



IAEA
International Atomic Energy Agency



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Embassy Suites Downtown Denver Convention Center

Assessment of Radon Concentration in Earthquake Affected Areas of Nepal

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Trip Supported by  **RCA**



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Outline

- RCA Support Program: Overview
- Radon and Environment
- Study sites: Nepal
- Post Earthquake Radon assessment
- Results
- Conclusions





Regional Agreements and Networks

- Regional agreements aim to promote:
 - ✓ Technical co-operation between the developing countries themselves,
 - ✓ Sharing of resources, including facilities, equipment and manpower,
 - ✓ Pooling of knowledge and closer communication and collaboration between scientists in the region.



Regional Cooperative Agreement

for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific

Vision

The **RCA** shall be recognized as an **effective partner** in providing nuclear technologies that address **socio-economic needs** and **contribute to sustainable development** in the region.

Mission



To identify and implement **nuclear technologies** that address **regional needs**



To encourage **sustainability of nuclear technology capacities** in RCA Government Parties



To coordinate **cooperative research in applications** of nuclear science and technology



To promote the **benefits of nuclear technologies** and identify partners and funding mechanisms



To **develop regional networks** for information and experience sharing, assistance and resource mobilization



Regional Cooperative Agreement

for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific

- Inter-governmental agreement established in **1972 as the first regional agreement**
- An effective and systematic **regional cooperative mechanism** to promote the application of nuclear science and technologies that enhance socioeconomic wellbeing and contribute to sustainable development
- Funded by IAEA and contributions of GPs and RCARO, **244 projects** have been implemented in the field of agriculture, human health, industry, environment and others, with the total expenditure of **USD 73.8 mil.**



Regional Cooperative Agreement

for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific

- **RCA Government Parties**

- ✓ **The RCA Government Parties (GPs)** are the Member States of the IAEA in the Asia-Pacific region who have notified their acceptance of the Agreement to the Agency. Since the RCA first came into force in 1972, twenty-two (22) GPs have entered into the Agreement.

- **IAEA and RCA**

- ✓ The IAEA assists the RCA through provision of technical advice and support as well as a major involvement in the implementation of the regional activities.
- ✓ Financial support of the RCA Programme is provided through the Technical Cooperation Fund, as well as through extrabudgetary donations from the GPs and funding from other regional/international bodies.



Regional Cooperative Agreement

for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific



- Australia (AUL)**
- Bangladesh (BGD)**
- Cambodia (KAM)**
- China (CPR)**
- Fiji (FIJ)**
- India (IND)**
- Indonesia (INS)**
- Japan (JPN)**
- Korea, Republic of (ROK)**
- Laos (LAO)**
- Malaysia (MAL)**
- Mongolia (MON)**
- Myanmar (MYA)**
- Nepal (NEP)**
- New Zealand (NZE)**
- Pakistan (PAK)**
- Palau (PLW)**
- Philippines (PHI)**
- Singapore (SIN)**
- Sri Lanka (SRL)**
- Thailand (THA)**
- Vietnam (VIE)**

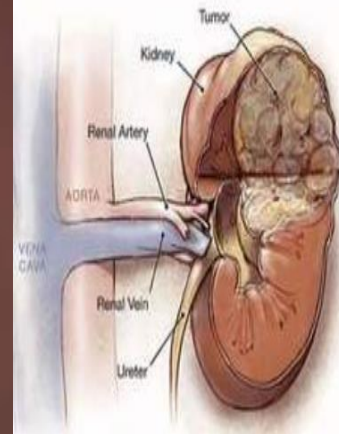
Radon and Environment



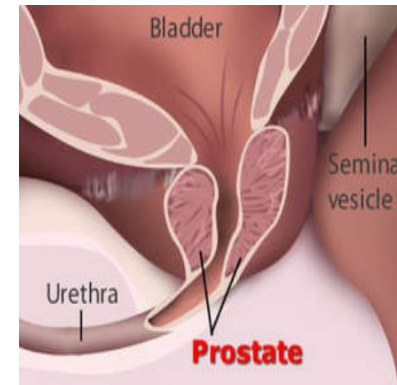
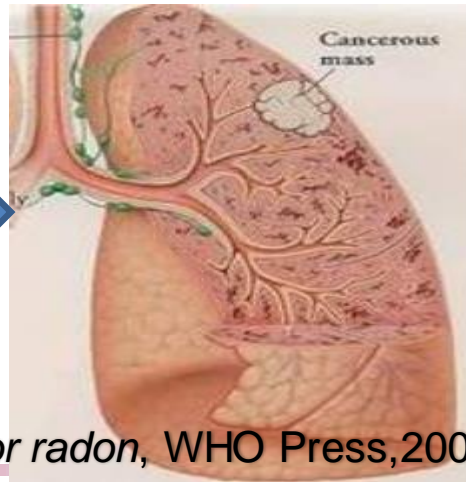
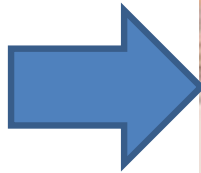
What happens when people smoke for long period of time?



Radon is second cause of lungs cancer after smoking.



Answer

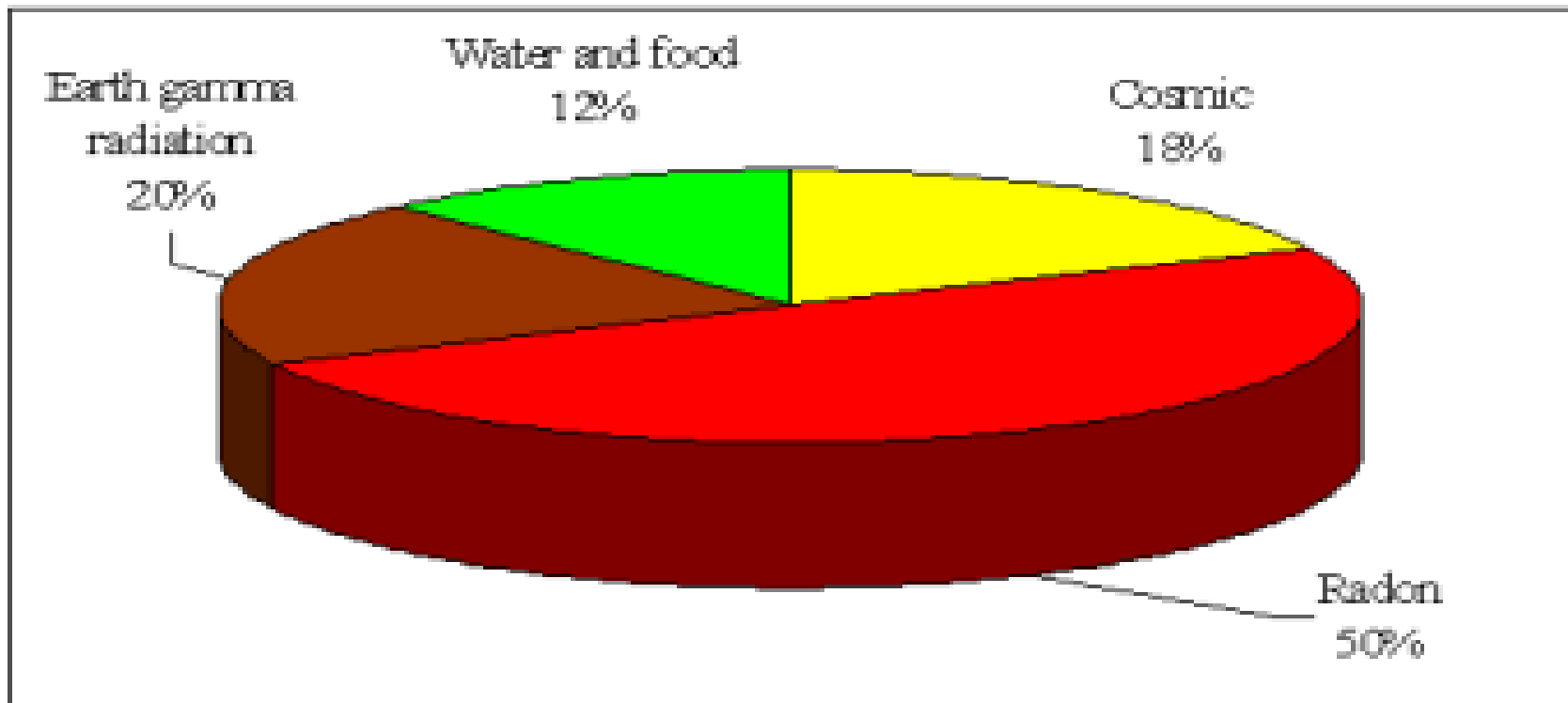


WHO, *Handbook for indoor radon*, WHO Press, 2009



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- Radiation in our Environment



Natural background Radiation

UNSCEAR, Report of General Assembly, UN, New York, Supplement No. 46(A/55/46), 2000



How do we get radon in indoor environment ?



