7^{th} *International Conference & Exposition on Petroleum Geophysics*

"HYDERABAD 2008"

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Surface Geochemical Studies for Light Gaseous Hydrocarbons: Findings from Recent Gas Seepages in Anantapur, Andhra Pradesh

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Summary

Geochemical prospecting for oil and gas comprises the study of hydrocarbon induced surface alterations which are indicative of subsurface accumulations in seepage dominant areas. The light gaseous hydrocarbons migrate upward towards the shallow surface (microseepage) from the subsurface oil/gas reservoirs and reside as free gases in the soil pores, interstitial gases occluded in pore spaces between sediment grains, gases adsorbed on to the soil particles and dissolved gases in the water column. The detection of the anomalous concentrations of the gases such as methane, ethane, propane and butane serves as a direct evidence for the presence of a working petroleum system in an area.

Emission of natural gas from the borewells of Vengannapally village in Anantapur district of Andhra Pradesh was reported off late and surface geochemical survey was carried out to determine the concentration and establish the source of the leaking gas. The Vengannapally village falls within Cuddapah basin which has been classified as category-IV sedimentary basin having possible existence of hydrocarbons. The light gaseous hydrocarbon concentration of 33 soil samples, collected from a depth of about 1 m were determined by acid desorption technique using Gas Chromatograph equipped with flame ionization detector. The observed concentrations (in ppb) vary from: CH_4, *= 12 - 223;* C_2H_6 *= 3 - 36;* C_3H_8 *= 2 - 24; i-*C_4H_{10} *=18; and n-*C_4H_{10} *= 1 - 21, respectively. The isotopic signature of the methane* $\delta^{13} C_1$ *ranges between* $-25^0/_{00}$ *&* $-35^0/_{00}$*. The head space gas analyses of the water samples collected from the borewells was also carried out. The observed concentrations (in ppm) vary from:* CH_4 *= 18 - 237626;* C_2H_6 *=2 - 4. The isotopic signature of the methane* $\delta^{13} C_1$ *ranges from* $-50^0/_{00}$ *to* $-63^0/_{00}$*. The present study attempts to characterize the light gaseous hydrocarbons in the shallow soil samples and gas samples from Vengannapally village in terms of its concentration distribution and nature of origin.*

Introduction

The hydrocarbons generated and trapped at depth in petroliferous basins seep in varying quantities to the surface, resulting in several surface manifestations indicative of the subsurface accumulations[1].The vertical/near vertical migration or the microseepage can be detected and quantified through various geochemical techniques[1,2]. The methods to recognize the surface or near-surface occurrences of hydrocarbons consists of adsorbed soil gas surveys, microbial methods, soil salts, trace element, fluorescence anomalies, mineralogical alterations etc. The soil gas survey for light gaseous hydrocarbons is direct and promising evidence of the seepage of subsurface hydrocarbons[2,3]. It includes the detection and quantification of light hydrocarbons ranging from methane to butane in shallow soil/sediments and water columns. The determination of high concentrations of methane, ethane, propane and butane help in demarcation of anomalous hydrocarbon zones and the compositional ratios of same predict the probable oil or gas potential[4]

The Surface Geochemical survey was carried out at Vengannapally village in Anantapur district of Andhra Pradesh in context with the recent gas emissions occurring from the existing borewells in the region. The

Vengannapally village is located in Cuddapah basin which is a proterozoic sedimentary basin, having a stratigraphic thickness of about 12 km[5]. Cuddapah, being category IV sedimentary basin is considered to have possible occurrences of hydrocarbons. The paper discusses the findings of the surface geochemical survey at Vegannapally in light of the mentioned fact.

Field work and Analytical Procedures

Cluster sampling on specific selected sites near the seepage was carried out to collect 33 soil samples from the depth of 1 to 1.5m using manual hammering. The samples were wrapped in alluminium foils with their GPS positions marked.

The 63 micron size soil sample was treated with ortho phosphoric acid under partial vacuum to desorb the soil gases. The CO_2 evolved was trapped in KOH solution and the hydrocarbons released were collected through water displacement in a graduated tube fitted with rubber septa . The 0.5 ml of the gas was injected in to the Varian CP-3380 Gas chromatograph equipped with Flame ionization detector. The calibration of GC was done by external standard with known concentrations of methane, ethane, propane, i-butane, n-butane. The quantitative estimation of light gaseous hydrocarbons constituents in each sample was made using peak area measurement as a basis and the correction for moisture content was applied. The accuracy of measurement of C_1 to C_4 components is < 1 ng/g.

