



Ain Shams University



Faculty of Science

Department of Geology

STRUCTURAL AND RADIOMETRIC STUDIES OF UM GURUF AREA, NORTH EASTERN DESERT, EGYPT

**A Thesis Submitted in Partial Fulfillment of the Requirements for the
Degree of Master in Science in Geology**

By

MAHMOUD MOHAMMED SALEM MAHMOUD

(B. Sc. Geology - 2013)

Nuclear Materials Authority

Supervised by

Prof. Dr. Ali Farrag Osman

Prof. of Igneous and Metamorphic Rocks
Geology Department, Faculty of Science
Ain Shams University

Prof. Dr. Falham Oraby Mahmoud

Prof. of Geology
Production Sector
Nuclear Materials Authority

Dr. Hamed Mohamed Dowidar

Lecturer of Structural Geology
Geology Department, Faculty of Science
Ain Shams University

To

**Geology Department
Faculty of Science, Ain Shams University
Cairo - (2019)**



Ain Shams University



Faculty of Science

Department of Geology

M. Sc. Thesis in Science in Geology

Title: Structural and Radiometric Studies of Um Guruf Area, North Eastern Desert, Egypt

By: Mahmoud Mohammed Salem Mahmoud

Supervision Committee

Prof. Dr. Ali Farrag Osman

Professor of Geology - Ain Shams University

Prof. Dr. Falham Oraby Mahmoud

Professor of Geology - Nuclear Materials Authority

Dr. Hamed Mohamed Dowidar

Lecturer of Geology - Ain Shams University

Examiners Committee

Prof. Dr. Mahmoud Mohammed Hassaan

Professor Emeritus of Geology - Al-Azhar University

Prof. Dr. Zakaria Elsayed Hamimi

Professor of Geology - Benha University

Prof. Dr. Ali Farrag Osman

Professor of Geology - Ain Shams University

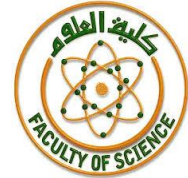
Prof. Dr. Falham Oraby Mahmoud

Professor of Geology - Nuclear Materials Authority

Date of Examination: 2 / 11 / 2019



Ain Shams University



Faculty of Science

Department of Geology

STRUCTURAL AND RADIOMETRIC STUDIES OF UM GURUF AREA, NORTH EASTERN DESERT, EGYPT

Name: Mahmoud Mohammed Salem Mahmoud

Scientific degree: Master in Science in Geology

Department: Geology

Faculty: Science

University: Ain Shams

NOTE

The present thesis is submitted to the Geology Department, Faculty of Science, Ain Shams University in partial fulfillment of the requirements for the Master degree of Science in Geology. Beside the research work materialized in this thesis, the candidate ***Mahmoud Mohammed Salem Mahmoud*** has attended five post-graduate courses for one year in the following topics:

1. Field Geology and Geostatistics
2. Advanced Lithostratigraphy and Biostratigraphy
3. Photogeology and Geomorphology
4. Sedimentary rocks and Sedimentation
5. Advanced Structural Geology and Geotectonics

He has successfully passed the final exam in the above mentioned courses, besides an English language course.

Prof. Dr. Ashraf Rushdi Mohamed Baghdady

Head of Geology Department

Faculty of Science

Ain Shams University

FOR

MY

FAMILY

ACKNOWLEDGEMENTS

Praise be to *Allah*, Lord of the worlds, by whose grace this work has been completed.

The author is very grateful and thankful to the *Geology Department, Faculty of Science, Ain Shams University* for the great help and facilities offered during the preparation of this work.

My great thanks to *Nuclear Materials Authority*, especially *Prof. Dr. H. I. Mera*, Chairman of the Nuclear Materials Authority, for providing all field and laboratory facilities during the work.

Very special thanks go to *Prof. Dr. A. F. Osman* and *Dr. H. M. Dowidar*, Geology Department, Faculty of Science, Ain Shams University for their kind supervision, continuous help, useful discussions, valuable advices and critically reading the manuscript.

My deep thanks to *Prof. Dr. F. O. Mahmoud*, Nuclear Materials Authority, for his kind supervision, constant guidance and suggestions during his revision.

The author wishes to express his gratitude and deep appreciation to *Assoc. Prof. H. I. El Sundoly* and *Dr. A. M. Abd El Hadi* for their continuous help and valuable advices.

Great thanks to my colleague' geologist, *M. A. Ibrahim* for his efforts during the filed works and valuable discussions.

Many thanks are due to *all members of the mining administration*, Nuclear Materials Authority, for their continuous help and encourage and saving time for me to finish this work.

Finally, I'd like to express my sincere thankfulness to *my family* for the support and encouragement during this work.

ABSTRACT

The present work aims to study the geology, structure and radioactivity of Um Guruf area to finding the relationships between structural and lithological features with the radioactive mineralizations. Um Guruf area is located in the North Eastern Desert covering an area of about 275 km². It includes Neoproterozoic basement rocks of older granitoids (oldest), Dokhan volcanics, Hammamat sedimentary rocks, younger granites and post granite dykes (youngest).

