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Measurement of Anomalies in The Spatial Distribution of Radon Content of Soil Gas in some regions of Middle Shivaliks, India

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ABSTRACT

In present study solid-state nuclear track detectors (LR-115 Type-II) (from Kodak France) is in order to determine the soil gas radon profile in areas of middle shivaliks active fault systems in Jwalaji and Dehra region ,India "a well known seismic zone".To study the radon anomalies of the region.Area under study divide into five profiles. Radon shows variation not only due to the tectonic structures but also due to change in lithology.Radon anomalies show that apart from conspicuous thrust MBT-2, the area under study is cut across by the N-S transverse faults/lineaments

Keywords: Radon; etched track detector; radon in soil-gas

INTRODUCTION

The Himalayas are tectonically active due to the northward movement of the Indian plate. The Indian plate converges northwards at an average rate of 50mm/y and is under thrusting Tibet. Of the total convergence, 20mm/y [1]is accommodated across the Himalaya and the remaining convergence is taken up farther north[2].The northward convergence of Indian plate keep Himalayan arc seismically active and earthquake prone. Major earthquakes in recent past along the Himalayan arc include Shillong earthquake (Ms 8.7, 1897), Kangra earthquake (Ms 8.6, 1905), Bihar–Nepal border (Ms 8.4, 1934) and Assam earthquake (Ms 8.7, 1950). The frequent occurrence of small magnitude earthquakes indicate that the Himalayas are under unusually high stress and strain.

Noble gases are excellent natural tracers for several geological features as they are chemically inert [3,4,5].Spatial variations of noble gases like radon (^{222}Rn) is widely applied in studies to locate buried/blind faults and in seismic monitoring activities[5,6]. Radon is the product of the uranium decay series. Several researchers have made efforts previously to elucidate the role of these gases in delineating active faults and their relationship to seismically active areas.

The present study aims at assessing the relationship between soil–gas radon distribution and thrust/neotectonic fault zones in the vicinity of tectonically active area of Middle Shivaliks in the region of NW Himalayas, India.

Geology of the area

Region under study situated on the southern escarpment of the Himalayas. The entire area of the district is traversed by the varying altitude of the Shivaliks, Dhauladhar and the Himalayas from north-west to south-east. The altitude varies from 500 metres above mean sea level (amsl) to around 5000 metres amsl[7,8]. It is encapsulated in the north by the districts of Chamba and Lahaul and Spiti, in the south by Hamirpur and Una, in the east by Mandi and in the west by Gurdaspur district of Punjab. Area under study divide into five profiles.Profie A from [Upper dhaliyara-D.A.V school Dehra] lies between N 31˚49.870'and E 76˚10.430' to N 31˚53.321' and E 76˚12.609',profile B from[Dehra gopipur-jawalagi] lies between N 31˚52.686' and E 76˚14.045' to N 31˚52.448' and E 76˚18.232', profile-C [Sanot to khabli] lies between N 31˚52.036' and E 76˚14.465' to N 31˚54.806' and E 76˚13.631', Profile-D[Kathog To Chambapattan lies between N 31˚49.851' and E 76˚16.088' to N31˚52.253'and E 76˚16.764' and Profile-E[Jawalaji To Naduan] lies between N 31˚45.629' and E 76˚18.929' to N 31˚51.370' and E 76˚20.565'