Radon.....?

- ☀ Radon is naturally occurring radioactive materials
- ☀ Radon is colorless, odorless and tasteless gas
- ☀ Half-life is 3.8 days
- ☀ In general, the primarily source of radon is the soil
- ☀ Radon is sparingly soluble in water
- ☀ Radon is alpha-emitter

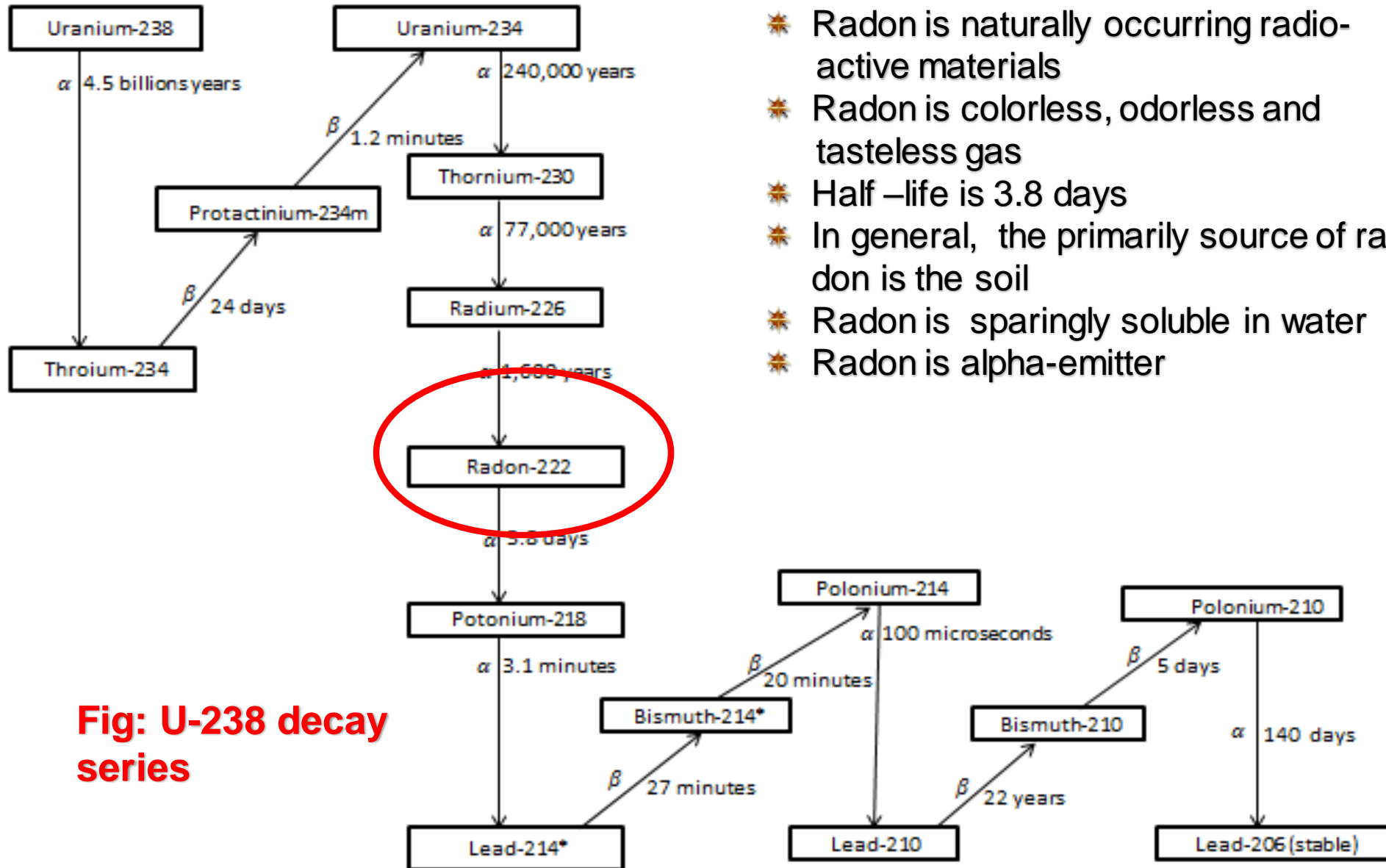
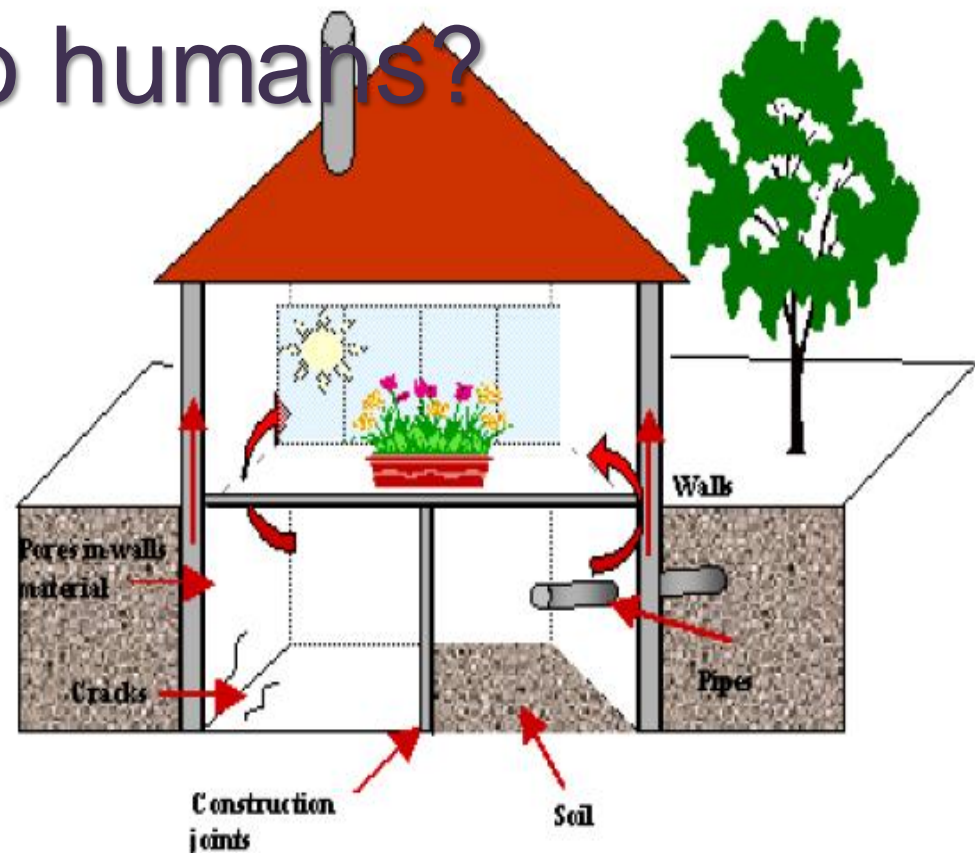
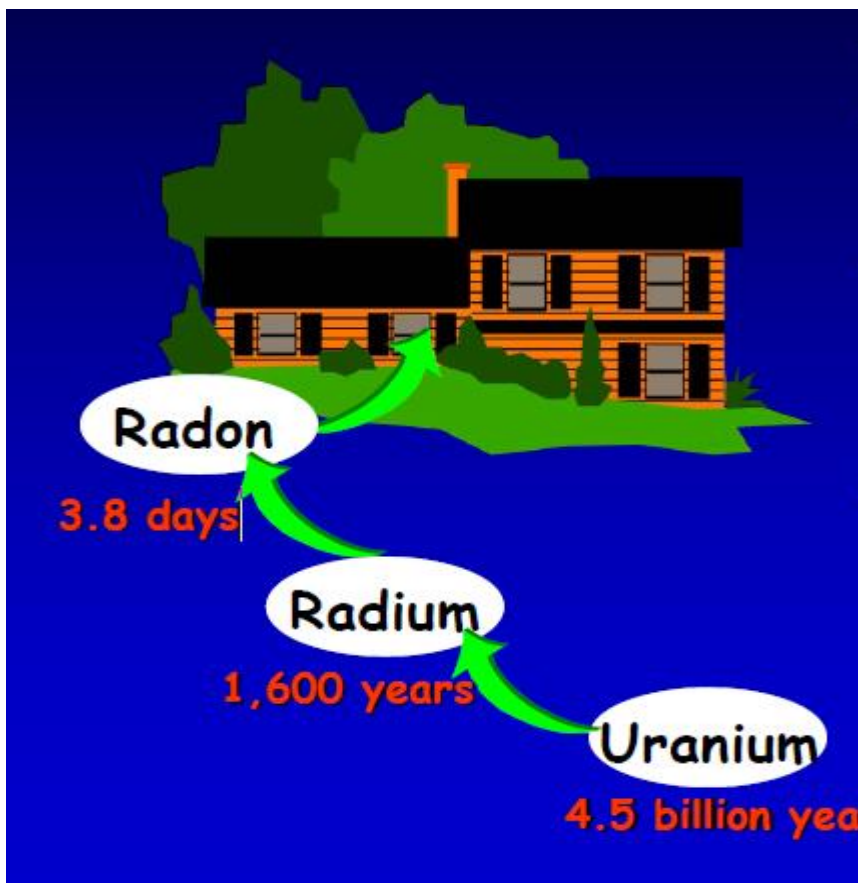


Fig: U-238 decay series



Routes of Radon to humans?

