



**INTERNATIONAL UNIVERSITY OF AFRICA**  
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**DEPARTMENT OF ECONOMIC GEOLOGY**



# **Sedimentary Iron Ore Deposits and Associated Manganese in Shendi –Atbara Basin, River Nile State, Sudan.**

A thesis submitted in fulfillment for the requirements' of

M.Sc. degree in Economic Geology

**BY**

**Abubaker Alamin Mohammed Ahmed Abasher**

**Supervisor**

**Dr. Mohmmmed Ahmed Amlas**

**Co- Supervisor**

**Dr. Sadam Hassan Mohmed Ahmed**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿لَقَدْ أَرْسَلْنَا رُسُلَنَا بِالْبَيِّنَاتِ وَأَنْزَلْنَا مَعَهُمُ الْكِتَابَ وَالْمِيزَانَ لِيَقُومَ النَّاسُ  
بِالْقِسْطِ وَأَنْزَلْنَا الْحَدِيدَ فِيهِ بَأْسٌ شَدِيدٌ وَمَنَافِعُ لِلنَّاسِ وَلِيَعْلَمَ اللَّهُ مَن  
يَنْصُرُهُ وَرُسُلَهُ بِالْغَيْبِ إِنَّ اللَّهَ قَوِيٌّ عَزِيزٌ﴾

سورة الحديد، الآية (٢٥)

# **Dedication**

**This humble work is dedicated to**

**my father, my beloved mother, my brothers, my**

**Teachers, and to everyone seeking knowledge.**

**Abubaker**

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# LIST OF CONTENTS

	Page
الإستهلال .....	I
Dedication .....	II
Acknowledgements.....	III
List of Contents .....	..V
List of Figures .....	..IV
List of Tables .....	X
List of Plates.....	IV
Abstract .....	IV
Abstract in Arabic .....	IV
<b>CHAPTER 1 INTRODUCTION</b> .....	<b>1</b>
1.1 Location of the study area .....	1
1.2 Physiographic features .....	2
1.2.1 Topography.....	2
1.2.2 Climate .....	4
1.2.3 Vegetation.....	4
1.2.4 Drainage system.....	5
1.2.5 Population.....	6
1.3 Previous studies .....	7
1.3.1 Sedimentological and Stratigraphical Characteristics.....	7
1.3.2 Evaluation of iron ore.....	8
1.4 Objectives of the study .....	9
 <b>CHAPTER 2 METHODOLOGY</b> .....	 <b>10</b>
2.1 Introduction.....	10
2.2 Office Work.....	10
2.2.1 General .....	10
2.2.2 Preparation of the maps .....	11
2.3 Field Work.....	11
2.3.1 Field Equipment.....	13
2.4 Laboratory Work.....	13
2.4.1 Preparation of Samples for chemical analysis .....	13
2.4.1.1 Atomic Absorption Spectrometry .....	13
2.4.2 Preparation of Samples for Petrographical Studies.....	17

<b>CHAPTER 3 REGIONAL GEOLOGY AND TECTONIC SETTING</b> .....	<b>20</b>
3.1 Regional geology .....	20
3.1.1 Basement Complex .....	21
3.1.2 Shendi Formation (Upper cretaceous sandstone) .....	23
3.1.3 Hudi chert (Tertiary sediments) .....	25
3.1.4 Cenozoic Volcanic .....	27
3.1.5 Superficial Deposits .....	28
3.2 Tectonic setting .....	30
<b>CHAPTER 4 GEOLOGY OF IRON AND MANGANESE ORES</b> .....	<b>32</b>
4.1 Iron Ore Deposits .....	32
4.1.1 World Iron Ore Production .....	32
4.1.2 Distribution of iron ore in Sudan .....	34
4.2 Iron Ore in Sedimentary Environments.....	37
4.2.1 Bog Iron Ores.....	37
4.2.1.1 Mineralogy.....	37
4.2.1.2 Mode of Occurrence.....	37
4.2.1.3 Mineral Associations and Textures.....	38
4.2.2 Ironstones.....	38
4.2.2.1 Mineralogy.....	38
4.2.2.2 Mode of Occurrence.....	38
4.2.2.3 Mineral Associations and Textures.....	38
4.2.3 Banded Iron Formations .....	39
4.2.3.1 Mineralogy.....	39
4.2.3.2 Mode of Occurrence.....	39
4.2.3.3 Mineral Associations and Textures.....	40
4.3 Origins of Iron-Rich Sediments .....	41
4.4 Manganese .....	42
4.4.1 Manganese Deposits of Orthoquartzite-Glaucanite-Clay Association .....	42
4.4.1.1 Mineralogy.....	42
4.4.1.2 Mode of Occurrence.....	43
4.4.1.3 Mineral Associations and Textures.....	43
4.4.2 Manganese Deposits of the Limestone-Dolomite Association.....	44
4.4.2.1 Mineralogy.....	44
4.4.2.2 Mode of Occurrence.....	44
4.4.2.3 Mineral Associations and Textures.....	44

