ISSN: 2634 - 8853

Journal of Engineering and Applied Sciences Technology

SCIENTIFIC Research and Community

Review Article

Open Access

Helium in Rocks of Vindhyan Super Group around Sagar, South Ganga Basin, Bundelkhand Region M.P India

Arun K Shandilya* and Prajapati KK

Department of Applied Geology, Doctor Harisingh Gour Vishwavidyalaya Sagar, M.P, India

ABSTRACT

Studies on the exploration of the Helium gasin the rocks of the Vindhyan Super Group around Sagar, South Ganga Basin, Bundel khand region, M.P. is carried out in the detail with joint collaboration of Deptt. of Applied Geology and ONGC Energy Centre, Ahmadabad. As Author has already reported the Discovery og Helium has leakages through more than 50 tube wells/e wells excavated in agriculture fields various Villages in Sagar Distt. The geochemical analysis of the soil, gas and water indicates remarkable amount of Helium gas in these tube wells, containing about 0.45 to 0.735 and methane varying from 72 % to 99%. These investigations were done in the long research work (more then 25 years) dedication carried out in this area and research finding published in the Journal of National and International repute, which has attracted the officers/ Scientists of ONGC, Dehradun, CGWB, Faridbad, Atomic Mineral Directorate Hyderabad and Bhabha Atomic Research Centre Mumbai.

The Result of the stable isotopic analysis of Ethane gas in these samples δ C13 value are ranging from -24.9 per mill w.r.t. PDB and -26.9 per mill w.r.t. PDB and the Methane gas are ranging from Isotopic Values -54.0- per mill w.r.t. PDB to -61.5 per mill w.r.t. PDB are indicative that this gas is of thermogenic origin, which must have been formed at very high temperature & pressure condition in the deeper horizon of the great Vindhyan sedimentary basin of late Proterozoic (>500m.y.) period. A reporting of leakages of above mentioned gas from 50 tubewells in the inliers of Vindhyan rocks and even in the Deccan trap rocks ensures that this area must be having a big gas reservoir within Vindhayn rocks around Sagar - Distt. in M.P.

The ONGC energy Centre Ahmadabad has started the detail collaborative geophysical work on the drilling exploration upto the depth of 600 m has been carried out and to be carried out in various location from where the leakages of has been earlier reported earlier. In these 600 m deepdrill holes detail geophysical logging including the gama ray logging and Neutron logging, lithological and structural logging will be carried out to know the probable gas reserve and at what depth the, we can get the gas for the exploration and utilization of these ases for industrial purpose and other uses etc.

The detail geophysical studies will be very much helpful in the gas reserve calculation and the depth of the gas pockes in the South Ganga Basin in Bundelkhand region in M.P.

***Corresponding author**

Arun K Shandilya, Department of Applied Geology, Doctor Harisingh Gour Vishwavidyalaya Sagar, M.P, India. Tel No: 07582 236597 (R) 09977576665 (M).

Received: November 28, 2024; **Accepted:** December 04, 2024; **Published:** December 12, 2024

Keywords: Vindhyan Rocks, Petroleum Gas, Helium, Proterozoic, Stable Isotopic, Geochemically, Leakages, Thermogenic

Introduction

The present studies on the discovery of leakages of rare gas Helium along with petroleum gases in the hydrocarbon rich zone has been done in the samples of soil, water and gas collected from the 50tubewells located in the various villages in the Garhakota, Khurai, Banda and Rahatgarh, Sagartahsils of Sagar and Jabera, Singrampur, Konda, Patharia tahsils of Damoh Districts in the South Ganga basin, Bundelkhandregion in the Upper Rewa rocks of Vindhyan Super Group in M.P.

The first time leakage of petroleum gas was reported in 1980 from the Meerkheri village located on the Sagar to Vidisha road, at about 15 km from the Rahatgarh town. In 1993, in another tube well at Rahatgarh the leakages was reported by the author.

