Relationship between radon concentration in soil gas and soil physical properties in Beijing

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Outline

- Soil types in geology
- Radon concentration in soil gas
- Soil radon and soil physical properties
- Radon in soil and physical parameters-case
- Conclusion

Soil types in geology

- Soil classification according to soil particle size
- Soil type and the concentration are related to soil parent material (geological lithology)

Soil classification in geology

Soil type	Clay	Sub-clay	Sub-sand	Clay-sand	Sand	Coarse
<0.01mm/%	>50	50～20	20～10	10～5	<5	_
Particle size/mm	0.005～0.02	0.02～0.05	0.05～0.25	0.25～0.5	0.5～2	>2

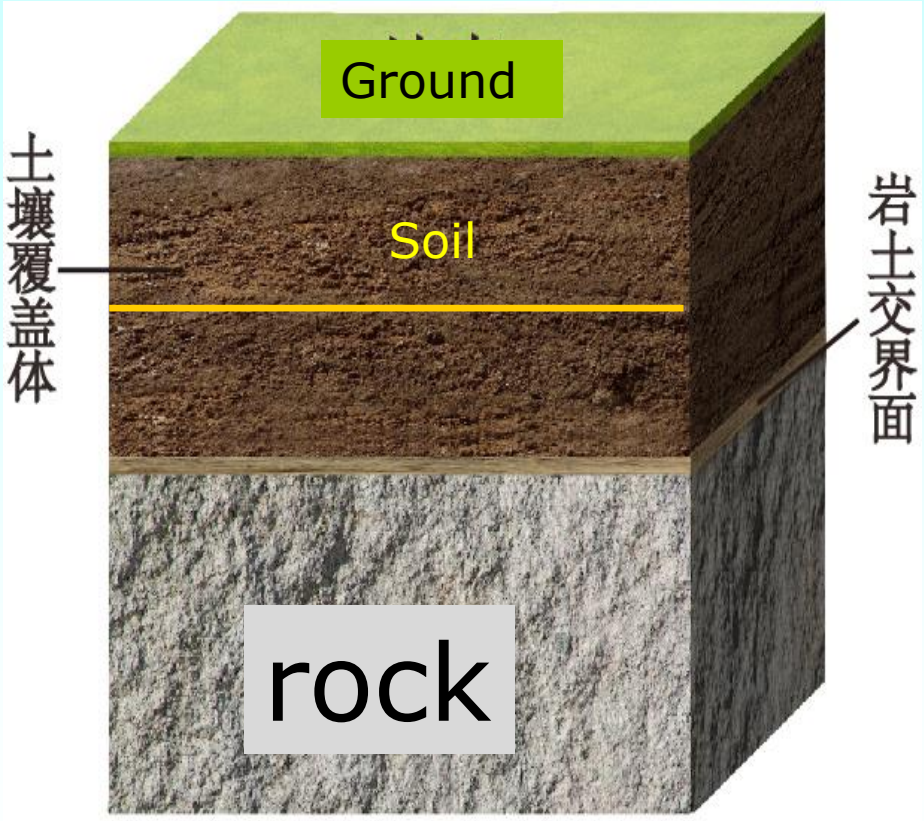
Radon concentration in soil gas

$$\frac{D_B^*}{P_{eff}}\frac{d^2C_B}{dz_2} - \frac{1}{P_{eff}}\frac{d(v_d C_B)}{dz} - \lambda_{Rn}C_B + \lambda_{Rn}C_{BS} = 0$$

