to enhance methane recovery. This technique may find application toward the end of the primary production cycle in the Ribolla Basin.

Selected Reference

Mukhopadhyay, P.K., J.A. Wade, and M.A. Williamson, 1994, Measured versus predicted virtinite reflectance from Scotian Basin wells *in* P.K. Mukhopadhyay, and W.G. Dow, (eds.), Vitrinite reflectance as a maturity parameter; applications and limitations: ACS Symposium Series, v. 570, p. 230-248.

RIBOLLA, 1930

Independent Resources plc

RIBOLLA, 2010

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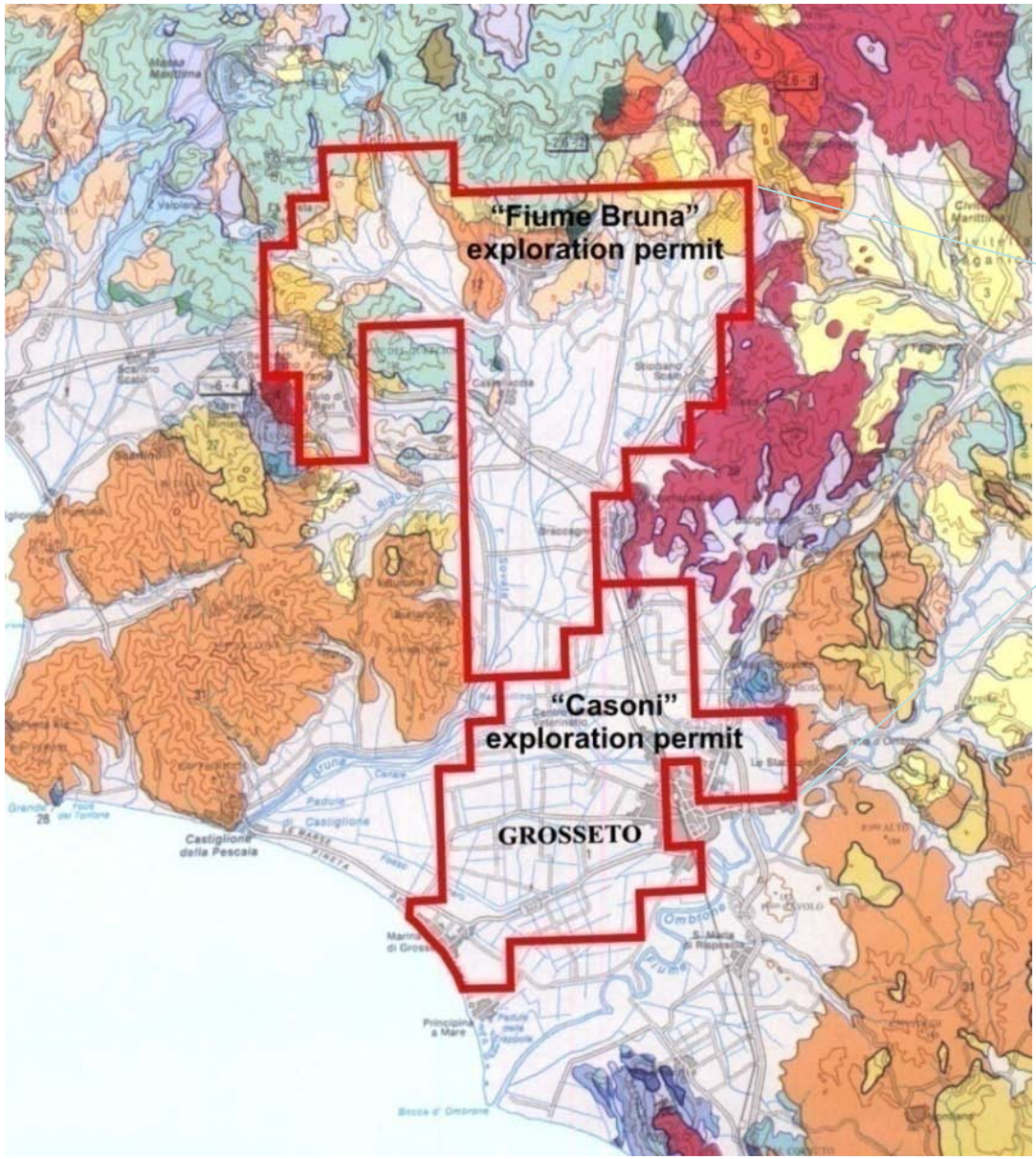
RIBOLLA BASIN LOCATION

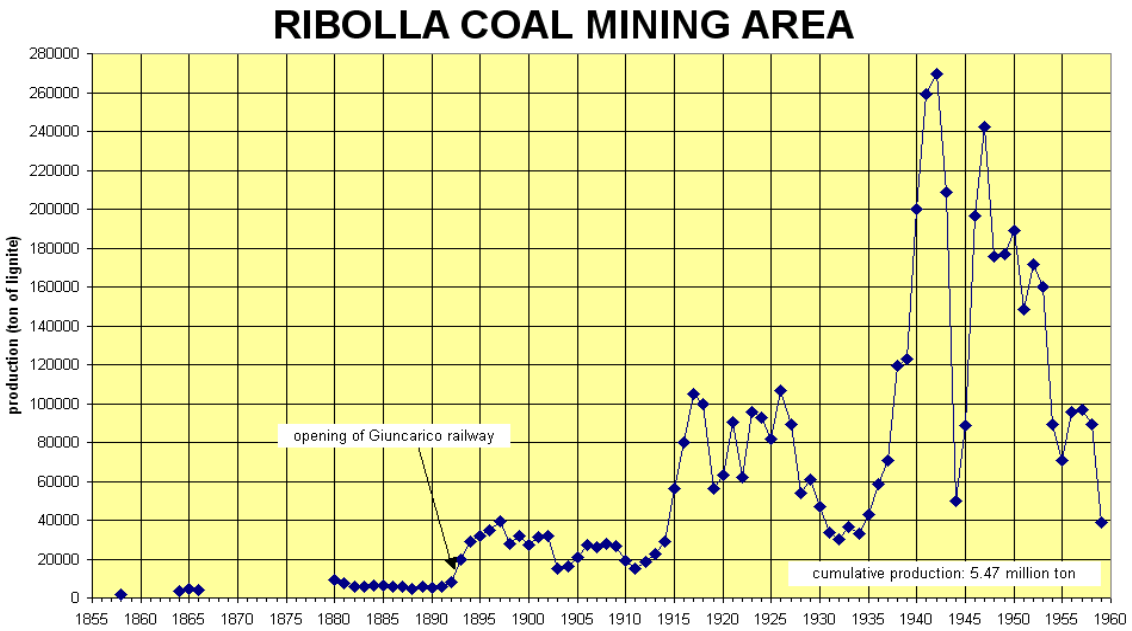


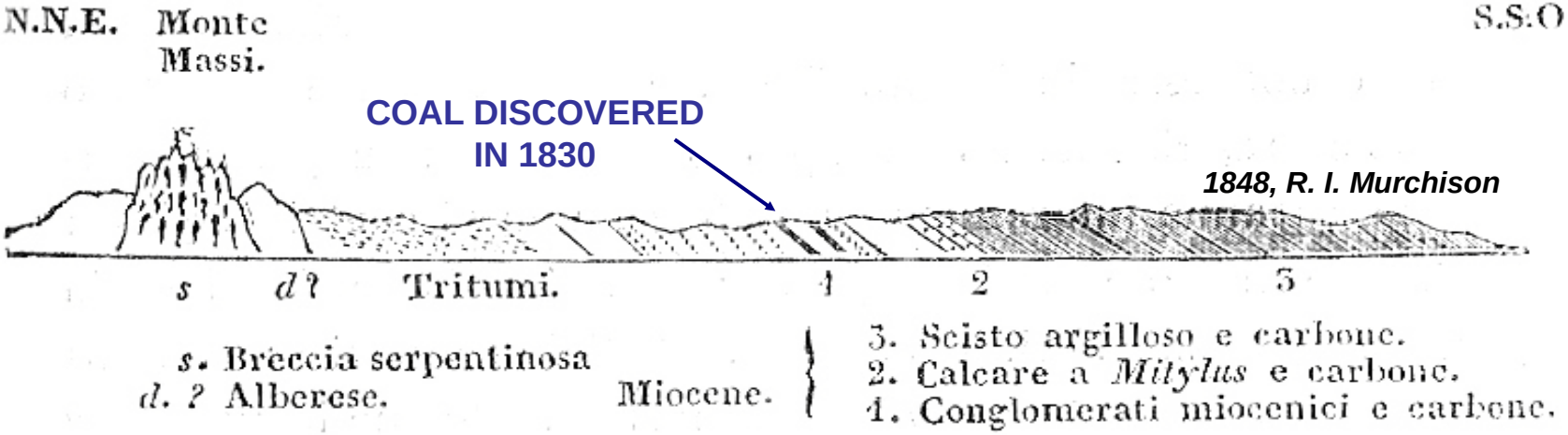
The Ribolla Basin is covered by two Exploration Licences:

