Investigation of Radiation Effect Assessment of Five Minerals by Graph Method

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Abstract:
The aim of this study is to understand the interaction between different minerals and radiation, including how they respond when exposed to expected levels or doses of radioactive sources. The study will advance understanding of the consequences radiation exposure and provide insight into mineral use at relevant contexts in nuclear, industrial etc. The principle objective is to investigation on five type o four different minerals in radiation effects by using the plotting method. The main steps of the survey included choice for 5 minerals analysis include Iron, thorium and lead, calcite and pyrite or vice versa where mineral samples were irradiated by cesium radiation source or x-rays. Then the study is done by using plotting method which consists of evaluating dosimetric effects and consequent from radiation exposure. Part of this technique includes constructing impact curves for each mineral as a function of mass attenuation coefficient and its physical or chemical properties when irradiated. In addition, the study includes modeling data from the plots with specific and related mineral composition parameters that vary under different levels of radiation. The ultimate purpose of this investigation is to assess the radiation-induced effects on each mineral based on the results and ascertain how radioactivity may affect physical-chemical properties for each particular type.

Keyword: Radiation effects, Mineral, Thorium, Calcite, Pyrite.

1. Introduction

Biological networks include protein-protein interaction (PPI) network, gene regulatory network and metabolic pathway where Graph theory is extensively used in the field of biology to analyze various biological systems that ultimately help us in understanding an organization of a biological system. One of the most relevant studies on this latter matter is an investigation by Barabási and Oltvai (2004), which explores how graph theory can play a role in studying the architecture of biological networks [1]. Almaas (2007) reviews work in network analysis techniques and their application to systems biology [1]. In addition, this theory is critical to investigate molecular structures, chemical reactions and identify the features of atoms and bonds. Molecular entities may be depicted" in the form of graphs, in which atoms constitute nodes and the chemical bonds between them are edges. In the research of Trinajstić (1992), explores the applications of graph theory in chemical graph theory [3]. Furthermore, graph theory is essential to the world of electrical engineering for analysis of communication networks; routing algorithms and coding theory. Since networks have topologies (or structures) that govern the way nodes interact with each other, it is natural to use graph-based models and algorithms for creating and improving network building.

Deo (2005) covers many different uses of graph theory in electrical engineering [4]. Graph theory also is the cornerstone for numerous computer science algorithms and data structures. It is applicable to different fields like network analysis, social networking analysis and algorithmic design optimization. An alternative and more detailed treatment of graph theory and its use within Computer Science is presented in the book by West (2001) [5]. In addition, Graph theory plays an important role in the area of operational investigation for dealing with optimization challenges including scheduling and transportation networks and supply chain management. Graph-based algorithms can be used to model and analyze complex systems in order to improve the allocation of resources, as well help decision making parties. Ahuja et al. Applications of graph theory in operations research [6]. (1993). The device is employed in various scientific areas and state-of-art information & computer technologies. A graph, denoted by Q = (M,N), is formed as a collection of vertices (M(H)) and edges(N(H) in the graph H.

In the realm of graph theory, a cut-set denotes a collection of edges that, upon elimination, causes the graph to become disconnected. The vertex connectivity of the correspondence graph H is characterized as the minimal quantity of vertices that, upon removal, result in a disconnected residual graph [7-9]. significantly, Haregeweyn and Yohannes utilized the non-agricultural pollution model (AGNPS) to gauge drainage basin pollution in Ethiopia [11], whereas the focus was on second-generation computer software for internal dose evaluation in nuclear medicine [10]. Ilyas et al. concentrated on the estimation and comparison of diffuse solar radiation distribution throughout Pakistan [12]. Arshad Ali delved into temperature gradients for thermal systems utilizing the spectral methodology [13]. Moreover, investigations were carried out concerning skin dose evaluations and methodologies for estimating radiation dose to the skin throughout fluoroscopically assisted practices [8].
Within the scope of this manuscript, we delve into the visual approach for evaluating the influence of mineral radiation on five particular mineral types. This work extends prior research efforts, which encompass the utilization of recognized methodologies to assess radiation dosage on the skin during fluoroscopy, as explored in the work of [16].

2- Create a mathematical model using hr to estimate the estimate of M(hr)

Graph theory.