The leakages of Hydrocarbon gas and helium gas has been discovered in Piparia-Bhutoli are near Chinnoaa in Garhakota Tahsil, Rahatgarh, Meerkheri, Hurraiin Sagar District, and Batiyagarh and Mahalwara, Sukha, Jabera, Konda, and Singrampur villages in Damoh District, about 140Km.X 20 Km area. The borewell varying in depth from 340' - 400' ft. on the II order stream of the Sonar river, which are located in the southern catchments area of the Ganga river system. The bore well owners contacted to the author regarding burning one meter high flame. The author has analyzed the gas, and found that this gas in burning in blue colour flame and reported the matter in the local newspaper Dainik Bhaskar and the ONGC, Petroleum Minister, Govt. of India and. Chief Minister, The Governor, Govt of M.P Bhopal. After confirmation of the gas the owner has started using this gas for his domestic purposes, i.e. for cooking the meals and he has tried to filled the LPG gas cylinders with this gas. Using the locally available nosal, plastic tube and valve etc.

In 1993 also author has discovered the occurrence of natural Petroleum gas in the Borewell of Sri Tiwari in Rahatgarh who is continuously using this gas for his daba/ hotel on way to Bhopal the state highway. In this well also after drying of the well hag started pouring the air/ petroleum gas, which is in continuous using for the hotel chulha.

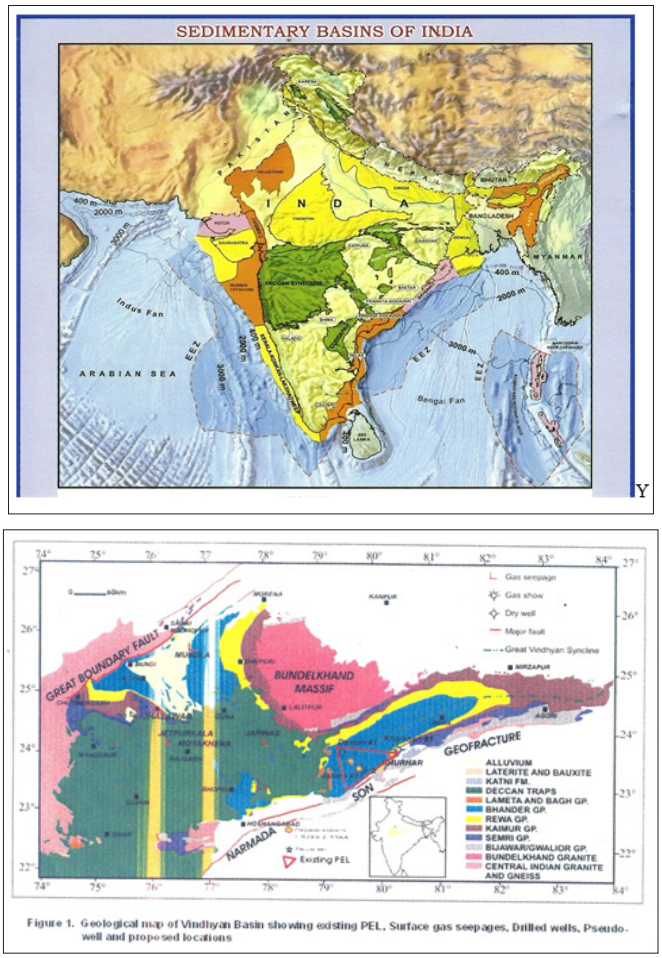

Figure 1. Geological map of Vindhyan Basin showing existing PEL, Surface gas seepages, Drilled wells, Pseudo-well and proposed locations

Figure 1: Sedimentary Basin of India

Geology

The present rare Helium gas and natural petroleum gas leakages has been discovered in the dried tube wells, located on the rocks of Sandstone, shale and limestone rocks of the Rewa and Bhander Group of the Vindhyan Super Group as the basement rocks. These petroliferous rocks are overlain by the Lameta bed in the western part of the Pipariya and Bhutoli area in Garhakota tahsil. On the western part of present area is overlain by the rocks of Upper Cretaceous Deccan Trap Basaltic flows, which are intercalated with intertrappean limestone. The area were the leakages of pertoleum gas has been discovered located on the alluvial soil cover. The Deccan Trap Basaltic rocks are exposed west of the Chinnoua village in Garhakota Tahsil. The dips of the sandstone and shales rocks are 10 - 15degree toward SE. The topography is more or less flat with some low-lying areas near the stream. Western fringe of The Rahatgarh and Meerkheri areas are covered mostly by the Basaltic flows of Deccan Traps. except few inliers of the rocks of Rewa Group and Bhander Group of the Vindhyan Super Group. The Deccan Trap basalt rocks are mostly covered by the black soil.