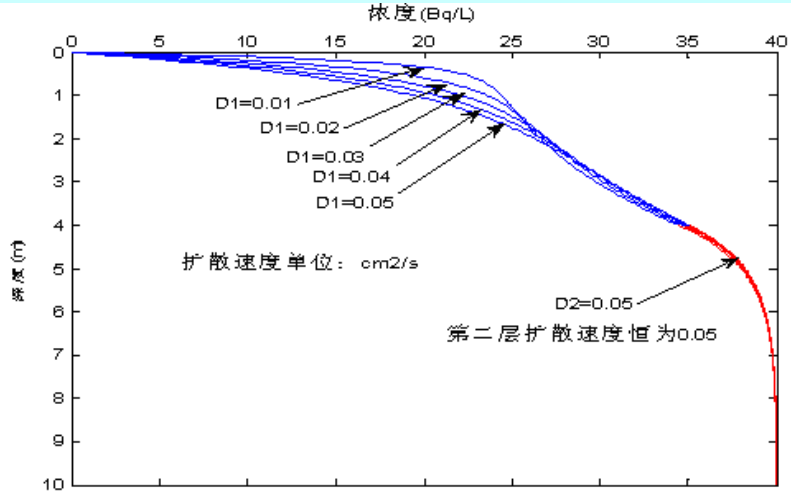
$$C_{BS} = \varepsilon a_B \rho / p_{eff}$$