4.4.3	Manganese Deposits of Volcanic Affiliation .....	45
4.4.3.1	Mineralogy.....	45
4.4.3.2	Mode of Occurrence.....	45
4.4.3.3	Mineral Associations and Textures.....	45
4.4.4	Modern Marine Deposits (Manganese Nodule).....	45
4.4.4.1	Mineralogy.....	45
4.4.4.2	Mode of Occurrence.....	46
4.4.4.3	Mineral Associations and Textures.....	46
4.5	Origins of Manganese-Rich Sediments.....	46
4.6	Iron Ore in study area.....	47
4.6.1	The iron ores.....	48
4.6.1.1	The Ferribands .....	49
4.6.1.2	Ferricretes .....	49
4.6.1.3	Oolitic ironstone.....	50
4.7	Petro graphic study of iron ore in study area.....	68
4.7.1	Polish sections description.....	68
4.7.2	Thin sections description.....	79

## CHAPTER 5 GEOCHEMISTRY OF IRON ORE AND MANGANESE ORE .....90

5.1	Geochemistry of Iron Ore.....	90
5.1.1	The Fe geochemical behavior in supergenic environment.....	92
5.1.2	Geochemical Signature of Iron Ores.....	93
5.2	Geochemistry of Manganese Ore.....	97
5.2.1	The Mn geochemical behavior in supergenic and hydrothermal systems.....	99
5.3	Detail geochemical analysis in the study area.....	102
5.3.1	Major oxides description in the study area.....	102
5.3.1.1	Concentration of Fe <sub>2</sub> O <sub>3</sub> in the study area .....	103
5.3.1.2	Concentration of SiO <sub>2</sub> in the study area .....	104
5.3.1.3	Concentration of Al <sub>2</sub> O <sub>3</sub> in the study area .....	105
5.3.1.4	Concentration of CaO in the study area .....	106
5.3.1.5	Concentration of K <sub>2</sub> O in the study area.....	107
5.3.1.6	Concentration of Na <sub>2</sub> O in the study area.....	108
5.3.2	Trace elements description in the study area.....	109
5.3.2.1	Concentration of Cr in the study area.....	110
5.3.2.2	Concentration of Co in the study area.....	111
5.3.2.3	Concentration of Cu in the study area.....	112
5.3.2.4	Concentration of Zn in the study area .....	113
5.3.2.5	Concentration of Mn in the study area .....	114

5.3.2.6	Concentration of Ni in the study area.....	115
<b>CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS.....</b>		<b>123</b>
6.1	Conclusions.....	123
6.2	Recommendations .....	125
References	.....	126



## LIST OF FIGURES

Figure		Page
1.1	Location map of the study area.....	1
1.2	Contour map of the study area.....	3
1.3	Flat topped (Mesa) Shendi formations.....	3
1.4	Vegetation of Central Sudan.....	4
1.5	Sudan vegetation distribution.....	5
1.6	Drainage system of the study area.....	6
2.1	Flow chart outlining the steps in the preparation of polished sections.....	19
3.1	Basement complex, Sabaloka inlier.....	22
3.2	stratigraphy of Cretaceous basins in Sudan.....	24
3.3	Nubian formation paleocurrent direction map.....	27
3.4	Geological map of the study area and vicinity.....	29
3.5	Schematic tectonic map depicting the relationship of the Atbara Rift with the Central African Shear ZoneV.....	31
4.1	World Iron Ore Production in 2013/2015.....	33
4.2	Iron Ore Production, On a Usable Basis, For Select Countries.....	34
4.3	Metals and Minerals in Sudan.....	36
4.4	Locations of iron.....	37
4.5	Textures observed in typical ironstones.....	39
4.6	Typical banded iron formation assemblages and textures.....	40
4.7	Manganese ores.....	43
4.8	vertical profile showing Alkarbikan area.....	52
4.9	vertical profile showing Awatib area.....	55
4.10	vertical profile showing Bejrawiah area.....	57
4.11	vertical profile showing Um Ali area.....	61
4.12	vertical profile showing Wadi Um Ali area.....	63
4.13	vertical profile showing Alnagaa1 area.....	65
4.14	vertical profile showing AlMusawarat 2 area.....	67
5.1	Approximate mineral composition of iron-bearing rocks.....	91
5.2	Eh-pH diagram for Fe-O-H system describing Fe mobility.....	93
5.3	Eh-pH diagrams of Mn-O-H.....	99
5.4	Eh-pH diagram of Mn-H <sub>2</sub> O system.....	101
5.5	Concentration of Fe <sub>2</sub> O <sub>3</sub> in the study area.....	103
5.6	Concentration of SiO <sub>2</sub> in the study area.....	104
5.7	Concentration of Al <sub>2</sub> O <sub>3</sub> in the study area.....	105
5.8	Concentration of CaO in the study area.....	106
5.9	Concentration of K <sub>2</sub> O in the study area.....	107
5.10	Concentration of Na <sub>2</sub> O in the study area.....	108

