CONTENTS				
	Subject	Page		
C	HAPTER 1 INTRODUCTION			
1.1	1.1 General outlines	1		
1.2	Aims of the present work	1		
1.3	Location and description of the study area	2		
1.3.1	Climate conditions	4		
1.3.2	Spatial variation of rainfall	5		
1.3.3	Rainfall frequency analysis	5		
1.4	Review of previous works	6		
CHAPTER 2 GEOMORPHOLOGY AND GEOLOGY				
2.1.	General outline	9		
2.2	Geomorphologic setting	9		
2.2.1	The structural plateau	10		
2.2.2	The elevated plain	11		
2.2.3	The oolitic sand dunes	11		
2. 3	Geological setting	12		
2.3.1	General outline	12		
2.3.2	Stratigraphy	12		
2.3.3	Wells types	18		
2.3.4	Water bearing formation	18		
CHAPTER 3 HYDROCHEMICAL CHARACTERISTICS OF THE GROUNDWATER				
	Origin and significance of the major ions in			
3.1.	natural water	21		
3.2	Results and discussion	24		
3.2.1	Variation of the hydrochemical Parameters	24		
3.2.2	Distribution of major ions	25		
3.2.3	Hydrochemical facies and genetic	42		
	classifications			

3.2.3.1	Piper diagram	42
	Salinization processes	
3.2.4	Hydrochemical coefficients	45
3.2.4.1		45
3.2.4.1.1	Sodium - Chloride relationship (Na ⁺ /Cl ⁻ ratio)	51
3.2.4.1.2	Calcium-Magnesium relationship (Ca ²⁺ /Mg ²⁺ ratio)	53
3.2.4.1.3	Magnesium-Chloride relationship (Mg ²⁺ /Cl ⁻ ratio)	54
3.2.4.1.4	Sulfate-Chloride relationship (SO4 ²⁻ /Cl ⁻ ratio)	56
3.2.4.1.5	(rCl ⁻ -rNa ⁺)/rCl ⁻ and (rNa ⁺ -rCl ⁻)/rSO ₄ ²⁻ ratios	56
3.2.4.1.6	Chloride-Bicarbonate relationship (Cl ⁻ /HCO ₃ ratio)	57
3.2.4.2	Mixing process with sea water	57
3.2.4.3	The rock-water interaction	58
CHA	ENVIRONMENTAL ISOTOPES IN GROUNDWATER	
4.1	Stable environmental isotopes	64
4.1.1	Stable isotopes distribution in atmospheric waters	66
4.1.2	The T-δ ¹⁸ O correlation in precipitation	67
4. 2	Groundwater dating with ³ H	68
4. 2.1	Tritium in hydrologic Cycle	68
4. 2. 2	Qualitative interpretation of ³ H data	69
4. 3	Groundwater dating with radiocarbon	70
4. 4	Results and discussion	71
CF	IAPTER5 Water Quality Criteria	
5.1	Trace elements and water quality	82
5.1.1	Perface	82
5.1.2	Trace elements investigations in the study area	85
5.2	Assessment of groundwater quality for drinking	86
5.3	Assessment of studied water for the domestic purposes	87
5.4	Assessment of groundwater quality for livestock and poultry	88
5.5	Assessment of the studied water for industrial purposes	90
5.6	Assessment of groundwater quality for agriculture	90

	purpose	
5.6.1	Total dissolved salts (TDS)	91
5.6.2	Sodium adsorption ratio (SAR)	92
5.6.3	The Percentage of sodium (Na %)	102
	Summary and conclusion	110
	References	118
	Arabic summary	125
	Annex I	128
	Annex II	139