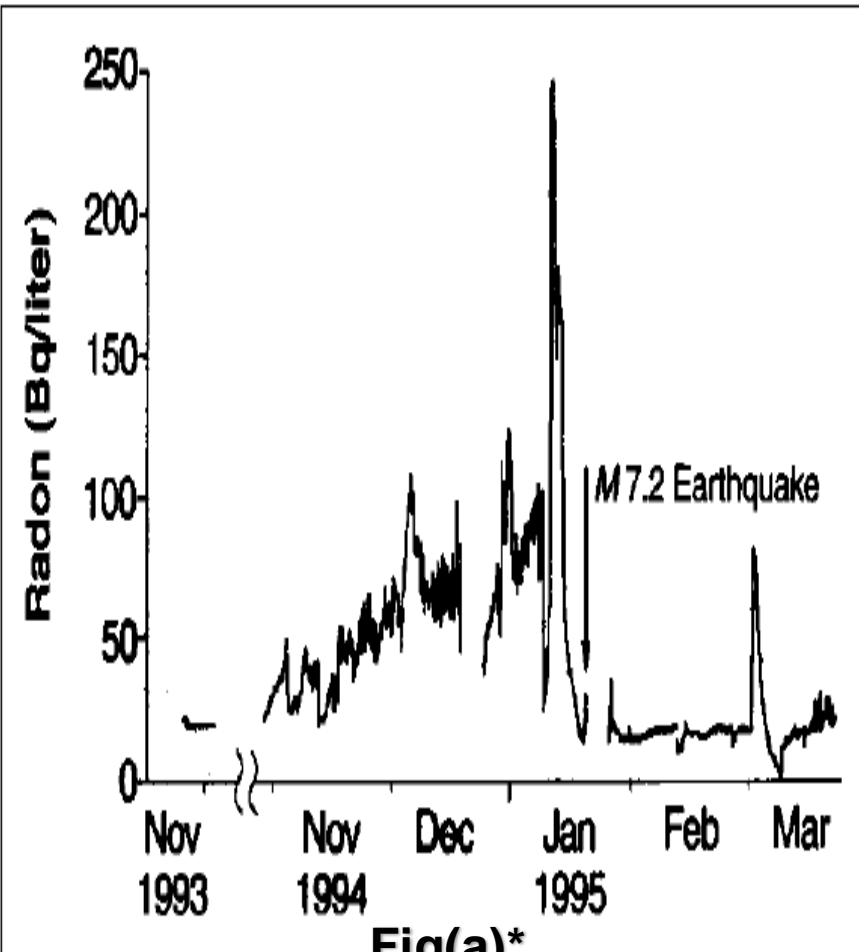


- ◆ Walls
- ◆ Pipes
- ◆ Cracks
- ◆ Construction joints
- ◆ Soil

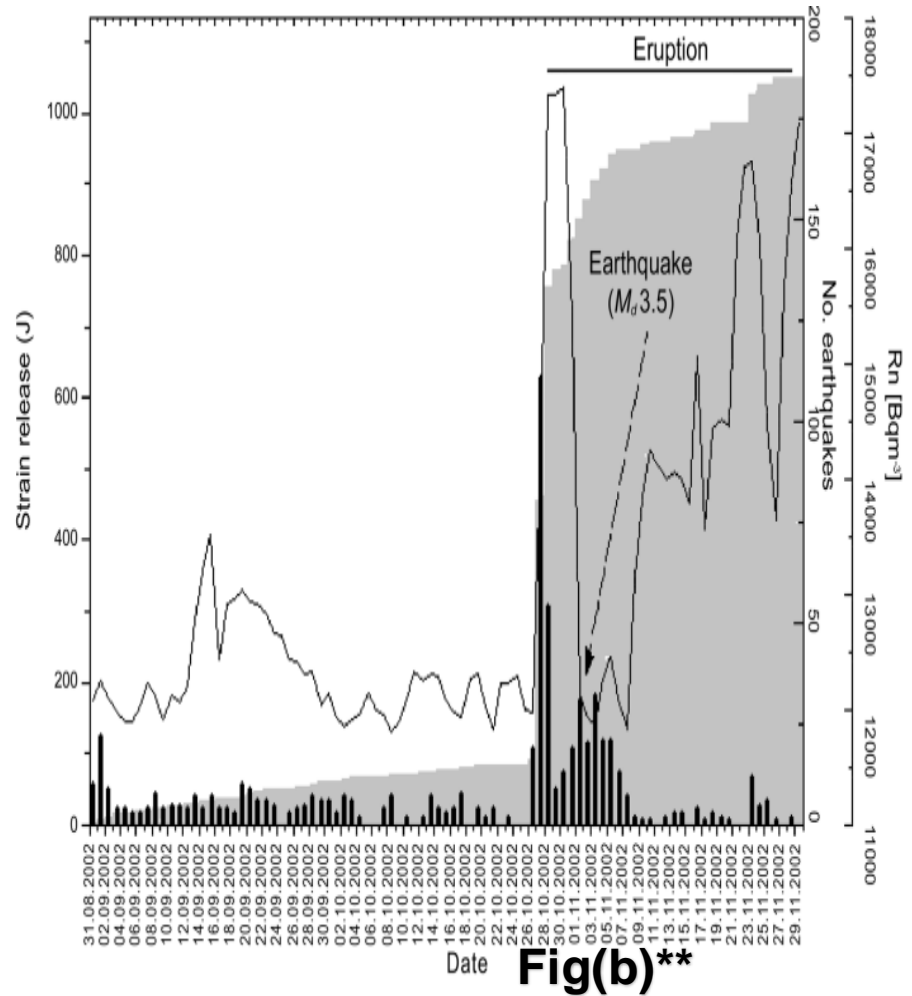
D.I. Preston et al., Radiat. Res., **160**, 381-407 (2003)



Earthquake and Radon



Fig(a)*



Fig(b)**

Fig(a)*: radon concentration in ground water Kobe earthquake, Japan (1995).
 Fig(b)** soil radon concentration recorded at Mt. Etna by Vena Station before and after earthquake eruption (2002)

*G. Igarashi *et al.*, *Science*, **269**, 60-61 (1995)
 G. Imme *et al.*, *Ann. Geophys.*, **48, 65-71 (2005)