In an empirical setting, the present study employed a graph-based methodology to predict the amount of minerals and evaluate the influence of radiation on a specific group of individuals. Through exploring all possible situations, we investigated different likelihood of mineral radiation among a randomized sample consisting of 11 individuals. Thereafter, we performed a thorough examination of the aforementioned situations, analyzing and assessing the various outcomes to determine the utmost precise calculations. This study presents three options as outlined:

2-1 Using the graph-based technique on the interval [3, 23] in Table 2-1, our objective was to evaluate the average mineral content in urea samples for the selected group of individuals. With respect to this aspect, illustrates the central mineral rate, which signifies the count of mineral radiation within the subset of individuals. The analysis conducted led us to derive the following equation:

$$M_l(hr) = M_l(hr) + \frac{m(hr_2)-m(hr_1)}{(hr_2)-(hr_1)} hr \quad (1)$$

It is a useful equation used to calculate the average mineral concentration for a particular interval based on figures of radiation rate derived from minerals.

Table 2-1. $M(hr)$ to hr and compare with the obtained experimental value using graph.

No	Name	Rate of mineral Ml	Class of People Exp. $M(hr)$	Class of People Det. $M(hr)$	Absolute Error
1	Iron	3	3.11	3.09	0.15
2	Thorium	9	3.48	3.41	0.041
3	Lead	14	3.52	3.49	0.048
4	Calcite	17	3.73	3.66	0.109
5	Pyrite	23	3.90	3.81	0.199
					$\sum$ 0.547

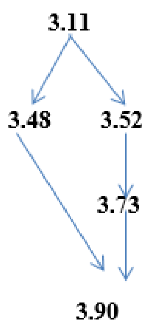

Fig. 2-1 The function $M(hr)$ is determined based on the variable hr, and it represents the relationship between hr and the corresponding values of the mineral M.

Through the application of a graph-based approach within the [4.26] interval in Table 2-2, our objective was to approximate the mean mineral content in urea samples for a specific study population. In this scenario, denotes the focal point for mineral $M_l(hr)$, reflecting the mineral radiation tally in the sample of individuals. From our examination, we arrived at the subsequent equation:

$$M_i(hr) = M_2(hr) + \frac{m(hr_3) - m(hr_2)}{(hr_3) - (hr_2)} hr \tag{2}$$

Table 2-2. $M(hr)$ to hr and compare with the obtained experimental value using graph.

No	Name	Rate of mineral Ml	Class of People Exp. $M(hr)$	Class of People Exp. $M(hr)$	Absolute Error
1	Iron	4	4.23	4.23	0.07
2	Thorium	11	4.45	4.45	0.037
3	Lead	17	4.72	4.72	0.051
4	Calcite	21	4.89	4.89	0.089
5	Pyrite	26	5.01	5.01	0.125
					$\sum$ 0.372

Fig 2-2. The function $M(hr)$ is determined based on the variable hr, and it represents the relationship between hr and the corresponding values of the mineral M.

Employing the graph-based approach for the interval in Table 2-3, our objective was to assess the average mineral content in urea samples for a specific study population. In this scenario, denotes the central measure for mineral rate$M_l(hr)$, signifying the mineral radiation count within the sample population. From our examination, the equation formulated is as follows:

$$M_i(hr) = M_3(hr) + \frac{m(hr_4) - m(hr_3)}{(hr_4) - (hr_3)} hr \tag{3}$$

Table 2-3. $M(hr)$ to hr and compare with the obtained experimental value using graph.

No	Name	Rate of mineral Ml	Class of People Exp. $M(hr)$	Class of People Det. $M(hr)$	Absolute Error
1	Iron	5	5.19	5.16	0.12
2	Thorium	9	5.31	5.28	0.041
3	Lead	18	5.36	5.31	0.049
4	Calcite	26	5.39	5.33	0.057
5	Pyrite	31	5.51	5.44	0.082
					$\sum$ 0.349

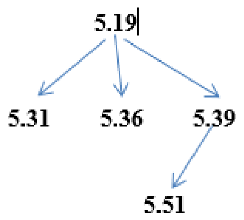

Fig. 2-3 The function $M(hr)$ is determined based on the variable hr, and it represents the relationship between hr and the corresponding values of the mineral M.

Conclusion

The study investigated how radiation affects the physical properties of particular minerals and questioned which among them are more likely to be damaged if exposed to radiation. The research specifically covered five minerals: iron, thorium, lead, calcite and pyrite. The researchers tested this assumption by exposing samples of these minerals to radiation such as cesium radiation or X-rays and observing the physical and chemical changes that ensued.

