GEOSCIENTIFIC RESEARCH IN NORTHEAST AFRICA



EDITED BY ULF THORWEIHE
& HEINZ SCHANDELMEIER

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Geoscientific Research in Northeast Africa

Edited by
ULF THORWEIHE & HEINZ SCHANDELMEIER
Technical University Berlin, Germany



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Cover photograph: Wadi Howar and late Proterozoic Jebel Rahib complex, Northwest Sudan (Photo by Stefan Kröpelin)

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Editorial comment

The idea to organize an international conference on 'Geoscientific Research in Northeast Africa' was suggested by a number of scientists during the last years. Staff members of the 'Special Research Project Arid and Semi-Arid Areas' (SFB 69) of the Technical University of Berlin, one of the biggest research projects engaged in Northeastern African geology, have responded to the proposals by organizing a conference from June 17th to the 19th 1993 in Berlin.

Information on a compilation of extended abstracts was distributed to some 500 individuals, resulting in more than 100, mostly co-authored contributions at the end of February 1993. The Organizing Committee decided that this abstract volume, although initiated in connection with the Berlin conference, should also be open to non-participants of the meeting.

The production of this volume in a few months was a difficult task, because many of the papers arrived late, rendering the application of a normal review process impossible. Many texts had to be reformatted and some had to be retyped and corrected for English. However, it was often not possible to send the modified texts to authors from countries, where the mail service is slow.

The contributions to this volume are generally closely oriented along the thematic lines of the conference, thus providing a large amount of new data and information on the topics of crustal accretion, intraplate dynamics, paleoclimate and hydrology. The extended abstracts, although certainly not a substitute for a comprehensive publication, nevertheless offered the opportunity for many researchers to quickly spread new ideas and results of on-going research in Northeast Africa in a condensed form.

We like to thank the publishing house Balkema for its cooperation and for the extremely favourable financial conditions, which facilitated this fast distribution of geoscientific information. We also like to thank G. Banks and A. Sarna from the secretarial office of SFB 69 for their technical assistance prior to printing.

Berlin, June 1993
U. Thorweihe
H. Schandelmeier



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1 Precambrian evolution



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The Pan African Belt of Northeastern and Eastern Africa, Madagascar, Southern India, Sri Lanka and East Antarctica: Terrane amalgamation during formation of the Gondwana Supercontinent

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The recently proposed SWEAT hypothesis (western North America, eastern Australia, eastern Antarctica and perhaps southern India were connected in the late Precambrian and broke apart some 740 Ma ago; Moores 1991, Dalziel 1991) implies that crustal accretion and orogenic activity along a broad belt along the eastern margin of Africa in what has traditionally been referred to as the Mozambique belt is the result of closure of the late Precambrian Mozambique Ocean and collision of two large continental masses to form East Gondwana (Fig. 1). The orogenic domain resulting from this accretion/collision event extends from eastern Africa via Mozambique to southern India, Sri Lanka and East Antarctica, and I examine this by briefly discussing segments of the Pan African domain in these areas.

Northeast Africa (Egypt and Sudan)

In NE Africa and Arabia, the Pan African terrain is generally referred to as Arabian-Nubian Shield (ANS) and consist to a large degree of juvenile crustal material accreted to the ancient African margin during the period ~900-700 Ma ago (Greenwood et al. 1980, Kröner et al. 1987, Kröner et al. 1992a). Although terranes of continental affinity, interpreted as microcontinents, were identified in the eastern part of the Arabian shield, there is still juvenile Pan African material farther east into the Oman, and the eastern



Figure 1. Computer reconstruction of the Eastern Australian (AUS), Eastern Antarctica (EANT), southern Indian (IND) and Laurentian (NAM) cratons in the late Precambrian (from Dalziel 1991).

margin of the accretionary domain is still not known.

In the Eastern Desert of Egypt, Sinai and southernmost Israel, Pan-African juvenile island arc assemblages were formed between ~640 and ~800 Ma ago, and the River Nile demarcates the approximate boundary between the juvenile and ancient, partly reworked, African craton (Kröner et al. 1987). There has been much debate, largely based on Pb isotopic data, on the involvement of older continental crust in the orogenic history of the Eastern Desert of Egypt, but to date no pre-Pan African rocks have been identified. Some of the best-liked candidates for this, the tonalitic, trond-hjemitic and granodioritic gneisses at Hafafit are derived from composite I-type granitoids which were emplaced 677-700 Ma ago as part of the island arc assemblage of this region. Other well layered tonalitic gneisses in the Wadi Hodein region, also previously suspected to represent ancient basement, have a similar age of 704±8 Ma.

Farther south, in the Red Sea Hills of the Sudan, several tectonostratigraphic terranes were identified, mostly bounded by ophiolite-decorated suture zones (Kröner et al. 1987). These are also made up of juvenile island arc material dating in age between ~850 and ~700 Ma (Kröner et al. 1991), The westernmost terrains were accreted onto the Archaean to early Proterozoic margin of Africa, and a zone of tectonic imbrication consisting of young (~720 Ma) and old (~2300 Ma) rocks is exposed at the River Nile SW of Wadi Halfa (Stern et al., this volume). This tectonic imbrication must have affected a broad zone along the River Nile and led to considerable crustal thickening, culminating in granulite formation some 720 Ma ago as exposed at Sabaloka N or Khartoum (Kröner et al. 1986) and at Jabal Moya (Stern and Dawoud 1991). Tectonically fragmented ophiolite sequences found in the above suture zones were dated between ~730 Ma and ~810 Ma and correlate well with similar ophiolites in Saudi Arabia, thus permitting terrain reconstruction accross the Red Sea (Kröner et al. 1992b).

Northeast Africa (Eritrea, Ethiopia and Somalia)

The juvenile Pan-African rock assemblage of northern Eritrea is essentially similar to that found in the Tokar Terrane of the southern Red Sea Hills and consists largely of an association of bimodal metavolcanic rocks, minor metasediments and pre- syn- and post-tectonic granitoids (M. Teklay, pers. comm., 1993). Rocks with ophiolitic affinity have so far not been reported. This assemblage is also broadly similar to late Precambrian rocks of the so-called "Upper Complex"exposed in western Ethiopia where age data range from ~830 to ~540 Ma and where isotopic systematics suggest a juvenile origin with no involvement of any older basement (Ayalew et al. 1990).