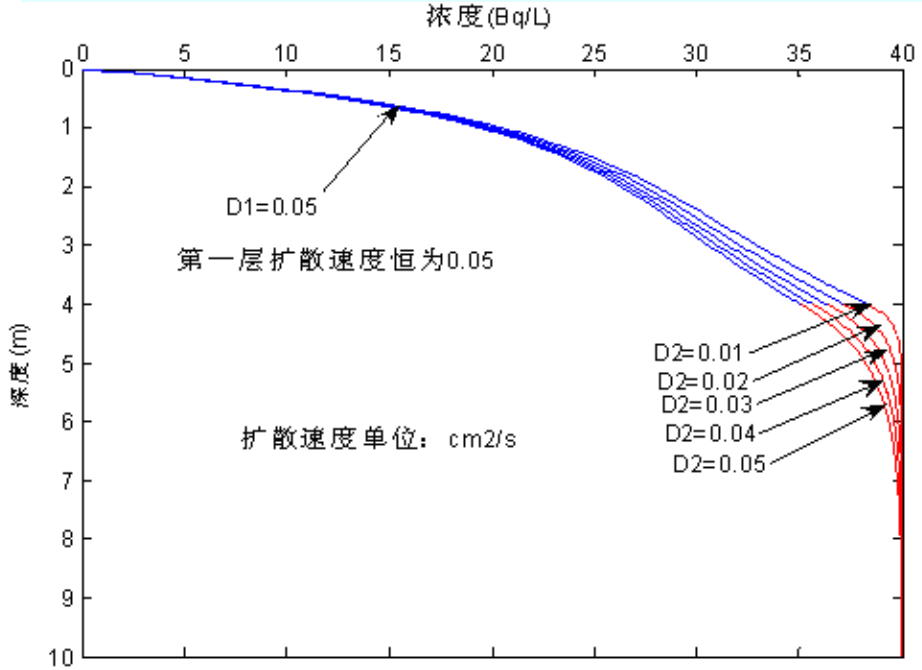
$$D_B = D_B^* / P_{eff}$$

Soil model



Radon and Diffusion coefficient





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