The older granitoids in the study area are mainly represented by granodiorite, which is intruded by younger granites and post granite dykes. Dokhan volcanics are widely distributed in the study area represented by acidic and intermediate lava flows and their associated pyroclastics of tuffs and agglomerates. The Hammamat sedimentary rocks are unconformably overlying the Dokhan volcanics composed of bedded series of conglomerates, breccias, greywackes, sandstones and siltstones with some bands of purple slates. Younger granites represent the main rock type in the present area. They are classified into syeno-to alkali feldspar granites and alkali feldspar granites. They intrude all the previous rock types and are cut by post granite dykes and veins. Post granite dykes are represented by acidic, intermediate and basic types. They cut all the previous rock types with NE-SW and ENE-WSW trends.

The study area is subjected to tectonic events displaying structural features, mainly represented by faults and joints. Faults are represented by strike slip type with some normal and reverse faults. The common fault trends based on their number proportions are NW-SE, NNW-SSE and NE-SW, while based on their length proportions are NNE-SSW and ENE-WSW. The main trends of joints are NE-SW, ENE-WSW, E-W and N-S. The recorded faults

are of compression stresses, while the recorded joints are of tension stresses. The NE-SW is the master trend in the study area controlling the structural and tectonic framework of the area followed by ENE-WSW trend, while the least common trends are NNW-SSE, N-S, NW-SE and WNW-ESE.

The radioactivity in the younger granites is higher than that of other older rocks. The radioactive anomaly is recorded in zoned pegmatite pocket in Hmrat El Sorwhyia alkali feldspar granites. It is structurally controlled by two hematized faults trending NNW-SSE and WNW-ESE and by two strongly hematized and silicified joints striking NNE-SSW and NW-SE. It is controlled by lithology containing U and Th-bearing minerals of uranophane, thorite and zircon in addition to apatite, sphene and iron oxides which capture U and/or Th elements.

CONTENTS

Content	Page
LIST OF TABLES.....	vi
LIST OF FIGURES.....	viii
 CHAPTER ONE: INTRODUCTION	
1.1. Location and Accessibility.....	1
1.2. Topography.....	1
1.3. Climate and Vegetation.....	5
1.4. General review on the basement rocks of Egypt.....	5
1.5. Previous works on the study area and Its Environs.....	10
1.6. Aim of the present study.....	16
1.7. Methodology.....	16
 CHAPTER TWO: GEOLOGICAL SETTING	
2.1. Older Granitoids.....	18
2.2. Dokhan Volcanics.....	22
2.3. Hammamat Sedimentary Rocks.....	25
2.4. Younger Granites.....	29
2.4.1. Syeno-to alkali feldspar granites.....	29
2.4.2. Alkali feldspar granites.....	33
2.5. Post granite dykes.....	34
2.5.1. Acidic dykes.....	34
2.5.2. Intermediate dykes.....	35
2.5.3. Basic dykes.....	37
2.6. Wadi deposits.....	37
 CHAPTER THREE: STRUCTURAL ANALYSIS	
3.1. Primary structures.....	38
3.1.1. Bedding and Lamination (S ₀)	38
3.1.2. Flow structures.....	40
3.1.3. Vesicular structures.....	41

3.2. Secondary structures.....	41
3.2.1. Foliation (S_1).....	41
3.2.2. Pencil structures.....	42
3.2.3. Faults.....	42
3.2.3.1. NW-SE trend.....	46
3.2.3.2. NNW-SSE trend.....	53
3.2.3.3. NE-SW trend.....	53
3.2.3.4. NNE-SSW trend.....	54
3.2.3.5. ENE-WSW trend.....	55
3.2.3.6. N-S trend.....	56
3.2.3.7. WNW-ESE trend.....	56
3.2.3.8. E-W trend.....	57
3.2.3.9. Stress analysis of the major recorded faults....	59
3.2.3.9.1. The first phase.....	59
3.2.3.9.2. The second phase.....	59
3.2.4. Folds.....	59
3.2.5. Joints.....	61
3.2.5.1. Joints in Granodiorites.....	61
3.2.5.2. Joints in Dokhan Volcanics.....	64
3.2.5.3. Joints in Hammamat Sedimentary Rocks.....	66
3.2.5.4. Joints in Younger Granites.....	68
3.3. Post granite dykes and veins.....	72
3.3.1. Acidic dykes.....	72
3.3.2. Intermediate dykes.....	75
3.3.3. Basic dykes.....	75
3.3.4. Aplite veins.....	75
3.3.5. Quartz veins.....	76
3.4. Surface lineament analysis.....	76
3.4.1. Part I.....	78
3.4.2. Part II.....	78
3.4.3. Part III.....	81
3.4.4. Part IV.....	81