Farther E, in the Harrar region, strongly foliated gneisses of the "Middle" and "Lower" complexes were previously considered to form a basement to the Pan-African assemblage (Kazmin et al. 1976), but new age data indicate that these rocks constitute a complex tectonic sequence including granitoid orthogneisses ranging in age from ~650 Ma to ~2490 Ma. Some of the Pan-African granitoid rocks contain xenocrystic zircons as old as 2350 Ma and thus also document the existence of ancient continental crust in this region (Teklay and Kröner, this volume). A very similar situation prevails in northern Somalia where plutonic rocks intrude amphibolite-facies metasediments and gneisses of unknown origin. A diorite S of Berbera contains a complex zircon population with a euhedral magmatic variety (mean age 814±7 Ma) and corroded xenocrysts with ages between 1730 and 1820 Ma. Granitoid gneisses in this region have primary crystallization ages between ~780 and ~840 Ma and also contain zircon xenocrysts up to 1816 Ma in age. These ages show that the northern Somalia and eastern Ethiopian basement is not a juvenile Pan-African terrane but consists of early to mid-Proterozoic crust affected by late Proterozoic magmatism broadly coeval with arc magmatism farther N in the ANS (Kröner et al. 1987, 1992a).

Basement rocks in the Buur area of southern Somalia include high-grade igneous and metasedimentary rocks of presumed early Proterozoic to Archaean age (Haider 1991), intruded by Pan-African (~470-550 Ma) granitoids (Lenoir et al. 1991). I have a strong suspicion that the granulites and migmatites exposed in this region are not Archaean but Pan-African and reflect a similar setting as found in Sabaloka and Jabal Moya in the

Sudan. The same goes for the high-grade Konso gneiss in southern Ethiopia which is likely to be Pan-African, as already suspected by Davidson et al. (1973). Presumed Archaean granitoid gneisses of the "Lower Complex" in southern Ethiopia are, in fact, late Pan-African (Teklay and Kröner this volume). The age distribution in Ethiopia and Somalia suggests that western and southern Ehtiopia is part of the predominantely juvenile Pan-African terrane, and the high-grade rocks in these regions document significant crustal thickening associated with accretion of this terrane with the African craton. The rocks in eastern Ethiopia, northern Somalia and possibly southern Yemen include early Proterozoic to Archaean crustal components with evidence of widespread Pan-African magmatism. Perhaps this entire terrane is another microcontinent, like the Afif terrane in Saudi Arabia.

East Africa (Kenya and Tanzania)

Recent work of Shackleton (1986, 1991) and Berhe (1990) has shown that virtually the entire Mozambique belt (MB) from the edge of the Archaean Tanzania craton to the east coast of Africa consists of suture-bounded terranes, and several ophiolite remnants have been identified. The MS in Kenya and Tanzania has long been regarded as consisting of ancient rocks overlain by late Precambrian sediments and reworked during the Mozambique orogeny, possibly as a result of Himalaya-type continental collision (Burke and Dewey 1972). However, to date no Archaean or early Proterozoic ages have been reported from this region, and Nd model ages for rocks of the MB in north-central Kenya are no older than ~900 Ma (Key et al. 1989). It is therefore likely, that the belt consists of a tectonic collage which may include juvenile Pan-African arc-type terranes as well as older microcontinental fragments. These fragments, if accreted broadly from E to W, probably include crustal elements derived from the eastern margin of Antarctica (Dronning Maud Land) if the SWEAT-model is correct.

Undated but Pan-African granulites exposed in central Kenya are probably part of a broad zone of high-grade rocks extending from Sudan to Tanzania and farther S into Malawi and reflect crustal thickening associated with the accretion event(s). In Tanzania, these rocks have yielded a U-Pb zircon age of 715+36/-49 Ma which is interpreted to reflect the granulite event (Maboko et al. 1985). If this interpretation is correct, then granulite-formation was probably broadly contemporaneous from northern Sudan to central Tanzania. However, it is also possible that the above zircon age dates the emplacement of the volcanic granulite precursor, and the true age of granulite metamorphism is then indicated by Pb-loss at 538+49/-35 Ma ago. The latter age is identical, within error, with high-grade metamorphism in Madagascar, southern India and Sri Lanka.

Malawi

The age and geodynamic relationships of the various rock units in northern Malawi are still uncertain due to the apparent superposition of three mobile belts, namely the Ubendian, Irumide-Usagaran and Mozambique. Granulites of uncertain age occur in this region, but are also found in central and southern Malawi, where they are ascribed to an ill-defined 850-1100 Ma "Kibaran" event (Andreoli 1984). The granulites consist of para- and orthogneisses, including charnockites, and the assignment of these rocks to the Kibaran event is based solely on a few Rb-Sr analyses. No zircon ages are available. It is therefore possible, that the age range reported by Andreoli (1984), in fact, reflects formation of the granulite precursors, and that the high-grade metamorphism took place much later during the Pan-African event as is also observed in Madagascar and Sri Lanka.

Madagascar

The Precambrian rocks of Madagascar occur in several tectono-metamorphic terranes which are bounded by major shear zones and ophiolite belts (Nicollet 1990; Windley unpubl. maps). Madagascar has long been regarded as a classical case of reworking of Archaean and Proterozoic rocks during the Pan-African event, and most of the high-grade

rocks, including voluminous granulites, were considered to have formed during the Kibaran event some 990-1260 Ma ago (Caen-Vachette 1979). Recent zircon and monazite dating, in southern Madagascar, however, shows the granulite metamorphism to have taken place some 560 Ma ago (Andriamarofahatra et al. 1990), and our own zircon dating (in pro-gress) on melt patches from the same region confirms this date.

Southernmost India

The high-grade metamorphic assemblages of southernmost India consist of a variety of granitoid gneisses, now largely charnockitized, and granulite-grade supracrustal units dominated by metasediments. They have traditionally been correlated with the late Archaean granulites farther N in the Nilgiri Hills, but limited dating of these rocks conclusively proves a Pan-African age around 550 Ma for this metamorphism (Hansen et al. 1985; Buhl 1987). The boundary between the Pan-African granulite domain and the Archaean granulite domain is not well defined at present but may coincide with one or several of the major high-strain zones such as the Palghat-Cauvery shear belt (Kröner 1991).

Sri Lanka

The basement rocks of Sri Lanka can be subdivided into three terranes characterized by distinct rock assemblages and isotopic characteristics (for details see Raith and Hoernes 1993). The central granulite terrain, known as Highland Complex (HC), consists of complexly deformed supracrustal rocks deposited some 2 Ga ago on an unknown basement and intruded by granitoids ranging in age between 650 Ma and 1940 Ma. The northwestern terrane, known as Wanni Complex, (WC) also consists of supracrustal rocks but these are not older than ~1400 Ma and were intruded by granitoids some 740 to 1100 Ma ago. Both the HC and WC were subjected to granulite metamorphism some 550-560 Ma ago, as documented by numerous zircon ages. The eastern terrain, known as Vijayan Complex (VC) consists almost exclusively of 1000-1030 Ma old amphibolite-grade I-type granitoid gneisses with island-arc chemical affinity and occurs in thrust contact with the HC. Earlier suggestions for high-grade metamorphism at ~2 and ~1 Ga in Sri Lanka could not be confirmed, and the Sri Lankan basement experienced its main evolution during a Pan-African collision event when the VC was amalgamated with the HC along a major suture zone, and crustal stacking transferred the HC and WC to lower crustal levels (Kröner 1991, Kröner et al. 1993).