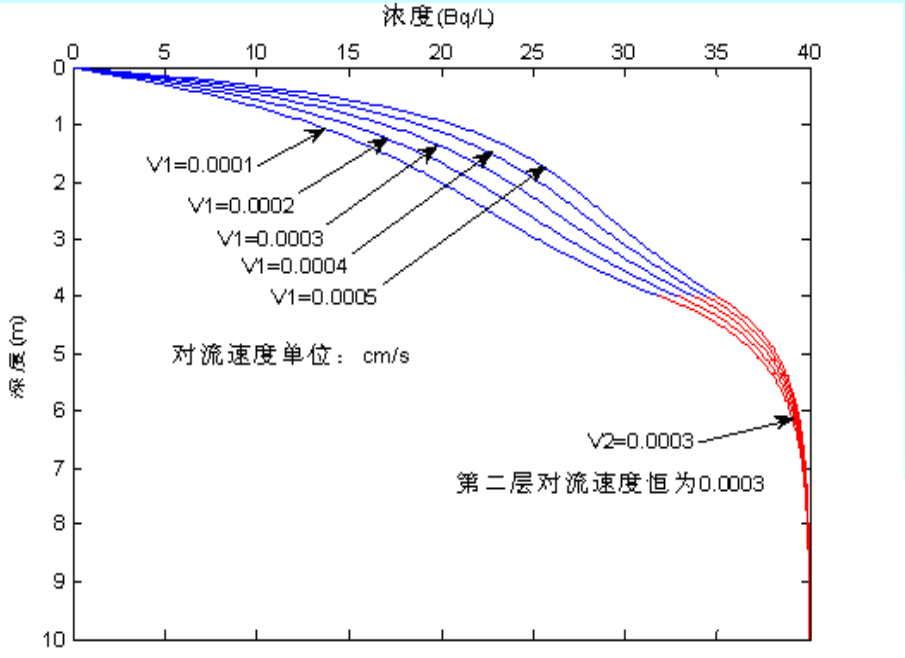
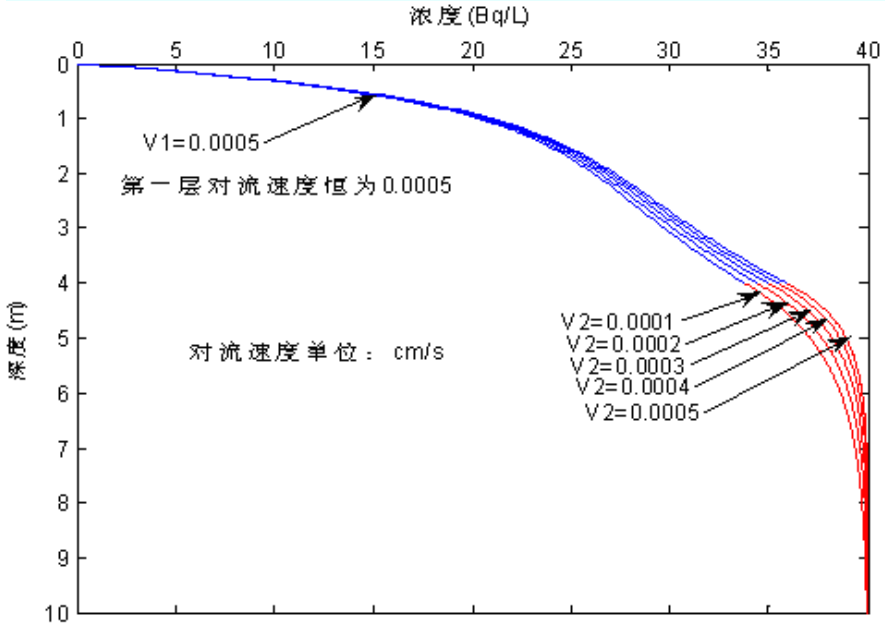
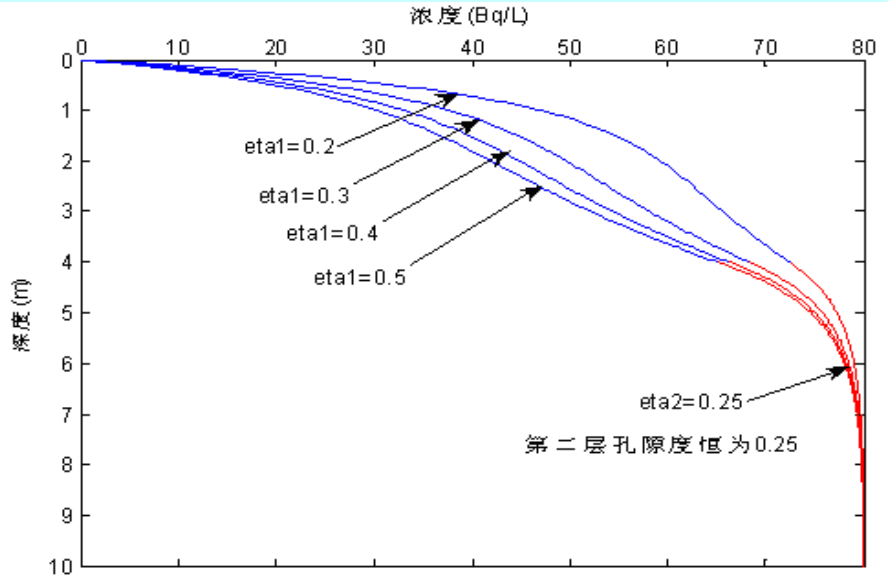
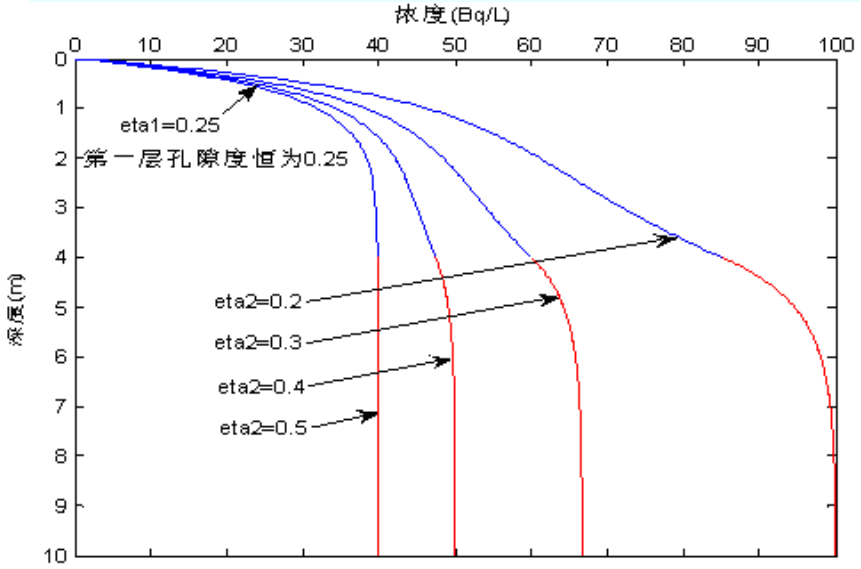
Radon and convection speed





