

Sedimentary Basins of the World, 3 (Series Editor: K.J. Hsü)

African Basins

Edited by

R.C. Selley

*Department of Geology
Imperial College of Science, Technology and Medicine
Royal School of Mines
London, United Kingdom*



ELSEVIER

Amsterdam – Lausanne – New York – Oxford – Shannon – Tokyo 1997

Contents

AN INTRODUCTION TO THE SERIES			
by K.J. Hsü	V		
INTRODUCTION AND ACKNOWLEDGEMENTS			
by R.C. Selley	IX		
LIST OF CONTRIBUTORS	XIII		
Part 1. North Africa			
<i>Chapter 1 THE SEDIMENTARY BASINS OF NORTHWEST AFRICA: STRATIGRAPHY AND SEDIMENTATION</i>			
by R.C. Selley	3		
Introduction	3		
Precambrian basement and infra-Cambrian sediments	4		
Cambro-Ordovician	5		
Silurian	8		
Devonian	11		
Carboniferous-Permian	12		
Mesozoic	12		
Selected Bibliography	16		
References	16		
<i>Chapter 2 THE BASINS OF NORTHWEST AFRICA: STRUCTURAL EVOLUTION</i>			
by R.C. Selley	17		
Introduction	17		
Tindouf basin	17		
Reggane basin	19		
Ahnet, Mouydir and Illizi/Ghadames basins	20		
Murzuk basin	21		
The Kufra basin	24		
Selected Bibliography	25		
References	26		
<i>Chapter 3 THE SIRTE BASIN OF LIBYA</i>			
by R.C. Selley	27		
Introduction	27		
Stratigraphy and facies	27		
Structure and tectonic evolution	31		
Igneous activity	34		
Selected Bibliography	35		
References	36		
<i>Chapter 4 SEDIMENTARY BASINS OF EGYPT: AN OVERVIEW OF DYNAMIC STRATIGRAPHY</i>			
by A.S. El Hawat	39		
Introduction	39		
Sedimentary basins	39		
The Afro-Nubian craton	39		
Intracratonic basins	40		
Pericratonic basins	43		
The Gulf of Suez rift basin	45		
The Palaeozoic	46		
Cambrian	48		
Ordovician-Silurian	49		
Devonian	49		
Carboniferous	50		
The Permian	53		
Geologic events and sedimentation	53		
Eustatic vs. tectonic control of sedimentation	53		
Palaeozoic glaciation	54		
Mesozoic	54		
Triassic	55		
Jurassic	55		
Cretaceous	57		
Early Cretaceous	57		
Late Cretaceous	60		
Geological events and sedimentation	66		
Early Cretaceous events: the end of the Nubian problem	67		
Late Cretaceous events	68		
Tertiary	69		
Palaeogene	70		
Palaeocene	70		
Eocene	71		
Oligocene	73		
Neogene	73		
Miocene	73		
Pliocene	76		
Geological events and sedimentation	79		
Neogene facies and events in North Africa	79		
Summary and common themes	81		
Acknowledgements	82		
References	82		
Part 2. Central Africa			
<i>Chapter 5 THE IULLEMEDEN BASIN</i>			
by R.T.J. Moody	89		
Introduction	89		
Structural setting	89		
Stratigraphy and sedimentology	91		
Precambrian	91		
Palaeozoic	92		
Permo-Triassic	92		
Jurassic Cretaceous	92		
Lower Cretaceous	93		
Upper Cretaceous	95		
Tertiary	98		
Quaternary	101		
References	101		
<i>Chapter 6 RIFT BASINS OF THE SUDAN</i>			
by R.B. Salama	105		
Introduction	105		
Geological sequence	106		
Precambrian-Cambrian	106		
Palaeozoic	106		