Study Sites, Nepal

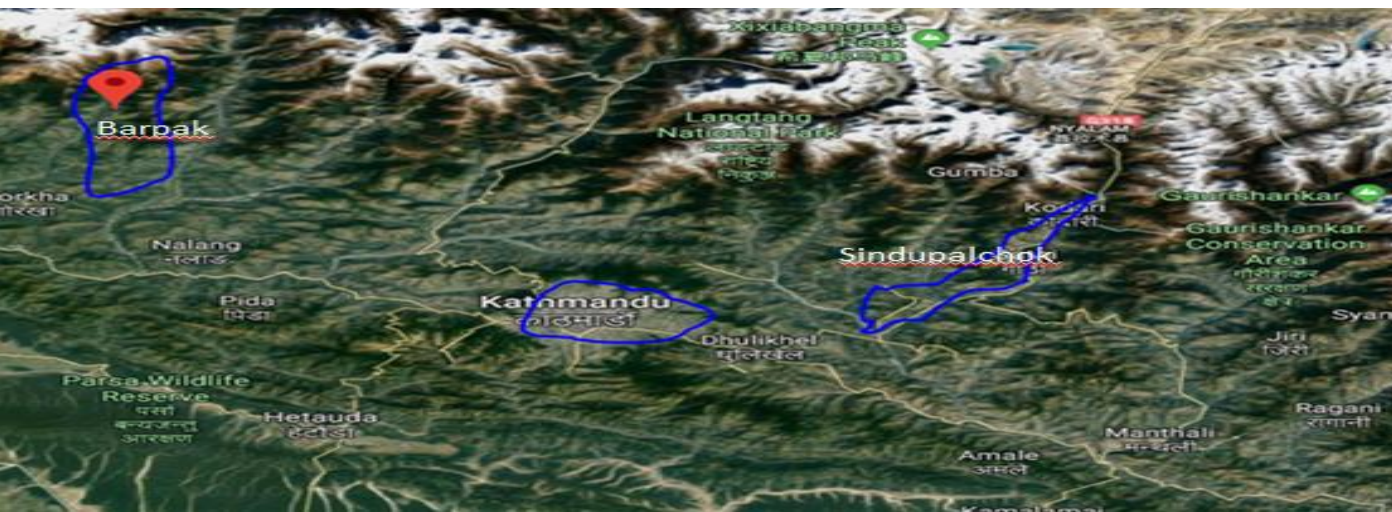
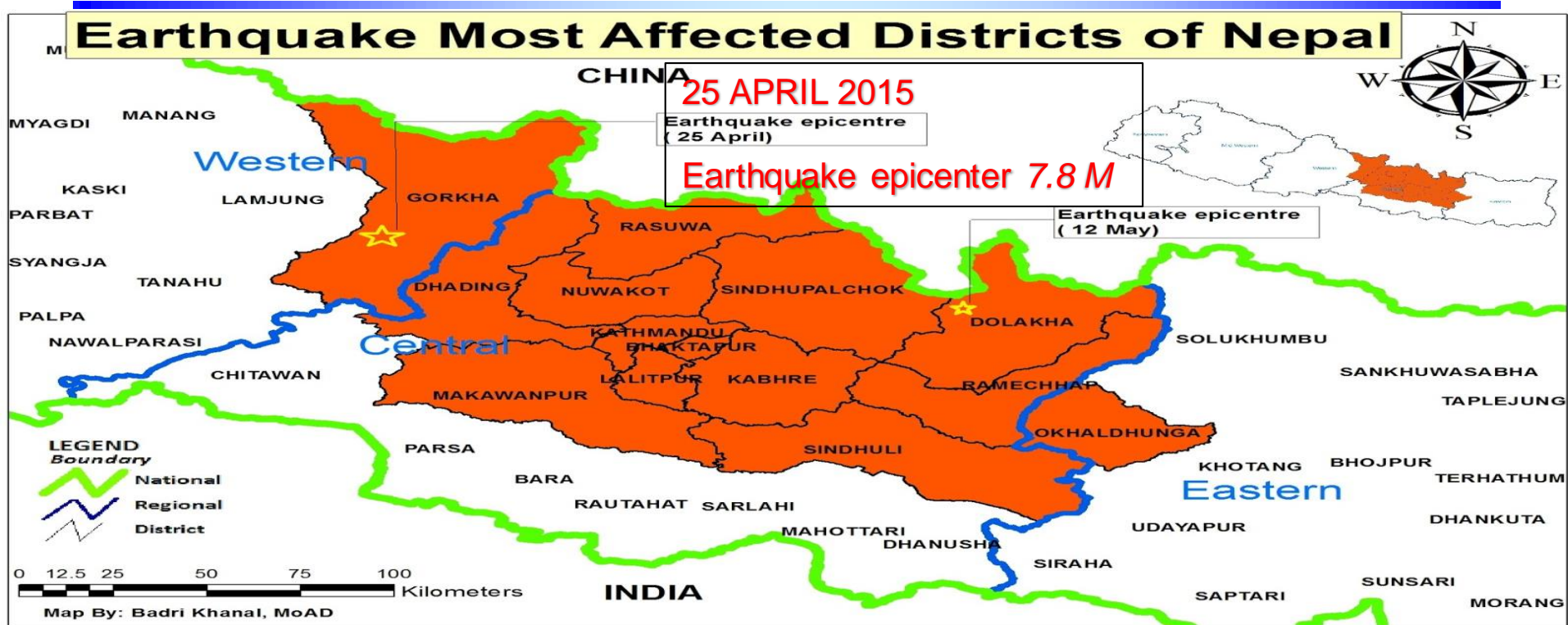
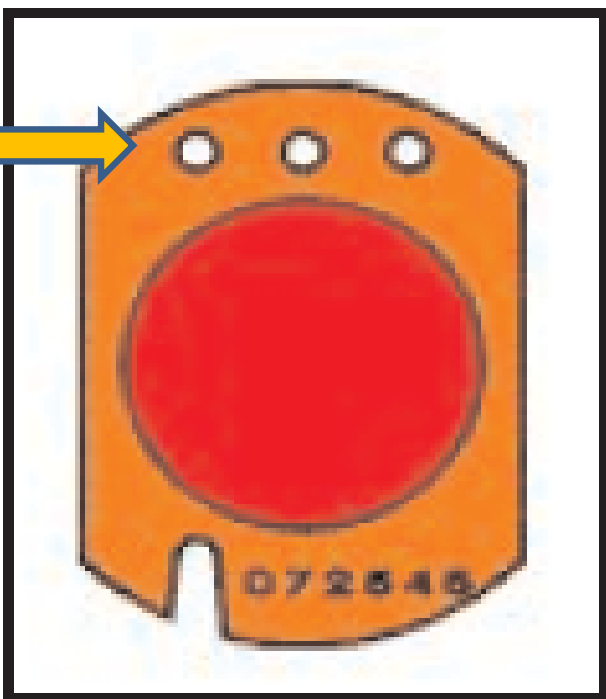


Fig (a) :the earthquake most affected districts of Nepal, Fig(b): the satellite picture of study site.

Material Used: Radon Assessment



Fixed for 100 days



Etching Process, in 2.5M of NaOH solution for 1.5h at 60°C



Observed under microscope



Laboratory Dosirad, France

Kodalpha Radon Dosimeter and LR-115 SSNTD specification; Accessible online www.radon.at/ download ch_det. (2014)



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Radon Exelation Rate :Can Technique

Samples were collected from Sindupalchok and Barpak includes Building materials like sand, rock, soil, cement, bricks.

