Sustainable Awareness and Safety Measures for Natural Radiation Protection in Granitic Terrains and Localities

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Abstract **- The natural radiation emitted by radio – active minerals present in surrounding rock and soils has direct bearing on the human health. The natural or background radiation is a constant source of ionizing radiation which present permanently and emitted from a variety of sources. The natural or background radiation level present in any locality depends on radio nuclie in soil/rock. In the Chhattisgarh state sporadically mineralized Archean terrain surrounding the oval cup shaped sedimentary basin form the potential zone for natural radiation. The paper deals with the awareness measures required to safeguard public health from Natural Radiations. The mitigative program will have to design in urban dwelling units for safety and socially sustainable activities.**

Index Terms **- Natural Radiation, Archean Granite, Awareness, Safety, Potential zones.**

INTRODUCTION

The Archean terrain surroundings the oval shaped protereozoic sedimentary basin (Chhattisgarh Basin) which occupies about 33,000 sq. Kms area in Central Chhattisgarh. The basin at outer fringes exhibits structurally disturbed basin boundaries. Physiographically, the Chhattisgarh region is represented in the north by hillocks and remanants of Structural hills and rugged terrains (650 m. AMSL) in the West by Dongargarh Hills (1000 mts. AMSL) in the south by Highlands and Hills (400 – 450 mts. AMSL) and in the east by isolated hills. Central part of Chhattisgarh region is plain area due to presence of sedimentary basin (Fig.1). The region is drained mainly by tributaries of Mahanadi. Huge loads of sediments flowed in the central basin area of the region. The radioactive minerals carried by the sediments got trapped here and there in the outer fringes forming unconformity of U deposits (AMD). In the context of the previous work and literature the deltaic region of Mahanadi tract forming coastal regions sands of Orissa has been studied by Mohanti AK (2004), discussed Natural Radioactive Whereas the Uranium isotopes in dissolved form in Mahanadi river and Eustarine system mentioned by Ray SB (1995). In Indian soils the natural activity levels illustrated by Mishra and Sadasiwan (1971) Indian rocks with average value of radioactivity emission given by Bhimasankram V.L. (1974). The occurrences of Uranium illustrated, and field dimensions written by Vyas KG (1988). The field investigations and dimensions of radio – active zone declared by AMD; studies are important literature for citations. The main purpose of present study is to discuss the attribution regarding Natural Radiation potential zones (NRPZ) in Chhattisgarh. It includes Chhattisgarh protereozoic sedimentary basin and its surrounding Archean Granites. The study helps in deducing awareness plan for safety of the society as well as mitigative measures.

B. GEOLOGICAL SETTING:- The regional geological setup exhibited the Igneous sedimentary and metamorphic all three types. Weathering and disintegration of rocks, during the process of natural disintegration, it will release small amounts of ionizing radiation. Uranium and Thorium are widely distributed and found in many regions. Traces of minerals found in building material and soils contain greater quantity of uranium. The emission of effective average dose from soil is considered approx. 0.5 msv per year. In the Chhattisgarh basin and adjacent Hills, the geological formations exposed, ranging from Archean to Recent in age the granite, gneisses, phyllite, schist, limestone, sandstone, laterite and alluvium are lithological assemblages of the region respectively (Table -1, Fig. 1).

C. HOST ROCKS OF URANIUM MINERALS: - Uranium and pitchblende are the primary mineral that occurs mostly in Granites and felspathic gneisses. Pitchblende in granite and pegmatite shows a density of 6.4 tons/m^3 when it is massive and 9.7 tons/m^3when it is crystallized. Concentration of uranium in various rock type are given in Table. The maximum radiation occurs in Kerala beaches, India, where ¾ of the thorium deposits of earth are located, the effective dose is 12.5 mSv (milli sieverts). Atomic minerals – The main atomic mineral uranium thorium constituting uranite and largest source of Uranium in monazite sands.

D. OCURRENCES OF URANIUM IN CHHATTISGARH: - The terrestrial Radio activity depends largely on the compositional constituents of rocks which is a major source of natural radiation, which causes terrestrial radioactivity. The main sources include natural deposits of uranium, potassium, and thorium. The discovery of Uranium at the base of the protereozoic sedimentary basin i.e., Eparchean unconformity (Saraswat, 1988) has provided clue to investigate Chhattisgarh sedimentary basin margin. The middle protereozoic basin of Chhattisgarh having an unconformable contact with the Archean Basement is considered potential locals for unconformity related uranium occurrences. It includes Indravati and Chhattisgarh Basins both. The UTUO (Unconformity Type Uranium Occurrences) constitute about 9.95% uranium in the country (Ref. AMD). The rift containing sedimentary basins which related to extensional tectonic regime includes following Unconformity Related Deposits (URD) (1.) Abujhmar (2.) Khairagarh (3.) Indravati (4.) Chhattisgarh (5.) Khariar Ambani etc. Other uranium occurrences identified by AMD in Chhattisgarh region are given in Table.

