

LIST OF TABLES -----	vxii
CHAPTER I: INTRODUCTION -----	1
I.1.: General Statement -----	1
I.2.: Location and Topography -----	1
I.3.: Previous Work -----	3
I.4.: Aim and Scope of the Present Work -----	9
CHAPTER II: GEOLOGICAL SETTING, GEOCHEMISTRY AND STRUCTURE -----	11
II.1: Geological Setting: -----	11
II.1.1: Metavolcanics -----	13
II.1.2: Diorites -----	13
II.1.3: Granodiorites -----	13
II.1.4: Hammamat Sedimentary Rocks -----	14
II.1.5: Acidic dykes: -----	21
II.1.6: Qattar Younger Granites -----	21
II.1.7: Post granitic dykes and veins -----	25
II.1.7.A: Pegmatites -----	25
II.1.7.B: Aplites -----	28
II.1.7.C: Quartz veins -----	28
II.1.7.D: Basic dykes -----	28
II.1.8: Geologic Setting in Mines -----	28
II.1.8.A: Geology of G.II uranium occurrence -----	28
II.1.8.B: Geology of G.V uranium occurrence -----	30
II.2: Geochemistry of G.Qattar Younger Granite ----	30
II.2.1: Geochemistry of major oxides -----	31
	iv
II.2.2: Geochemical Classification -----	31
II.2.3: Magma type -----	31

II.2.4:Tectonic setting -----	35
II.2.5:Origin and Petrogenesis -----	37
II.3: Structural Setting of G.Qattar -----	39
CHAPTER III: TERMINOLOGY AND ESTIMATION OF RADON DAUGHTERS CONCENTRATION -----	45
III.1: Overview of radon properties and radon in Mines ----	45
III.1.1: Underground mines atmosphere -----	46
III.2: Health Hazard from Radon Daughters -----	47
III.3: Working Level (WL) -----	48
III.3.A: Working Level hour (WLh) -----	48
III.3.B: Working Level Month (WLM) -----	49
III.4:Methods for Measuring Radon Daughter Concentrations	49
III.4.A: One-Count Method -----	49
III.4.A.1: WL Determination by Kusnetz Method -----	50
III.4.A.2: WL Determination by Roll Method -----	51
III.4.B: Three-Count Method -----	53
III.4.B.1:WL Determination by Modified Tsivoglu -----	53
CHAPTER IV: RADIOELEMENT DISTRIBUTION IN G.QATTAR AREA -----	59
IV.1: Distribution of Radioactivity on the Surface -----	59
IV.2: Distribution of Radioactivity in the Underground Tunnels	62
CHAPTER V: INSTRUMENTS AND TECHNIQUES OF RADON MEASUREMENTS IN G.QATTAR AREA -----	70
V.A: Air Sampler -----	71
V.B: Filter and Filter Holder -----	72
v	
V.C: Alpha Counter -----	73
V.D: Gamma Dose Distribution -----	75

CHAPTER VI: EXPERIMENTAL RESULTS AND DISCUSSION -	79
VI.1. Radon Behavior in a Closed Confined Space Box -----	79
2. Radon Study in Underground Mine -----	83
3. Comparative Study of radon concentrations in the Box and those in the underground mines -----	83
4. Comparative evolution with the uranium content of the ore -	87
5. Study of effective dose in the field locations-----	88
CHAPTER VII : SUMMARY AND CONCLUSIONS -----	90
REFERENCES -----	
APPENDIX I -----	101
1: Obtained results of the mineralized granite samples	101
2: Results obtained from the mineralized Hammamat sedimentary rocks -----	105
APPENDIX II -----	108

LIST OF FIGURES	Page
Fig. 1: Location Map of G.Qattar Area, Eastern Desert, Egypt	2

Fig. 2: Geological map of north Gabal Qattar area, North Eastern Desert, Egypt -----	12
Fig. 3: Photograph showing exfoliation and sheeting structures In granodiorite; looking NW -----	15
Fig. 4: Photograph showing joint sets in Hammamat sedimentary Rocks along Wadi Balih; looking SW -----	17
Fig. 5: Photograph showing foliated Hammamat sedimentary With different colors, west G.Qattar; looking NW	17
Fig. 6: Photograph showing a close up view of the Hammamat Conglomerate with abundant granitoid and volcanics clasts Northeastern flank of Wadi Balih; looking SE -----	18
Fig. 7: Photograph showing general view of foliated siltstone beds In the Hammamat sediments of Wadi Balih; looking NE	18
Fig. 8: Photograph showing a view showing the intrusion of G.Qattar granites into the Hammamat sediments, southern Bank of Wadi Balih; looking NE -----	19
Fig. 9: Photomicrograph showing lithic and crystal fragments in the Hammamat conglomerates, G.Qattar area; P.L., X35	19
Fig. 10: Photomicrograph showing the graded bedding and the Mineralogical composition of the hammamat greywacke, G.Qattar ar26ea; P.L., X35 -----	20
Fig. 11: Image of Qattar-II and V prospect area, Gabal Qattar North Eastern Desert, Egypt -----	23
Fig. 12: Photograph showing string-shaped perthite in leucogranite G.II uranium occurrence, C.N., X35 -----	26
Vii	
Fig. 13: Photomicrograph showing secondary uranium mineralization associated with opaques and included in	