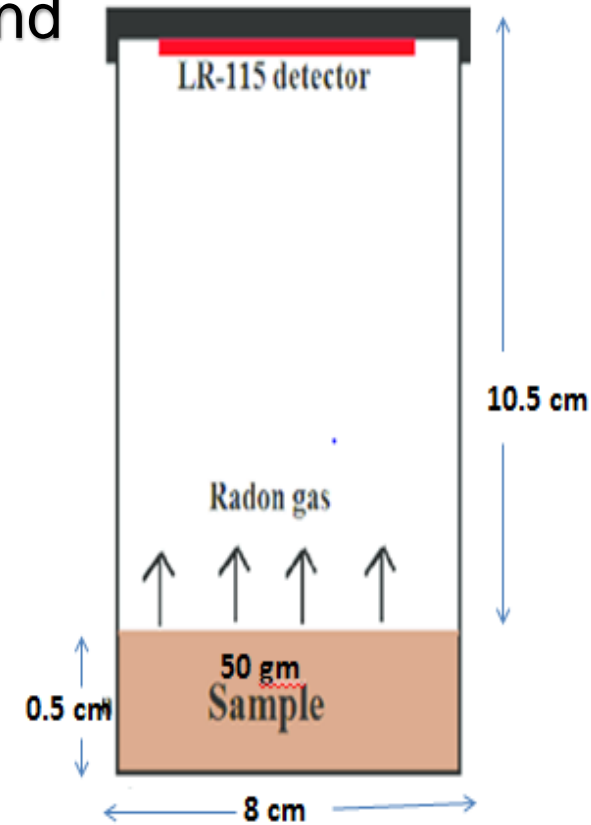


Fig: Plastic can

- ❑ Detector was fixed at top
- ❑ Made air tight
- ❑ Kept for 100 days

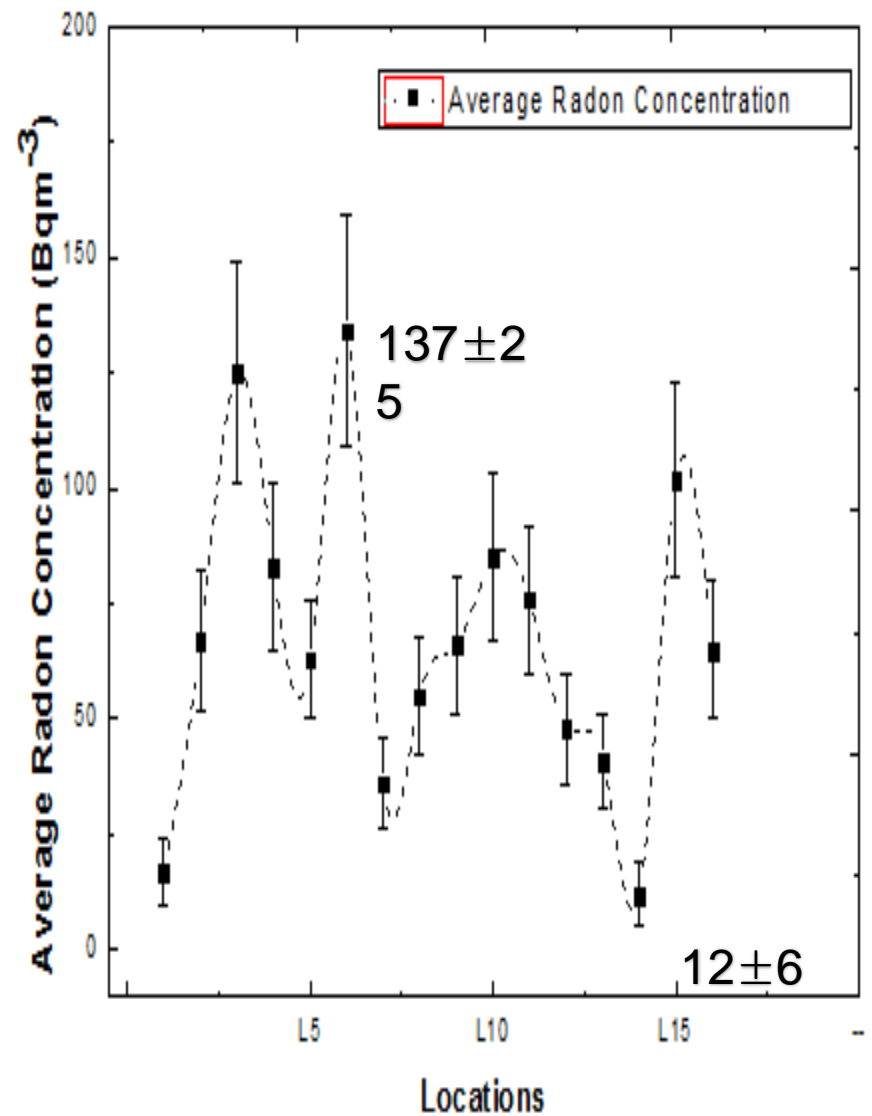
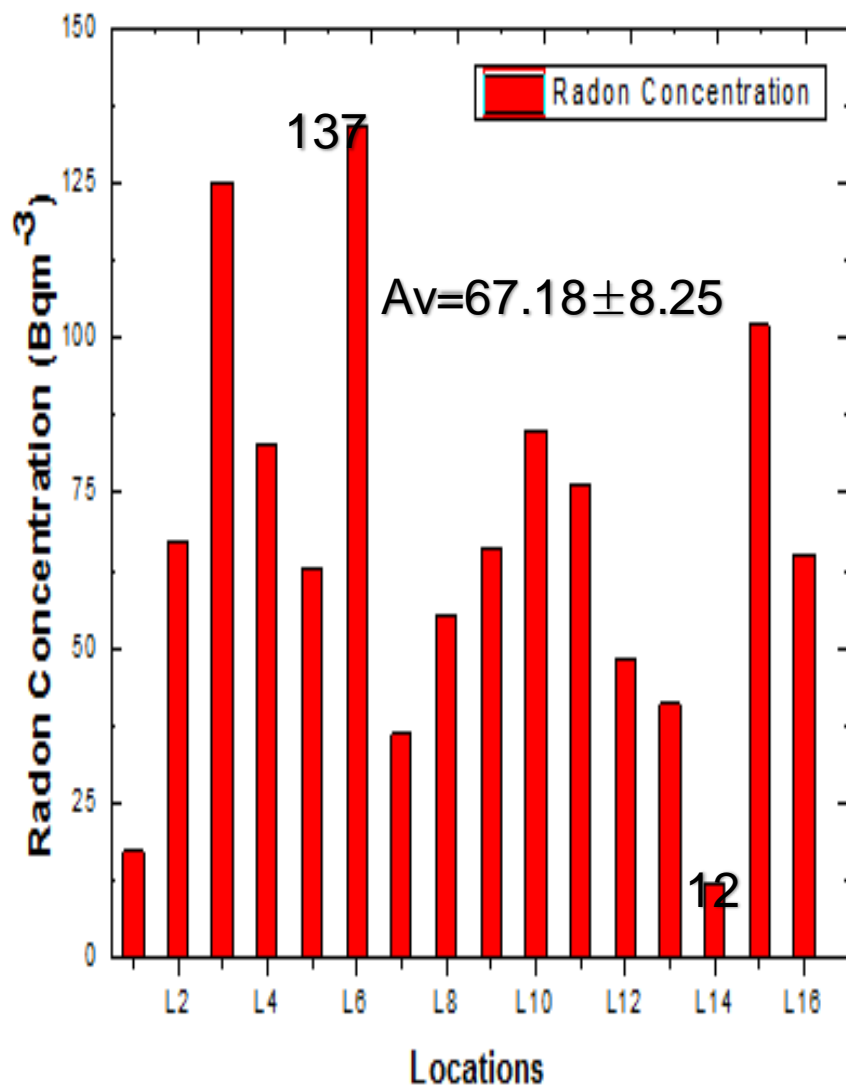
M. Abd-Elzaher, AJAS, 9, 1653-1659 (2012)



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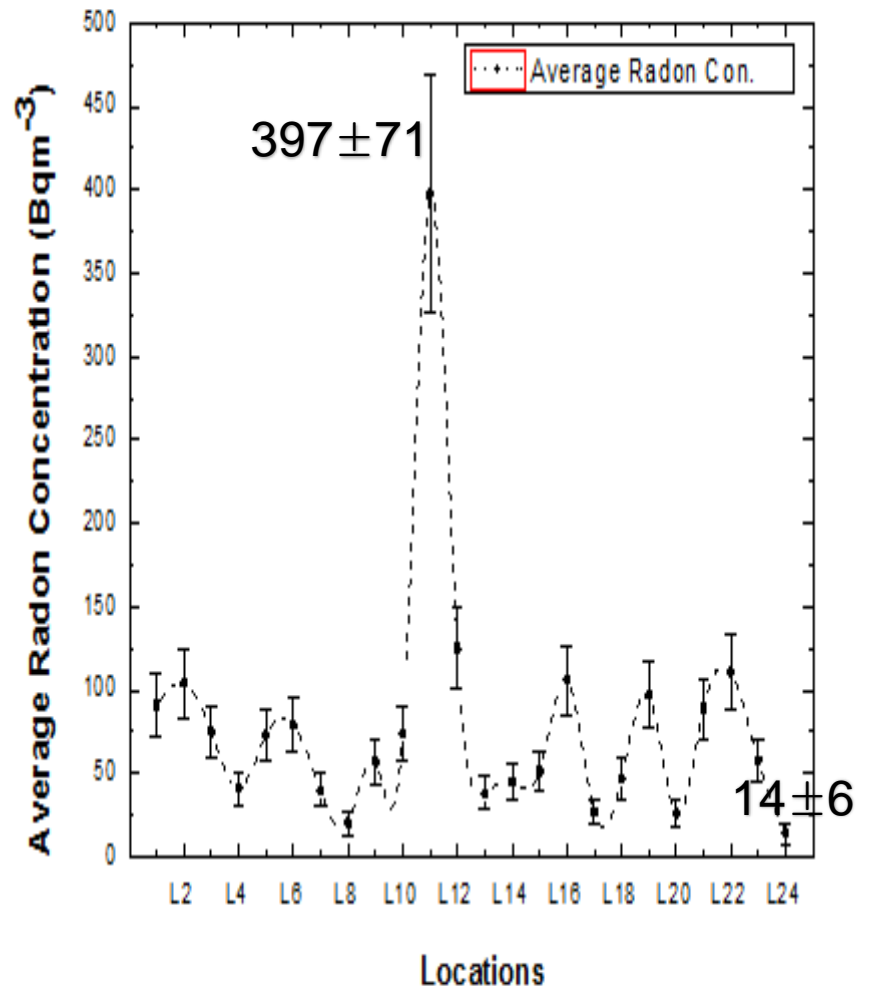
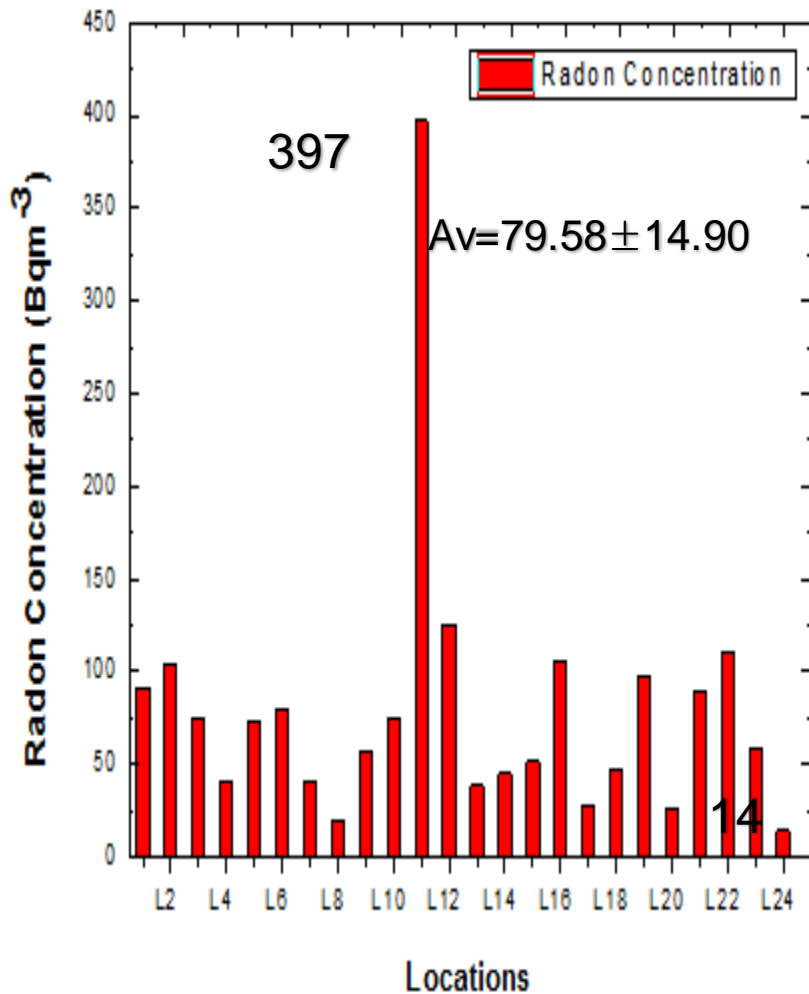
Results/Findings