- **"Fiume Bruna"**
- **"Casoni"**

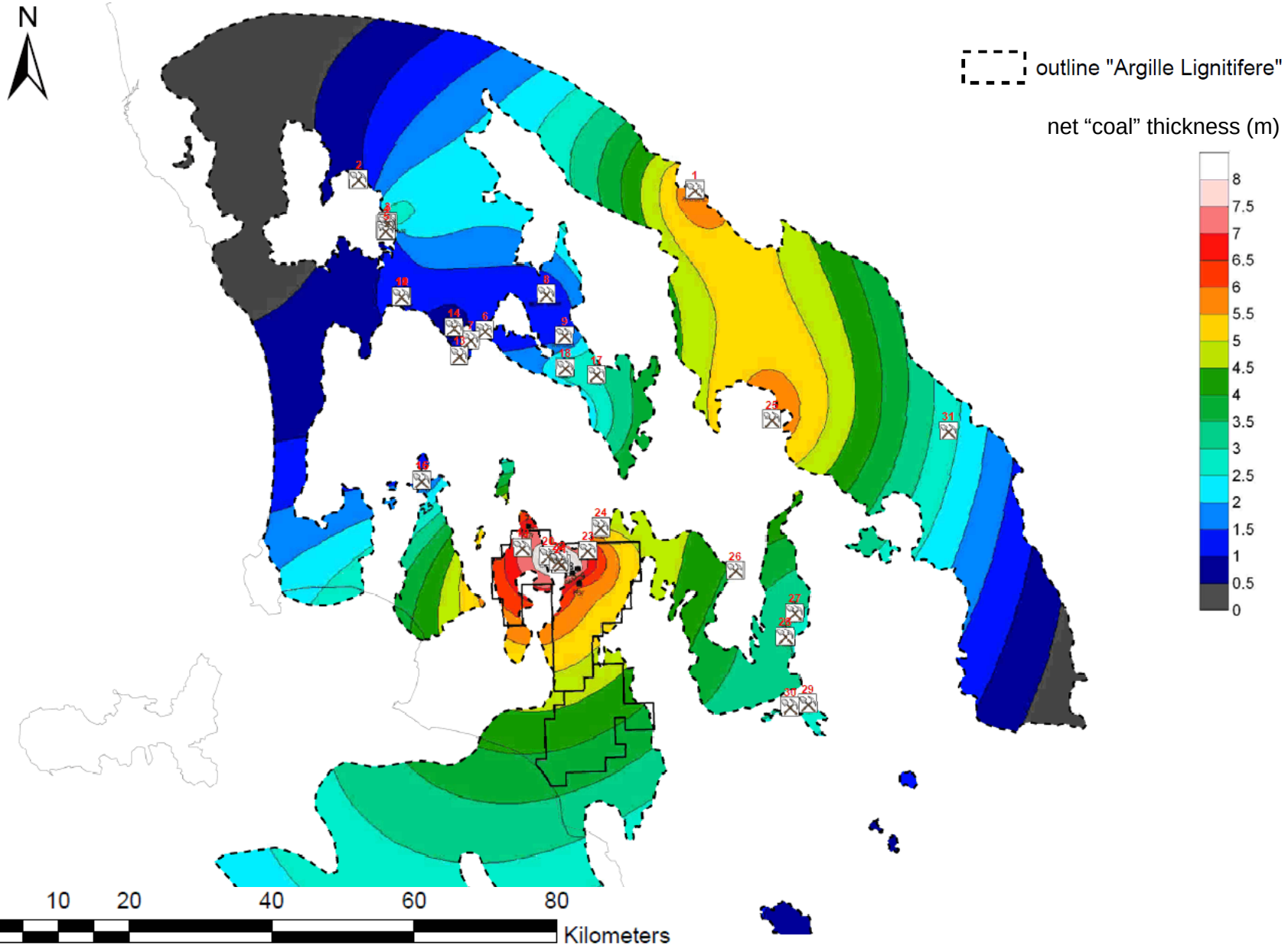
100% IR plc

RIBOLLA COAL MINING

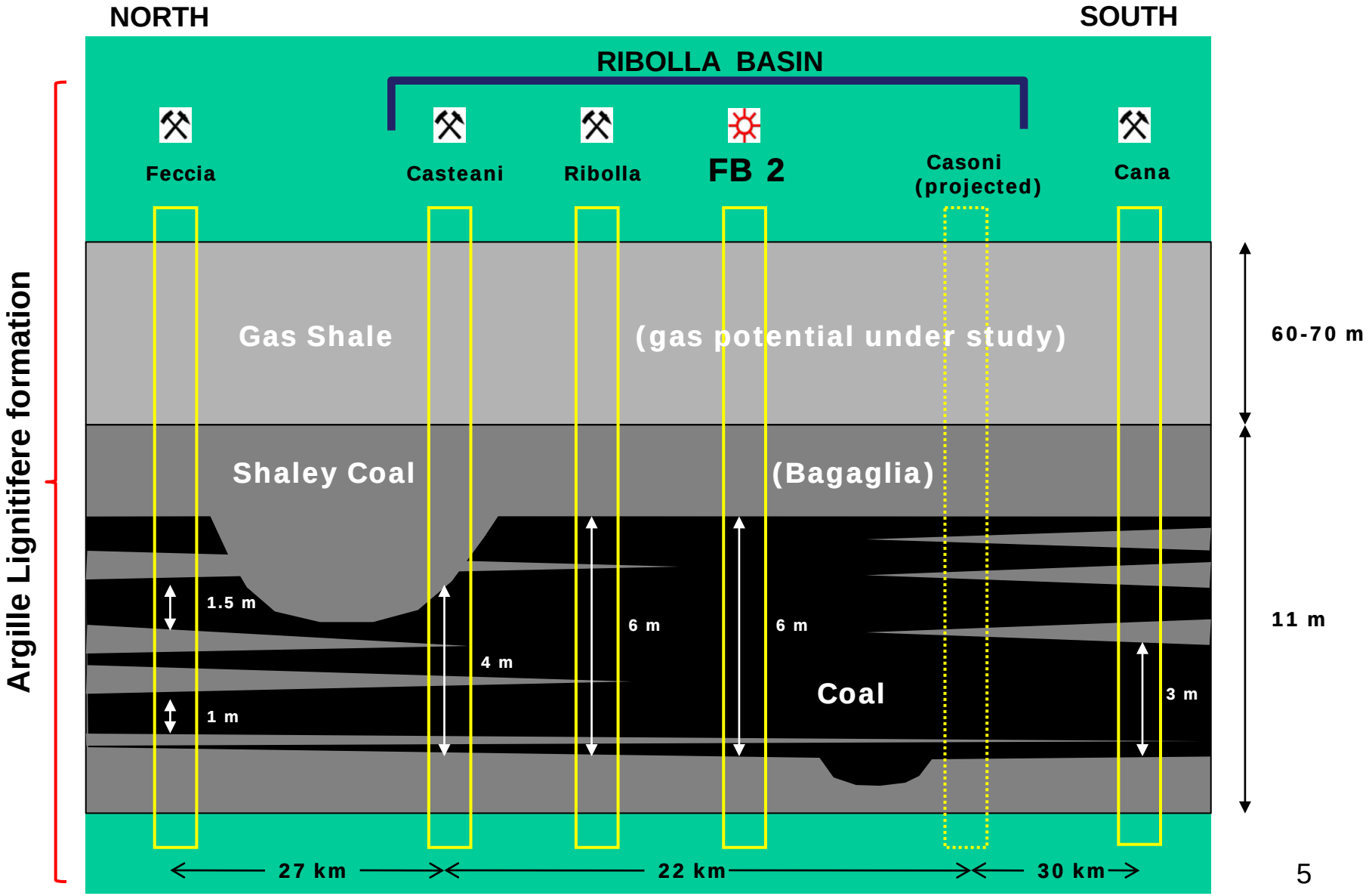




