

Statistical analysis of radioactive variables in two phosphate ores from Sudan.

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Abstract:

Multivariate statistical techniques are efficient ways to display complex relationships among many objects. An attempt was made to study the radioactive data in two types of Sudanese phosphate deposits; Kurun and Uro phosphate, using several multivariate statistical methods. Pearson correlation coefficient revealed that a U-238 distribution in Kurun phosphate is controlled by the variation of K-40 concentration, whereas in Uro phosphate it is controlled by the variation of U-235 and U-234 concentration. Histograms and normal Q-Q plots clearly show that the radioactive variables did not follow a normal distribution. This non-normality feature observed may be attributed to complicating influence of geological factors. The principal components analysis (PCA) gives a model of five components for representing the acquired data from Kurun phosphate, where 89.5% of the total variance is explained. A model of four components was sufficient to represent the acquired data from Uro phosphate, where 87.5% of the total data variance is explained. The hierarchical cluster analysis (HCA) indicates that U-238 behaves in the same manner in the two types of phosphates; it associated with a group of four radionuclides; U-234, Po-210, Ra-226, Th-230, which the most abundant radionuclides, and all belong to the uranium-238 decay series. Two parameters have been adapted for the direct differentiate between the two phosphates. Firstly, U-238 in Uro phosphate have shown higher degree of mobility ($CV\% = 82.6$) than that in Kurun phosphate ($CV\% = 64.7$), and secondly, the activity ratio of Th-230/Th-232 in Uro phosphate is nine times than that in Kurun phosphate.