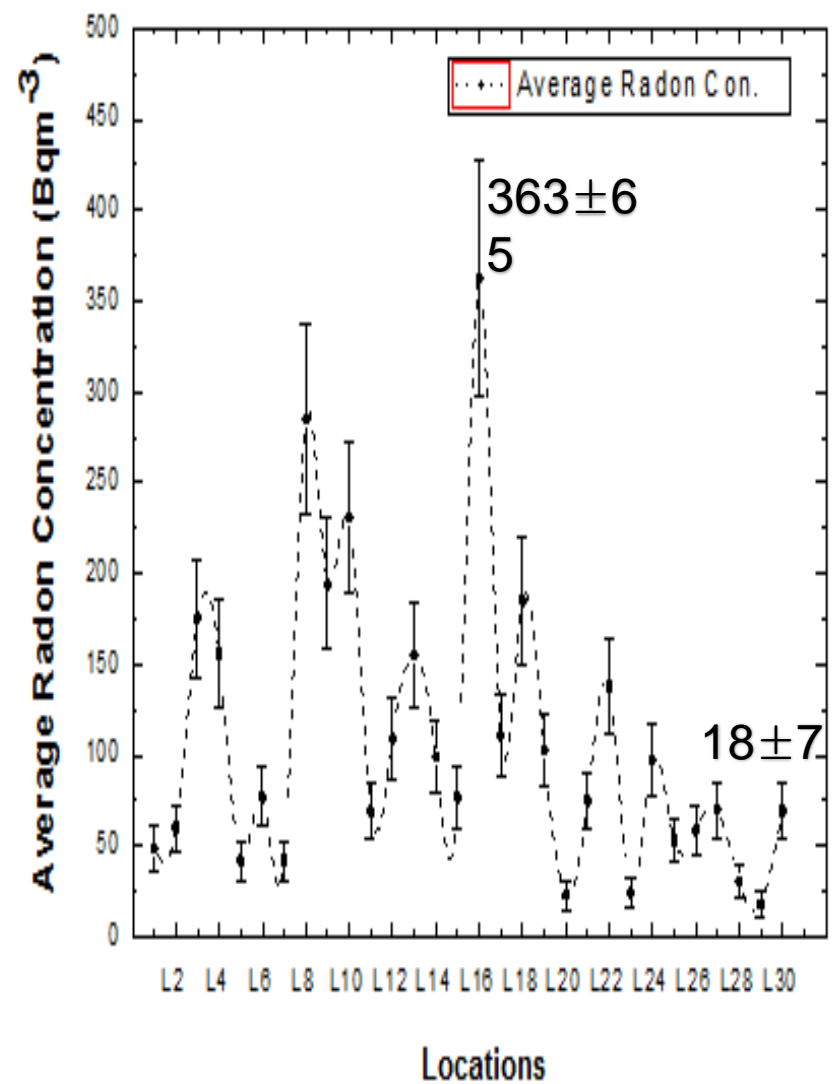
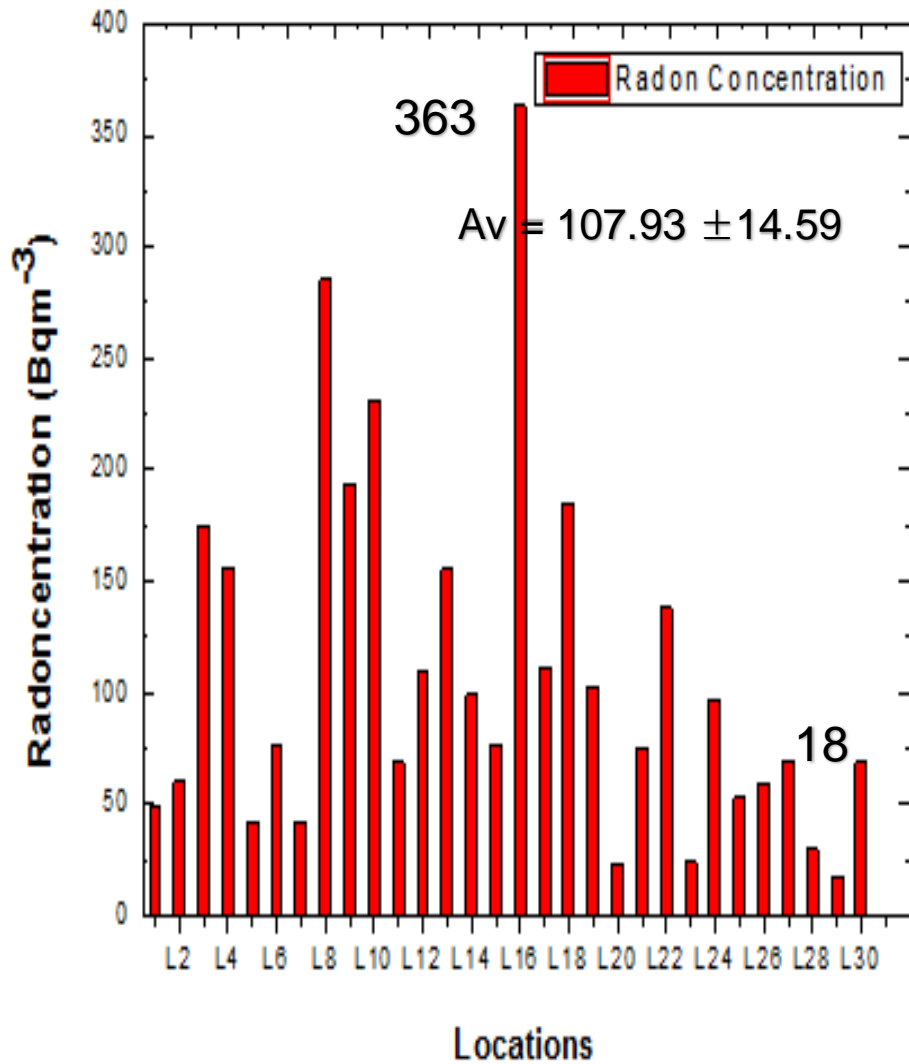
Radon concentration and locations with fluctuation of radon concentration in each location of **Kathmandu Valley**





Radon concentration and locations with fluctuation of radon concentration in each location of **Sindhupalchwok District**





Radon concentration and locations with fluctuation of radon concentration in each location of **Barpak, Gorkha District**