E. NRPZ OF CHHATTISGARH: - In the Chhattisgarh state more than 25 major localities of uranium occurrences have been marked by the AMD. The important locations are: - (1.) Bodal (2.) Bhandaritola (3.) Jangalpr (4.) Majaraa (5.) Baghnadi (6.) Kolarghar (7.) Jaijawal (8.) Dhabi (9.) Dunahat (10.) Jorhat (11.) Kawrisot (12.) Ghurdhara (13.) Garia (14.) Barrau (15.) Meraraich (16.) Bari (17.) Lal Bera (18.) Dongararh (19.) Shrimal (AMD). Chhattisgarh basin considered and declared as potential belt /areas by AMD. The Bodal and Jaijawal localities are marked as uranium deposits. As such central Chhattisgarh plain and surroundings may be recognized as NRP (Fig.).

F. NATURAL RADIATION AND BUILDING MATERIAL (STONE/GRANITE): - The knowledge of natural radioactivity from building material is also important because concrete mixer with nearly 60% sand may contain concentration of natural radio nuclides (Mungesam, 2011). The building materials act as source of radiation and also a shield against outdoor radiation (UNSCEAR, 1988). The major factor that affects indoor absorbed dose is in two ways.

1. The activity concentration of Natural radiation in the wall materials.
2. The radiation emitted by some outdoor as effectively absorbed by the walls.

As a result, the dose rate in air indoors will be elevated accordingly to the concentration of the naturally occurring radio – nuclides used in construction materials. Like most natural stones, the Granite is a natural source of radiation. Usually, some Granite contain 10 to 20 ppm of uranium whereas mafic rocks Tonalite, Gabbro, Dacite have 1 to 5 ppm of uranium.

G. UTILZATION OF GRANITES BY DU: - The utilization of Granites by Dwelling units in Urban Centre of Chhattisgarh have be attempted. The information regarding consumption and sources of Granite rocks in different construction works using Granite was collected by field survey. The field data were compared synthesized and interpreted as given in Table VII. In dwelling units, the Granite and Marble Slabs are frequently used for decorative and finishing purposes. The data regarding source of granite consumption was collected from Traders. It was found that people from effluent society of higher / high / upper / middle income group make their dwelling units using Granite. The Granite consumption is 54% in the urban area and 46% in small town.

H. AWARENESS AND PROTECTION POLICIES FOR NUCLEAR AND RADIATION SAFETY – AERB, IRPA: - At present, the radioactive substances have been increasingly used for generation of power, research and medicinal purposes. The radiation from industrial and research units are generally considered negligible since it is shield proof measures that radiation level below the danger dose and reactors are

safely designed and not harmful. The real danger come from the use of radioactive material for the explosive purposes like Fission Bomb dropped during world war II in Hiroshima and Nagasaki (Japan). It creates ionizing radiations which causes injury to protoplasm. Nuclear weapons use Uranium 235 and Plutonium 239 for fusion and additional hydrogen or lithium for hydrogen bomb. The radio activity enters into food chain and affect the biota – organisms of livings, effect on human body to induce mutation and break in Chromosomes eg. The soil, water, and vegetation over 60 Km surroundings area in the Chernobyl, Ukraine (1986) were severely damaged. Since there is no cure of damage caused by radiation, the prime controlling way is the preventive measures. It can only be performed with the public awareness and Govt. Regulations, Authorities of the states. The words International Radiation Protection Association (IRPA) efforts have been made in the field of radiation protection, defined under normal levels of radiation for community risk below 5% per Sv level. The legislative provisions of Govt. policy/Regulatory Authority (AERB) works with fundamental objectives that "the use of ionizing radiation and nuclear energy in India does not cause undue risk to health of people and environment". The Regulatory Body can take steps in case of extraordinary nuclear events under civil liability for nuclear damage Act, 2010. It has powers to lay down safety standards and safety rules.

I. DISCUSSION AND CONCLUSION: - Central Chhattisgarh plain is densely populated area. The Uranium mineralization in its surrounding is a cause of great concern with respect to Natural Radiation Hazards (NRH) people of effluent societies are at higher risk of radiation hazard due to indiscriminate use of granite in their dwelling houses. It is not so that all granite emits harmful radiations and as such quality control may play significant role in minimizing the radiation hazards. Traders as well users will have to be made aware of harmful effects of radiation on human health. So far as possible trade in granite be allowed only after through quality check. Various protective measures adopted by AERB in India, formulating the Rules.

