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Research on Influencing Factors of the Rn Concentration Measured Result in Uranium Exploration

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Abstract: Based on the theory of radon survey and the experimental results, the measurement results of radon concentration influence factors are studied, such as pressure, temperature, moisture content and radium content. And the corrected technique of measuring radon concentration in air pressure is put forward to ensure that the sandstone type uranium deposit of radon measurement result is accurate and reliable.
Keywords: Radon concentration, Pressure, Temperature, Moisture content, Radium content

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1. INTRODUCTION

In recent years, it has been recognized that Rn and its daughters are harmful to humans[1,2,3]. Radon (Rn) is a natural radioactive inert gas in the nature which is produced by radioactive element radium decay and has been identified by world health organization (WHO) as one of the 19 major natural environmental carcinogens. Thus the study of Rn has become a hot topic, which has attracted the attention of more and more countries and research institutes[2,3]. Due to the randomness of Rn release and the complexity of Rn gas migration, the results of Rn measurement are influenced by the structure, particle size, soil porosity, moisture content of geological body and temperature, humidity, pressure and so on. Besides, when the work area is poor permeability of soil, the amount of gas collected by pump sampling is difficult to reach the ideal value, and it will cause large error for the measurement result and affect the practical application effect of the Rn measurement technology[4,5,6]. Therefore, this paper studies the influence of pressure, temperature, moisture content and radium content on the measured results of Rn concentration by experimental method.

2. QUANTITATIVE ANALYSIS AND CORRECTION OF THE PRESSURE INFLUENCE ON SOIL RN CONCENTRATION

Assuming the volume of the collection chamber is V_0, and the volume of actually collected gas from soil is V_x. Then the calculation formula of Rn concentration is $C = Q/V$ (C is

concentration of the Rn measured gas; Q is the Radioactive activity of R_n;V is the volume of gas).

If the soil permeability is better, we can conclude that

$$V_X = V_O \text{ and } C_{soil} = Q/V_X = Q/V_O = C_{room} \tag{1}$$

If the soil permeability is poor, the collected gas from soil is reduced, and we can conclude that

$$V_X < V_O \text{ and } C_{soil} = Q/V_X > Q/V_O = C_{room} \tag{2}$$

We can know that the Rn concentration is the Rn concentration of collected room for the instrument of pump suction type for the measurement of soil Rn, However, the phenomenon that the Rn concentration of collected room is less than the actual Rn concentration from the soil is ignored which causes measurement error. Thus it is necessary to correcte the formula (2). The corrected formula is as showed in formula (3):

$$C_{soil} = KC_{room} = \frac{V_O}{V_X} C_{room} \tag{3}$$

In this formula, K is the pressure correction coefficient is calculated by the state equation of ideal gas when the surrounding soil of sampling point, the collected room and the pipe which is connected with the surrounding soil are treated as sealing space.

$$K = \frac{V_0}{V_X} = \frac{P_0}{P_X} \tag{4}$$

The pressure correction coefficient is used to measure the difference of Rn concentration before and after correction. If the value of K is greater, we can know the measurement value farther deviates from the real value. In contrast, when the value of K approaches or is equal to 1, the correction effect is not obvious. Figure 1 is a contrast chart of Rn counting before and after the calibration of soil Rn in someone region. We can know the corrected value is better correspond to Rn concentration which is deduced by the specific activity of Ra by data analyzing.