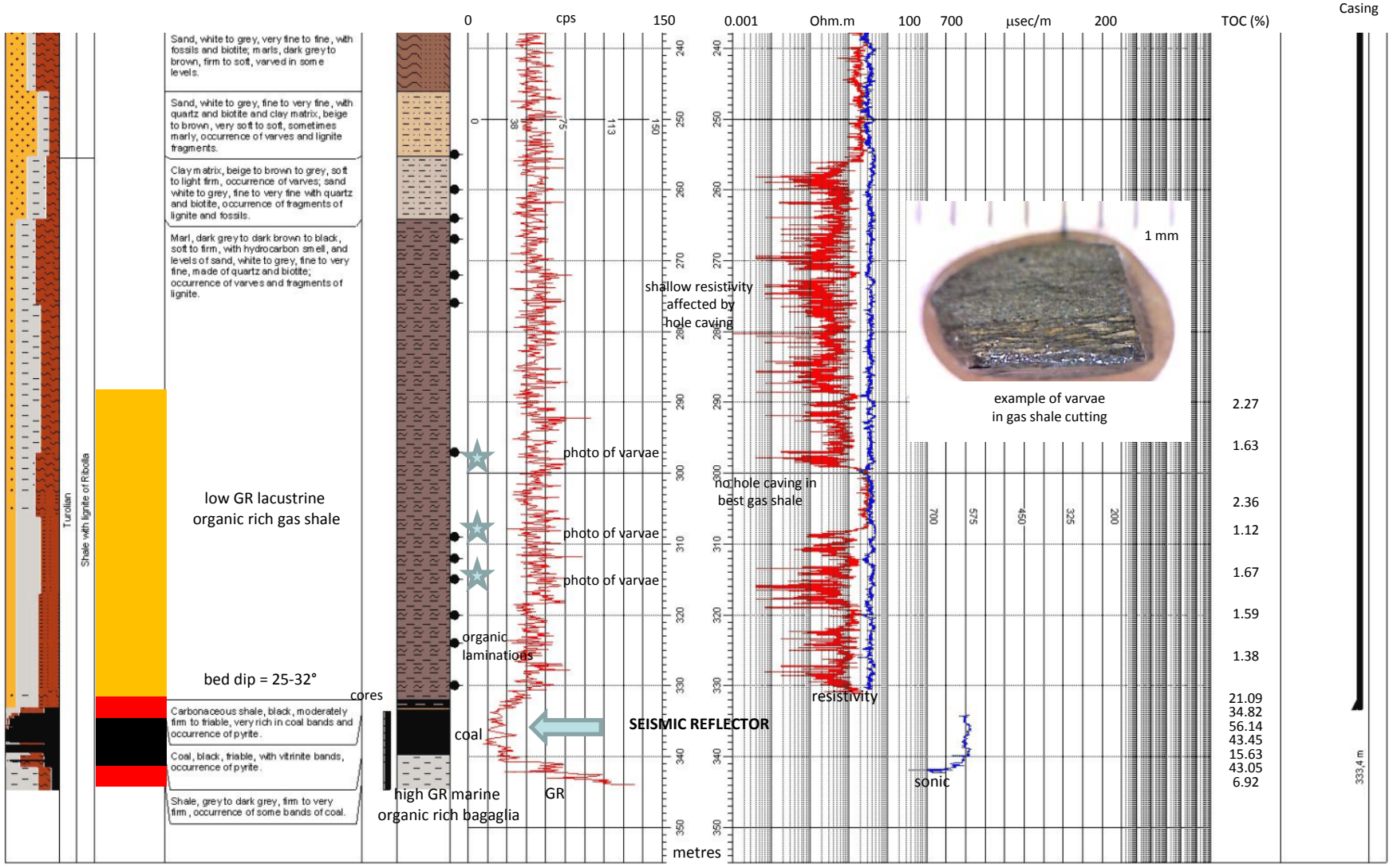
NET “COAL” THICKNESS



DEPOSITIONAL MODEL



GAS INTERVALS



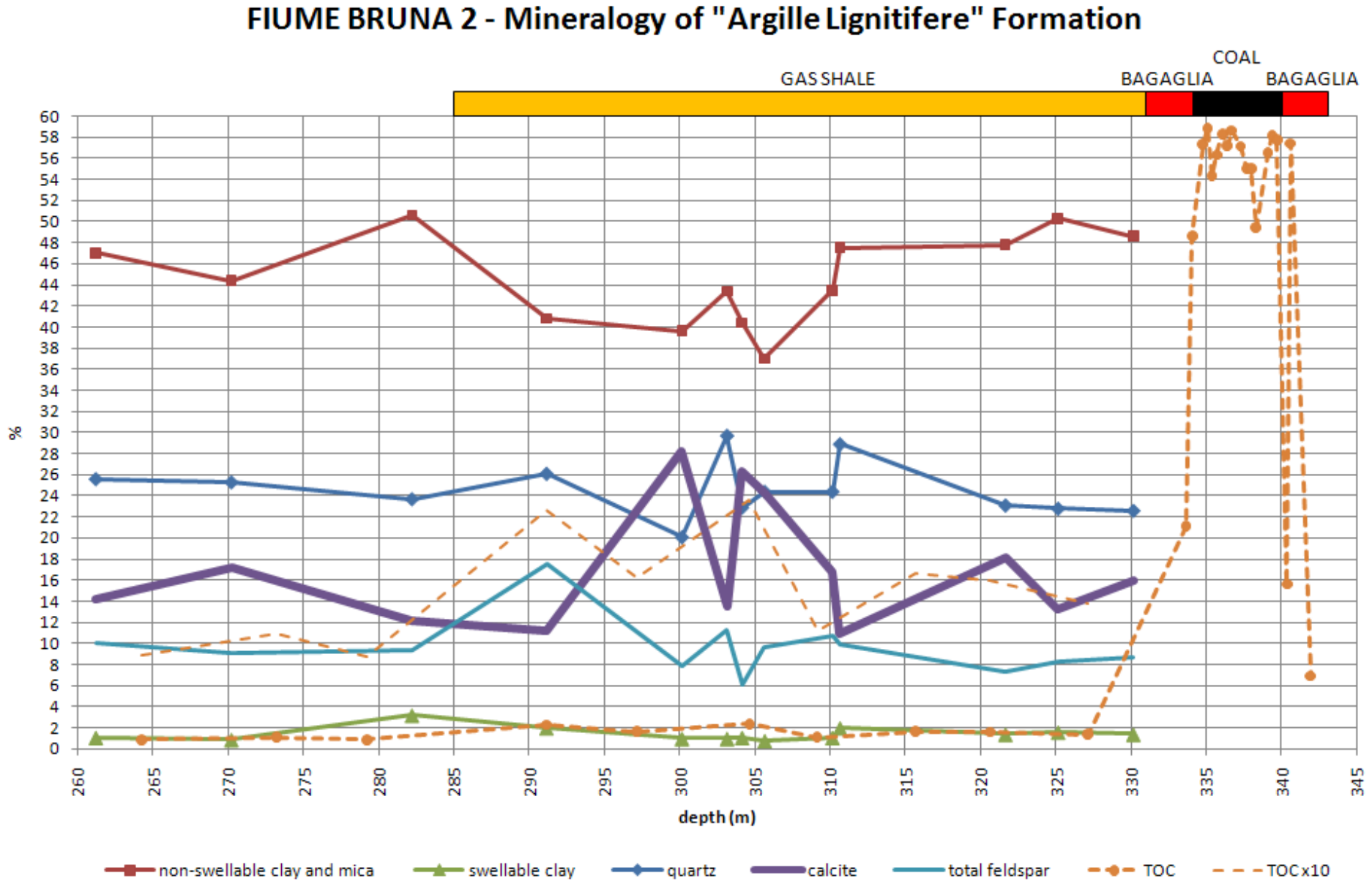
coal

bagaglia (coaly shale)