Table 1: The Generalised Stratigraphic Succession of South Ganga Basin, around Sagar M.P

AGE	FORMATION
RECENT- SUBRECENT/ QUATERNARIES	Alluvium soil Black soil
UPPER CRETACEOUS	Trap Basalt (with Intertrapean limestone)
LOWER CRETACEOUS	Lameta Formation
LATE PROTEROZOIC VINDHYAN SUPER GROUP MIDDLE PROTEROZOIC BIJAWAR SUPER GROUP EARLY PROTEROZOIC BUNDELKHAND GRANITIC COMPLEX ARCHEAN MEHRONI SUPER GROUP	Bhander ==== (Containing the Petroleum gas &Helium gas) Rewa Kaimur Semri Phosphastic Dolomite Dolomite. Ferrugenous Shale Ferrugenous Sandstone Iron Formation / BHQ Quartzite Conglomerate bed. Quartz reef intrussion Pegmatitic intrussion Ultramafic intrusive Granite Intrussive rocks. Granite Gneiss Biotite Schist Intrussive body Dolomitic Marble Slate Ferrugenous Formation Quartzite Schist

(After Rajrajan 1978)

Geochemical Analysis

The samples were analysed in the geochemical laboratory of KDM IPE Kaulagarh Road, ONGC, Dahradun.

Table 2: Geochemical Value of Natural Gas, Soil and Water

S.N.	Bore Well	Chemical Composition % (v/v)						Isotopic Values (δC^{13})
		He	O_2	N_2	CO_2	C_1	C_{2+}	δC^{13}
1	Pipariya	0.34	1.6	24.87	0.93	72.14	0.03	- 61.5
2	Rahatgarh	0.72	0.65	14.37	0.28	84.00	0.02	- 54.0
3	Bhatoli	0.30	1.6	25.02	0.96	75.00	0.03	- 61.5
4	Bannad	0.31	1.8	26.03	0.81	78.02	0.03	- 59.4
5	Patneshwar	0.30	1.9	23.06	0.83	79.04	0.03	- 59.4
6	Parsoriya	0.29	2.0	25.08	0.96	73.35	0.02	- 60.3
7	Semra Angad	0.27	1.7	24.59	0.92	79.07	0.04	- 53.7
8	Khiriya	0.33	1.8	23.07	0.89		0.029	- 6
9	Mahalwara	0.35	2.0	26.04	0.95	88.0	0.03	- 62.7
10	Batiyagarh	0.36	2.0	26.09	0.89	90.00	0.04	- 60.06
11	Sukha	0.31	1.9	25,03	0.94	84.0	0.03	- 62.8
12	Singrampur	0.32	1.9	24.07	0.96	86.02	0.039	- 62.5
13	Meerkheri	0.35	2.0	20.53	0.39	89.00	0.03	- 55.4
14	Konda	0.29	1.9	23.39	0. 88	86.03	0.04	- 62.1
15	Jabera	0.36	2.0	24.49	0.89	90.36	0.04	- 63.3

Observation

Author has requested to the Director Exploration, KDM IPE, ONGC Dehradun, who has sent a team of Geologists on 8th May 2007 for the detailed investigation. Along with the team of ONGC and author, has visited the Piparia-Bhutoli and Rahatgarh and Meerkheri area and collected the samples of soil, water and gas. We have observed that the petroleum gas is coming out from the bore well of Sri Bhagwan Singh Yadav's agriculture field. The pipe of the borewell was connected through the plastic pipe, which was giving the bubbling in the bucket of water. Then we have observed that this air cum gas coming out the bore well is burning in blue colour flame, we have tested in the burner also and the photograph has been taken. In the start the villagers were afraid of any disaster or calamities due to burning the gas in the field. Thanks god there was no houses or forest nearby the well site.

