Ternary Radioelement Image Processing for Islamabad District of Tehran province

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Abstract: Fully processed gamma ray data may be displayed by a variety of methods that can interpret profiles and radioelement networks. After the 1990s, advances in gamma ray spectrometry data, regarding image processing techniques have been useful. However, traditional mapping methods like profiles and contour maps have their own advantages and are still being used today. Although, some visualization techniques can be considered in order to display the updated gamma ray spectroscopy data, but none of the those methods, alone, are not being used for mapping and the appropriate interpretation and they should be combined with other methods. Graphical representation of airborne gamma ray spectrometry data along with developing low-cost processing systems has gained tremendous popularity. Image format enables the interpreter to benefit from a variety of digital image processing techniques, including image enhancement and extracting special shapes. In this paper, we have used different techniques of visualizing digital as well as different color spaces. Acquired radiometric data of elements such as potassium, uranium and thorium in Islamabad district were converted to color images using Geosoft software and then, ternary radioelement map of this region provided in RGB color space. Finally, we processed the images, extracted significant shapes, identified hot areas of uranium anomalies, and suggested promising indices of radioactive mineral deposits for the exploratory procedures.
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1. Introduction

In recent years, methods of visualizing data had stunning progress and by creating color images of anomalies in the target area, contributed in better and easier processing of the area. In order to process the data, we should not solely rely on color images, but these processes can be used as an auxiliary method along with other methods such as classical statistical and fractal methods to interpret airborne radiometric data.

Preparation of digital data using new mapping software and hardware can provide an important preliminary understanding from providing contour maps to attractive and interesting pictures that can have an important role in regulating and controlling of operations. If the data entered to a computer for image processing were satisfactory, then the process will be of good quality. The information of these maps and images are qualitative.

2. Methodology and Data

2.1 Pictorial representation techniques

2.1.1 Color Spaces

Color space is a model that facilitates the determination and embodiment of a color. Color space models are being used for special applications such as displaying and printing signs or improving conjectural recognition of colors. One of the methods of depicting colors in exploratory maps is a RGB (Red-Green-Blue) color space. Three primary colors (red, green, and blue) are defined by phosphorus radiation characteristics in computer displays and other colors can be displayed as a combination of three primary colors. When the phosphorous is off, the screen remains dark and appears as black. If phosphorous be in its maximum voltage, the resulting color is white (IAEA, 2003).

The yellow color can be produced by equal intensities of red and green colors while, blue is off. Equal amounts of red, green, and blue results in combinational colors from black to white. Color space of Cyan - Magenta - Yellow which is based on a system of colors is used in printing and painting. A disadvantage of CMY and RGB color spaces is that, they are attributed to the characteristics of human's color perception in a conjectural manner. For example, if a color needs to be saturated, the associated changes are not visible in RGB values by guesswork.

This weakness of the RGB space, mainly similar to Intensity-Hue-Saturation space, expresses the popularity of color perception space. IHS color space is based on human's perception of hue, saturation, and intensity. Hue is a featured wavelength of a color, saturation is the net amount or the final amount of pure white light in a color, and intensity is related to the total amount of light that reaches the eye (Niblack, 1986).

IHS color space only provides a raw

approximation of a uniform conjectural color space. In a regular uniform color space, the Euclidean distance between colors simulates a conjectural color difference between two colors.

Since the sensitivity of the eye to color and saturation changes depends on the wavelength, uniform change in saturation and hue of a color are not considered as equal changes in saturation and hue. Conjectural uniform color spaces can be used to overcome this problem. Disadvantages of uniform conjectural color spaces is that they cannot have universal application as conversions between red, green, and blue phosphorus and their coordinates which are depended to display signs and should be obtained by calibration.

2.1.2. Pseudo-color and shaded relief images

Pseudo-color, using color tables, can be used as an alternative way to display radiometric data. A color lookup table determines the cumulative combinations of red, green and blue colors to create separate colors. Color lookup table should preferably be designed so that, the observed changes in color can conjecturally attributed to changes in concentrations of radioelements. One simple way is changing the values of red, green, and blue colors. In this mode, the intensity and saturation is kept constant while the color averagely changes. This color coding techniques is called pseudo-color mapping (Reeves, Reford, Milligan, 1997).

Pseudo-color coding can be combined with shaded relief image networks. This method is an effective way to control the quality of networked data, either for line to line and flight to flight changes or for high-frequency noises. Figures 1, 2, and 3 show the color images of radiometric data of potassium, thorium, and uranium for Islamabad district of Tehran. The figures have obtained by image processing of radiometric data of airborne spectrometry through adapting with spatial RGB model in a shaded form using Geosoft software. These maps are applied-exploratory maps for uranium, thorium and potassium elements in Islamabad district of Tehran in order to explore radioactive elements. As shown in the figures, the scale of radiation intensity in different parts of Islamabad district has been processed with the combination of red, green, and blue colors. High-grade zones of radioactive elements are highlighted with warm colors and by moving toward low-grade zones, the colors will be cooler. This spectrum is usually used for exploratory maps. Figure 1, 2, and 3 depict the map of potassium, thorium, and uranium elements, respectively.

2.1.3. Ternary radioelement maps

One of the most widely used exploratory maps in geophysical stages of identifying radioactive elements is ternary radioelement maps. A ternary radioelement map is a colored combinational image that is produced by regulating the displaying signs of red, green, and blue phosphorus or yellow, magenta and cyan colors of a corresponding printer with radioelements concentration values of total radiation networks of potassium, uranium and thorium. Using red, green, and blue, respectively, for potassium, uranium, and thorium in order to show gamma ray spectrometry data is a standard way. Using this applied exploratory map in radioactive element exploration regions, allows us to identify overlapping ranges of radioactive elements or effective and important ratios of certain elements (Milligan and Gunn, 1997).