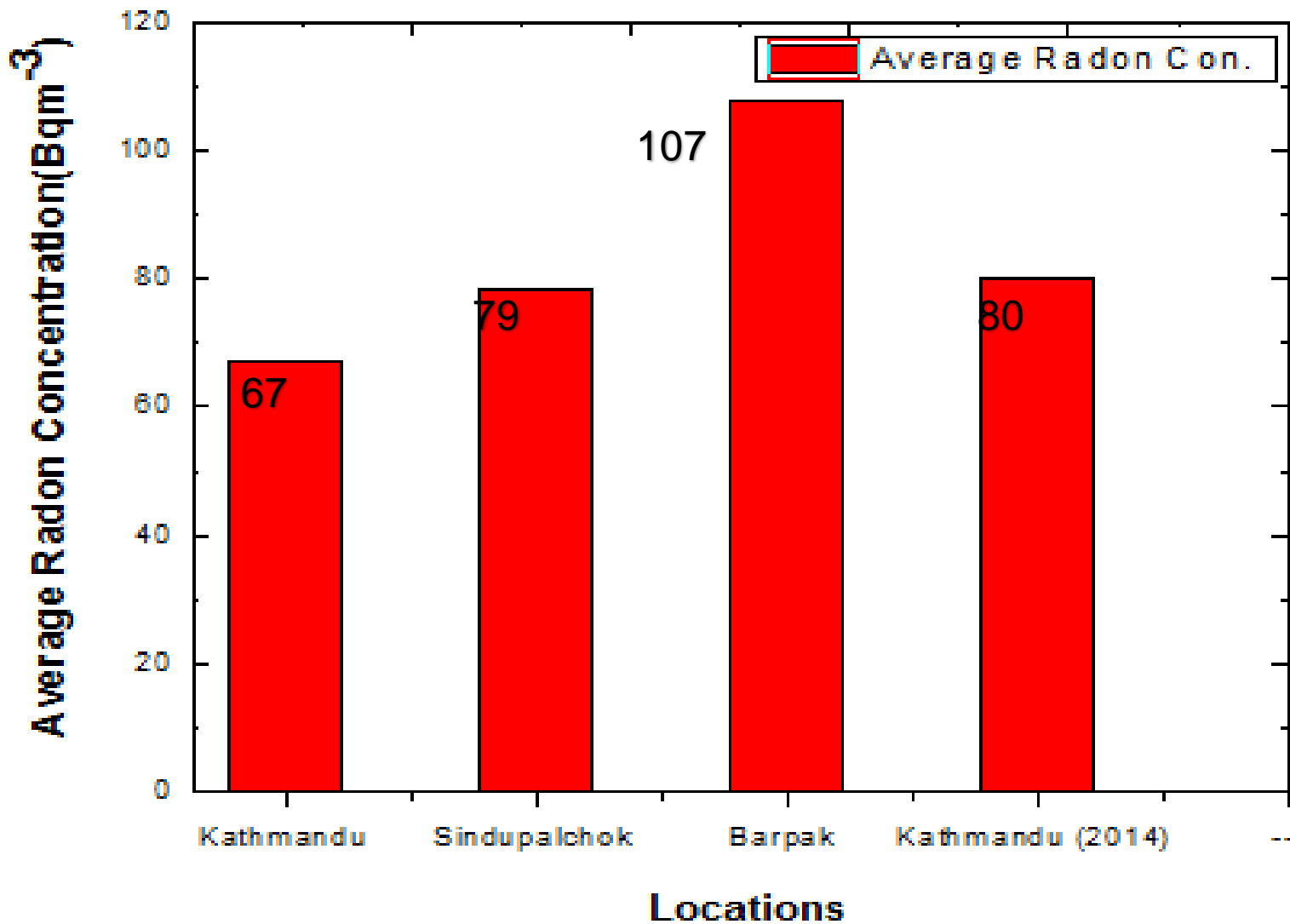


Figure represents the average radon concentration of Kathmandu Valley, Sindupalchok District, & Barpak and comparing with the value of Kathmandu Valley (2014).

D. Thapa, and B.R. Shah, in proceeding of AARST Int. Rn Sym., Sc (2014)



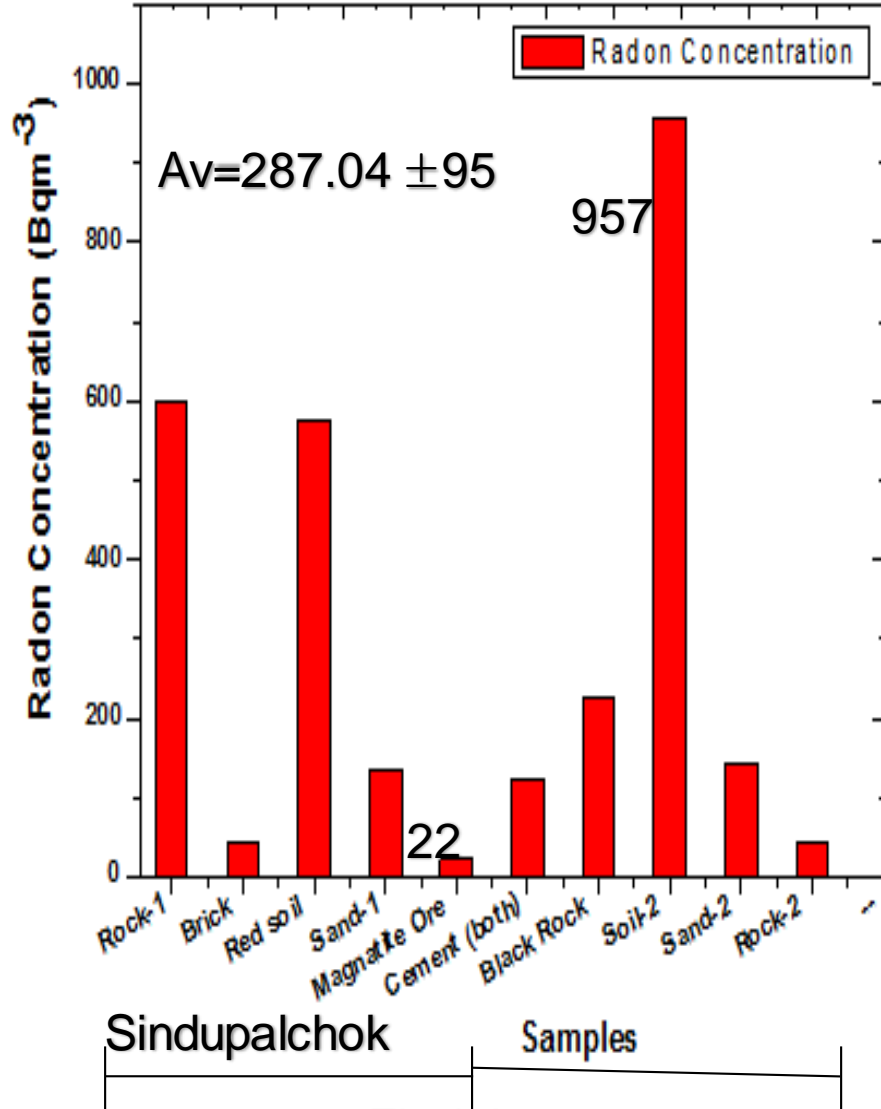


Fig (a)