Radon and *effective porosity* (most important)

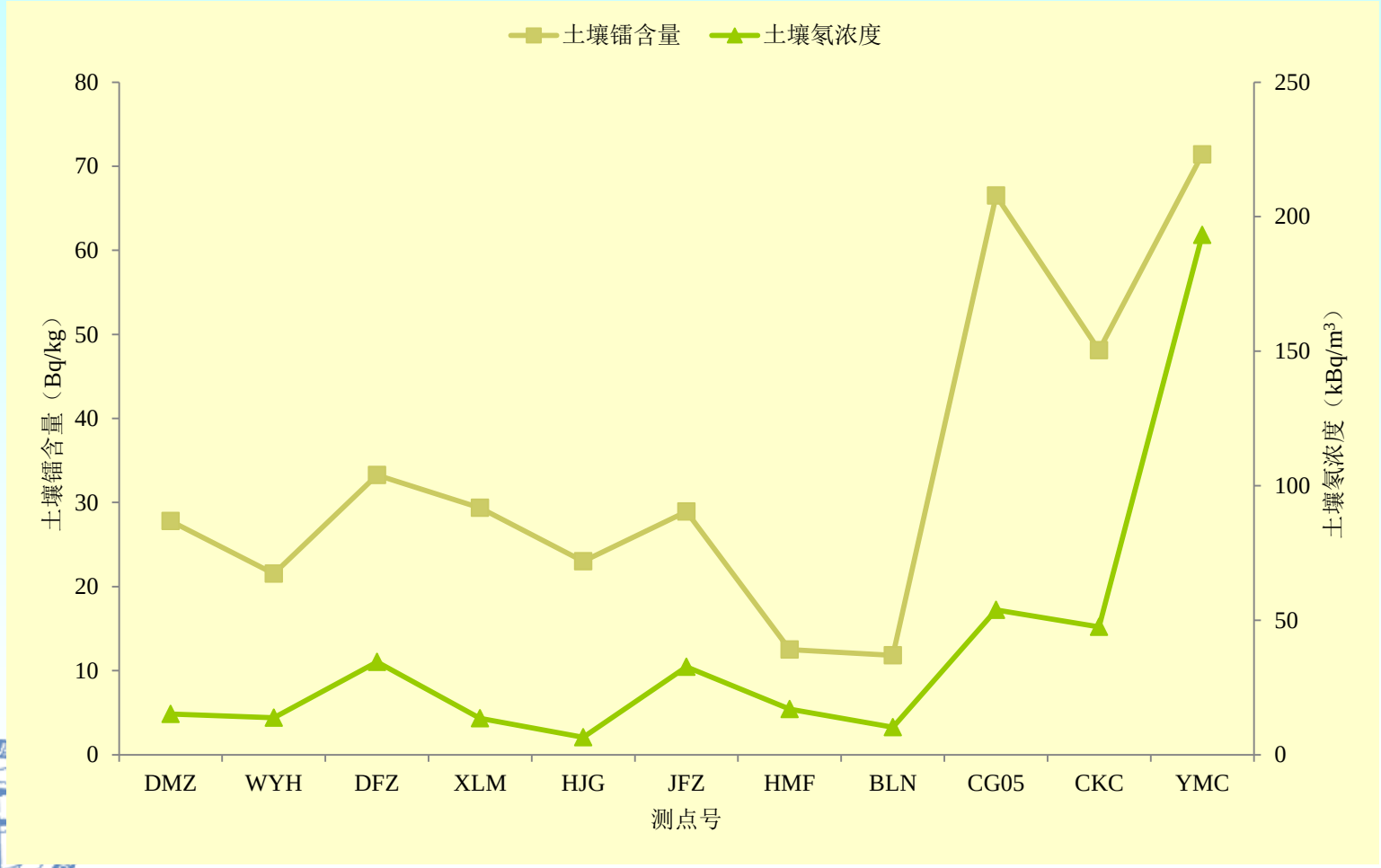




Soil radon and soil physical properties

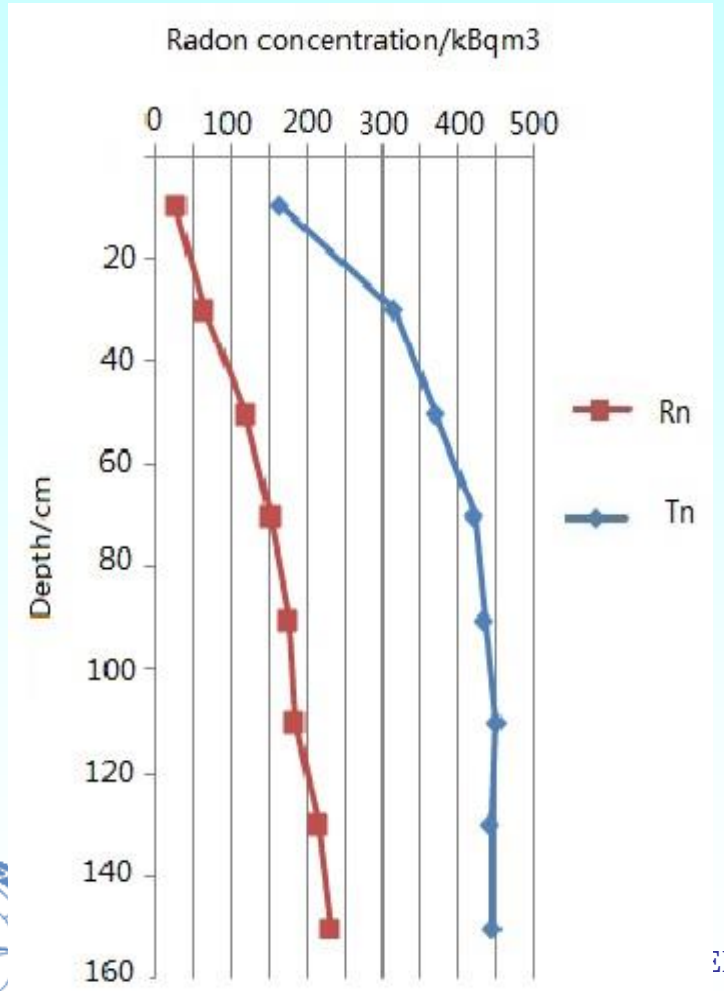
- Radon concentration is dealing with radium content (or U content) in soil.
- Radon concentration is affected by radon emission coefficient, effective porosity, and diffusion coefficient.
- Most important parameters are soil moisture, soil particle size, and porosity.