quartz, G.II uranium occurrence, C.N., X35 -----	26
Fig. 14: Photomicrograph showing plagioclase with lamellar twining included in perthite, quartz corroded perthite, G.II uranium occurrence, C.N., X35 -----	27
Fig. 15: Photomicrograph showing orthoclase perthite crystal rimmed by albite rapakivi texture, G.Qattar uranium occurrence, C.N., X35 -----	27
Fig. 16: Photograph showing joint sets filled with quartz, G.II uranium occurrence, looking SW -----	29
Fig. 17: Photograph showing a basalt dyke intruding the younger granites of G.Qattar, northern bank of Wadi Gattar; looking NE -----	29
Fig. 18: Ab-Or-An ternary diagram (Streckeisen, 1976) --	36
Fig. 19: SiO ₂ versus (Na ₂ O+K ₂) variation diagram (Irvine and Baragar, 1971) -----	36
Fig. 20: 100 (MgO+FeO+TiO ₂) / SiO ₂ versus (Al ₂ O ₃ +CaO) / (FeO+Na ₂ O+K ₂ O) variation diagram (Sylvester, 1989)	36
Fig. 21: Al ₂ O ₃ / (Na ₂ O+K ₂ O) versus Al ₂ O ₃ / CaO+Na ₂ O+K ₂ O variation diagram (Maniar and Piccoli, 1989) ----	36
Fig. 22: Y versus Nb variation diagram (Pearce et al., 1984)	38
Fig. 23: Qz-Ab-Or ternary diagram (Tuttle and Bowen, 1958)	38
Fig. 24: One of master joints striking N15°E, filled with thin films of secondary uranium mineralization, G.II uranium occurrence looking south -----	40
Fig. 25: Contour diagram of poles of some joints in the younger granite of G.Qattar, plotted on lower hemisphere ---	40
Fig. 26: Rose diagram showing the strike frequencies of joints in the younger granite -----	42

Fig. 27:Secondary uranium mineralization staining fracture surface striking N15°E -SSW, G.II uranium occurrence; looking south -----	42
Fig. 28:Rose diagram showing the strike frequencies of faults in the younger granites -----	43
Fig. 29:Geological map of G.II uranium occurrence ---	60
Fig. 30:Geological map of G.V uranium occurrence -----	61
Fig. 31:Geological map of the western and eastern tunnel --	63
Fig. 32:Subsurface structural map of the western tunnel of G.II G.Qattar with uranium, thorium and working level(WL)	64
Fig. 33:Subsurface structural map of the eastern tunnel of G.II G.Qattar with uranium, thorium and working level(WL)	65
Fig. 34:Isorad map of G.II uranium occurrence with western and eastern tunnels -----	68
Fig. 35:Isorad map of G.V uranium occurrence with the subsurface tunnel -----	69
Fig. 36:A portable air sample pump of the type L5-10 RB -----	74
Fig. 37:The sampler counter manufactured by Tri-Met LT, WINNPEL Canada -----	74
Fig. 38:The RDS-100 Survey Meter ALNOR, Sf 20101 Turku, Finland -----	75
Fig. 39:A glass box tightly sealed having the dimension 60 cm length x 40 cm width x 30 cm high -----	76
APPENDIX II -----	108

vx

LIST OF TABLES

Page

Table. 1:Chemical analyses of major oxides and trace elements of

G.Qattar granitic rocks -----	32
Table. 2: Average major oxides and trace elements of the studied Qattar granitic rocks compared with averages published by other authers -----	33
Table. 3: Normative minerals and some parameters of G.Qattar granites -----	34
Table. 4: Radiometric analysis for the different mineralized rock samples of G.Qattar -----	35
Table. 5: The range of concentration of U-238, U-235, Th-232 and K-40 in Bq/Kg in some mineralized rock samples, G.Qattar -----	56
Table. 6: Kusnetz Factor of Radon Daughter calculation --	57
Table. 7: Roll Method (Waiting Factor) Sampling Period(min.)	58
Table. 8: Mathematical calculation for the relation between T(hr) & WL in mineralized younger granite samples ---	81
Table. 9: Mathematical calculation for the relation between T(hr) & WL in mineralized Hammamat sediment samples	82
Table. 10: Comparison between the working level value in the box and in the tunnel at mineralized younger granite (G.II)	84
Table. 11: Comparison between the working level values in the box and in the tunnel at the mineralized Hammamat sediment (G.V) -----	84
Table. 12: Mathematical relation between average values of the box and that of the tunnel (Mineralized younger granite sample) -----	86
vxi	
Table. 13: Mathematical relation between average values of the box and that of the tunnel (Mineralized Hammamat	

sediments samples) -----	88
Table. 14: Dose in location of younger granite samples	89
Table. 15: Dose in location of Hammamat sediment samples	89
 APPENDIX I	
1-Obtained results of the mineralized granite samples	101
2-Results obtained from the mineralized Hammamat sedimentary rock -----	105