The carbon isotopic composition of methane from the soil sample and head space gas was measured by GC-C-IRMS comprising of Agilent 6890 Gas Chromatograph (GC) coupled to a Finnigan – Delta Plus^{XP} Isotope Ratio Mass Spectrometer via a GC combustion III interface. The carbon isotope ratio in the sample was compared with NIST RM 8560(IAEA NGS2) using ISODAT software. The precision of the isotopic measurement was ± 0.5%

Results and Discussion

The observed concentrations (in ppb) of adsorbed light gaseous hydrocarbons vary from: CH_4, = 12 - 223; C_2H_6 = 3 - 36; C_3H_8 = 2 - 24; i-C_4H_{10} =18; and n-C_4H_{10} = 1 - 21, respectively. The location map of the study area and the concentration distribution of CH_4, C_2H_6, C_3H_8 is shown in the fig.1. The crossplots among the components such as C_1-ΣC_{2+}, C_2-C_3 show good linear correlation ($r \geq 0.7$) indicating that the hydrocarbons are genetically related and are not altered during migration. The compositional ratio of C_1/C_2+C_3 less than 50 and the δ^{13} C value of methane ranging between $-25^0/_{00}$ to $-55^0/_{00}$ PDB as suggested by Bernard are typical for the thermogenic hydrocarbons[6]. The C_1/C_2+C_3 varies between 1-10 and the isotopic signature of the methane δ^{13} C_1 ranges from $-25^0/_{00}$ to $-35^0/_{00}$, suggesting its possible thermogenic origin. The concentrations (in ppm) of light gaseous hydrocarbons in head space gas samples vary from: CH_4 =18 - 237626; C_2H_6 =2 - 4. The C_1/C_2+C_3 varies between 16000-21000 and the isotopic signature of the methane δ^{13} C_1 ranges from $-50^0/_{00}$ to $-63^0/_{00}$, suggesting a biogenic origin

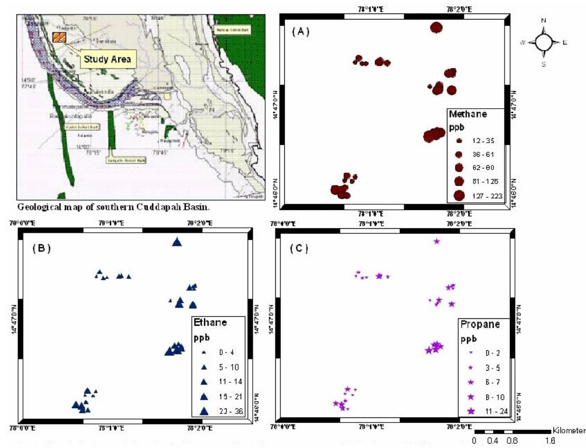

Figure 1: Adsorbed soil sample location in Vengannapally with concentration of (A) Methane (B) Ethane (C) Propane

Conclusions

The adsorbed soil gas survey for light hydrocarbons in Vengannapally gas seepages have shown the presence of methane and its higher analogues such as ethane, propane and butane with occurrences from possible thermogenic source.

The head space gas analyses have shown predominantly methane of biogenic origin and may be derived from the source different from the above. This paper presents the preliminary results of the gas seepage which took place from the boreholes. For a better assessment of the hydrocarbon prospects in the region, still larger soil gas data set integrated with available geoscientific information may be helpful.

References

1. Schumacher, D. and Abrams, M.A., 1996, Hydrocarbon migration and its near surface expressions, AAPG Memoirs, 66, 445PP.

2. Klusman, R.W., 1993, Soil gas and related methods for natural resource exploration, John Wiley & Sons Ltd., UK.

3. Horvitz L., 1985, Geochemical Exploration for petroleum, Science, Volume 229, Number 4716.

4. Jones, V. T., and Drozd, R.J., 1983, Prediction of oil and gas potential by near surface geochemistry, AAPG, V.67, No.6 p 932-952

5. Nagaraja Rao, B.N., Rajurkar, S.T., Ramalingaswamy, G. and Ravindra Babu. (1987) Stratigraphy, structure and evolution of the Cuddapah basin, Purana basins of Peninsular India, GSI.Mem. 6, pp.33.

6. Bernard, B.B., Brooks, J.M., and Sackett, W.M. (1977) A geochemical model for characterization of hydrocarbon gas sources in marine sediments. Proc. 9th offshore Technology Conf., Houston, TX, pp.435.

Acknowledgment

The authors are thankful to Director, NGRI for his consent to publish this work. The OIDB is gratefully acknowledged for funding towards setting up of National facility for Surface Geochemical Prospecting of Hydrocarbons at NGRI. One of the authors (DM) acknowledges CSIR for Senior Research Fellowship.