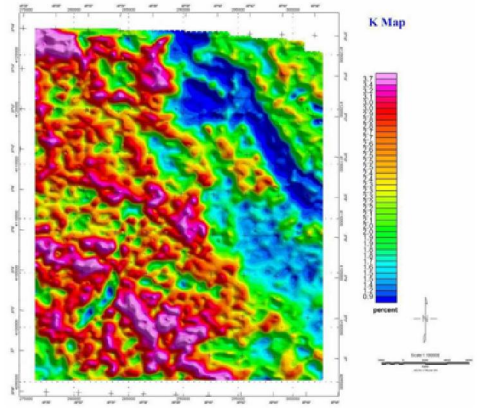

Figure 1: Color image of potassium radioelement in Islamabad district

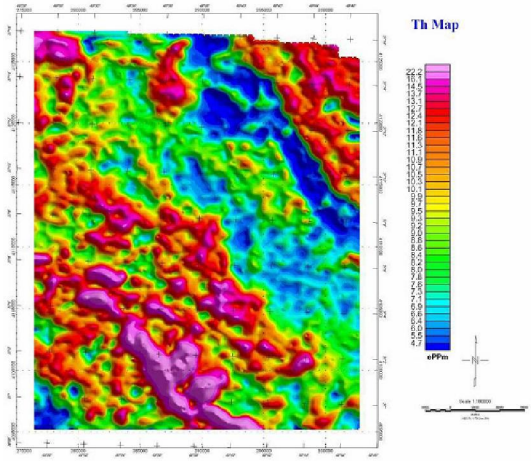

Figure 2: Color image of thorium radioelement in Islamabad district

In ternary radioelement map of Islamabad exploratory region, we have used blue color to depict the uranium channel since, this channel is the most noised channel and human eye has the least sensitivity for changes and intensity of blue color. The areas with low radioactivity and therefore low signal to noise ratio could be covered in total

counting network by installing a threshold. This preserves more color space and provides a better color enhancement for remaining data. Figure 4 shows the ternary radioelement map for investigating gamma ray spectrometry survey at Islamabad district.

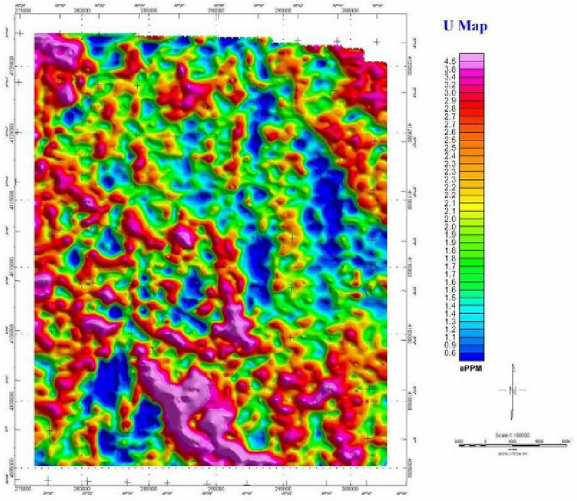

Figure 3: Color image of uranium radioelement in Islamabad district

3. Results

The combinations of colors are being used in the image processing methods to provide useful images. The single radioelement channels can transform to pseudo-color form in order to allow interpreter to identify the regional distribution of radioelements. As shown in Figures 1 to 3, we can easily find the anomaly ranges of each radioelement with a simple look at the photos. Figure 4 shows the ternary radioelement map of the area that can be a good guideline to simultaneously show the three potassium, uranium, and thorium radioelement in the region where, white color is the combination of three colors of, blue, red, and green that human eye sees it as white. Therefore, where there is white color, it indicates the presence and overlap of three potassium, thorium, and uranium elements in the radioactive elements exploration area at the same time. In contrast, where there is black color, it indicates the lack of presence of all of three elements at the same time. This color combination could be a useful guide to reach to uranium deposits, since, in exploring radioactive deposits, uranium deposits have great importance. Usually, identified anomalies are associated to three radioactive elements of uranium, thorium, and potassium and identifying uranium anomalies with small amounts of thorium and potassium is an appropriate approach to introduce mineral indices of uranium for next stages of exploration. However, we should note that, these images give a qualitative interpretation of the area and benefitting quantitative methods of classical statistics, fractal methods, and geostatistics methods can be complementary.

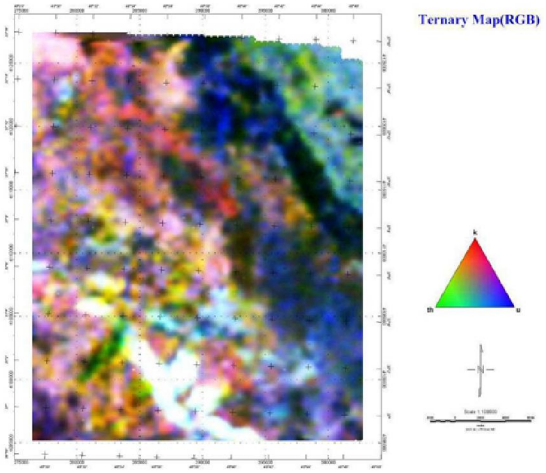

Figure 4: Ternary radioelement map of radiometric data of uranium, thorium, and potassium in Islamabad district

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