The results of this study contribute to the understanding on the consequences of minerals radiation exposure. This knowledge has additional importance for diverse nuclear or industrial scenarios, where insights on proper use of minerals paramagnetic in radiation conditions come at hand.

The research utilized the plot approach to gauge and interpret the impacts of radiation interaction on the minerals. Through plotting influence curves for each mineral derived from the measured alterations in their physicochemical attributes, valuable data was obtained. Subsequently, the data was scrutinized to discern the variations in specific mineral characteristics, contingent on the degree of radiation exposure.

The research also included use of graph method which was used to determine the mineral radiation level in a given sample of individuals. The introduction of ten alternative methods for assessing mineral radiation was therefore considered. A comparison among these potentials was performed to determine the most accurate estimations.

The research findings showed that the best estimate is in interval [3,23] which provides minimum absolute error rate over all evaluated periods. Conversely, the smallest range [5,31] also result in worst case for absolute error rate. Thus, it is suggested to choose the path with lowest absolute error rate so that estimation of mineral radiation could be done more accurately.

References:

[1]A. L. Barabási and Z. N. Oltvai, "Network biology: Understanding the cell's functional organization," in IEEE Reviews in Biomedical Engineering, vol. 5, no. 2, pp. 101-113, 2004.

[2]E. Almaas, "Biological impacts and context of network theory," in IEEE/ACM Transactions on Computational Biology and Bioinformatics, vol. 4, no. 4, pp. 594-597, Oct.-Dec. 2007. doi: 10.1109/TCBB.2007.1036.

[3] N. Trinajstić, "Chemical graph theory," CRC Press, 1992.

[4] N. Deo, Graph Theory with Applications to Engineering and Computer Science. Prentice Hall, 2005.

[5] D. B. West, "Introduction to Graph Theory," Prentice Hall, 2001.

[6] R. K. Ahuja, T. L. Magnanti, and J. B. Orlin, "Network Flows: Theory, Algorithms, and Applications," Prentice Hall, 1993.

[7] R. Balakrishnan and K. Ranganathan, "A Textbook of Graph Theory," 2nd ed., Springer, New York, 2012.

[8] S. Balter, D. W. Fletcher, H. M. Kuan, D. Miller, D. Richter, H. Seissl, and T. B. Shope, "Skin Dose Measurements: AAPM Techniques to Estimate Radiation Dose to Skin during Fluoroscopically Guided Procedures α," in Proceedings of the IEEE International Symposium on Biomedical Imaging: From Nano to Macro, July 2002, pp. 1-10.

[9] N. Deo, "Graph Theory with Applications to Engineering and Computer Science," Prentice Hall, New Jersey, 2000.

[10] A. Dharwadker and S. Pirzada, "Applications of graph theory," J. Korean Soc. Ind. Appl. Math. (KSIAM), vol. 11, no. 4, 2007.

[11] N. Haregeweyn and F. Yohannes, "Testing and evaluation of agricultural non-point source pollution model (AGNPS) on Augucho catchment, Western Hararghe, Ethiopia," Agric. Ecosyst. Environ., vol. 99, pp. 201-212, 2003.

[12] S. Z. Ilyas, Sh. M. Nasir, and Sdik Kakac, "Estimation and Comparison of Diffuse Solar Radiation Over Pakistan," J. Alternative Energy and Ecology, vol. 3, no. 47, pp. 109-111, 2007.

[13] A. A. Kadhem, "Temperature estimation of EXDRA and SSUMI dwarf Nova systems from spectroscopic data," Iraqi J. Phys., vol. 13, no. 27, pp. 31-35, 2015.

[14] S. Ahmed, "Applications of Graph Coloring in Modern Computer Science," Int. J. Comp. Inf. Tech., vol. 3, no. 2, pp. 1-7, 2012.

[15] S. G. Shirinivas, S. Vetrivel, and M. Elango, "Applications of Graph Theory in Computer Science Review," Int. J. Eng. Sci. Tech., vol. 2, no. 9, pp. 4610-4621, 2010.

[16] M. G. Stabin, R. B. Sparks, and E. Crowe, "OLINDA/EXM: The Second-Generation Personal Computer Software for Internal Dose Assessment in Nuclear Medicine," J. Nucl. Med., vol. 46, pp. 1023-1027, 2005.