In the month Jan.2008 a letter has been written to the Dr. P.M. Tejale, Director General Geological Survey of India, Kolkatta and to the V.P. Dimri, Director, (Rtd) National Geophysical Research Institute, Hyderabad regarding the further investigation of the natural gas under the joint collaboration with this University. A team of scientists from NGRI have visited various bore wells and collected the samples of soil, water and gas from different localities for the geo-chemical analysis and isotopic studies. The samples were collected from the following localities-

Piparia, Bhutoli (lat: 23°47'59.2"N, long 79°05'29.6" E, Elevation 448m).

The tube wells (depth 400 feet) (lat: 23°48'20" N, long: 79°50'20.7" E,elevation 450m). Rahatgarh (The leakage of petroleum gas is reported since 1993.) Meerkhedi: This tube well (lat: 23°45'56"N, Long: 78°18'9.6"E, Elevation 440m). The area falls in the toposheet of India No. 55 I/5. This tube well is the eastern extremity of village meerkhedi, 13 km of Rahatgarh on way to Vidisha. Mahalwara, Bannad, Semra - Hilgan Patneshwar village, Semar Angad Parsoriya, Ghoghra, Batiyagarh, Khiria – Bineki, Batiyagarh,

The Oil and Natural Gas Commission Dehradun has concluded with, the seepaged gases of Pipariya Bhatoli and Rahatgarh are predominantly methane (72.14%-84 % in Pipariya Bhutoli and 99% in Tiwari Dhaba, Rahatgarh Bore well and are devoid of higher hydrocarbons. the hydrocarbon gases seem to have predominance of bacterial methane. The pressure of both the seepages is extremely low. As per the owners, the quantity of gas is diminishing day-by-day. The results this time of methane is concerned. Genetically the seepage gases from Pipariya Bhatoli and Rahatgarh seem to be different from thermogenic gases encountered in exploratory well jabera-1, drilled by ONGC in Distt. Damoh (M.P.).

In January 2008 in Bhutoli village further land owner bore the well up to 400 ft. deep there is huge quantity of natural gas has been reported to governmental agencies. In the Fab.2008 two villagers at Pipariya- Bhutoli have drilled two more tube wells upto the depth of 300- 350 feet about 600-700 m away from the earlier wells in the shales and sandstone rocks of Lower Bhander they could not got the ground water, but there is leakages of natural gas, which is also giving the blue flame. Another set of samples were analysed at NGRI, HYDERABAD-

The samples of petroleum gas, soil, water were also collected jointly by the scientists Dr. A.M. Dayal (Rtd), Dr. Ravi Srivastava, and Dr. D.J. Patil of NGRI Hyderabad along with the author on 4-5 May 2008.The detail geochemical and stable Isotopic studies of the natural petroleum gas and water sample has been done in the Laboratories of NGRI. The following are the finding-

Table 3: Stable Isotopic Value of Natural Gas in Sagar

LOCATION	NAME OF PETROLEUM GAS	STABLE ISOTOPIC VALUE δ C^{13}
Piparia	Methane Ethane	-43.6 per mil w.r.t. PDB -24.6per milw.r.t. PDB
Rahatgarh	Methane Ethane	-54.9 per mil w.r.t. PDB -26.4 per mil w.r.t. PDB
Bhutoli	Methane Ethane	-43.6per mil w.r.t. PDB -24.6per milw.r.t. PDB
Meerkheri	Methane Ethane	-54.9 per mil w.r.t. PDB -26.4 per mil w.r.t. PDB
Bannad	Methane Ethane	- 44.7per mil w.r.t. PDB -27.5 per mil w.r.t. PDB
Patneshwar	Methane Ethane	-44.8 per mil w.r.t. PDB -26.9 per mil w.r.t. PDB
Mahalwara	Methane Ethane	-56.8 per mil w.r.t. PDB -29.8 per mil w.r.t. PDB
Batiyagarh	Methane Ethane	-44.6 per mil w.r.t. PDB -26.3per mil w.r.t. PDB
Singrampur	Methane Ethane	-45.7 per mil w.r.t. PDB -29.4per mil w.r.t. PDB
Jabera	Methane Ethane	-58.4 per mil w.r.t. PDB -28.3per mil w.r.t. PDB

