



Stable isotope geochemistry of coalbed gas with special focus on CO₂

Mohammad Asif¹, Aashish Sahu¹, D.C. Panigrahi¹, Paul Naveen²

1. Department of Mining Engineering, IIT (ISM), Dhanbad, India

2. Department of Petroleum Engineering, IIT (ISM), Dhanbad, India

AGU
100
ADVANCING EARTH
AND SPACE SCIENCE

FALL MEETING
Washington, D.C. | 10–14 Dec 2018

INTRODUCTION

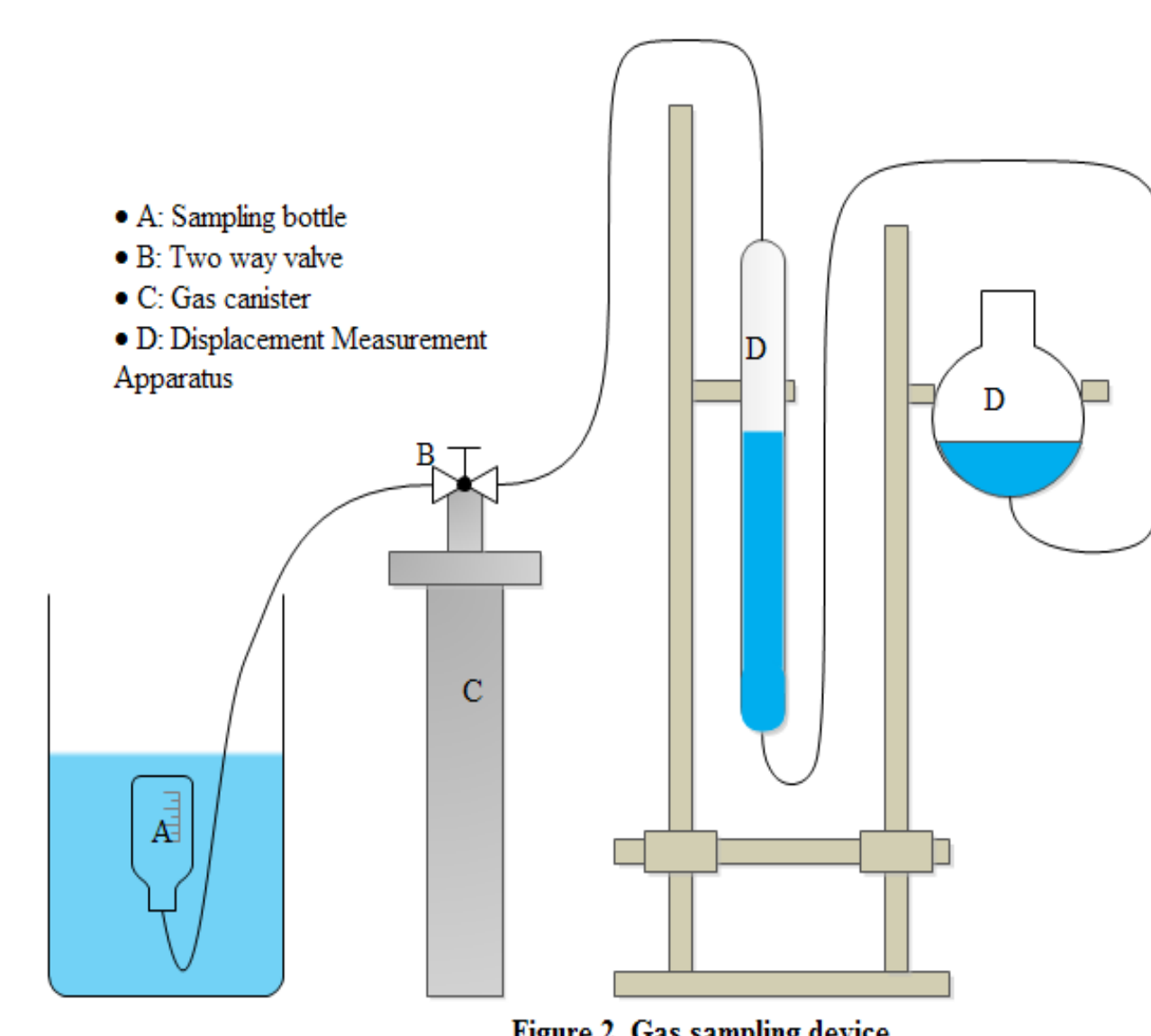
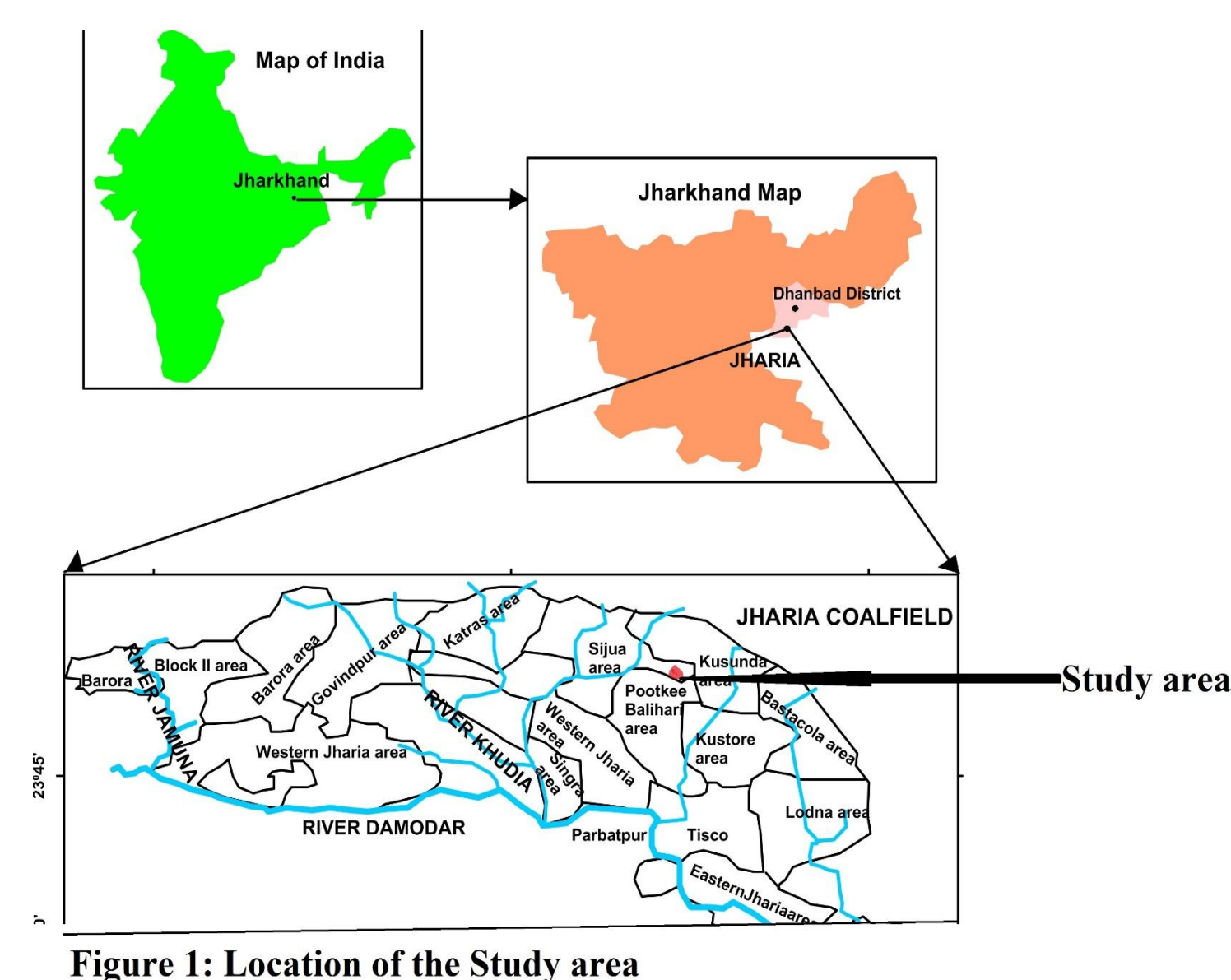
- Coalbed gases are the mixture of mainly hydrocarbon and CO₂
- Geochemical analyses of coalbed gases help us to predict and prevent the gas outburst from mine and CO₂ is one of the main reasons for gas outburst
- Coalbed methane is unconventional source of energy to mitigate the growing energy demand of the globe
- CO₂ sequestration is often used to enhance the methane recovery from coalbed and often attributed as Enhanced Coalbed Methane Recovery
- In this paper stable isotopic analysis of coalbed gas has been done to identify the source and origin of coalbed gas for management to plan accordingly for reduction of gas outbursts