Mesozoic	109	Cenozoic Niger delta	163
Rift structures and rifting phases	111	The modern delta	163
The Sudanese rift system	114	Lithostratigraphy	166
Bahr El Arab rift	114	Evolution of depobelts and sequences	166
White Nile rift	115	Structure	169
Blue Nile rift	116	Petroleum geology	170
River Atbara rift	116	Conclusion	171
Wadi El Kuu rift	116	Acknowledgements	171
Sedimentary sequence of the Sag period	117	References	171
Deltas and river fans	118	<i>Chapter 8 THE WEST AFRICAN COASTAL BASINS</i>	
Bahr El Arab rift palaeoriver system	120	by M.A. Ala and R.C. Selley	173
Wadi El Kuu	121	Introduction	173
Wadi Ibra, Wadi Bulbul and Wadi Nyala	122	The Rio del Rey and Douala basins	174
Bahr El Arab palaeoriver system	122	The Gabon basin	174
Bahr El Ghazal and Bahr El Jebel	122	Pre-salt sequence	176
Sobat River	122	Salt sequence	177
Wadi El Ghalla	122	Post-salt sequence	177
White Nile rift palaeoriver systems	123	The Congo basin	180
Khor Abu Habil	123	Pre-salt sequence	180
Khor Yabus and Khor Adar	124	Salt sequence	181
Blue Nile rift palaeoriver system	124	Post-salt sequence	181
River Atbara rift palaeoriver system	124	The Angola (or Cuanza) basin	182
Sediment loads, estimated volumes and source		Pre-salt sequence	182
scenarios	124	Salt sequence	182
Natural resources of the rift basins	129	Post-salt sequence	183
Ground-water resources of the rift basins	129	The Orange River basin	184
Types of aquifers and aquifer characteristics	130	Syn-rift sequence	184
Blue Nile rift basin	132	Post-rift (drift) sequence	185
White Nile rift basin	133	References	186
River Atbara rift basin	133	<i>Chapter 9 THE EAST AFRICAN RIFT BASINS</i>	
The evolution of the ground-water flow systems	134	by L.E. Frostick	187
Ground-water resources	135	Introduction	187
Petroleum resources of the Sudanese Rift System and		Geomorphology	187
the role of ground water in its migration and		Climate and vegetation	189
accumulation	135	Pre-rift geology	189
Petroleum discovery and resources	135	Plate tectonic setting	191
Hydrocarbon migration and accumulation		Structure	192
through ground-water flow in the rift		Mantle and lower lithosphere	192
basins	136	Crustal structure	193
Buried saline lakes of the Sudanese Rift System	137	Volcanicity	194
Lake Sudd	137	The basin fills	196
White Nile rift, the Nuba saline lakes	139	Geometry of the fills	196
Blue Nile lakes	140	Sedimentary facies and depositional environments	196
Soba lake	140	Fluvial sediments	196
Relative age of the saline lakes and relation to		Lake sediments	197
East Africa lakes	140	Sequences and cyclicity in the fills	198
The evolution of the River Nile	141	The faulted margin	199
The Blue Nile in Ethiopia	141	Lake centre	200
The White Nile in Equatoria	143	The flexured margin	200
Late Quaternary River Nile	144	Examples of basin types	201
The evolution of the River Nile and the buried		The Lake Tanganyika basin	201
saline rift lakes in Sudan	144	The Lake Turkana basin	202
Acknowledgments	147	Baringo-Naivasha-Magadi basins	203
References	147	Conclusions	206
<i>Chapter 7 THE NIGER DELTA BASIN</i>		Controls on differences in structure and sedimentary	
by T.J.A. Reijers, S.W. Petters and		fill	206
C.S. Nwajide	151	Importance of the East African Rift basins	206
Introduction	151	Acknowledgements	206
Tectonic setting	153	References	207
Antecedent deltas in the Benue trough	154	<i>Chapter 10 THE COASTAL BASINS OF SOMALIA,</i>	
Deltaic sedimentation in the Anambra Basin	156	KENYA AND TANZANIA	
The Campanian	159	by E.I. Mbede and A. Dualah	211
The Maastrichtian	159	Introduction	211
The Paleocene	159		
The Eocene	159		
Sequence stratigraphy of the Anambra Basin	159		