The presence of the ethane gas in all Localities, and δ C13 value in the range of -24.9 per mil. w.r.t. P.D.B. and- 29.8 per mil. w.r.t. P.D.B. indicate the thermogenic source of these gases. With these samples it will be possible to know the amount of Hydrocarbon and at what depth the reservoir is present depth of the4 reservoir. In this view further another team of 04 scientist of NGRI Hyderabad have visited sagar area and they have collected about 200 samples of soil, water & gas along the road sections - Sagar - Garhakota - Rahatgarh - Sagar - Gourjhamar, Sagar- Rahatgarh - Meerkheri - Khurai, Jaisinagar, Bandri- Malthone (NH.12).

On the basis of the geochemical and stable isotopic studies of the natural petroleum gas, soil and water suggest that the samples of the Piparia-Bhutoli-Rahatgarh-Meerkheri of Sagar District containing 72% to 99% of methane,0.34% -0.742% of Helium, along with the oxygen, carbon dioxide and Nirogen gases. The stable isotopic δ C13value in the range varying from -43.6 per mil. w.r.t PDB for methane -24.66 per mil. w.r.t PDB for ethane at Piparia – Bhutoli to -54.9 per mil. w.r.t PDB for methane and per mil. w.r.t PDB for at Rahatgarh are indicative of the THERMOGENIC origin.

Table 4: The Absorbed Soil Hydrocarbon gas concentration in Sagar Distt

	C1	C2	C3	i C4	n C4	∑C3+
Minimum	1	1	1	1	1	1
Maximum	104	14	10	09	08	41
Mean	19	2	1	0.5	0.3	4
Standard Deviation Soil Gas sample (%)	22	4	2	2	1	8

(After Prasanna et al 2010)

Table 4: Absorbed Hydrocarbon ration in soil samples in Sagar District

Ratio	Thresold value	% of at incidence in survey at Sagar	Reference
C1/C2+C3	<10	79	16
C1/C2	<16	96	18
C2 /∑ C3 +	<1.3	50	17

(After Prasanna et al 2010)

Conclusion

In my opinion the natural helium and petroleum gas are containing the higher amount of methane (72-99 %), and remarkable content 0.34 % to 0.742 %of Helium, and minor amount of oxygen, nitrogen, and carbon di oxide, it suggests that it must have been formed at higher temperature condition at deeper level in the Pre - Cambrian Vindhyan sedimentary basin. The reservoir must be lying below the ground at least 1000-2000 m or more depth. The present leakages of natural gas releasing through many hairline cracks/ fracture and feather joints in the sandstone, shales and limestone rocks of the Rewa and Bhander group rocks of the Vindhyan Super Group.

As per the geochemical and stable isotopic studies of Gas samples analysed at NGRI. find out the methane and ethane gas. The presence of ethane gas collected from the above mentioned localities and the δ C13 stable isotopic value in the range of -24.9 per mil.w.r.t. per mil to - 26.9 per mil w.r.t. PDB. indicative of the thermogenic sources [1-19].

It is remarkable to note that the leakage of petroleum and Helium gas occurring in the different16 tubewells are spread over more than 140 x 20 km area from Meerkheri- Rahatgarh - Pipariya-Bhutoli, Mahalwatra (Patharia) villages of Garhakota tahsil is about 40 km in the east of Sagar town, and the another tube well at Rahatgarh tube well site is about 40 km and meerkheri is about 60kmwest of Sagarand 70 km east of sagar is Mahalwara containing a large reservoir. Through the minor cracks/ fractures in the country rocks the natural petroleum and helium gas in the tube well is pouring in the Sagar district. The Director General Hydrocarbon, Ministry Petroleum and Natural Gas, Newdelhi has assured for detailed Deep seismic survey in this hydrocarbon and heliumrich zone will be done soon.

Acknowledgement

The author is thankful to the Director, NGRI, A.M. Dayal (Rtd). NGRI Hyderabad and the Director, KDMIPE, ONGC, Dehradun for the geochemical and stable isotopic analysis for the various samples. The author is highly thankful for the critical comments on this paper by Prof. R.P.Tiwari, Vice Chancellor, Dr.HSG University, Sagar, Prof. S.P. Banerjee and Prof. K.S Pitre, Deptt. of Chemistry Dr.HSG University, Sagar, for the suggestions and Prof. P.S.Sakalni (Ex.) VC HNB Garhwal University Srinagar Garhwal for the critical comments on the manuscript.

