Ain Shams University
Faculty of Science

Geophysics Department

Detection of Radioactive Occurrences, East of Qena, Using Airborne Gamma-Ray Spectrometric and Magnetic Survey Data, Eastern Desert, Egypt.

A Thesis Submitted to

Geophysics Department, Faculty of Science, Ain Shams University for Ph.D. Degree of Science in Applied Geophysics

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(M.Sc. in Geophysics, Ain Shams University, 2014)

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Approval Sheet

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ABSTRACT

The area under study lies in the Eastern Desert of Egypt to the east of Qena city. It is enclosed between latitudes 25^{o} 58′ 3.79″ N & 26^{o} 19′ 60″ N and longitudes 32^{o} 50′ 42.58″ E & 33^{o} 14′ 60″ E, with moderate terrain except at zones of Thebes Formation and Taref sandstone, the topographic values range from 73 – 655 meters asl. It drew attentions due to the presence of the considerable and remarkable exposures of the Duwi Formation and Dakhla shale, while these formations are enriched with radioactive minerals as interbeds of the uranium bearing phosphates. the surface geological settings of the study area show sedimentary rocks range in age from cretaceous (pre-Campanian) to Holocene sediments cover the whole area, with no igneous outcropping, while the structural settings delineate that the main trend of the surface lineaments mainly related to NE-SW, NNW-SSE and NW-SE directions.

The remote sensing imagery data Landsat 8 OLI and Aster bands are used in an integration with the aerospectrometric and aeromagnetic data to delineate the surface uranium provinces in addition to their probable extensions within subsurface, as well as their relation with existed clay minerals and hematite mineralizing zones.

The remote sensing succeeds in modify the compiled surface lithological map of the area under study as well as in delineating zones of clay and hematite mineralizing zones, the Landsat 8 OLI and Aster bands subjected to preprocessing and processing techniques before used in a support vector machine as a supervised classification using known ROIs that used as training sets to produce a lithological classified image of the study area with an accuracy of 98.07%.

Landsat 8 OLI and Aster imagery data are used in detection of existed clay minerals as (Illite, Kaolinite, smectite, montmorillonite, chlorite and Sepiolite) as well as hematite using Crosta technique, these mineralizing clay minerals zones are agreeing with the deduced clay minerals from the spectrometry data, and emphasize the association of clay minerals with the uranium province zones in Duwi Formation, Dakhla and Esna shales, notable feature that these mineralizing zones are related with zones of shale occurrences in different lithological units.

The aerospectrometric data show that maximum values of eU, eU/eTh and eU/k are associated mainly with Duwi Formation as 25.9 ppm eU, 6.9 and 42.6 with averages of 9 ppm eU, 2.2 and 18.4, respectively, as well as Dakhla shale as 12.1 ppm eU, 4.2 and 36.2 with averages of 4.2 ppm eU, 1.3 and 11.6, respectively. the factor analysis technique is used to derive the ILRU map using the ternary colour composite image from the derived three factors F1, F2 and F3, the provided ILRU map enhanced and modified using the statistical signatures of different lithological units obtained from the compiled geological map in addition to the lithological facies and existed clay minerals that deduced using the eTh/eU and eTh/K, respectively. the uranium migration calculations elucidate that Duwi, Thebes and Issawia formations, as well as Dakhla and Esna shales show uranium migration in.

The uranium province zones that exceeds X+2S and/ or X+3S are mainly associate with Duwi Formation and Dakhla shale as well as small areas in Esna shale, Thebes and Issawia formations. The ground spectrometric verification ensures the high uranium occurrences in Duwi Formation and Dakhla shale reach (112.6 and 25.1) ppm eU.

The aeromagnetic different maps, RTP, residual, regional analytical signal, enhanced residual, horizontal derivative, theta angle, tilt derivative and its total horizontal derivative and their enhanced ones, provide an interpreted structural elements map emphasize that these elements are mainly oriented in NW-SE and NE-SW, as well as locating three diabasic dykes that trending toward NW-SE and their depths using the 3D Euler deconvolution technique that oscillates from 1000-1500 meters. Also 3D Euler deconvolution used in detection of the location of the contacts of magnetic causative bodies in residual and regional magnetic fields as well as their depths that declared as 1000- 1500 m and 2000 – 2500 m, respectively. These depth results are agreeing with the residual, and regional depths extracted from the magnetic power spectrum of the RTP map as 1100 and 2500 respectively.

In addition to locating the main sedimentary basin using the 2D magnetic model of RMS of 2.8 %, that trends from southwestern to northeastern directions with a length

of 57 km, that show an incensement in the thickness of this basin toward the center, reaches 2 km, while this thickness decreased toward the northeastern and southwestern as less than 1 km through the study area, that illustrate the reason for the surface exposures of Duwi Formation toward these directions from area center, so it gives a probability of the subsurface extensions of the uranium province zones of Duwi Formation and Dakhla shale toward southwestern direction of the study area through the dedicated basin.

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