5.11	Concentration of Cr in the study area.....	110
5.12	Concentration of Co in the study area.....	111
5.13	Concentration of Cu in the study area.....	112
5.14	Concentration of Zn in the study area .....	113
5.15	Concentration of Mn in the study area .....	114
5.16	Concentration of Ni in the study area.....	115
5.17	Histograms showing distribution of major oxides for each location in the study area .....	116
5.18	Histograms showing distribution of major oxides for each location in the study area.....	117
5.19	Histograms showing distribution of major oxides for each location in the study area.....	118
5.21	Histograms showing distribution of trace elements for each location in the study area.....	119
5.22	Histograms showing distribution of trace elements for each location in the study area.....	120
5.23	Histograms showing distribution of trace elements for each location in the study area.....	121
5.24	Showing Isoconcentration Map of Iron in Study Area .....	122
5.25	Showing Isoconcentration Map of Manganese in Study Area .....	122

## LIST OF TABLES

Table	Page
2.1	Sample numbers and GPS location of the different localities sampled, elevation and depositional setting ..... 12
3.1	Stratigraphic sequence and age of the study area .....20
3.2	Comparison of lithological of Merkhiyat and Quatzone sandstone Nubian Formation .....25
5.1	Abundance of iron in common rock types .....91
5.2	Principal features of iron formation facies .....95
5.3	Iron-formation minerals .....96
5.4	Abundance of Mn in common rocks .....98
5.5	Results of the chemical analysis (major oxides) of samples ..... 102
5.6	Results of the chemical analysis (trace elements) of samples ..... 109

## LIST OF PLATES

Plate	Page
4.1	53
4.2	54
4.3	56
4.4	58
4.5	58
4.6	59
4.7	59
4.8	60
4.9	60
4.10	62
4.11	64
4.12	66
4.13	66
4.14	68
4.15	69
4.16	70
4.17	71
4.18	72
4.19	73
4.20	74
4.21	75
4.22	76
4.23	77

4.24	Photomicrograph of the slab composed mainly of Ferruginated mudstone, fine grained composed of interlayering of iron oxide (magnetite – hematite) and limonite - Musawarat3 area .....	78
4.25	Photomicrograph showing light color (brownish), granular texture, angular to sub angular grains (mainly quartz); iron ore matrix fine grains - Alkarbican area.....	79
4.26	Photomicrograph showing interlayering of oxides and silica Typical banded iron formation assemblages and textures, Layered subhedral - Awatib area. ....	80
4.27	Photomicrograph showing light color (brownish), granular texture , angular to sub angular grains ( mainly quartz) , iron ore matrix fine grains - Awatib area.....	81
4.28	Photomicrograph showing light color (brownish), shows the typical rounded to subrounded quartz grains - Bigrawiah area .....	82
4.29	Photomicrograph showing the zonation of the iron (oolites), Textures observed in typical oolitic ironstones - Um Ali area.....	83
4.30	Photomicrograph showing the zonation of the iron, Textures observed in typical oolitic ironstones. Distorted ooliths comprised of fine-grained chamosite, Hematite and goethite - Goz Alhaj area .....	84
4.31	Photomicrograph showing the light color (brownish), granular texture, angular to sub angular grains (mainly quartz); iron ore matrix fine grains - Musawarat 1 area .....	85
4.32	Photomicrograph showing the Iron oxide cement medium to coarse sub round quartz grain, Rock fragment - Alnagaa1 area .....	86
4.33	Photomicrograph showing the Manganese (black) and iron (red) cements surrounding quartz and filled fractures of alkali feldspar grains - Alnagaa2 area. ....	87
4.34	Photomicrograph showing the light color (brownish), granular texture, angular to sub angular grains (mainly quartz), iron ore matrix fine grains, mica (muscovite) - Musawarat 2 area .....	88
4.35	Photomicrograph showing the light color (brownish), granular texture, showing manganese (black) and iron (red) cements surrounding quartz - Musawarat 3 area.....	89