gas shale

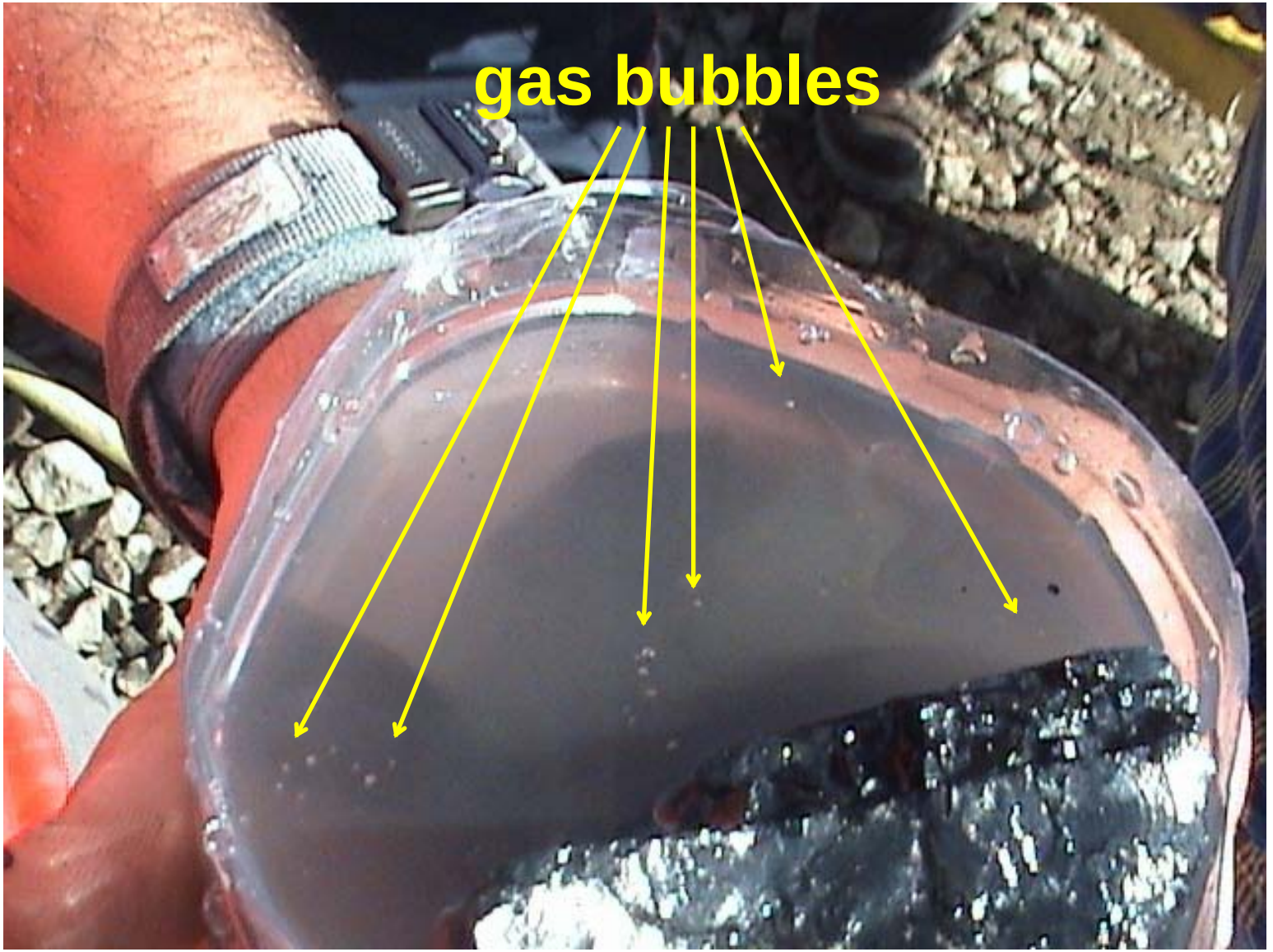
Fiume Bruna 2 well

TOC AND MINERALOGY



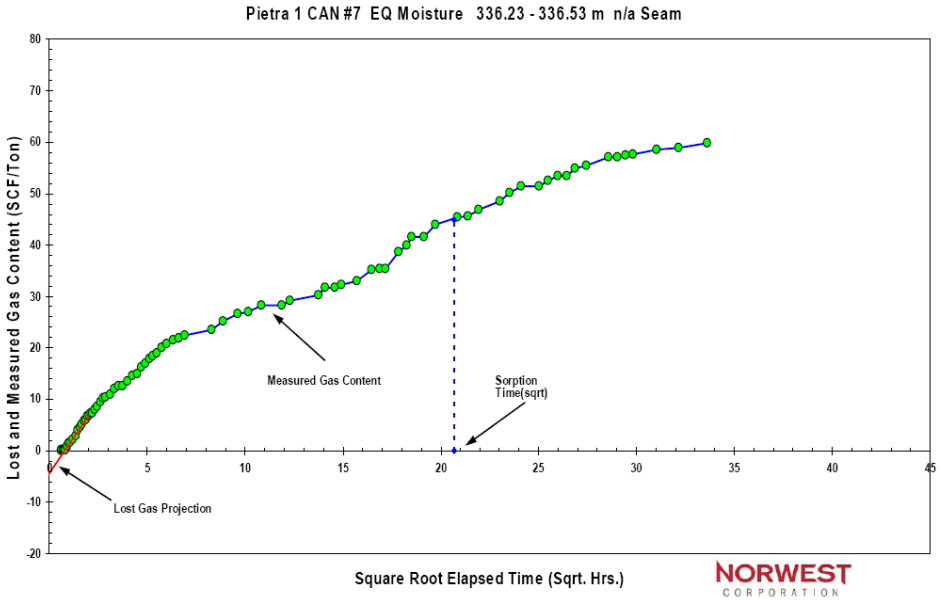
COAL WIRELINE CORING

SATURATED COAL BUBBLING GAS



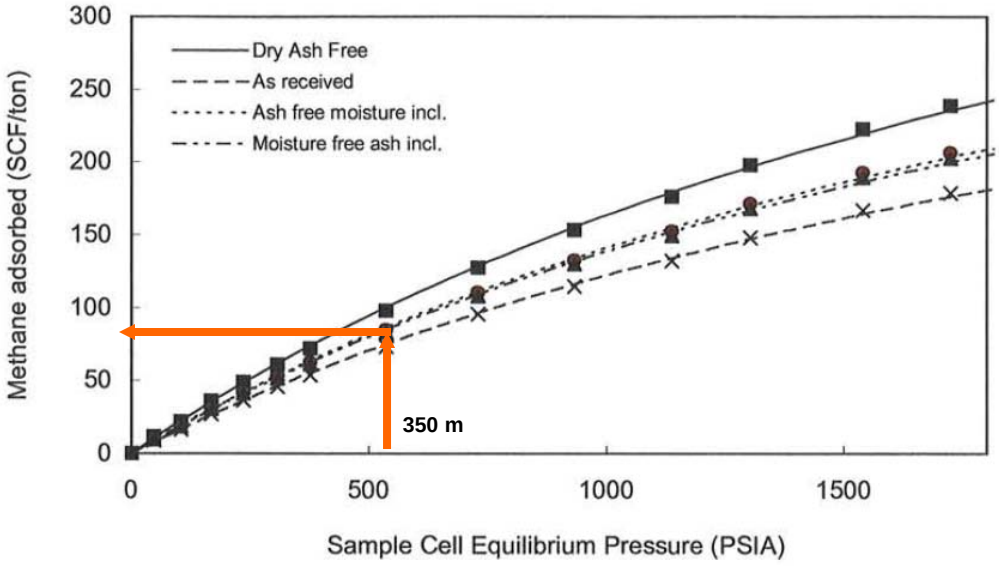
MEASURING COAL GAS CONTENT

COAL GAS CONTENT



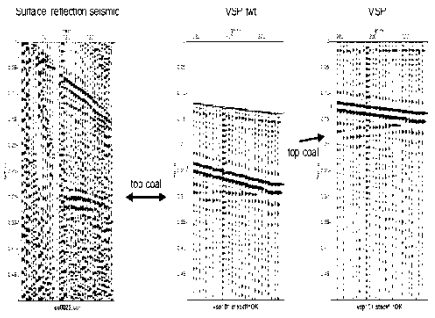
Coal and Gas Shale at Ribolla are gas saturated