Age	Geological Formation/Group	Lithology
Recent to Pleistocene	-	Laterite, Alluvium
Upper Proterozoic	Chhattisgarh super group	Shale, L/st, Dolomite, S/st. conglomerate
Middle Protereozoic/ Archean	Unclassified, Metamorphic unclassified Basement Granitoids	Phyllite, Schist Granite Gneiss Metavolcanics

TABLE – I GEOLOGICAL SUCCESSION

TABLE – II (A) URANIUM CONCENTRATION IN VARIOUS ROCKS

Rock Type	Uranium X 10^4%
A. Igneous	
1. Acidic Rocks	4.0
2. Intermediate Rocks	1.4
3. Basic Rocks	1.1
4. Ultrabasic Rocks	0.6
B. Sedimentary	
1. Clay	4.3
2. Sandstone	2.0
3. Limestone	1.4

TABLE – II (B) ATOMIC MINERAL DEPOSIT DISTRIBUTION

S. No.	Radioactive Mineral/Elements	Host Rock/Ore Mineral	Locality	Deposits/Production
1.	Uranium	a. Igneous Archean Rocks metamorphic Rocks b. Sedimentary rocks	Jharkhand Gaya, Singhbhum Saharanpur Udaipur Copper mines Raj.	30,450 tons About 2% production of world
2.	Monzanite	Sea coast sand/sediments	Kerala Coast	15,200 tons uranium Content in monzanite
3.	Thorium (Thornamite minerals)	Igneous Rocks content 10% Thoria 0.03% Uranium	Kerala, Rajasthan, Bihar, TN, Rajasthan	4,57,000 tons about 50% of the total world deposits
4.	Beryllium	Oxide of Berillium	Jharkhand, Bihar	-
5.	Lithium	Lepidolite Life Spodumene	Rajasthan, Bihar	Micaceous Deposits
6.	Zirconium	Alluvium Sea Beach Sands	Ranchi Jharkhand Hazaribagh Kerala Beach	-

NB. Atomic Energy Deptt. GOI has estimated resources about 30,480 tons. India produces 2 percent of Worlds Uranium Production.

TABLE – III COMMON RADIATION SOURCES AND EXPOSURE LEVELS / VALUE

S. No.	Source	Value Millirem/ Yr.
1.	Cosmic Rays	35
2.	Air	5
3.	Building Materials	34
4.	Food	25
5.	Earth's Surface (Ground)	11
6.	Jet Flight (Coast to Coast)	5
7.	Residential Television	1
8.	X- ray	50
9.	Nuclear Power Plant (50 miles peripheries per person/living	0.001

TABLE – IV NATURAL RADIATION DOSES

S. No.	Region / Area	Dose (Value) mSv
1.	Worldwide Av. effects as	2.4 m Sv
2.	Canada	1.8 mSv
3.	Kerala Coast (India)	12 mSv
4.	North Iran	200 mSv

TABLE – V ELECTROMAGNETIC SPECTRUM (major types of radiations)

Energy Sources	Natural Celestial Atmosphere	Gamma Chamber Medicine Treatment Radiology	Thermograph Film	Sky	Sunrays	Invisible Encergy	Heat waves	Voice Telecommunication
Types		Ionized Radiation				Non-Ionized Radiation		
Wave Forms	Cosmic	Gamma	X- Ray	Ultraviolet	Visible Light	Infra-Red	Microwaves	Radio

TABLE – VI MAJOR CATEGORIES OF URANIUM RESOURCE DEPOSITS

S. No.	Major Categories	Resources %	Cummulative %	Localities
1.	Carbonate Deposit	42.24	42.24	Chhattisgarh Gwalior
2.	Metamorphic Type	31.55	73.79	Rohil Ghar Aravallli Raj
3.	Granitic	1.99	75.78	Singhbhum
4.	Sandstone Type	10.33	86.11	Gwalior, son Valley
5.	Unconformity Type	9.95	96.06	Chhattisgarh
6.	Metasomatite	3.74	99.80	Shillong
7.	QPC	0.19	99.99˜100%	Walkunj

N.B. In India the Uranium Resources (RAR and Inferred) amounting to 1,81,606 t u. Deposits.

TABLE – VIII OCCURRENCES OF URANIUM IN C.G.