Radon and radium

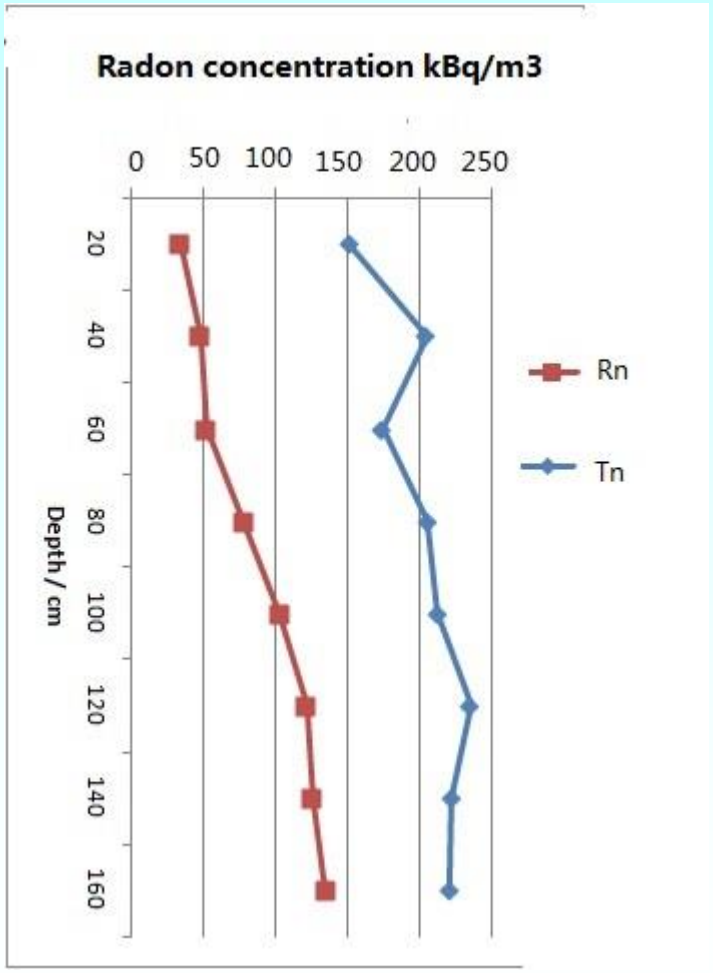


Radon and soil parent material

Granite site



Volcanic site



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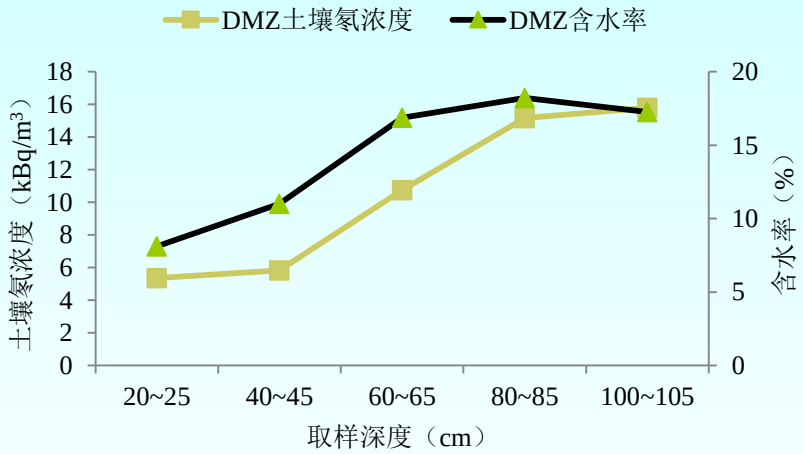
Results in Beijing