The similarity in rocks types, deformation and metamorphism suggests Sri Lanka, southernmost India and Madagascar to have been part of the same orogenic belt, and Kröner (1991) suggested these domains to constitute the eastern margin of the Mozambique belt which resulted from the collision of West Gondwana (Africa and South America) with East Gondwana (Antarctica, Australia and India) after the Mozambique ocean (Fig. 1) had closed.

Dronning Maud Land, Antarctica

The best documented evidence for Pan-African high-grade metamorphism and granitoid plutonism comes from the basement complex exposed in the Yamato Mts. and the coast of Lützow-Holm Bay in Eastern Dronning Maud Land (Shibata et al. 1986). Some of the supracrustal metamorphic assemblages have a striking similarity with those of the Highland Complex in Sri Lanka, and the metamorphic evolution of these two terranes has been correlated (Hiroi et al. 1987). Furthermore, the granitoid gneisses of the Sri Lankan Vijayan Complex have been correlated with similar rocks in the Yamato-Belgica Complex, suggesting that the two were one unit after collision of East Antarctica with Africa/Madagascar/Sri Lanka (Fig. 2).

Conclusions

The tectonic and metamorphic evolution of the entire eastern margin of Africa, Mada-

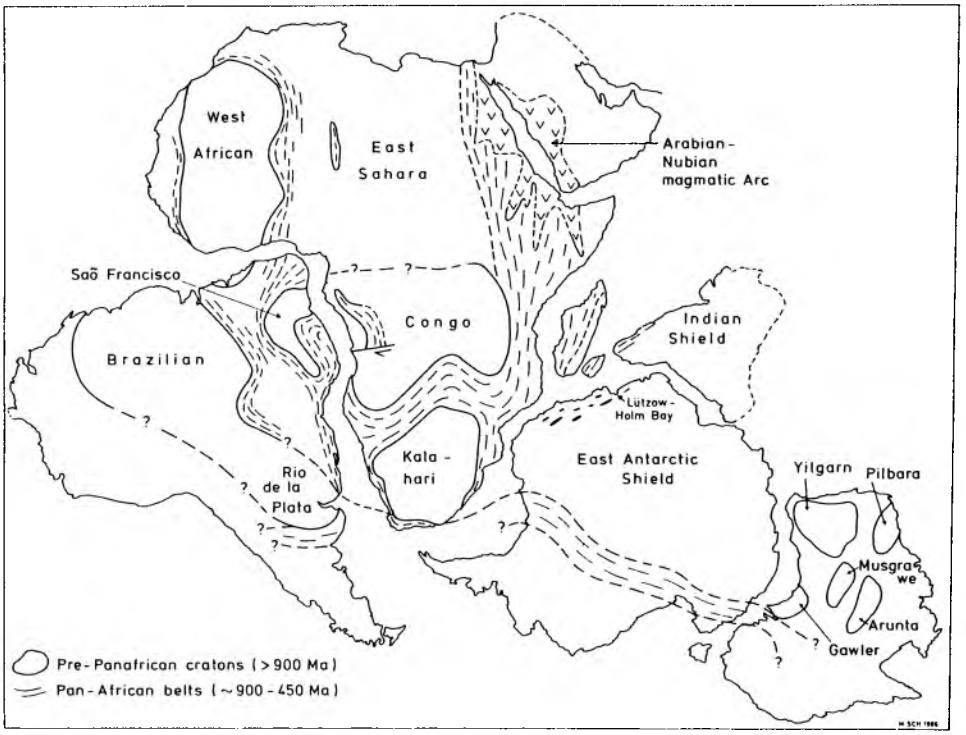


Fig. 2. Reconstruction of Gondwanaland after ~550 Ma ago, showing major Precambrian cratons and Pan-African mobile belts (from Kröner, 1991).

gascar, southwestern India, Sri Lanka and parts of East Antarctica can best be explained within the framework of a major Pan-African collision event between West and East Gondwana, following closure of the Mozambique ocean (Fig. 2). It is speculated that juvenile island arcs (as in the Arabian-Nubian shield) as well as microcontinental fragments (eastern Ethiopia-northern Somalia-southern Yemen) were accreted to the East African margin during the process of ocean closure, and the main high-grade metamorphic event at around 550-560 Ma took place when continental collision and tectonic stacking led to significant crustal thickening over a broad region and caused granulite metamorphism in lower crustal levels, while higher levels experienced extensive migmatization and granitoid emplacement.

This entire scenario is compatible with the SWEAT hypothesis and suggests that ocean closure and terrane accretion occured some 600-800 Ma ago between East and West Gondwana, while rifting and ocean opening took place between North America and East Gondwana at about the same time.

References

Andriamarofahatra, J., de la Boisse and C. Nicollet 1990. Datation U-Pb sur monazites et zircons du dernier épisode tectono-métamorphique granulitique majeur das le Sud-Est de Madagascar. C.R. Acad. Sci., Paris, 310, Série II: 1643-1648.

Ayalew, T., Bell, K., Moore, J.M. and Parrish, R.R. 1990. U-Pb and Rb-Sr geochronology of the Western Ethiopian shield. Geol. Soc. America Bull., 102: 1309-1316.

Berhe, S.M. 1990. Ophiolites in Northeast and East Africa: implications for Proterozoic crustal growth. J. Geol. Soc. 147: 41-57.