S. No.	Locality	Dimensions / Deposit type	Host Rock / Basin	District
1.	Bodal	Vein type uranium deposit over a stretched length of 100mts. Vertical depth 40 mts.	Protereozoic Bimodal Volcanics	Rajnandgaon
2.	Jaijawal	Vein Type 300 metres Stretch Vertical depth 40 mts.	Protereozoic Crystallines	Sarguja
3.	Dumhat	-	Protereozoic Crystallines	Sarguja
4.	Dhabi	-	Syenite with Crystallines	Sarguja
5.	Bhandaritola	-	Acid Crystallines	Rajnandgaon

TABLE – VIII USE OF GRANITES IN URBAN DWELLING UNITS

S. No.	Dwelling Unit Categories	Builtup Area (Sq. ft.) G.F.	Required Granite Stone Construction (Sq.ft.)	Location
1.	Housing – Residential (small)	1200-1500	200-250	West Raipur Housing Colonies
2.	Housing Bungalow(medium)	2400-3000	350-400	Samta Colony, Choubey colony
3.	Housing Bungalow (Big)	4000-5000	450-550	Shankar Nagar , khamhardih
4.	Small market/ Showrooms/ Suits of Apartment (luxury)	6000-8000	700-1000	Pandri, Saddu, Mova
5.	Commercial Complexes / Big Shops/ Market	10000-12000	2000-2500	Telibandha, VIP road
6.	Malls/ Multiplexes, 3/5 star Hotels	25000-40000	3500-5000	Naya Raipur

