CAPTER VII
SUMMARY AND CONCLUSIONS

The present work was carried out to study in general geological setting, structural and geochemical characteristics of the G. Qattar batholith and radioactivity for both G.II and G.V uranium occurrences, together with detailed studies of radon daughter concentrations and calculating working level and determining the radiation dose that will acquired by the workers in these occurrences mines.

Uranium occurrences of G.II and G.V are devoted to younger granites and Hammamat sediments rock types respectively. Gabal Qattar younger granites are pink in color, medium to coarse-grained with zoned feldspar, quartz and biotite.

The post magmatic hydrothermal alteration features in these granites are recognized along the major faults and shear zones and represented by hematitization, silicification, kaolinization, chloritization, episyenitization and spotly manganese oxides or dendritic.

The Hammamat sedimentary rocks of G. Umm Tawat are located in the northern part of the study area and their thickness is about 400m. The bedding planes of Hammamat sediments are nearly striking NE-SW to ENE-WSW and dips between 15º to 25º to the SE and SSE, respectively. They are ranging in color from deep green to dark grayish green. The Hammamat sedimentary rocks are intruded by the younger granites of G. Qattar. Thus, they are slightly metamorphosed up to green schist facies.

The secondary uranium mineralization was recorded in the Hammamat sedimentary rocks along their contact with G. Qattar granite. Petrographically, uranium mineralized granites are medium to coarse grained and exhibit hypidiomorphic granular texture. They are composed of potash feldspar which is mainly kaolinized orthoclase perthite with subordinate amount of microcline, interstitial secondary albite and fine grained quartz.

Geologic setting study in mines revealed that in G.II uranium occurrence younger granite in the western tunnel is relatively fresh, pink to reddish brown in color and coarse to medium grained. Quartz grains are abundant and of smoky color due to radiations emitted from uranium mineralization. The studied granite is strongly fractured and jointed. Some of these fractures and joints are filled with quartz, fluorite as well as uranium minerals especially in the high radioactive zones that associating iron oxides. On the other hand, in G.V uranium occurrence the Hammamat sedimentary rocks are mainly composed of greywackes and siltstones. They are well distinct in the tunnel with their alterations around the contact zone with the younger granites.

Geochemical characteristics of G. Qattar younger granite indicated that it is alkali feldspar granite originated from peraluminous calc-alkaline magma with alkaline affinity due to the partial contribution of the lower crust. Tectonic setting is suggested to be of within-plate granites due to their high content of the alkali feldspars with increasing K_2O, Rb, Nb, Ba and Y contents formed at shallow depths and its crystallization occurred at temperatures ranging from 800 ^{o}C to 850 ^{o}C hence it could be considered as mesozonal granite.

Structurally, joints and fractures are the commonest secondary structures in the prospect area, especially in the granitic rocks. These joints have various directions some of them are filled with films of secondary uranium mineralization.

Statistical analysis and graphical representation by a rose diagram of faults in the study area revealed that these faults predominate in the following order; NNE-SSW, NW-SE, NE-SW and N-S.Uranium mineralization is located at the intersection of NNW-SSE faults with the E-W faults.

Safety management for the underground radioactive mines represents an important factor in the mining operation, either in the design stage or in the operating one. In the present work, a well tight glass box loaded with ore samples was used to estimate mine atmosphere.

The relation between radon concentration values measured in the box and the corresponding values in the mining activities in the field was studied. The behavior of radon in relation with time emanated in this box showed reasonably correlated relations. The resulted correlation factor reached 0.86. In the mineralized younger granite area, the relation between the average values in the box and those in the different underground locations is:

$$Y = 0.4 \, Ln(x) + 0.6 \qquad R^2 = 0.85$$

While in the mineralized Hammamat sediments area

$$Y = 0.0847 + 0.547 \qquad R^2 = 0.81$$

The concluded relations can be later used to obtain the expected radon concentrations in certain mining activity using samples representing the exploration tunnels in the preliminary stage of the operation. This technique will save the cost of risk estimation and facilitates safety study

A detailed radiation survey of some sites in Qatar granites and Hammamat sediments was performed first to choose the ore samples used in the simulation box. This radiation survey showed that radon decay products represent the major source of radiation risk. In most locations the radiation levels seem to be much higher than that internationally recommended due to bad ventilation. The application of the efficient ventilation systems reduces this risk to the accepted levels.

The proposed radiation dose for the mine workers was estimated according to the measured radiation levels which equals to 0.86 rem/year while the permitted radiation dose calculated by IAEA is 1 rem/year.

Bad correlations are found between radon concentration and the analysed uranium concentration due to the effect of other factors such as porosity and permeability of the rock as well as fracture system and crystal age.