

Studies of Carbon Isotopic Ratios in Atmospheric Methane and Some of It's Sources in India

D.K. Rao and R.A. Jani

Physical Research Laboratory, Ahmedabad 380 009, India; +91079-26314261, E-mail: amesh@prl.res.in

Methane (CH_4) is one of the important greenhouse gases with increasing concentration in the atmosphere. Methane currently has a globally averaged mixing ratio of ~ 1.8 ppmV in the troposphere. Its concentration has been increasing in the atmosphere for the last 200 years and it has more than doubled to a present value compared to pre-industrial time. The carbon isotopic composition of methane is useful for constraining the global CH_4 budget and identifying CH_4 sources. This technique is widely used all over the world to identify the methane sources, especially in the Northern Hemisphere. Very limited work is done from India in the last decade to measure $\delta^{13}\text{C}$ of methane in the atmospheric air to identify its sources. We present here the data obtained using conventional method of CH_4 isotope analysis. Atmospheric air samples were collected during: 1) September-October 2002 for spatial variation, 2) during night time on 4-5 December 2002 & 10-11 June 2003 for diurnal variations from Ahmedabad ($23^\circ 02' \text{ N}$, $72^\circ 33' \text{ E}$), India at a height of ~ 80 ft above the ground to estimate the mean isotopic composition of the local methane source. The mean overnight source mix (for the period 23:45 until 06:45, 4-5 December), calculated using the Lever rule, was $-51.7 \pm 1.1\%$ and suggests that the excess methane is mainly contributed by a single anthropogenic source, where as $\delta^{13}\text{C}$ of methane sources varies between -8.8 to -34.4% for the period 21:00 to 8:00 hours on 10-11 June 2003. The data (figure) suggests that two dominant sources (automobile exhaust and natural gas leakage) contribute during night time. Both the sources have equal contributions from 21:00 to 6:00 where as automobile exhaust dominates after 6:00 hours. We also determined the $\delta^{13}\text{C}$ signatures of different methane sources in India.

Sr.no	Source	Place	Location	No. of samples	$\delta^{13}\text{C}$ (‰)
1	Paddy fields	A.P state	$16^\circ 97' \text{ N}$; $82^\circ 15' \text{ E}$	10	-57.2 ± 0.5
2	- do -	Gujarat	$22^\circ 20' \text{ N}$; $72^\circ 40' \text{ E}$	5	-54.3 ± 0.5
3	Gas hydrates	Arabian Sea	$10^\circ 51' \text{ N}$; $73^\circ 36' \text{ E}$	2	-65 ± 1
4	Gas seeps	Manipur	$24^\circ 48' \text{ N}$; $93^\circ 56' \text{ E}$	2	-44.5 & -48.7
5	Coalbed	Jharkhand	$23^\circ 47' \text{ N}$; $86^\circ 25' \text{ E}$	4	-45 ± 1.0

Table: $\delta^{13}\text{C}$ of methane in some of the sources in India

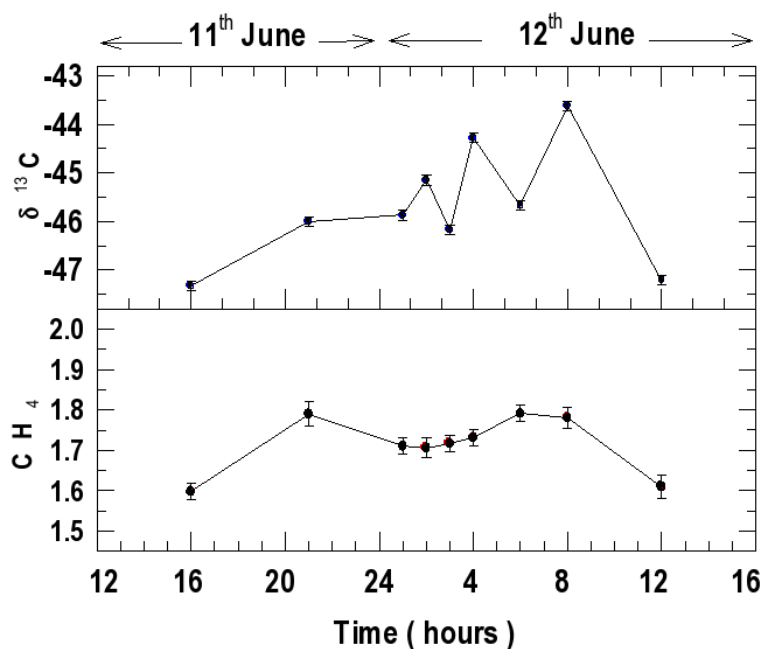


Figure 1. Diurnal cycle of CH_4 (ppmv) mixing ratio and $\delta^{13}\text{C}$ (‰) in Ahmedabad city during 11-12 June 2003.