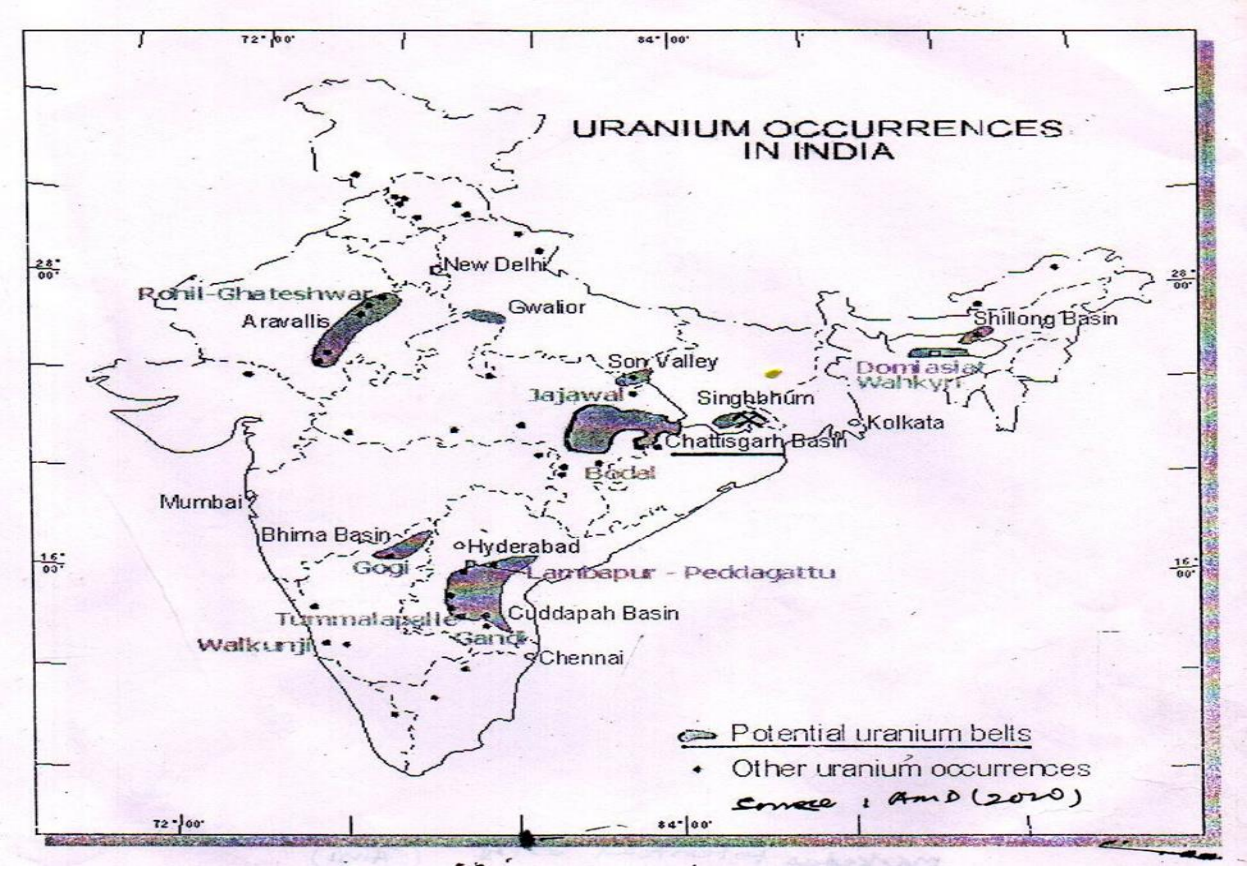

FIG.I - Occurrences of Uranium Deposits in India

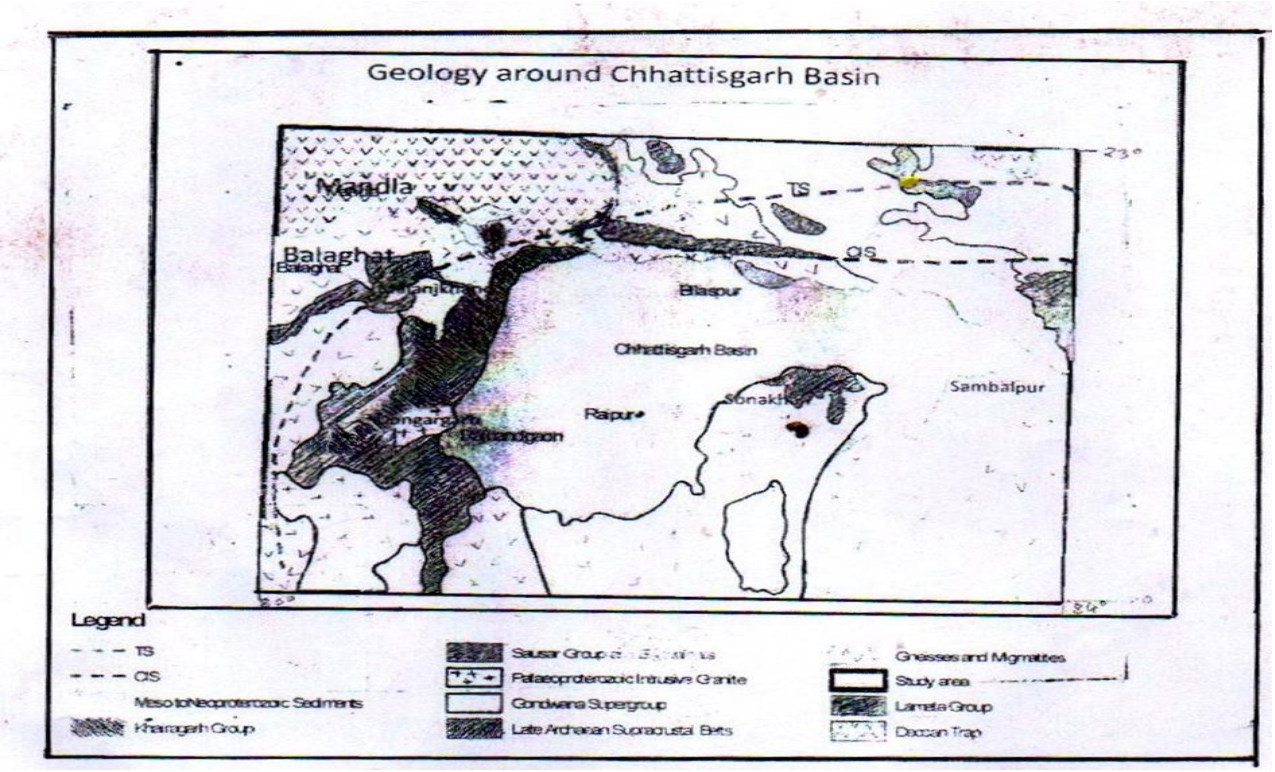

FIG –II Peripheries of Chhattisgarh Basin (Marked as Potential zone)