Fiume Bruna Can. 13 338.90-339.20 m



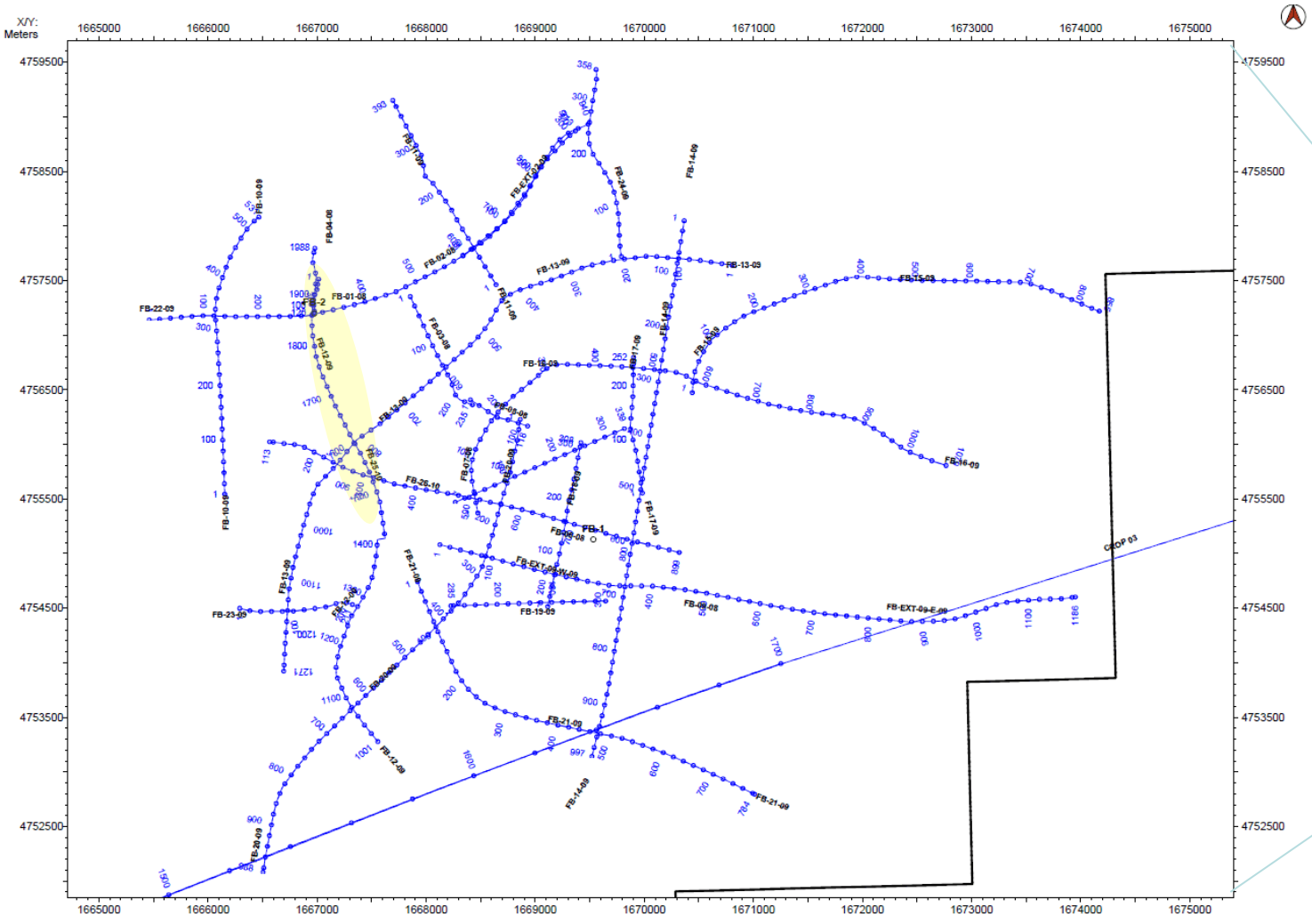
SEISMIC ACQUISITION

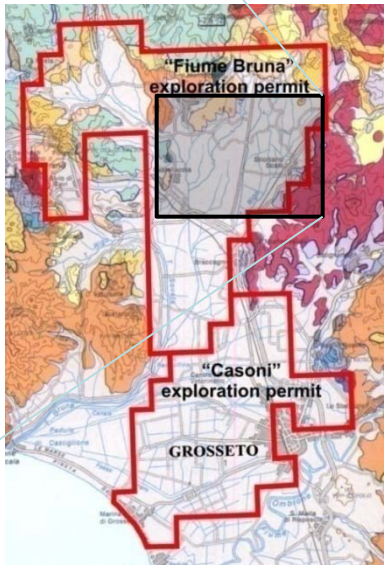
Phase 1



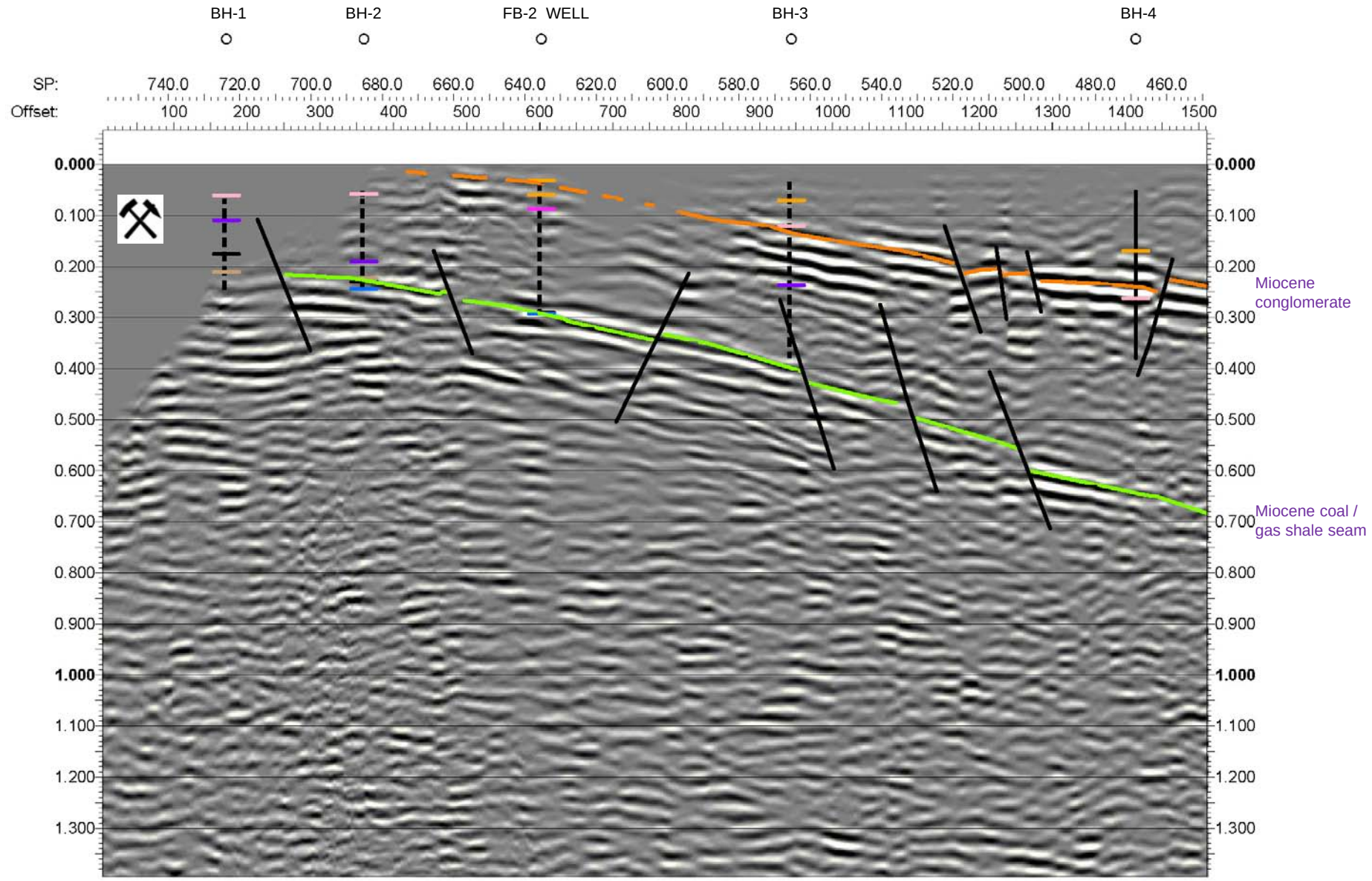
Phase 2

2008-2010 SEISMIC SURVEYS





RIBOLLA SEISMIC SECTION



2010 COAL STIMULATION

2010 COAL STIMULATION

GAS COMPOSITION

GOOD NEWS:

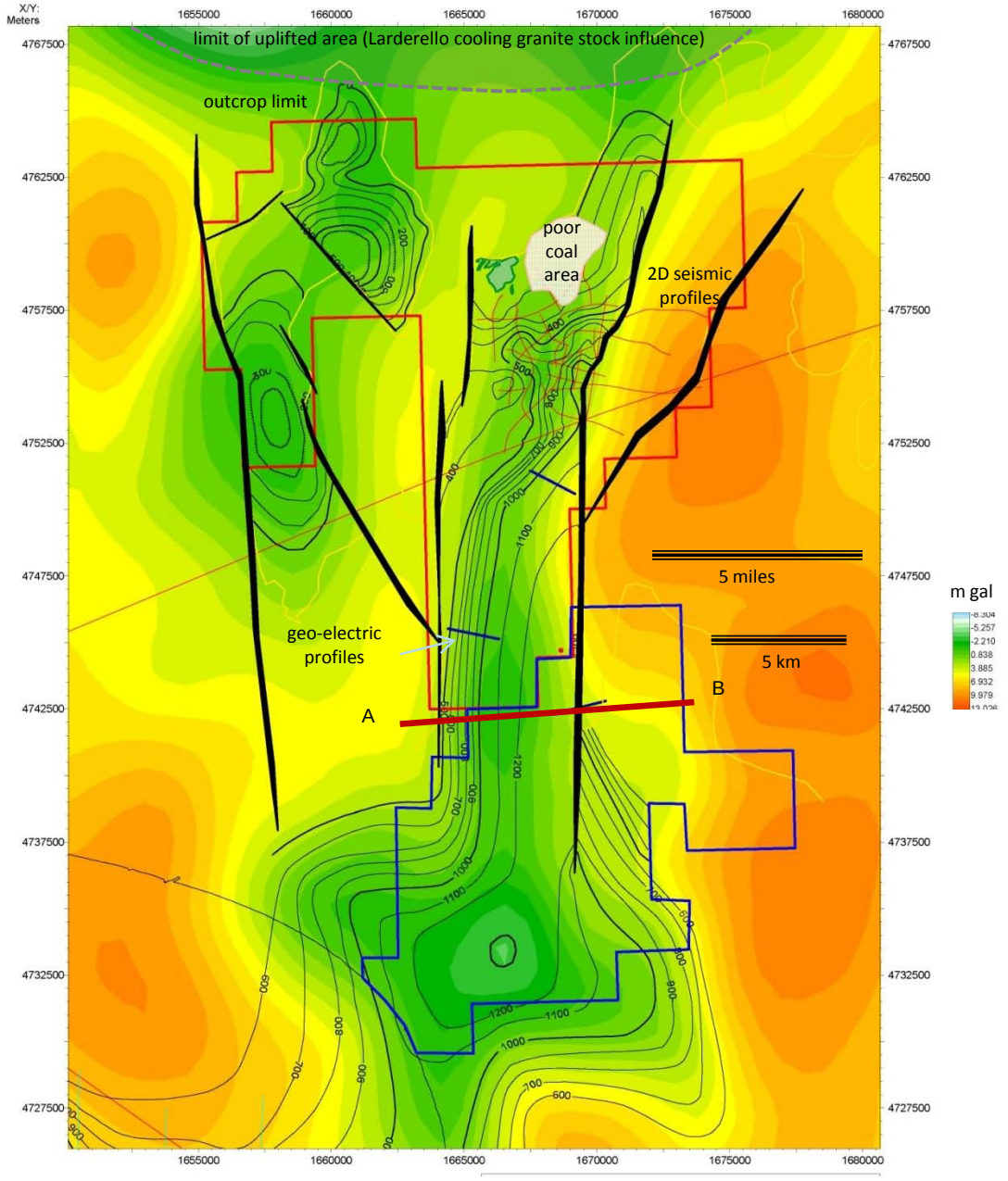
Methane	93-94%
Ethane	1-2%
Nitrogen	4%
CO_2	1%

SPECIAL GOOD NEWS:

the gas is of thermogenic origin (Delta $^{13}C_{methane}$ -28 permil)

Considering that the section has not been uplifted, this means that the coal /gas shale seam produced many times the gas it is able to trap by absorption in the matrix, and that the seam is always saturated with gas.