Buhl, D. 1987. U-Pb und Rb-Sr Altersbestimmungen und Untersuchungen zum

Strontium-Isotopenaustausch an Granuliten Südindiens. Unpubl. Dissertation, Univ. Münster, Germany.
Burke, K. and Dewey, J. 1971. Orogeny in Africa. In: T.F.J. Dessauvagie and A.J. Whiteman (eds.), African geology. Univ. Ibadan, Nigeria, 538-608.
Caen-Vachette, M. 1979. Le Précambrien de Madagascar: Radiochronométrie par isochrones Rb/Sr sur roches totales. Rev. Géol. Dyn. Geogr. Phys. 21: 331-338.
Dalziel, I.W.D. 1991. Pacific margins of Lairentia and East Antarctica-Australia as a conjugate rift pair: Evidence and implications for an Eocambrian supercontinent. Geology 19: 598-601.
Davidson, A., Moore, J.M. and Davies, J.C. 1973. Preliminary report on the geology and geochemistry of parts of Sidamo, Gemu Gofa, and Kefa Provinces. Rept. Omo River Project 1, Ministry of Mines, Addis Ababa.
Haider, A. 1991. The Precambrian geology of Buur area, southern Somalia. UNESCO, Geology for Development, Newsletter-Bulletin, 8: 35-42.
Hansen, E.C., Hickman, M.H., Grant, N.K. and Newton, R.C. 1985. Pan-African age of »Peninsular Gneiss« near Madurai, southern India. EOS 66: 419-420.
Hiroi, Y., Yoshida, M. and Vitanage, P.W. 1987. Relict kyanite in the Highland and Southwestern Gneisses in Sri Lanka: evidence of prograde metamorphism and a characteristic in common with the Lützow-Holm Complex in East Antarctica. Abstr.-vol., IGCP-Project 235 (Precambrian events in the Gondwana fragments), Colombo, 28.
Key, R.M., Charsley, T.J., Hackman, B.D., Wilkinson, A.F. and Rundle, C.C. 1989. Superimposed Upper Proterozoic collision-controlled orogenies in the Mozambique orogenic belt of Kenya. Precambrian Res. 44: 197-225.
Kazmin, V., Shifferaw, A. and Balcha, T. 1976. The Ethiopian basement: Stratigraphy and possible manner of evolution. Geol. Rundschau 67: 531-546.
Kröner, A. 1991. African linkage of Precambrian Sri Lanka. Geol. Rundschau 80: 429-440.
Kröner, A., Greiling, R., Reischmann, T., Hussein, I.M., Stern, R.J., Dürr, S., Krüger, J. and Zimmer, M. 1987. Pan-African crustal evolution in the Nubian segment of northeast Africa. American Geophys. Union, Geodynamics Series 15: 235-257.
Kröner, A., Eyal, M., Eyal, Y., Sassi, F. and Teklay, M. 1989. Extension of the Arabian-Nubian shield into southern Israel, Ethiopia and northern Somalia. Terra Cognita
Kröner, A., Pallister, J.S. and Fleck, R.J. 1992a. Age of initial oceanic magmatism in the late Proterozoic Arabian shield. Geology 20: 803-806.
Kröner, A., Todt, W., Hussein, I.M., Mansour, M. and Rashwan, A.A. 1992b. Dating of late Proterozoic ophiolites in Egypt and the Sudan using the single zircon evaporation technique, Precambrian Res. 59: 15-32.
Kröner, A., Kehelpannala, K.V.W. and Kriegsman, L. 1993. Origin of compositional banding and causes for crustal thickening in the high-grade terrain of Sri Lanka. Precambrian Res., in press.
Lenoir, J.-L., Kuster, D., Liegeois, J.-P., Utke, A., Haider, A. and Matheis, G. 1991. Age, nature and origin of the late granitoids in Somalia and the possible continuation of the Mozambique belt through the Horn of Africa. UNESCO, Geology for Development, Newsletter-Bulletin, 8: 31-33.
Maboko, M.A.H., Boelrijk, N.A.I.M., Priem, H.N.A. and E.A.Th. Verdurmen 1985. Zircon U-Pb and biotite Rb-Sr dating of the Wami River granulites, eastern granulites, Tanzania: evidence for approximately 715 Ma old granulite-facies metamorphism and final Pan-African cooling approximately 475 Ma ago. Precambrian Res., 30, 361-378.
Moores, E.M. 1991. Southwest U.S.-East Antarctic (SWEAT) connection: A hypothesis. Geology 19: 425-428.
Nicollet, C. 1990. Crustal evolution of the granulites of Madagascar. In: Vielzeuf, D. and Vidal, Ph. (eds.) Granulites and crustal evolution. Kluwer Academic Publ., Dordrecht, 291-310.
Raith, M. and Hoernes, S.(eds.) 1993. Tectonic, metasmorphic and isotopic evolution of deep crustal rocks, with special emphasis on Sri Lanka. Precambrian Res., in press.
Shackleton, R.M. 1986. Precambrian collision tectonics in Africa. In: Coward, M.P. and Ries, A.C. (eds.) Collision tectonics. Geol. Soc. London, Spec. Publ. 19: 329-349.

Shackleton, R.M. 1991. Problems with the Mozambique belt of Tanzania. UNESCO, Geology for Development, Newsletter-Bulletin, 8: 23-30.
Shibata, K., Yanai, K. and Shiraishi, K. 1986. Rb-Sr whole rock ages of metamorphic rocks from Eastern Qúeen Maud Land, East Antarctica. Japanese National Institute for Polar Research, Mem., Spec. Issue 43: 133-148.
Stern, R.J. and Dawoud, A.S. 1991. Late Precambrian (740 Ma) charnockite, enderbite, and granite from Jebel Moya, Sudan: a link between the Mozambique belt and the Arabian-Nubian shield. J. Geol., 99, 648-659.

The Pan African Belt of Northeastern and Eastern Africa, Madagascar, Southern India, Sri Lanka and East Antarctica: Terrane amalgamation during formation of the Gondwana Supercontinent

Andriamarofahatra, J. , de la Boisse and C. Nicollet 1990. Datation U-Pb sur monazites et zircons du dernier épisode tectono-métamorphique granulitique majeur das le Sud-Est de Madagascar. C.R. Acad. Sci., Paris, 310, Série II: 1643–1648.

Ayalew, T. , Bell, K. , Moore, J.M. and Parrish, R.R. 1990. U-Pb and Rb-Sr geochronology of the Western Ethiopian shield. Geol. Soc. America Bull., 102: 1309–1316.

Berhe, S.M. 1990. Ophiolites in Northeast and East Africa: implications for Proterozoic crustal growth. J. Geol. Soc. 147: 41–57.

Buhl, D. 1987. U-Pb und Rb-Sr Altersbestimmungen und Untersuchungen zum Strontium-Isotopenaustausch an Granuliten Südindiens. Unpubl. Dissertation, Univ. Münster, Germany.

Burke, K. and Dewey, J. 1971. Orogeny in Africa. In: T.F.J. Dessauvagie and A.J. Whiteman (eds.), African geology. Univ. Ibadan, Nigeria, 538–608.

Caen-Vachette, M. 1979. Le Précambrien de Madagascar: Radiochronométrie par isochrones Rb/Sr sur roches totales. Rev. Géol. Dyn. Geogr. Phys. 21: 331–338.

Dalziel, I.W.D. 1991. Pacific margins of Lairentia and East Antarctica-Australia as a conjugate rift pair: Evidence and implications for an Eocambrian supercontinent. Geology 19: 598–601.