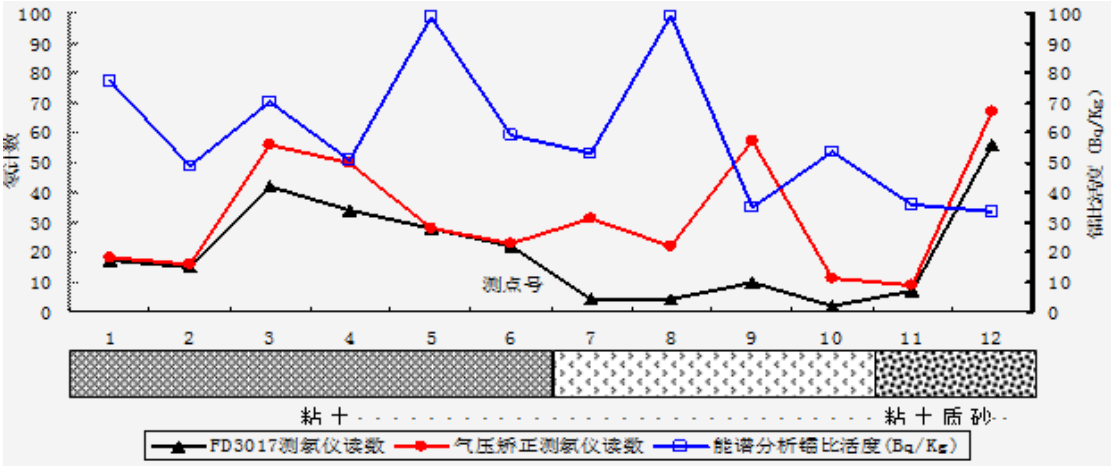

Fig. 1 contrast curves of Rn counting before and after the revision of soil Rn in someone region

3. THE INFLUENCE OF TEMPERATURE ON THE RESULT OF SOIL RN MEASUREMENT

We choose 2 days date from the long-term observation data of soil Rn and the date is shown in figure 2. It could be seen that soil temperature is positively correlated with Rn counting from the fiugre2. With the temperature rising and the pressure dropping, the Rn overflows from the pores of the soil rock and then the Rn is easier to spread in the soil. The calculation results show that, the temperature coefficient of soil Rn (The change of unit temperature causes the change of radon count) is -0.0634 Rn counting /60min/℃ in the selected Chengdu observation area.

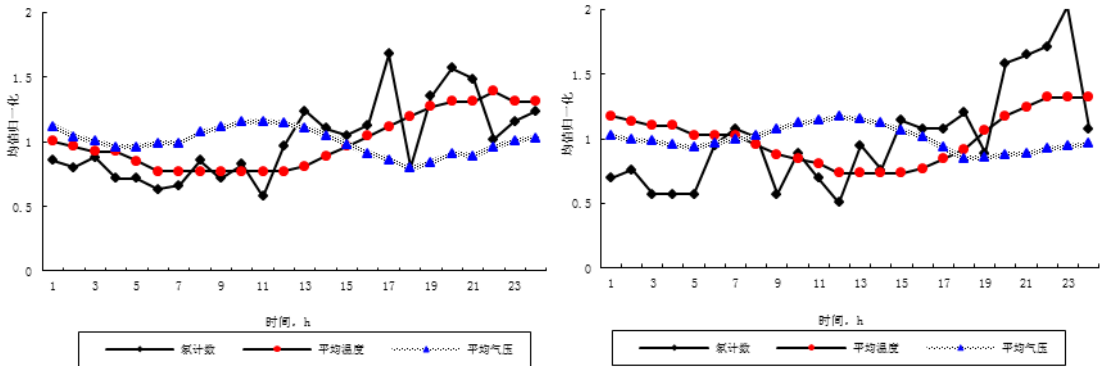

Fig 2. Rn counts in soil

4. RESEARCH ON THE INFLUENCE OF MOISTURE CONTENT, RADIUM CONTENT IN SOIL ON THE RESULT OF SOIL RN MEASUREMENT

Figure 3 is drawn from the measured data and the analysed results of laboratory samples, which includes the relationship of the different types of soil Rn counts and moisture content, radium

specific activity. Besides, radium specific activity is measured in laboratory lead rooms by microcomputer multichannel spectrometer.