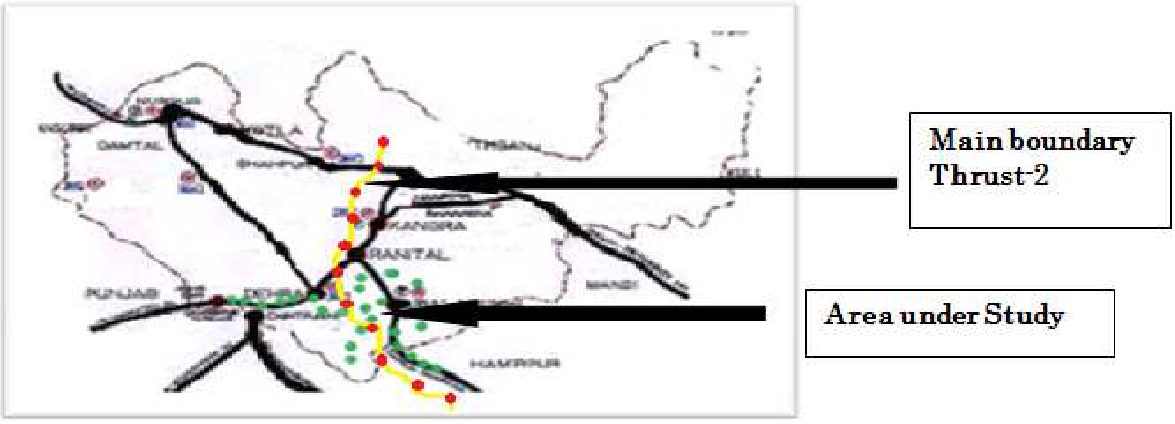

Fig.1- Map showing the locations of Area under Study in Middle Shivaliks, India

MATERIAL AND METHODS

In the present investigations, the passive technique using the SSNTDs has been utilised for the comparative study of the soil gas radon (^{222}Rn) level. Radon activity concentrations were measured mainly using the passive closed-and-open can techniques (cylindrical can made of high grade plastic having diameter of 5 cm, height of 25 cm and thickness of 0.5 mm). Each can was equipped with a polymeric nuclear track detector LR-115 type II plastic. Detector (which was purchased from Kodak France) each with a size of about ($1.5×1.5\ cm^2$) fixed at its top.

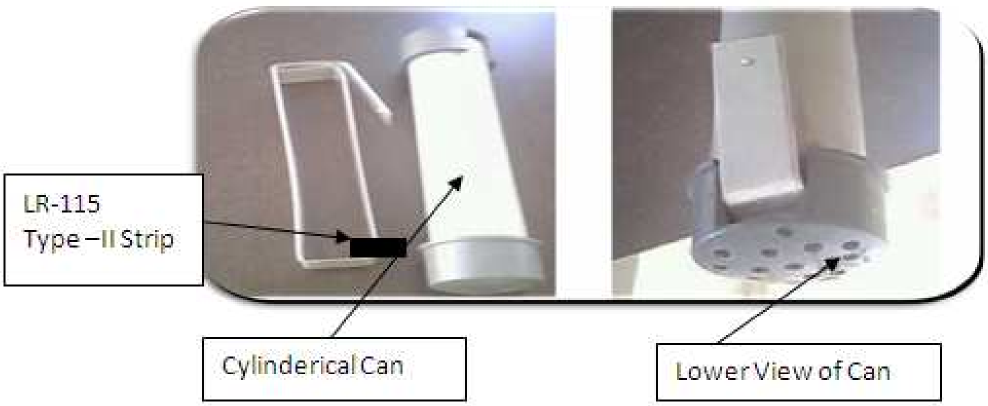

Fig.2 - Radon Discriminator

Alpha particles emitted by ^{222}Rn and its daughter products strike the detectors and leave latent tracks in it.After the exposure time(15 days), the detectors from all cans were retrieved. For the revelation of tracks, the detectors were chemically etched in 2.5 N NaOH with an etching time of 90 min and etching temperature of 60^{o}C in a water bath..After the etching period, the detectors were removed from the etchant and immediately washed with distilled water and then dried in air. After a few minutes of drying in air, the detector was ready for track counting. The etched tracks were counted using an optical microscope(X 400 magnification). The area of one field of view was calculated with a stage micrometer and the track density was calculated in terms of number of tracks per cm^{-2}. The correction was applied for the background alpha tracks in LR-115 plastic by subtracting the number of tracks observed in the unexposed detector. The number of tracks counted per unit area was then converted into radon concentration by applying the conversion factor for LR-115type II detectors in the can-technique dosemeters as 0.034 ± 0.002 tracks cm^{-2} d^{-1} per kBq m^{-3}.