Davidson, A. , Moore, J.M. and Davies, J.C. 1973. Preliminary report on the geology and geochemistry of parts of Sidamo, Gemu Gofa, and Kefa Provinces. Rept. Omo River Project 1, Ministry of Mines, Addis Ababa.

Haider, A. 1991. The Precambrian geology of Buur area, southern Somalia. UNESCO, Geology for Development, Newsletter-Bulletin, 8: 35–42.

Hansen, E.C. , Hickman, M.H. , Grant, N.K. and Newton, R.C. 1985. Pan-African age of »Peninsular Gneiss« near Madurai, southern India. EOS 66: 419–420.

Hiroi, Y. , Yoshida, M. and Vitanage, P.W. 1987. Relict kyanite in the Highland and Southwestern Gneisses in Sri Lanka: evidence of prograde metamorphism and a characteristic in common with the Lützow-Holm Complex in East Antarctica. Abstr.-vol., IGCP-Project 235 (Precambrian events in the Gondwana fragments), Colombo, 28.

Key, R.M. , Charsley, T.J. , Hackman, B.D. , Wilkinson, A.F. and Rundle, C.C. 1989. Superimposed Upper Proterozoic collision-controlled orogenies in the Mozambique orogenic belt of Kenya. Precambrian Res. 44: 197–225.

Kazmin, V. , Shifferaw, A. and Balcha, T. 1976. The Ethiopian basement: Stratigraphy and possible manner of evolution. Geol. Rundschau 67: 531–546.

Kröner, A. 1991. African linkage of Precambrian Sri Lanka. Geol. Rundschau 80: 429–440.

Kröner, A. , Greiling, R. , Reischmann, T. , Hussein, I.M. , Stern, R.J. , Dürr, S. , Krüger, J. and Zimmer, M. 1987. Pan-African crustal evolution in the Nubian segment of northeast Africa. American Geophys. Union, Geodynamics Series 15: 235–257.

Kröner, A. , Eyal, M. , Eyal, Y. , Sassi, F. and Teklay, M. 1989. Extension of the Arabian-Nubian shield into southern Israel, Ethiopia and northern Somalia. Terra Cognita

Kröner, A. , Pallister, J.S. and Fleck, R.J. 1992a. Age of initial oceanic magmatism in the late Proterozoic Arabian shield. Geology 20: 803–806.

Kröner, A. , Todt, W. , Hussein, I.M. , Mansour, M. and Rashwan, A.A. 1992b. Dating of late Proterozoic ophiolites in Egypt and the Sudan using the single zircon evaporation technique, Precambrian Res. 59: 15–32.

Kröner, A. , Kehelpannala, K.V.W. and Kriegsman, L. 1993. Origin of compositional banding and causes for crustal thickening in the high-grade terrain of Sri Lanka. Precambrian Res., in press.

Lenoir, J.-L. , Kuster, D. , Liegeois, J.-P. , Utke, A. , Haider, A. and Matheis, G. 1991. Age, nature and origin of the late granitoids in Somalia and the possible continuation of the Mozambique belt through the Horn of Africa. UNESCO, Geology for Development, Newsletter-Bulletin, 8: 31–33.

Maboko, M.A.H. , Boelrijk, N.A.I.M. , Priem, H.N.A. and E.A. Th. Verdurmen 1985. Zircon U-Pb and biotite Rb-Sr dating of the Wami River granulites, eastern granulites, Tanzania: evidence for approximately 715 Ma old granulite-facies metamorphism and final Pan-African cooling approximately 475 Ma ago. Precambrian Res., 30, 361–378.

Moores, E.M. 1991. Southwest U.S.-East Antarctic (SWEAT) connection: A hypothesis. Geology 19: 425–428.

Nicollet, C. 1990. Crustal evolution of the granulites of Madagascar. In: Vielzeuf, D. and Vidal, Ph . (eds.) Granulites and crustal evolution. Kluwer Academic Publ., Dordrecht, 291–310.

Raith, M. and Hoernes, S. (eds.) 1993. Tectonic, metasmorphic and isotopie evolution of deep crustal rocks, with special emphasis on Sri Lanka. Precambrian Res., in press.

Shackleton, R.M. 1986. Precambrian collision tectonics in Africa. In: Coward, M.P. and Ries, A.C. (eds.) Collision tectonics. Geol. Soc. London, Spec. Publ. 19: 329–349.

Shackleton, R.M. 1991. Problems with the Mozambique belt of Tanzania. UNESCO, Geology for Development, Newsletter-Bulletin, 8: 23–30.

Shibata, K. , Yanai, K. and Shiraishi, K. 1986. Rb-Sr whole rock ages of metamorphic rocks from Eastern Qúeen Maud Land, East Antarctica. Japanese National Institute for Polar Research, Mem., Spec. Issue 43:

133–148.
Stern, R.J. and Dawoud, A.S. 1991. Late Precambrian (740 Ma) charnockite, enderbite, and granite from Jebel Moya, Sudan: a link between the Mozambique belt and the Arabian-Nubian shield. J. Geol., 99, 648–659.

Revision of the first 1968 edition of the International Tectonic Map of Africa at 1:500000 of the Commission for the Geological Map of the World

C.G.M.W. 1968. Carte Tectonique Internationale de l'Afrique. G. Choubert & A. Faure-Muret coordin. UNESCO, Paris, 9 sheets at 1:5 000 000.
C.G.M.W. 1990a. Carte Géologique Internationale de l'Afrique. G. Choubert & A. Faure-Muret coordin. UNESCO, Paris, 6 sheets at 1:5 000 000.
C.G.M.W. 1990b. Report on the first workshop to prepare the draft of the International Tectonic Map of Africa, second edition, scale 1:5 000 000. Pretoria, South Africa, 28–29 June 1990, 9p.
C.G.M.W. 1991. Report on the second workshop regarding the preparation of the International Tectonic Map of Africa, Harare, Zimbabwe, 24–26 September 1990, 11p.
C.G.M.W. 1992a. Report on the third workshop regarding the preparation of the draft of the International Tectonic Map of Africa, Franceville, Gabon, 29th April – 2nd May 1992, 15p.
C.G.M.W. 1992b. Report on the fourth workshop regarding the preparation of the draft of the International Tectonic Map of Africa, Dodoma, Tanzania, 26–29th May 1992, 38p.
Maniar, P.D. & Picolli P.M. 1989. Tectonic discrimination of granitoids. Geol. Soc. Am.,. 101: 635–643.