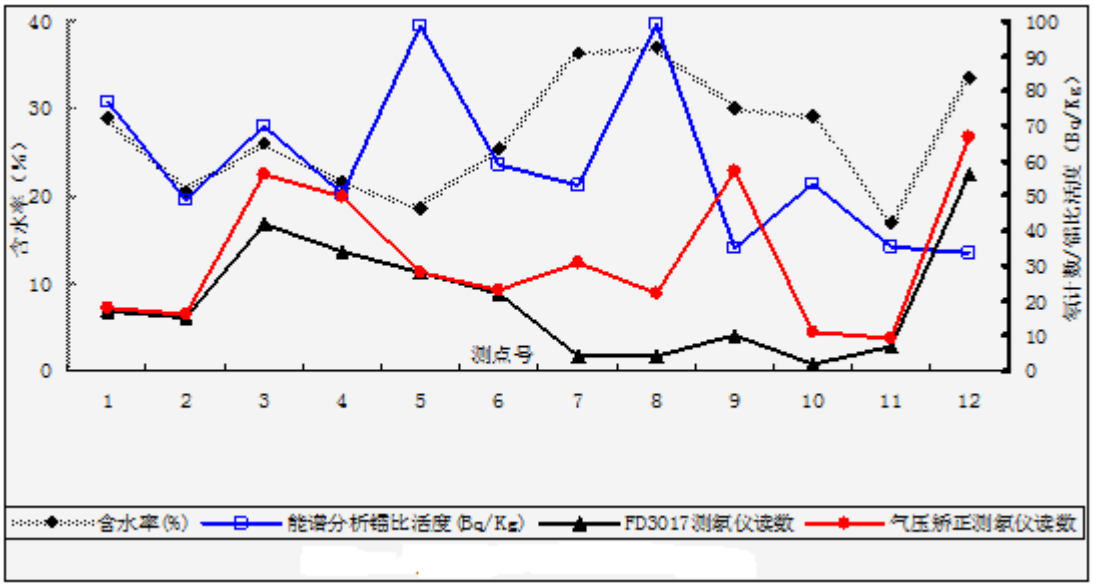

Fig.3 The correlation figure about Rn concentration and the surface of the medium

The results show that: a. Rn counts fit better with radium specific activity b. Water content has great influence on soil Rn measurement and the high moisture content decreases the porosity of the soil and prevents the migration of some free Rn in the soil, which reduces the concentration of Rn concentration and results in a small measurement result.

5. CONCLUSION

Based on experimental data, this paper analyzes the effect of pressure, temperature, soil moisture content and radium content on Rn concentration measurement's result. And thus we put forward the technique of measuring radon concentration in air pressure correction which is as a reference for soil Rn measurement in uranium exploration.

REFERENCES

[1] Nero A V. Indoor radiation exposures from 222Rn and its daughters: a view of the issue [J]. Health Physics, 1983, 45(2): 277-88.

[2] Barillon R, Chambaudet A. Alpha-Particle Dosimetry Using Solid State Nuclear Track Detectors: Application to 222Rn and its daughters [J]. Journal of Radioanalytical & Nuclear Chemistry, 2000, 243(3): 607-620.

[3] Hamanaka S, Shizuma K, Wen X Q, et al. Radioactive Disequilibrium between 222Rn and Its Daughter Nuclides in Ground Water.[J]. Radioisotopes, 1998, 47(9): 686-690.

[4] Tang D, Liu H, Duan H, et al. Locating karst depressed columns by means of Rn measurement on the surface [J]. Nuclear Techniques, 1999.

[5] Xi-Jun W U, Zhi-Qiang L I, Dan J, et al. The Research on Calibration of ~(220)Rn Measurement about Semiconductor Detection-based ~(220)Rn Measurement Instrument [J]. Journal of University of South China, 2015.

[6] Shen F, Chen X, Zheng Z, et al. Experimental Test of Soil Rn Measurement Crossing an Active Fault in Haikou City [J]. Technology for Earthquake Disaster Prevention, 2012.