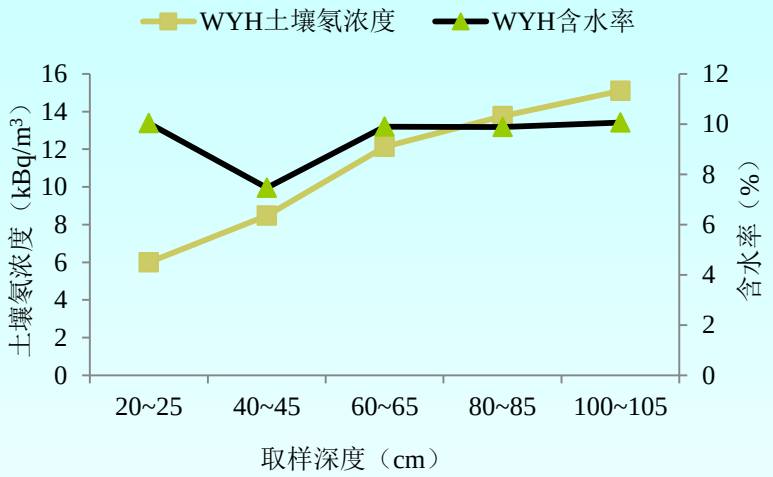
- 5 soil profiles
- Clay and sub clay

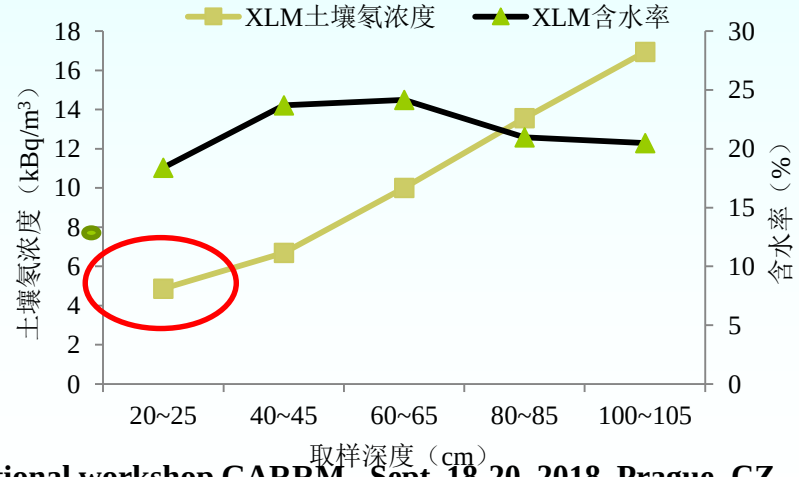
Radon concentration increases as the depth

Depth(cm)	Soil radon concentration（kBq/m^3）				
	TZ distric		FT district	MTG district	
	DMZ	WYH	DFZ	XLM	DJZ
20	5.35±1.26	5.99±1.47	13.02±1.92	4.86±1.20	1.38±0.85
40	5.82±1.33	8.48±1.71	25.50±2.66	6.69±1.40	3.29±1.12
60	10.75±1.77	12.12±1.96	28.61±2.85	10.00±1.70	4.59±1.26
80	15.16±2.09	13.76±2.09	34.52±3.16	13.56±1.96	4.77±1.32
100	15.78±2.15	15.10±2.17	36.70±3.28	16.95±2.20	5.07±1.36

Radon concentration and water humidity in soil (effective porosity)







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Conclusions

- **Geology is important (radon concentration is different in different soil, depends on their parent material)**
- **Most important parameters are soil moisture, porosity (pemeability) and soil particle size.**

What is ongoing?

Two research program by NSFC

1. Research on Radon Mapping Method Based on Full Spectrum Data of Airborne Gamma Energy Spectrum (41474107, 2015-2018)

2. Study on rapid method of monitoring and evaluation for rare earth radioactive contamination (No. 41674111, 2017-2020)

Thanks NSFC (41474107 and 41674111) to support our research.

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Hope to see you in Beijing

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Thank you for your attention!

谢谢！

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