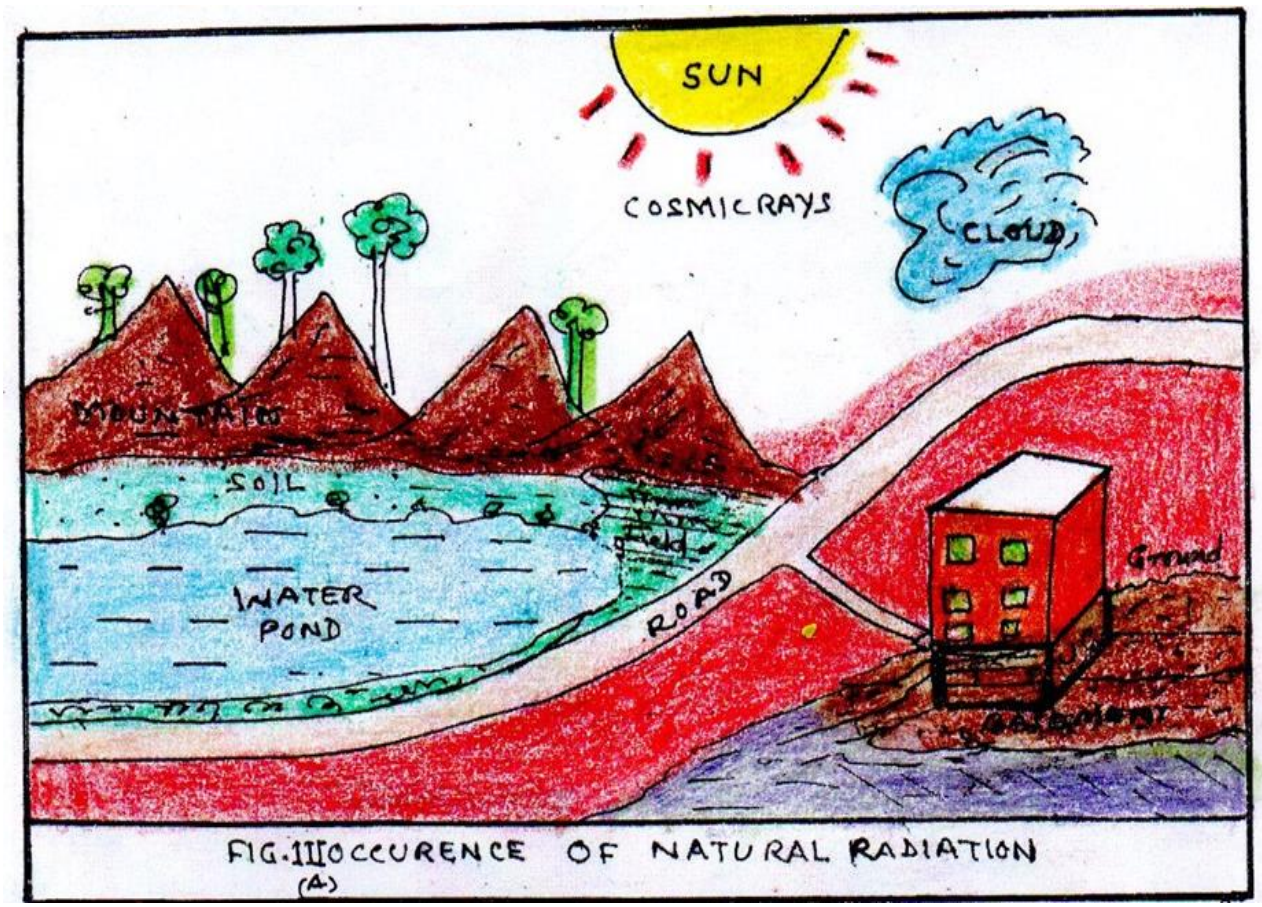

Fig III (a) 1. Atmosphoric Cosmic Rays 2. Terrestrial Hills 3. open Large ponds. 4. Tree Veg 5. Soil 6. U.G. Buildings.