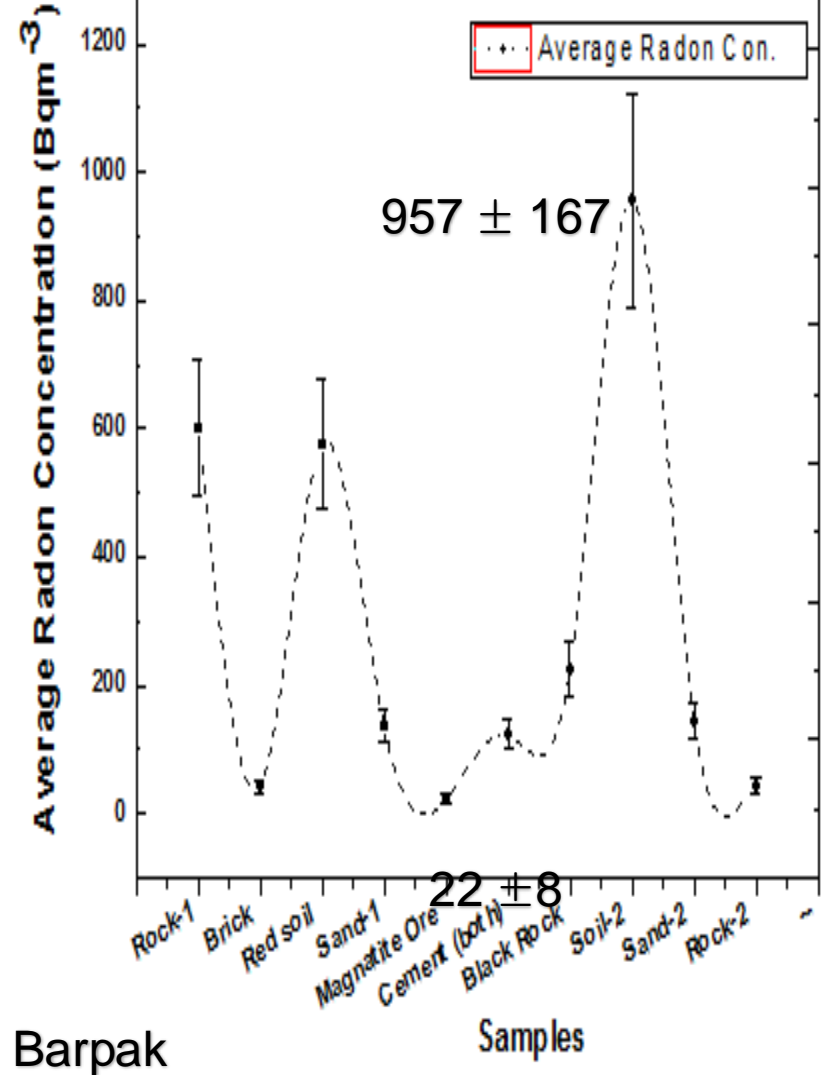


Fig (b)

Fig (a) & Fig(b) represent plot of radon concentration and samples, and fluctuation of radon concentration from each samples respectively collected from **Sindupalchok District and Barpak**.



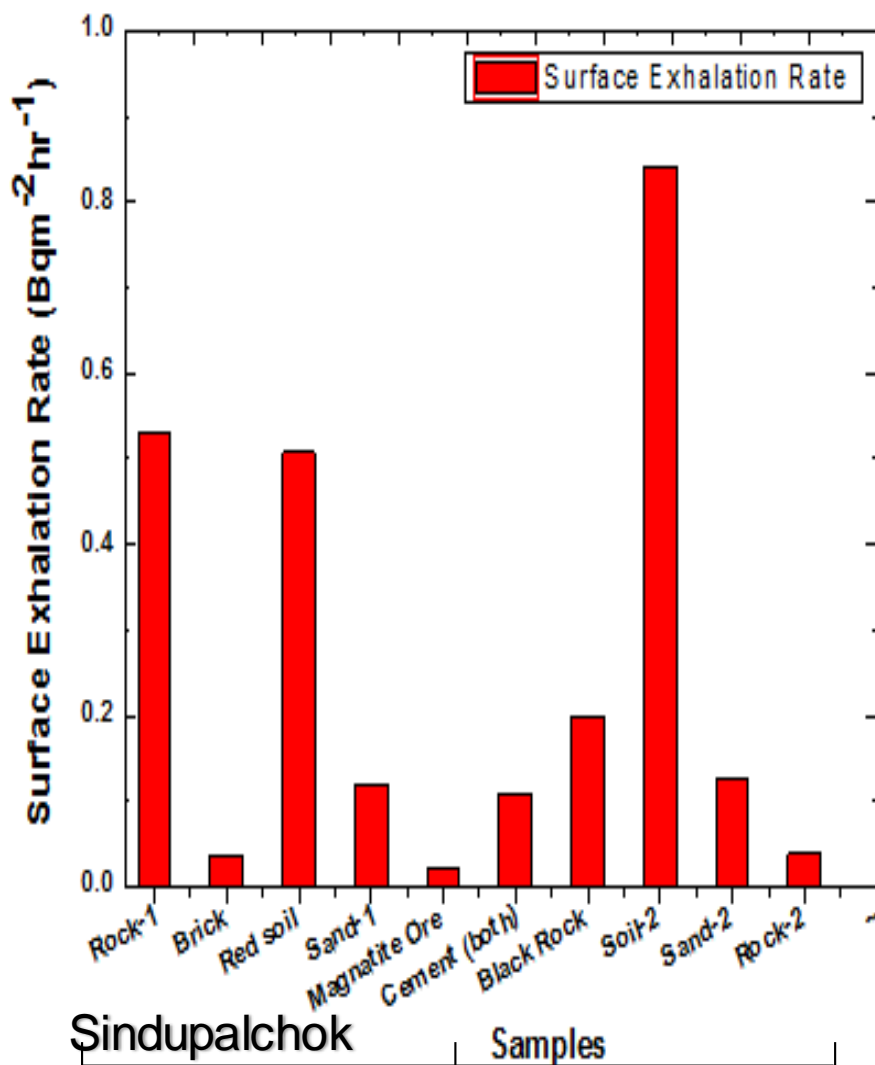
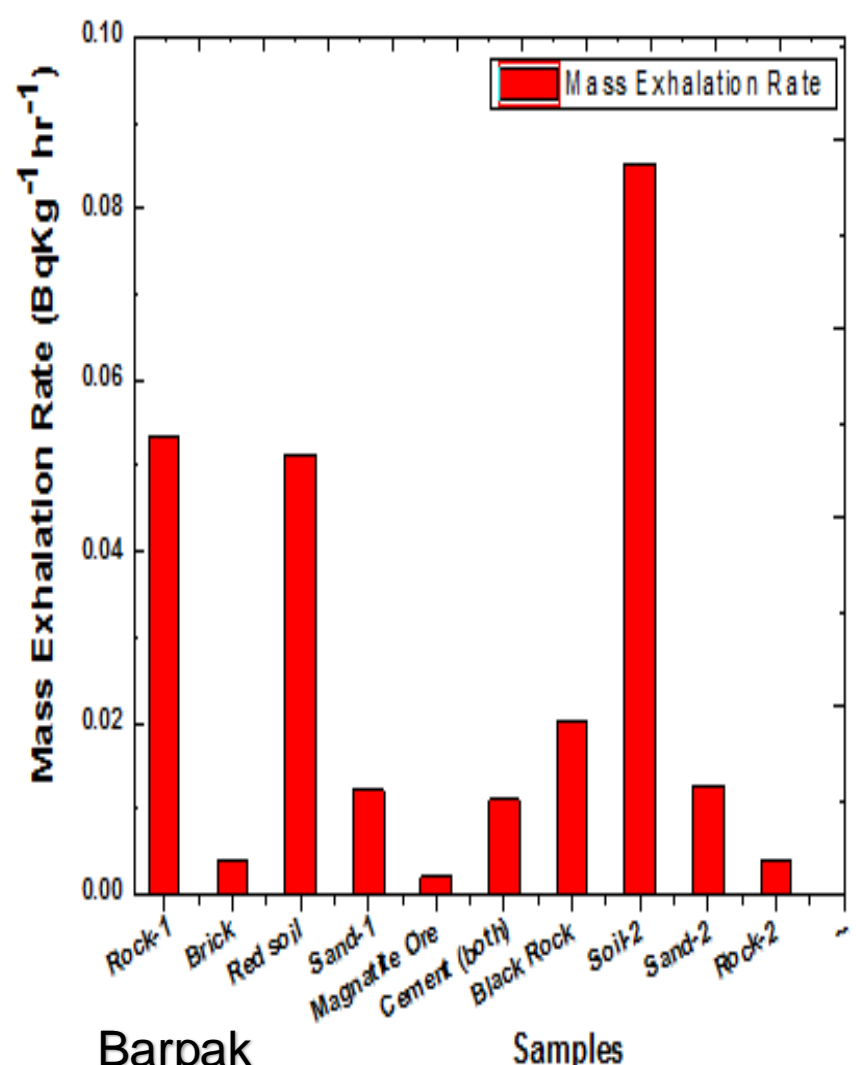


Fig (a)



Fig(b)

Fig (a) & Fig(b) represent plot of **surface exhalation rate & samples**, and **mass exhalation rate & samples** respectively.



Conclusion and Recommendation

- ⊕ Radon concentration was found **higher at Barpak** than Kathmandu Valley and Sindupalchok District.*
- ⊕ Radon concentration is below the permissible level of **200-600 Bq/m³** as recommended by ICRP (Pub No. 65)**
- ⊕ Annual effective dose is also **below the level, 3-10 mSv per year** as recommended by ICRP.
- ⊕ **Low radiological (life- time fatality) risks** from radon in the residential area.

* *D. Thapa, and B.R. Shah, in proceeding of AARST Int. Rn Sym., Sc (2014)*

** *ICRP, Publication No. 65, Pergamon Press, Oxford (1993)*



Acknowledgements

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Thank you for your Kind Attention!