Towards a comprehensive structural synthesis of the (Proterozoic) Arabian-Nubian Shield in E.Egypt

Bennett, J.D. , & P.N. Mosley 1987. Tiered-tectonics and evolution,E Desert and Sinai, Egypt. Current Res. African Earth Sciences ed. G. Matheis & H. Schandelmeier , Balkema, 79–82.
El Ramly, M.F. , R. Greiling , A. Kröner & A.A. Rashwan 1984. On the tectonic evolution of the Wadi Hafafit area and environs EDE. Bull. Fac. Earth Sci. King Abdulaziz Univ. 6, 113–126.
Greiling, R.O. , M.F. El Ramly , H. El Akhal & R.J. Stern 1988. Tectonic evolution of the Red Sea margin as related to basement structure. Tectonophysics 153, 179–191.
Kamal El Din, G.M. , A.A. Khudeir & R.O. Greiling 1992. Tectonic evolution of a Pan-African gneiss culmination, Gabal El Sibai area, CED, Egypt, Zbl. Geol. Paläont. T. I 1991, 2637–2640.
Rashwan, A.A. 1991. Petrography, Geochemistry and Petrogenesis of the Migif-Hafafit Gneisses at Hafafit Mine area, Egypt. Scient. Ser. Int. Bureau 5, 359 pp.
Reynolds, S.J. & G.S. Lister 1990. Folding of mylonitic zones in Cordilleran metamorphic core complexes. Geology 18, 216–219.
Ries, A.C. , R.M. Shackleton , R.H. Graham & W.R. Fitches 1983. Pan-African structure, ophiolites and mélange in the EDE: A traverse at 26° N. J.Geol. Soc. London, 140, 75–95.
Stern, R.J. and C.E. Hedge 1985. Geochronologic and isotopic constraints on Late Precambrian crustal evolution in the EDE Am. J. Sci. 285, 97–127.
Sultan, M. , R.E. Arvidson , I.J. Duncan , R.J. Stern & B. El Kaliouby 1988. Extension of the Najd Shear System from Saudi Arabia to the CED of Egypt based on integrated field and Landsat observations. Tectonics, 7, 1291–1306.

Distinction of different syn- and late orogenic Pan-African sedimentary sequences by metamorphic grade and illite crystallinity (W. Zeidun, Central Eastern Desert, Egypt)

Kisch, H.J. 1980. Incipient metamorphism of Cambro-Silurian clastic rocks from Jamtland Supergroup, central Scandinavian Caledonides, western Sweden: illite crystallinity and "vitrinite" reflectance. J. geol. soc. London. 137: 271–288
Osman, A.F. , Greiling, R.O. and Ragab, A.I. 1992. Late Pan-African tectonic evolution in Wadi Zeidun, central Eastern Desert, Egypt. Frankf. geowiss. Arb. A 11:273.
Roberts, D. , Morrison, C. and Hirons S. 1990. Low grade metamorphism of the Manx Group, Isle of Man: a comprative study of white mica "crystallinity" techniques. J. geol. soc. London. 147: 271–277

Warr, L.N. & Robinson, D. 1990. The application of the illite “crystallinity” technique to geological interpretation : a case study from north Cornwall. Proc. Ussher soc. 7: 223–227

Kinematics of Panafrican thrusting and extension in Egypt

Akaad, M.K. & A. Noweir 1969. Lithostratigraphy of the Hammamat-Um Seleimat district, Eastern Desert, Egypt. Nature 223: 284–285.

El Gaby, S. , F.K. List & R. Tehrani 1990. The basement complex of the Eastern Desert and Sinai. in Said R. (ed) The Geology of Egypt: 175–184.

Gass, I.G. 1977. The evolution of the Pan-African crystalline basement in NE Afrika and south Arabia. J. Geol. Soc. London 134: 129–138.

Ries, A.C. , R.M. Schackelton , R.H. Graham & W.R. Fitches 1983. Pan-African structures, ophiolites and melange in the Eastern Desert of Egypt, a traverse at 26° N. J. Geol. Soc. London 140: 75–95.

An outline of the tectonic framework for the Pan-African orogeny in the vicinity of Wadi Um Relan area, south Eastern Desert, Egypt

El-Gaby, S. , F.K. List & R. Tehrani 1988. Geology, evolution and metallogenesis of the Pan-African belt in Egypt. In S. El-Gaby & R.O. Greiling (eds), The Pan-African Belt of Northeast Africa and Adjacent Areas; tectonic evolution and economic aspects of a late Proterozoic orogen, p. 17–65. Braunschweig/Wiesbaden: Vieweg & Sohn.

Kröner, A. , R.O. Greiling , T. Reischmann , I.M. Hussein , R.J. Stern , S. Durr , J. Druger & M. Zimmer 1987. Pan-African crustal evolution in the Nubian segment of northeast Africa In A. Kröner (ed) Proterozoic Lithospheric Evolution, p.235–257. Washington D.C.: American Geophysical Union.

Miller, M.M. & T.H. Dixon 1992. Late Proterozoic evolution of the northern part of the Hamisana zone, northeast Sudan: constraints on Pan-African accretionary tectonics. Journal of the Geological Society, London. 149:743–750.

Shackleton, R.M. 1986. Precambrian collision tectonics. In M.P. Coward & A.C. Ries (eds), Collision Tectonics, p.329–349. London: Geological Society.

Stern, R.J. , K.C. Nielsen , E. Best , M. Sultan , R.E. Arvidson & A. Kröner 1990. Orientation of the late Precambrian sutures in the Arabian-Nubian shield. Geology. 18:1103–1106.

Igneous and structural relations in the Pan-African Hammamat Group, Igla Basin, Egypt

Akaad, M. K. 1957. Petrography, structure and time relations of the Igla Formation, Eastern Desert. Egypt. J.Geol. 1; 93–103.

Akaad, M. K. 1958. Dykes, felsite intrusions and intrusion breccias at Wadi Igla, Eastern Desert. Egypt. J. Geol. 3; 89–105.

Greiling, R. O. & M. F. El Ramly 1990. Wadi Hafafit – Structural Geology map 1:200,000. Technische Fachhochschule, Berlin.

Harris, N. B. W. , J. A. Perace & A. G. Tindle 1986. Geochemical characteristics of collision-zone magmatism. In M. P. Coward & A. C. Ries (eds.), Collision Tectonics. Geological Society Special Publication No 19, p. 67–81.: Oxford: Blackwell.

Hussein, A. A. , M. M. Ali & M. F. El Ramly 1982. A proposed new classification of the granites of Egypt. J. Volc. Geoth. Res. 14; 187–198.

Stern, R. J. & C. E. Hedge 1985. Geochronologic and isotopic constraints on late Precambrian crustal evolution in the Eastern Desert of Egypt. Am. J. Sci. 285, 97–127.

Preliminary comparison of six late- to post-Pan-African molasse basins, E. Desert, Egypt

Abdeen, M. M. , A. A. Dardir & R. O. Greiling 1992a. Hammamat pebbles in felsite at Wadi Queih, north of Quseir, Eastern Desert of Egypt. Ann. Geol. Surv. Egypt 17: in press.