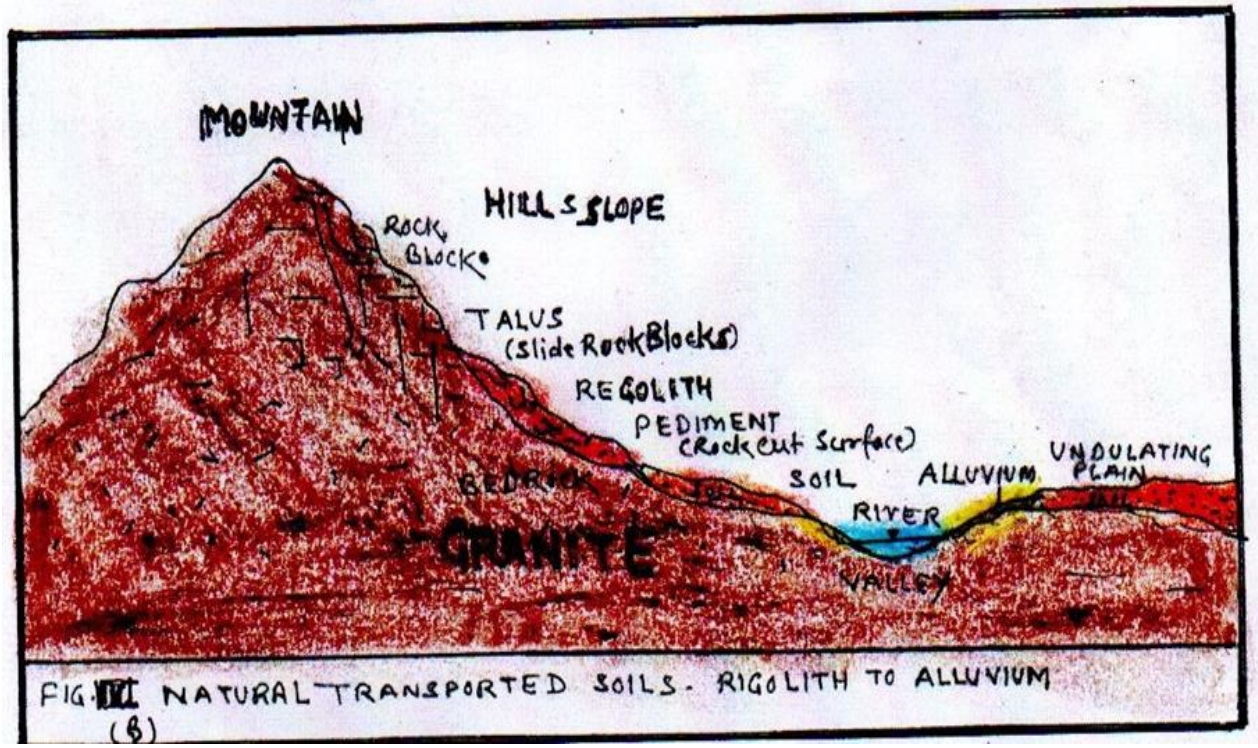

Fig III (b) Granite Rock – Contains Radioactive Minerals, various types of Geomorphic Zone