RESULTS AND DISCUSSION

The values of radon concentration in soil gas samples from different locations in the study area are given in Table 1.

Sr.No.	Profile	Elevation	Location	Radon Concentration(kbq/m^3)
Profile-A				
1	A-1	2570	Upper dhaliyara	104
2	A-2	2073	Dhaliyara	114
3	A-3	1752	Badhun	99
4	A-4	1507	Sunhet	90
5	A-5	1415	D.A.V School dehra gopipur	76
Average Radon Concentration(kbq/m^3) in profile-A				96.6
Standard Deviation				14.41
Profile-B				
1	B-1	1541	Sanot	133
2	B-2	1499	jawalagi	69
3	B-3	1442	kudlihaar	78
4	B-4	1563	Kathog	139
5	B-5	1546	Ganjiwaal	119
Average Radon Concentration(kbq/m^3) in profile-B				107.6
Standard Deviation				32.12
Profile-C				
1	C-1	1602	Sanot 1	148
2	C-2	1512	Sanot 2	82
3	C-3	1611	Shivnath	124
4	C-4	1740	Khabli do sadkaa	239
5	C-5	1539	Mairi	149
6	C-6	1568	Khabli	124
Average Radon Concentration(kbq/m^3) in profile-C				144.3
Standard Deviation				52.36
Profile-D				
1	D-1	1564	Gharlahad	253
2	D-2	1607	Sihorpai	85
3	D-3	1629	Sihorpai	196
4	D-4	1508	G.H.S Balardu	251
5	D-5	1447	Nahnala	175
Average Radon Concentration(kbq/m^3) in profile-D				192
Standard Deviation				68.84
Profile-E				
1	E-1	1678	Amb	224
2	E-2	1622	Balh	116
3	E-3	1551	Bedli	57
4	E-4	1530	Nagarda	155
5	E-5	1560	Maivalghal	76
Average Radon Concentration(kbq/m^3) in profile-E				125.6
Standard Deviation				66.71

Profie A from [Upper dhaliyara-D.A.V school Dehra] lies between N 31˚49.870'and E 76˚10.430' to N 31˚53.321' and E 76˚12.609'and radon concentrtion ranging from 114kBqm^{-3} to 76kBqm^{-3},profile B from[Sanot - Ganjiwaal] lies between N 31˚52.686' and E 76˚14.045' to N 31˚52.448' and E 76˚18.232'and radon concentrtion ranging from 139kBqm^{-3} to 78kBqm^{-3} , profile-C [Sanot to khabli] lies between N 31˚52.036' and E 76˚14.465' to N 31˚54.806' and E 76˚13.631'and radon concentrtion ranging from 239kBqm^{-3} to 82kBqm^{-3}, Profile-D[Gharlahad To Nahnala] lies between N 31˚49.851' and E 76˚16.088' to N31˚52.253'and E 76˚16.764', radon concentrtion ranging from 253kBqm^{-3} to 85kBqm^{-3} and Profile-E[Amb To Maivalghal] lies between N 31˚45.629' and E 76˚18.929' to N 31˚51.370' and E 76˚20.565', radon concentrtion ranging from 224kBqm^{-3} to 57kBqm^{-3}.

CONCLUSION

Radon gas patterns, combined with geological observations, can supply useful constraints for deformation tectonic environments. The present study concludes that radon concentration not only varies with tectonic features but also with the change in lithology. From the radon anomalies it was observed that the anomalies are not only distributed on the conspicuous thrust MBT-2 but also along the drainage system in the study area. Anomalies along these drainage systems indicate the presence of transverse lineaments which are intersecting the longitudinal thrust (MBT-2). Intersection of these two fault systems might have made the region tectonically active and interesting for the further studies.

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