Abdeen, M. M. , A. A. Dardir & R. O. Greiling 1992b. Sequence of structural events in the late Pan-African basement of the Easatern Desert of Egypt. Abs. Frankfurter geowiss. Arb A, 11: 193.

Akaad, M. F. & A. M. Noweir 1980. Geology and lithostratigraphy of thee Arabian Desert orogenic belt of Egypt between latitudes 25°35'and 26°30'N. I. A. G. Bull. Jeddah 3: 127–136.

Dewey, J. F. 1988. Extensional collapse of orogens. Tectonics 7: 1123–1139.

Egyptian Geological Survey 1981. Geologic map of Egypt. 1:200,000 scale

Hassan, A. H. & A. H. Hashad 1990. Precambrian of Egypt. In R. Said (ed.), The Geology of Egypt. Rotterdam: Balkema 201–248,

Osman, A. F. , R. O. Greiling , & A. I. Ragab 1992. Late Pan-African tectonic evolution in Wadi Zeidun, Central Eastern Desert, Egypt. Abs. Frankfurter geowiss. Arb. A, 11, 273.

Osman, A. F. , R. O. Greiling , M. E. Hilmy , A. I. Ragab , & M. F. El Ramly 1993. Distinction of differing syn- and late orogenic Pan-African sedimentary sequences by metamorphic grade and illite crystallinity (W. Zeidoun, Central Eastern Desert). Rotterdam, Balkema. This vol.

Rice, A. H. N. , M. F. Sadek & A. A. Rashwan 1993. Igneous and structural relations in the Pan-African Hammamat Group, Igla Basin, Egypt. Rotterdam, Balkema. This vol.

Robinson, D. , L. N. Warr & R. E. Bevins 1990 The illite `crystallinity' technique: a critical appraisal of its precision. J. Metam. Geol. 3: 333–344.

Stern, R. J. 1985. The Najd Fault system, Saudi Arabia and Egypt: a late Precambrian rift system. Tectonics 4:497–511

Stern, R. J. & C. E. Hedge 1985. Geochronologic and isotopic constraints on late Precambrian crustal evolution in the Eastern Desert of Egypt. Am. J. Sci. 285: 97–127.

Zabargad Island: A detached block from the Eastern Desert or a raised upper mantle

Bonatti et al. 1981. Geology, 9, 474–479.

Bonatti et al. 1983. J. Geol. Soc., London, 140, 667–690.

Bonatti et al. 1986. J. Geophys. Res., 91, 599–631.

El-Gaby , List & Tehrani 1987. In: El-Gaby & Greiling (eds.), the Pan-African belt of NE Africa and adjacent areas, Vieweg Verlang, 17–68.

Seyler & Bonatti 1988. J. Geophys. Res., 150, 177–207.

The Sa'al Group: An ensialic island arc sequence in Sinai

Furnes, H. Shimron, A.E. & D. Roberts. 1985. The geochemistry of Pan-African volcanic arc sequences in southeastern Sinai Peninsula and plate tectonic implications. Precambrian Res. 29:359–382.

Shimron, A.E. 1980. Proterozoic island arc volcanism and sedimentation in Sinai. Precambrian Res. 12:437–458.

Shimron, A.E. 1984. Evolution of the Kid Group, southeast Sinai Peninsula: thrusts, melanges and implications for accretionary tectonics during the Late Proterozoic of the Arabian-Nubian Shield. Geology. 12:242–247.

Shimron, A.E. 1988. Discussion on the age of the Feiran basement rocks, Sinai:implications for late Precambrian crustal evolution in the northern Arabian-Nubian shield. J. Geol. Soc. London. 144:569–575.

Comparative study on two radioactive exposures in Southeastern Desert of Egypt

Abdel Aziz, A.H. , Ali, M.M. and El Ramly, M.F. 1982. A proposed new classification of the granites of Egypt. Journal of Volcanicity and Geothermal Research, 14 Elsevier Scientific Publication Company, Amesterdam, pp. 187–198.

El Gaby, S. 1975. Petrochemistry and geochemistry of some granites from Egypt. Neues Jahrb. Miner. Abh. 124, pp. 147–189.

El Ramly, M.E. and Akkad, M.K. 1960. The basement Complex in the Central Eastern Desert of Egypt between latitudes 24° 30′ and 25° 40′N. Geol. Surv. and Miner. Research. Dept. Paper No. 8.
El Ramly, M.E. 1972. A new geological map for the basement rocks in the Eastern and Southern Western Desert of Egypt. Annals of Geol. Surv., Egypt, Vol. 2, pp. 1–8.
El Shazly, E.M. 1964. On the classification of the Precambrian and other rocks of magmatic affiliation in Egypt, UAR, Intern. Geol. Cong. India.
Farag, S.S. 1990. Geology and radioactivity of Magal Gebriel area, southeast Aswan, Egypt. M.Sc. Thesis, Faculty of Science, Al Azhar University, 141 p.
Hashad, A.H. Sayyah, T.A. El Kholy, S.B. and Yousef, A. 1972. Rb/St isotopic age determination of some basement Egyptian granites, Egypt J. Geol. 16, No. 2.
Ibrahim, M.E. 1986. Geologic and radiometric studies on Um Ara granite pluton south-east Aswan, Egypt. M.Sc. Thesis, Faculty of Science, Mansoura University, 177p.
Kamel, A.F. 1989. Contribution to the study of radioactivity in younger granites in Southeastern Desert, Egypt. Journal of African Earth Sciences, Vol. 9, No. 2, pp. 297–301.
Lockwood Survey Corporation Limited 1968. Airborne geophysical survey conducted in collaboration with the United Arab Republic and the United Nations Development Programme. Regional Planning of Aswan, Egypt.
Rogers, J.J.W. 1978. Infrared composition of Early Archean crust and variation in crustal composition through time, in Windley, B.F. and Naqvi, S.M. eds, Archran Geochemistry. (Developments in Precambrian Geology, Vol. 1), Elsevier, pp. 25–39.
Shehata, W.M. 1964. Distribution of radioactivity in some granitic and pegmatitic rocks in Egypt, M.Sc. Thesis, Faculty of Science, Ain Shams University.