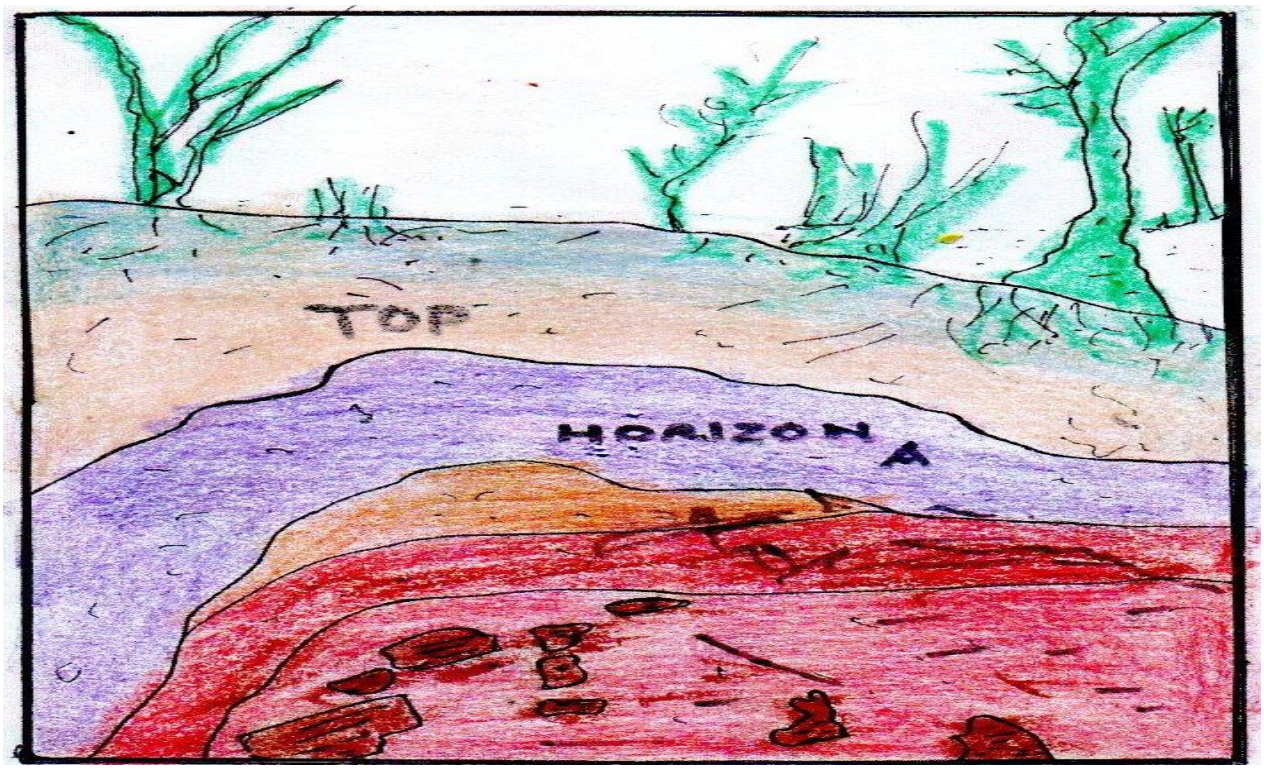

FIG-IV (A)- VERTICAL SOIL PROFILE (leacning of solutes to soil horizons)

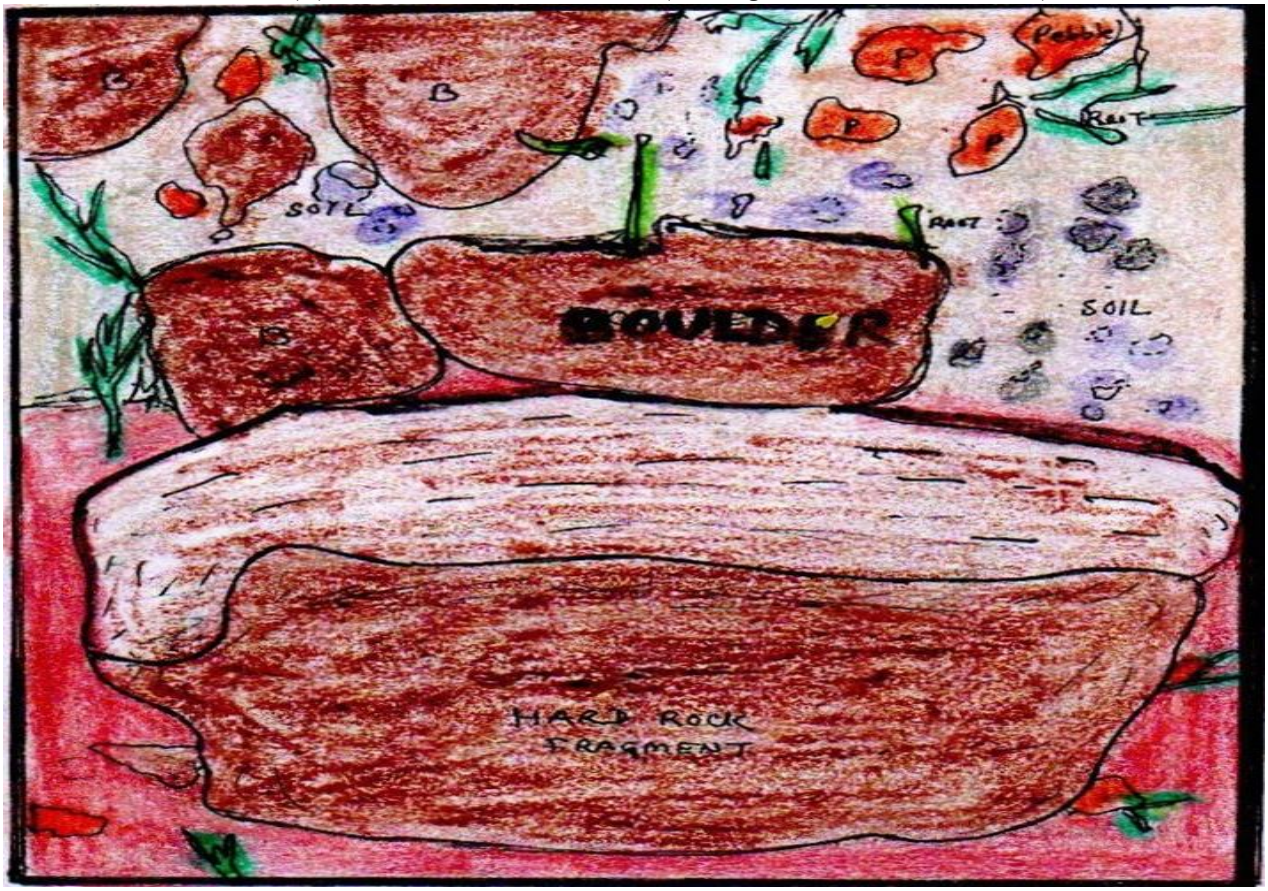

FIG-IV-(B) VEGETATION ROOT ZONE (PROMOTE INFILTRATION OF SOLUTES)

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