## ABSTRACT

The study area is located in the eastern part of the River Nile State of northern Sudan between Latitudes 17°20'0" and 16°40'0"N and longitudes 33°30'0" and 34°10'0"E. The main geological units in the study area are composed of Basement Complex (Pre-Cambrian), Nubian sandstone formation (upper Cretaceous), Hudi Chert (Oligocene) and Quaternary superficial deposit in ascending chronological order. The aim of this study is to investigate the geological and geochemical behavior and geochemical conditions affecting precipitation of sedimentary Iron ore and associated Manganese. The methodologies have been used to realize the objectives of this study included; fieldwork, office mapping, remote sensing, and as well as the Geographic Information System (GIS), geochemical data analyses, thin sections, polished sections. The main findings are summarized below: according to field observation Sedimentary Iron and Manganese ores can broadly be considered as occurring in three major classes: Bog iron ores, Ironstones, and Banded Iron formations. Vertical sedimentary profiles revealed that the Iron and Manganese ores occurred in study area at different types in stratigraphic sequence such as cap, bedded and interbedded. Petrographic study of Iron and Manganese ores in collected samples includes study of the textures and structures of ores to obtain ore history. The main types of textures and structures in studied samples are oolitic, granular, lamellar and bands. According to above results the origin of iron ore and associated manganese it's forming by chemical precipitation during chemical weathering of surrounding areas that means its continental lacustrine environment. Geochemical investigation of studied samples includes chemical analysis, trace element analysis and major oxide analysis. Fe<sub>2</sub>O<sub>3</sub> content in study area ranging between maximum 79.52% in Goz Alhaj area to minimum 2.49% in Alnagaa area and the average is 47.04%. Mn in study area ranging between Maximum 11659.7 ppm in Elnagaa1 area to Minimum 216 ppm in Alnagaa3 area and the average is 2985.35 ppm. All these results have been to construct isoconcentration maps of the Iron and Manganese ores their and its distribution in study area and potentiality for future mining works.

## ملخص الرسالة

تقع منطقة الدراسة في الجزء الشرقي لولاية نهر النيل شمال السودان بين خطي طول "0'20'17 - 0'40'16" N و خطي عرض "0'30'33 - 0'10'34". التكوين الجيولوجي لمنطقة الدراسة يتكون من صخور الأساس التي يعود عمرها لفترة ما قبل الكامبري والحجر الرملي النوبي ذو العمر الكريتاسي الأعلى و صوان الهودي ذو العمر الأولوجيوسيني والرسوبيات الحديثة. تهدف هذه الدراسة الي دراسة السلوك الجيولوجي والجيوكيميائي والظروف الجيوكيميائية التي تتحكم في ترسيب خامات الحديد الرسوبي وخامات المنجنيز الرسوبي المصاحب له. لتحقيق هذه الأهداف أستخدم الآتي: العمل الحقلية، التخريط المعملية، الإستشعار عن بعد بالإضافة الي نظم المعلومات الجغرافية والتحليل الجيوكيميائي والشرائح الرقيقة والشرائح المصقولة. أهم نتائج هذه الدراسة الآتي: بناءً على الملاحظات الحقلية فإن خامات الحديد والمنجنيز الرسوبية تتواجد في ثلاثة أشكال رئيسية هي خامات الحديد العقدي وأحجار الحديد والحديد المتحزم. دراسة المقاطع الرسوبية الرأسية أشارت الي أن خامات الحديد والمنجنيز تتوضع في ثلاثة أشكال رئيسية في التتابع الطبقي هي : شكل الغطاء، شكل طبقات وشكل طبقات بينية. الدراسة البتروجرافية لخامات الحديد في العينات المأخوذة تضمنت دراسة أنسجة وبنيات الخامات لمعرفة تاريخ نشأة الخام. الأنواع الرئيسية من الأنسجة والبنيات في العينات المدروسة هي: الأنواع البطروخية، الأنواع الحبيبية، الأنواع الرقائقية والأنواع المتحزمة. بناءً على النتائج أعلاه فإن خامات الحديد والمنجنيز المصاحب تكونت عن طريق الترسيب الكيميائي أثناء التجوية الكيميائية للمناطق المحيطة وهذا يعني انها ترسب في بيئة قارية بحيرية. الدراسة الجيوكيميائية للعينات المدروسة تضمنت التحليل الكيميائي ، تحليل العناصر الشحيحة وتحليل الأكاسيد الرئيسية. محتوى أكسيد الحديد في منطقة الدراسة يتراوح بين %79.52 في منطقة قوز الحاج الي %2.49 في منطقة النقعة بمتوسط %47.04 . محتوى المنجنيز في منطقة الدراسة يتراوح بين 11659.7 ppm في منطقة النقعة ١ الي 216 ppm في منطقة النقعة ٣ بمتوسط 2985.35 ppm . كل هذه النتائج أستخدمت لإنشاء خرائط تساوي التراكيز لرواسب خامات الحديد والمنجنيز وتوزيعها في منطقة الدراسة وإحتمالياتها للأعمال المنجمية المستقبلية .