STRUCTURE AND GRAVITY MAP

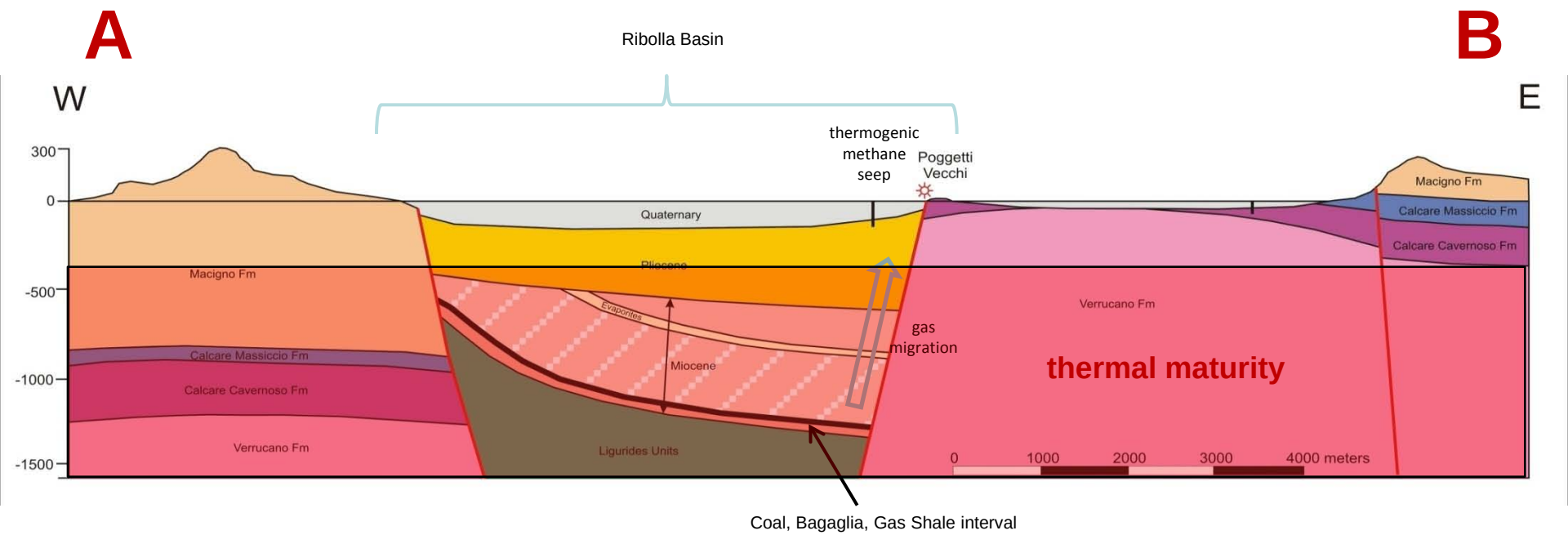


SCHEMATIC CROSS-SECTION

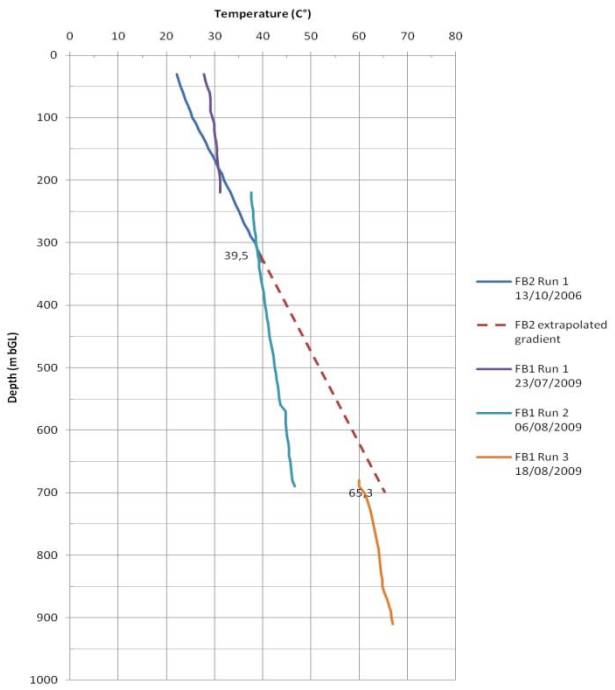
Legend

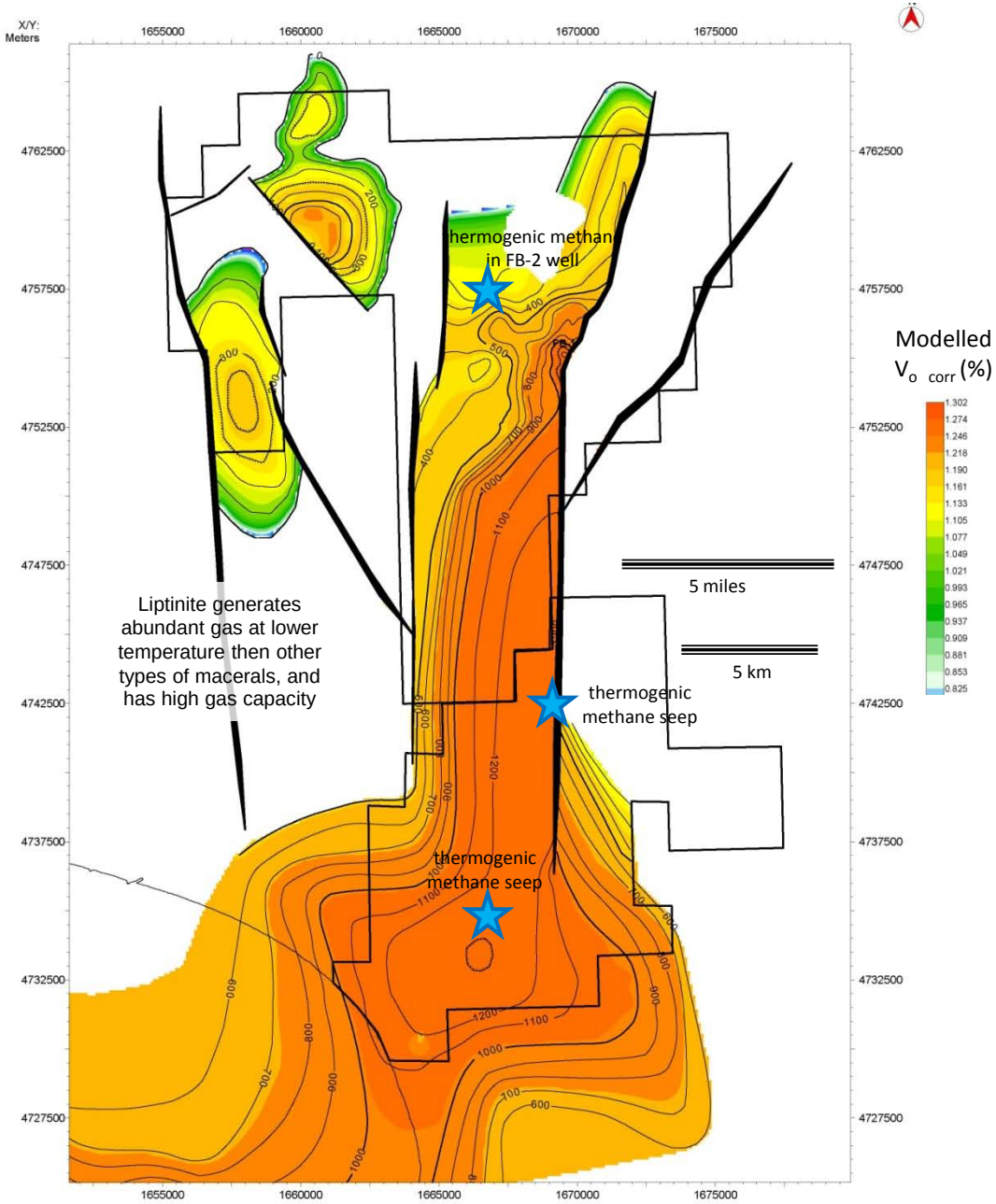
- Quaternary, clay, sand, conglomerate
- Pliocene, clay, sand
- Miocene, claystone, siltstone, coal, evaporites
- Cretaceous-Eocene, claystone, marl, limestone (allochthonous units)
- Oligocene, sandstone, marls (Macigno Fm)
- Jurassic, limestone (Calcare Massiccio Fm)
- Triassic, dolomitic limestone (Calcare Cavernoso Fm)
- Triassic, quartzites, shales (Verrucano Fm)