References

1. Rajrajan K (1978) Geology of Sagar district and western part of Damohdistt. Memoirs. GSI 109: 1-99.
2. Shandilya Arun K (2007) Natural Petroleum Gas found in Piparia-Bhutoli- Rahatgarh in Sagar District, Bundelkhand Region M.P. University Journal Madhya Bharati 53: 122-124.

3. Shandilya Arun K (2008) Discovery of Natural Petroleum gas in the rocks of the Vindhyan Super Group in Sagar Distt. Bundelkhand Region, M.P. Qtrly Journal of GARC 16: 24-27.
4. Shandilya Arun K (2008) Fuel HO - Leakages of Gas in Tubewells spew natural gas. The News Magzine mach 31-32.
5. Shandilya Arun K (2008) Natural Gas leakages from Bore wells in the rocks of the Vidhyan Super group in Sagar and Damoh Distts. M.P. Jour. Himalayan Geology 29: 174-175.
6. Shandilya Arun K (2008) Natural Gas Reserves in Sagar District. "Srujun" University News Letter 9: 19.
7. Shandilya Arun K (2009) Gas in the backyard. in the Business India Magazine 144.
8. Shandilya Arun K (2009) Thermogenic Petroleum Gas found in tubewells of Sagar District M.P. Madhya Bharati Diamond Jubilee 314-319.
9. Shandilya Arun K (2009) The possibility of Petroleum Gas reserve in Southern Bundelkhand Region. M.P. University News Letter, Vishwavidyalaya Samvad 2: 1-3.
10. Shandilya Arun K (2011) The Discovery of natural petroleum and Helium gas in Tube wells of Sagar- Damoh Distt. in Vindhyan Rocks, M.P. Proc. Sedimentary Basins of India, Gondwana Geological Society, Nagpur 125-130.
11. Shandilya Arun K, Anurag S, Anupam S (2012) Hydrocarbon gaseous anomalies found in Agriculture Field around Sagar and Damoh Distt. Southern fringes of Bundelkhan region, M.P. Int. Journal of Chemical and lifescience 1: 1039-1044
12. Shandilya Arun K (2012) Thermogenic Petroleum gas around Sagar, M.P. Jour ONGC Bulletin 38: 165-171
13. Shandilya Arun K (2013a) Unconventional Gas Reserve of Natural Pertoleum Gas in Tube wells around Sagar- Damoh Distt. M.P. India. Proc. Inter. Conf on Global Innovation in Science & Management - 2013 Swami Vivekanand University, Sagar M.P 07.
14. Shandilya Arun K (2013b) Isotopic studies of Petroleum Gas around Sagar, South Ganga Basin, Bundelkhand region M.P. India. University Jour. Madhyabharati 58.
15. Shandilya Arun K (2013c) Studies of Petroliferous Tube wells in the South Ganga Basin around Sagar. M.P. India. Proc. Int. Conf. on Geo Hydrology, (AWRDM) Punjab University, Chandigarh.
16. Shandilya Arun K (2013d) Stable Isotopic studies of Petroleum Gas around Sagar, South Ganga Basin, Bundelkhand region M.P. India. Conf. Volume - National Seminar on PETROFEST 2013, Andhra University, Vishakapatnam 27-29.
17. Shandilya Arun K (2015) Studies on the Helium gas in South Ganga Basin, Distt.Sagar M.P. INM\India. In Ed.Dr Shalini Yadav, Book on Water Resources. Springer Co 255-270.
18. The News of Discovery of Petroleum gas was published in Newspapers. Dainik jagran, Dainik Bhaskar, Raj express, Nav- Bharat, Nai Dunia, Hindustan times, Acharan, Times of India, Indian Express, etc.
19. The News of Discovery of Petroleum Gas was broad casted in Various T.V Channels. DD, Sahara national, India T.V., ETV, NDTV, SMBC, Times, AajTak, CVN, LTV, and Arabic TV Channel in Egypt.