METHODOLOGY

- Two coal samples have been collected from exploratory borehole of Jharia coalfield (figure 1)
- Sample descriptions are shown in table 1
- Soon after retrieval of the samples from borehole, samples were sealed into the canister to measure the gas content
- During the desorption, gas samples were collected in gas samples bottle to find its chemical and isotopic composition
- Gas bottles were filled with NaCl solution as shown in Figure 2

Table 1. Samples description

Sample	Depth Interval	Mean Depth	Reservoir temperature (°C)	Reservoir Pressure (psi)
JJ/01	389.50-389.90	389.70	41.7 °C	549.9
JJ/02	472.51-473.05	472.78	47.2 °C	667.2



RESULTS AND DISCUSSIONS

- Stable isotopic fractionation and coalbed gas composition is shown in table 2

Table 2. Gas composition and stable isotope analysis

S.N.	Sample	C ₁	C ₂	N ₂	Air	CO ₂	δ ¹³ C ₁	δ ¹³ C ₂	δ ¹³ CO ₂
1	J/01	83.21	1.21	4.59	7.94	3.05	-50.7	-18.9	-21.3
2	J/02	72.25	0.76	8.77	15.59	2.63	-45.5	-23.9	-17.9

- CDMI index ((Eq. (1)) ranges from 3.51 to 3.54 which shows that coalbed gas is of thermogenic origin

$$CDMI = \frac{CO_2}{CO_2 + CH_4} \times 100\% \quad (1)$$

- C_{HC} (Eq. (2)) index ranges from 68.77 to 95.07 which shows generated CO₂ is of organic in nature

$$C_{HC} = \frac{C_1}{C_2 + C_3} \quad (2)$$

- Dryness index (DI) (Eq. (3)) ranges from 0.986 to 0.990 which shows that coalbed gas is dry to very dry in nature

$$DI = \frac{C_1}{C_{1-5}} \quad (3)$$

- For the thermogenic gas, δ¹³C_{CH₄} (X) was calculated from following equations: (R₀ for the sample was observed 1.43% and 1.78 respectively)

$$\delta^{13}C_{CH_4} = -26.20 \times \log(R_0) - 34.12 \quad (R_0 < 1.30\%) \quad (4)$$

$$\delta^{13}C_{CH_4} = 25.85 \times \log(R_0) - 43.08 \quad (R_0 \geq 1.30\%) \quad (5)$$

- Based on the past studies on stable isotope geochemistry, δ¹³C_{CH₄} (Y) for the biogenic gas belongs in the range of -70‰ to -75‰

- δ¹³C_{CH₄} for biogenic gas is assumed the average of both the values i.e. -72.5‰ for these samples

- Thermogenic (x) and biogenic proportions (y) have been calculated from the following equations:

$$xX + yY = Z \quad (6)$$

$$x + y = 1 \quad (7)$$

RESULTS AND DISCUSSIONS

Z is the δ¹³C₁ for the coalbed gas

- Thermogenic proportion (x) for the samples was observed 65.20% and 75.20% respectively while for Biogenic proportion (y), it was found around 34.80% and 24.80%

- Results were tabulated in the following table

Table 2. Stable isotope analysis result

S.N.	Sample	CDMI	C _{HC}	DI	X	Y	x	y
1	J/01	3.54	68.77	0.986	-39.06	-72.5	65.2	34.8
2	J/02	3.51	95.07	0.990	-36.61	-72.5	75.2	24.8

CONCLUSIONS

- Current study shows the coalbed gas composition and stable isotope analysis of coalbed gas which is the basic study for the characterization of coalbed gas
- Analyzed coalbed gas contains mainly thermogenic methane with substantial amount of biogenic methane. Thermogenic gas is generated during the late stage of coalification
- Primary biogenic gas was observed in the studied gas samples
- This study gives the prior knowledge on CO₂ origin, so it is the ideal study for the CO₂ sequestration and Enhanced coalbed methane recovery
- Results of isotope analysis shows the complex mechanism of generation and accumulation of coalbed gas in coal

REFERENCES

- Asif, M. ; Naveen, P.; Panigrahi, D.C.; Ojha, K. ; Anwer SS. Multicomponent Adsorption Modelling for Enhanced Coalbed Methane Recovery from Jharia Coalfield Using Iterative Method. 80th EAGE Conf. Exhib., 2018, p. 12–14.
- Q. Li, Y. Ju, Y. Bao, Z. Yan, X. Li, Y. Sun, Composition, origin, and distribution of coalbed methane in the Huaibei Coalfield, China, Energy and Fuels. 29 (2015) 546–555.

Contact Information: Mohammad Asif, IIT (ISM), Dhanbad, India (email id : masifkhan92@gmail.com)