3.5. Correlation between total faults, total joints, total dykes and total surface lineaments.....	82
--	----

CHAPTER FOUR: PETROGRAPHY

4.1. Older Granitoids.....	86
4.2. Dokhan Volcanics.....	91
4.2.1. Lava flows.....	91
4.2.1.1. Intermediate lava flows.....	91
4.2.1.1.1. Porphyritic andesite.....	91
4.2.1.1.2. Trachy andesite.....	93
4.2.1.1.3. Basaltic andesite.....	93
4.2.1.2. Acidic lava flows.....	94
4.2.1.2.1. Dacite.....	94
4.2.1.2.2. Rhyodacite.....	96
4.2.1.2.3. Rhyolite.....	96
4.2.2. Pyroclastics.....	97
4.2.2.1. Acidic lithic crystal tuffs.....	97
4.2.2.2. Intermediate lithic crystal tuffs.....	99
4.2.2.3. Welded tuffs (Ignimbrites).....	99
4.2.2.4. Andesitic agglomerates.....	100
4.3. Hammamat Sedimentary Rocks.....	100
4.3.1. Conglomerates and breccias.....	100
4.3.2. Greywackes.....	101
4.3.3. Sandstones.....	101
4.3.4. Siltstones.....	103
4.3.5. Purple slates.....	103
4.4. Younger Granites.....	104
4.4.1. Hmrat El Sorwhyia granites.....	104
4.4.1.1. Hmrat El Sorwhyia syeno granites.....	104
4.4.1.2. Hmrat El Sorwhyia alkali feldspar granites....	108
4.4.2. G. El Resha and G. Al Hamra alkali feldspar granites.....	109
4.5. Post granite dykes.....	112

4.5.1. Acidic dykes.....	112
4.5.1.1. Granite porphyry dykes.....	112
4.5.1.2. Granophyre dykes.....	114
4.5.1.3. Rhyolite dykes.....	115
4.5.1.4. Dacite dykes.....	115
4.5.2. Intermediate dykes.....	116
4.5.2.1. Andesite dykes.....	116
4.5.3. Basic dykes.....	118
4.5.3.1. Dolerite dykes.....	118
4.5.3.2. Basalt dykes.....	119

CHAPTER FIVE: MINERALOGY OF THE YOUNGER GRANITES

5.1. Methodology.....	120
5.2. Heavy minerals identification.....	121

CHAPTER SIX: RADIOACTIVITY

6.1. Radiometric investigations.....	137
6.1.1. Field measurements.....	137
6.1.2. Analytical measurements.....	137
6.2. Distribution of total gamma radioactivity and radioelement concentrations in the studied rock types	139
6.2.1. Granodiorites.....	139
6.2.2. Dokhan Volcanics.....	148
6.2.3. Hammamat Sedimentary Rocks.....	150
6.2.4. Younger Granites.....	151
6.2.4.1. Syeno-to alkali feldspar granites.....	152
6.2.4.2. Alkali feldspar granites.....	155
6.2.5. Pegmatites.....	157
6.2.6. Acidic dykes.....	158
6.2.7. Intermediate dykes.....	159
6.2.8. Basic dykes.....	159
6.2.9. Aplite veins.....	161

6.2.10. Quartz veins.....	162
6.3. Radioactive equilibrium.....	162
6.4. Favorability of radioelements in the studied rock types.	165
6.4.1. Radioelement favorable areas.....	165
6.4.2. Effect of the rock alteration on the uranium mobilization and favorability.....	168
6.5. Radioactive anomaly.....	169
6.6. Radioactivity relationships.....	171
6.6.1. Structural control of gamma radioactivity distribution.....	171
6.6.2. Lithological control of gamma radioactivity distribution.....	174
CHAPTER SEVEN: SUMMARY AND CONCLUSIONS..	175
REFERENCES.....	182
ARABIC SUMMARY	

LIST OF TABLES

Table		Page
Table 1.1.	Some classifications of basement rocks of Egypt.....	9
Table 3.1.	Frequency distribution of 90 faults recorded in the study area.....	47
Table 3.2.	The detailed characteristic features of 90 faults recorded in the study area.....	50
Table 3.3.	Frequency distribution of the main trends of 1103 joints measured in the various rock types of the study area.....	62
Table 3.4.	Frequency distribution of different dykes and veins measured in the study area.....	73
Table 3.5.	Surface lineaments recorded in the study area.....	79
Table 3.6.	Frequency distribution of 4338 Surface lineaments recorded in the study area.....	79
Table 3.7.	Frequency distribution of recorded total faults, total joints, total dykes and total surface lineaments in the study area.....	83
Table 4.1.	The modal analysis of the studied granitic rocks of Um Guruf area.....	87
Table 6.1.	Statistical analyses of field gamma radioactivity measurements of the study area...	140
Table 6.2.	Radiometric analytical measurements of representative samples collected from various rock types of the study area.....	143

Table 6.3.	Calculated average contents of U, Th and their Th/U ratio of the various rock types of the study area compared with that of some rock types.....	149
Table 6.4.	Favorability indices of radioelements in the studied rock types.....	166
Table 6.5.	Radiometric analytical measurements of four samples collected from the anomalous pegmatite in the study area.....	173