Separating geophysical anomalies in airborne radiometric data by applying fractal concentration-area model, Tark 1:50,000 Sheet, NW Iran

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ABSTRACT

Geophysical airborne radiometric data have high importance for uranium exploration. In fact it is first step for radioactive mineral exploration. Most important problem is data interpretation especially separating anomalies from background. One of modern technique for this operation is fractal methods. These are very useful and suitable for separating data distribution due to their fractal behavior in nature. Concentration-area method is very useful and high level confidence especially for airborne data. In this study, fractal concentration-area (C-A) method is applied in airborne radiometric data interpretation collected from Tark 1:50,000 sheet situated in NW Iran. These data is included U, U/Th and U/K. First, statistical parameters of these data were considered that it shown these has normal distribution. Next, possible and probable anomalies were signed by traditional statistical method. Then, U, U/Th and U/K anomalies were separated by fractal C-A method and these results was comprised with traditional statistical results. Finally, anomalies were controlled by field data.

Keywords: Concentration-area fractal method, Tark 1:50,000 sheet, Airborne radiometric data, Geophysical anomalies.

INTRODUCTION

Separation of background and anomaly is a fundamental issue in geophysical and geochemical exploration. A geophysical or geochemical anomaly is defined as a region where the concentration of a specific element or geophysical parameter is greater than a certain threshold value, and the latter is determined based on statistical parameters, such as mean, median, and standard deviation (Li, Ma and Shi, 2003). However, the traditional methods emphasize only the frequency distribution of the elemental concentration, but ignore its spatial variability. Specially, the information about the spatial correlation is not always applicable. In addition, these methods are only applicable to situations where geochemical data follow a normal distribution. However, the normal distribution is not also a unique pattern of geophysical and geochemical distribution (Li, Ma and Shi, 2003). Furthermore, the data needs to be changed in traditional methods such as rejection of outliers and normalization of data. On other hands, statistical methods such as histogram analysis or Q-Q plot follow a certain form of distribution these factors (normal and lognormal) and neither of them considers the shape, extent and magnitude of anomalous areas. In addition to geological and geochemical environments which were not affected for separation of geophysical and geochemical populations (Rafiee, 2005). Fractal models could be used in solving these problems. The word “Fractal” was coined by Benoit Mandelbrot (1983) from the latin word “fractus”, meaning broken, which he has applied to objects that were too irregular to be described by ordinary Euclidean geometry (Davis, 2002). Fractal theory has been applied to mineral resources studies since late 1980s (e.g., Turcotte, 1986; Meng and Zhao, 1991). Cheng et al. (1994) proposed a method based on the premise that geochemical distributions are multifractal in nature. This heuristics provided a mean to demonstrate the empirical concentration-area (C-A) relationships on which it is supported, but only few applications have been reported in the literature and explaining its vast applications (Goncalves et al., 1998; Cheng, 1999). This method is used for separation of geophysical anomalies (Sim et al., 1999).

Use of airborne geophysical data is highly suitable to complement ground observations for uranium exploration. The U, K and Th maps, exhibit to the first order, a fairly good correlation with lithological units recognized by geologists in the field (Martelet et al., 2006). In this study by airborne radiometric data interpretation collected from Tark 1:50,000 sheet No. 5565II situated in NW Iran expectation areas for uranium were recognized.

GEOLOGICAL SETTING

Tark 1:50000 sheet (≈ 614 km^2) is situated in Eastern Azerbaijan, NW Iran. Its bed rock is intrusive granitoids and metamorphic rocks. This area is situated in intersection of Uremia-Dokhtar magmatic belt, Sanandaj-Sirjan metamorphic belt and Zagros ophiolitic belt. There are proper positions for uranium mineralization especially hydrothermal type.