Review of the geology of the Somali Coastal Basin	212	Drakensberg Group and associated intrusions	303
Introduction	212	Basin history	305
Somali Coastal Basin	214	Tectonic setting	305
Luugh-Mandera Basin	214	Dwyka glaciers and ice sheets	308
Somali Embayment	215	Ecca seas and deltas	308
Geological review of the Kenya Coastal Basin	217	Beaufort alluvial plains	309
Introduction	217	Post-Beaufort floodplains and deserts	309
Karoo	218	Igneous events and Gondwana break-up	309
Post-Karoo	218	Economic resources	310
The geological review of Tanzania Coastal Basin	221	Coal	310
Introduction	221	Oil and gas	310
Selous-Ruvu-Tanga Basin	221	Uranium and molybdenum	310
The Lindi Rift Basin	225	References	313
Structural evolution	227		
Economic geology	230	<i>Chapter 13 LATE MESOZOIC SEDIMENTARY</i>	
Hydrocarbon prospectivity	230	BASINS OFF THE SOUTH COAST OF	
Other mineral deposits	231	SOUTH AFRICA	
References	232	by I.K. McMillan, G.J. Brink,	
		D.S. Broad and J.J. Maier	319
Part 3. Southern Africa		Introduction	319
		Regional setting	319
<i>Chapter 11 THE OWAMBO BASIN OF NORTHERN</i>		Previous work	322
NAMIBIA		General structure and history of the southern offshore	
by R. McG. Miller	237	basins	323
Introduction	237	Bredasdorp basin	324
Regional stratigraphy	238	Introduction	324
The Damara Sequence	238	Basin evolution	329
The Nosib Group	238	Rift tectonics and sedimentation (D to 1At1)	329
The Otavi Group	243	Transitional-early drift tectonics and	
The Abenab Subgroup of the Otavi		sedimentation (1At1 to 13At1)	344
Mountainland	243	Late drift tectonics and sedimentation (13At1 to	
The Abenab Subgroup west of the Otavi		present day)	345
Mountainland	243	Pletmos basin and Infanta embayment	347
The Tsumeb Subgroup	245	Introduction	347
The Mulden Group	252	Basin evolution	348
Structure of the late-Proterozoic rocks of the Owambo		Rift tectonics and sedimentation (D to 1At1)	348
Basin	256	Transitional-early drift tectonics and	
The Karoo Sequence	256	sedimentation (1At1 to 13At1)	355
The Kalahari Sequence	260	Late drift tectonics and sedimentation (13At1 to	
Summary	265	present day)	358
Acknowledgements	267	Gamtoos and Algoa basins	358
References	267	Introduction	358
		Basin evolution	359
<i>Chapter 12 THE FORELAND KAROO BASIN, SOUTH</i>		Rift tectonics and sedimentation (D to 1At1)	359
AFRICA		Transitional-early drift tectonics and	
by M.R. Johnson, C.J. van Vuuren,		sedimentation (1At1 to 13At1)	370
J.N.J. Visser, D.I. Cole, H. de V. Wickens,		Drift tectonics and sedimentation (13At1 to	
A.D.M. Christie and D.L. Roberts	269	present day)	373
Introduction	269	Acknowledgements	374
Stratigraphy and palaeoenvironments	270	References	374
Dwyka Group	270		
Ecca Group	275	Part 4. Summary	
Basal formations in the south, west and		<i>Chapter 14 PUZZLING QUESTIONS IN THE SIMPLE</i>	
northwest	275	HISTORY OF A CONTINENT	
Southern formations (above the Whitehill		by K.J. Hsü	379
Formation)	278	References	382
Western and northwestern formations (above the			
Whitehill Formation)	283	AUTHOR INDEX	383
Northeastern formations	288	GEOGRAPHIC, TECTONIC AND	
Beaufort Group	295	STRATIGRAPHIC INDEX	389
Adelaide Subgroup	295	MINERALS, PETROLEUM, ROCKS AND	
Tarkastad Subgroup	299	FOSSILS INDEX	393
Molteno Formation	301		
Elliot Formation	302		
Clarens Formation	302		