Vertical exaggeration: 2



VITRINITE REFLECTANCE MAP



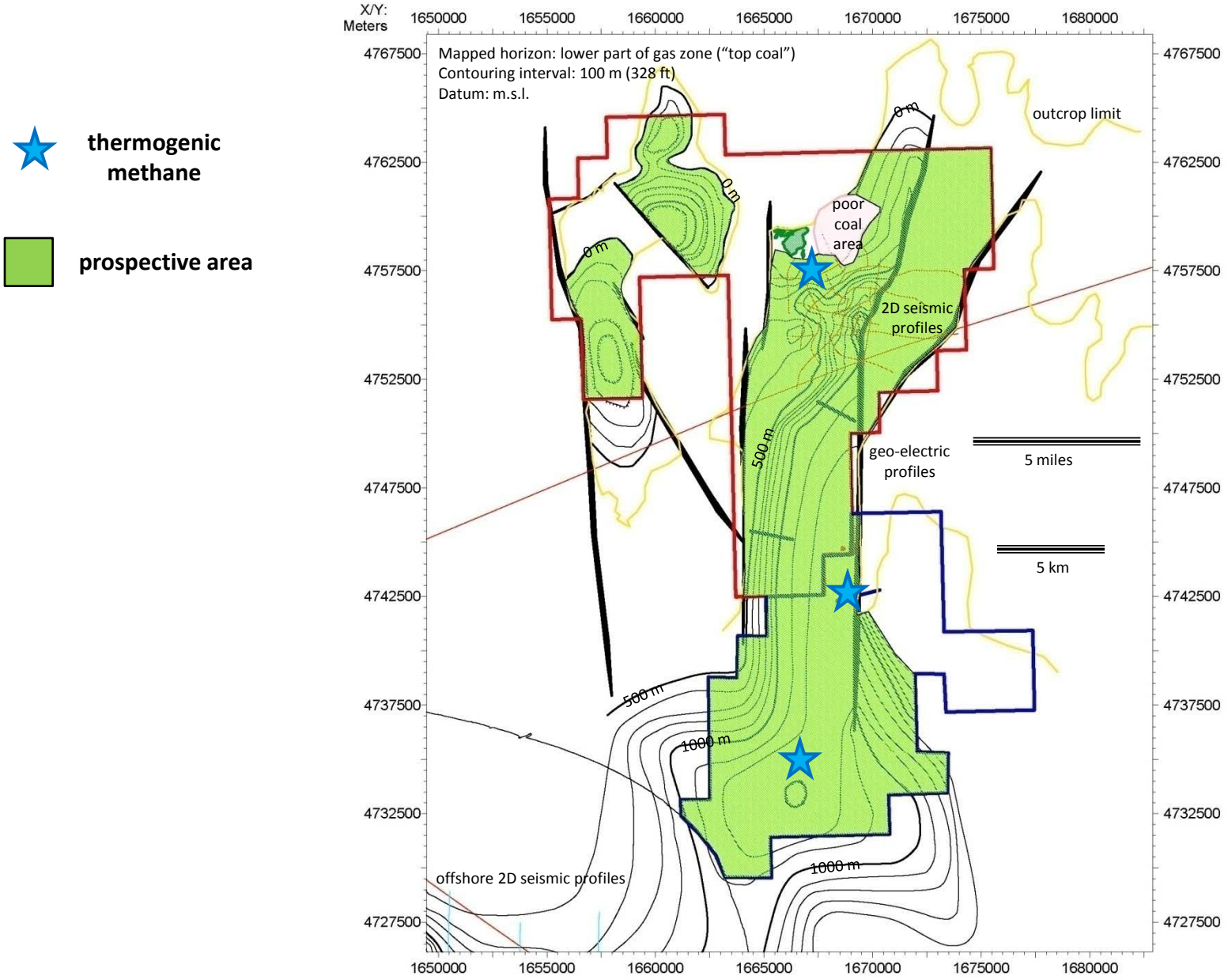


Notes:

FB-2 well sapropelic, lacustrine coaly sequence:
- suppressed maturity indicator (V_o=0.46%);
- exceptionally high content of Liptinite (12-22%);
- high geothermal gradient (twice the normal);
- young age of rocks (Late Miocene, 6 MY) .

Modelled vitrinite reflectance is based on FB-2 values, extrapolated on the basis of Horseshoe Canyon / Drumheller coal maturity vs depth in the Alberta Basin, and corrected for suppression ($V_{o\ corr}$ = V_o + 0.6%, *after P. Mukhopadhyay, 1994*).

STRUCTURAL FORM-LINE MAP

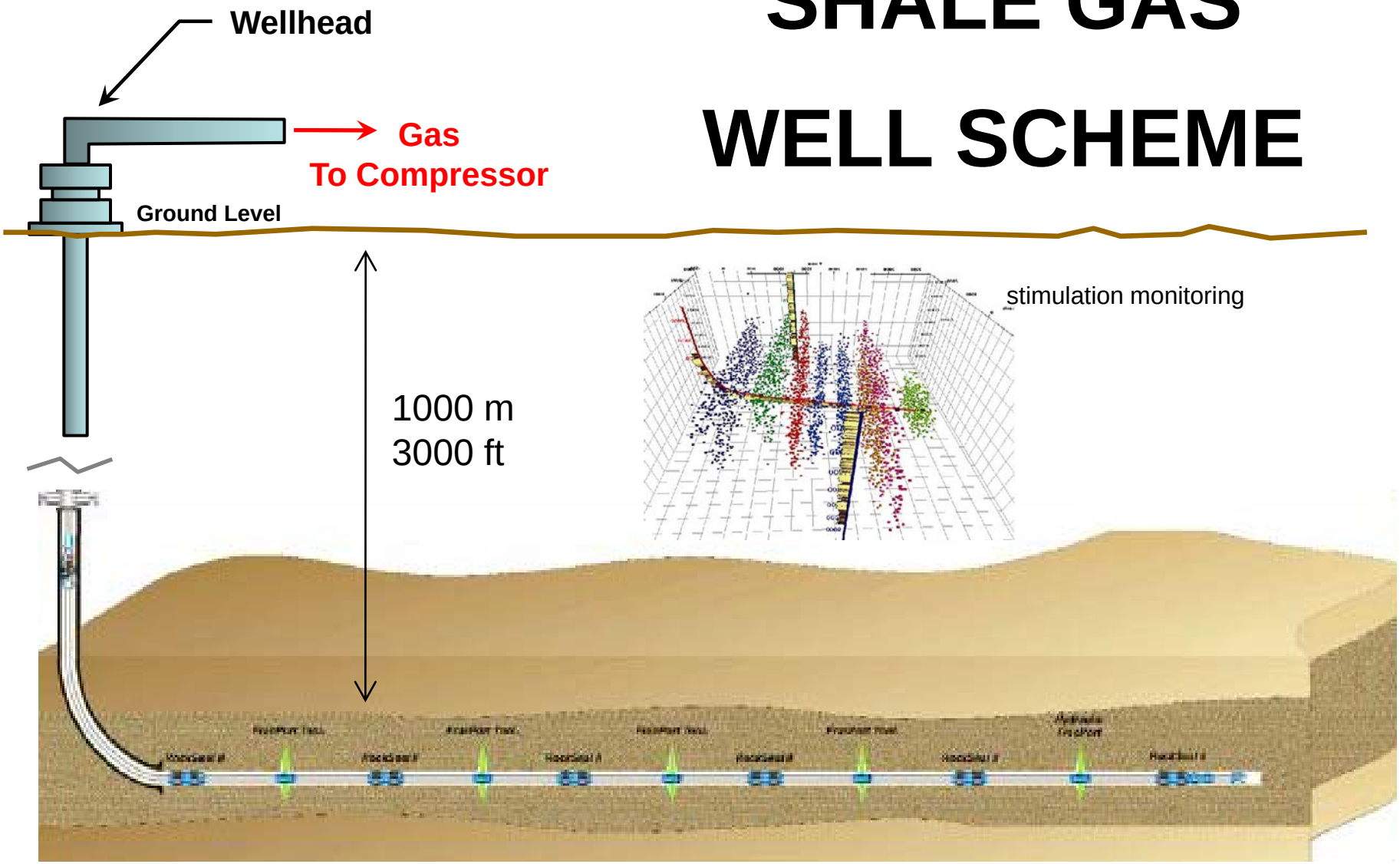


RESULTS TO DATE

- Single play: coal and gas shale (tens of metres thick)
- Coal and Gas Shale have similar gas content of 4.7 m^3/t (152 scf/ton) at approx. 80 bar
- Dry organic rock with 1-2 mD permeability, gas saturated
- Water-based frac tried. Next: nitrogen frac
- Seam responds overall more like Gas Shale than classic high permeability CBM coal

- More than 190 km^2 (47,000 acres) of potentially productive area with seam at an average depth of 1000 m (3280 ft)
- Estimated **27.4 BCM** (968 BCF) of gas in place
- Estimated **5.7 BCM** (203 BCF) of recoverable gas
  69% Shale Gas and 31% CBM/CSM

SHALE GAS WELL SCHEME



Source: National Energy Board, Canada

WORK PROGRAMME

- Test future wells - dry Shale Gas style
- Obtain “Exploitation Concession”
- Produce material amount of methane
- Test CO_2 injection and methane recovery
- Inject CO_2 at full rate and recover methane
- Abandon site safely and responsibly

thank you for attention