Late Panafrican dyke rocks in the Bir Safsaf complex, Western Desert, S-Egypt

Harms, U. 1989. Krustenentwicklung in NE-Afrika: Geochemische und Isotopenuntersuchungen an Granitoiden aus Südägypten und Nordsudan. Berliner Geowissenschaftliche Abhandlungen A 108:1–152.
Hildreth, W. & S. Moorbath , 1988. Crustal contributions to arc magmatism in the Andes of Central Chile. Contributions to Mineralogy and Petrology 98: 455–489.
Leake, B.E. 1978. Nomenclature of amphiboles. Mineralogical Magazine 42: 553–563.
O'Hara, M.J. & R.E. Mathews 1981. Geochemical evolution in an advancing, periodically replenished, periodically tapped, continuously fractionated magma chamber. Journal Geological Society, London 138: 237–277.
Rocci, G. 1965. Essai d'interpretation de mesures geochronologiques. La structure de L'Ouest africain. Sciences de la Terre 10: 461–479.
Wood, D.A. , J.-L. Joron , M. Treuil , M. Norry & J. Tarney 1979. Elemental and Sr isotope variations in basic lavas from Iceland and the surrounding ocean floor. Contributions to Mineralogy and Petrology 70: 319–339.

On the location of the boundary between the Nubian Shield and the old African continent: Inferences from U-Pb (zircon) and common Pb data

Cahen, L. , Snelling, N.J. , Delhal, J. , and Vail, J.R. , 1984, The geochronology and evolution of Africa: Clarendon press, Oxford, 512 p.
Harms, U. , Schandelmeier, H. , and Darbyshire, D.P.F. , 1990, Pan-African reworked early/middle Proterozoic crust in NE Africa west of the Nile: Sr and Nd isotope evidence: Geological Society of London Journal, v. 147, p. 859–872.
Klerkx, J. , 1980, Age and metamorphic evolution of the basement complex around Jabal al Awaynat: in Salem, M.J. and Busrewil, M.T. , eds., The Geology of Libya 3: New York, Academic Press, p. 901–906.
Kröner, A. , Greiling R. , Reischmann, T. , Hussein, I.M. , Stern, R.J. , Dürr, S. , Krüger, J. , and Zimmer, M. , 1987, Pan-African crustal evolution in the Nubian segment of north-eastern Africa: in Kröner, A. , ed., Proterozoic lithospheric evolution: American Geophysical Union Geodynamics Series 17, p. 235–257.
Kröner, A. , Reischmann, T. , Wust, H.-J. , and Rashwan, A.A. , 1988, Is there any Pre-Pan-African (>950 Ma) basement in the Eastern Desert of Egypt? in El-Gaby, S. and Greiling R.O. , eds., The Pan-African belt of northeast Africa and adjacent areas: International monograph series on interdisciplinary earth science and applications, Vieweg, Wiesbaden, p. 95–119.
Nelson, B.K. , and De Paolo, D.J. , 1985, Rapid production of continental crust 1.7 to 1.9 b.y. ago: Nd isotopic evidence from the basement of the North American mid-continent: Geological Society of America Bulletin, v. 96, p. 746–754.

Pegram, W.J. , Sando, T.W. , and Hodges, K.V. , 1980, Rare-earth element geochemistry and Nd isotopic composition of some Egyptian Younger Granites: Geological Society of America Abstracts with Programs, v. 12, p. 497.
Schandelmeier, H. , Darbyshire, D.P.F. , Harms, U. , and Richter, A. , 1988, The East Sahara Craton: evidence for pre-Pan-African crust in northeast Africa west of the Nile, in El-Gaby, S. , and Greiling R.O. , eds., The Pan-African belt of northeast Africa and adjacent areas: International monograph series on interdisciplinary earth science and applications, Vieweg, Wiesbaden, p. 69–94.
Sultan, M. , Bickford, M.E. , El Kaliouby, B. , and Arvidson, R.E. , 1992, Common Pb systematics of Precambrian granitic rocks of the Nubian Shield and tectonic implications, Geological Society of America Bulletin, v. 104, p. 456–470.

Juvenile Pan-African and remobilized ancient crustal components preserved in the basement around Wadi Halfa, N.Sudan: Insights into the evolution of the foreland to the Arabian-Nubian Shield

Kober, B. 1987. Single-zircon evaporation with Pb+ emitter-bedding for 207Pb/206Pb investigations using thermal ion mass spectrometry, and implications to zirconology. Contributions to Mineralogy and Petrology 96:63–71.
Pearce, J.A. , N.B.W. Harris , & A.G. Tindle 1984. Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. J. Petrology 25:956–983.
Sultan, M. , M.E. Bickford , B. El Kaliouby , & R.E. Arvidson 1992. Common Pb systematics of Precambrian granitic rocíes of the Nubian Shield (Egypt) and tectonic implications: Geological Society of America Bulletin 104: 456–470.
Whalen, J.B. , K.L. Currie , & B.W. Chappell 1987. A-type granites: Geochemical characteristics, discrimination, and pedogenesis. Contributions to Mineralogy and Petrology 95:407–419.

Evidence for a new Late Proterozoic suture in Northern Sudan

Abdel Rahman, E.M. , U. Harms , H. Schandelmeier , G. Franz , D.P.F. Darbyshire , P. Horn & D. Müller-Sohnius 1990. A new ophiolitic occurrence in NW Sudan – constraints on Late Proterozoic tectonism. Terra Nova 2: 363–376.
Abdelsalam, M.G. & A.S. Dawoud 1991. The Kabus ophiolitic mélange, and its bearing on the western boundary of the Nubian Shield. J.Geol.Soc.London 148: 83–92.
Denkler, T. , U. Harms , G. Franz , D.P.F. Darbyshire , J. Pilot & H. Schandelmeier 1993. Evolution of the south-western part of the Late Proterozoic Atmur-Delgo suture zone (Northern Province, Sudan). *This volume.*
Kröner, A. , R. Greiling , T. Reischmann , I.M. Hussein , R.J. Stern , S. Dürr , J. Krüger & M. Zimmer 1987. Pan-African crustal evolution in the Nubian segment of northeast Africa. In A. Kröner (ed.), Proterozoic Lithosphere Evolution, Am. Geophys. Union Geodynamic Series 17: 235–257.
Stern, R.J. & A. Kröner in press. Late Precambrian crustal evolution in NE Sudan: Isotopic and geochronologic constraints. Journal of Geology.

Evolution of the south-western part of the Atmur-Delgo suture

Abdelsalam, M.G. & A.S. Dawoud 1991. The Kabus ophiolitic melange, Sudan, and its bearing on the western boundary of the Nubian Shield. Journal of the Geological Society, London 148:83–92.
Harms, U. , H. Schandelmeier & D.P.F. Darbyshire 1990. Pan-African reworked early/middle Proterozoic crust in NE Africa west of the Nile: Sr and Nd isotope evidence. Journal of the Geological Society, London 147:859–872.
Kröner, A. 1985. Ophiolites and the evolution of tectonic boundaries in the late Proterozoic Arabian-Nubian Shield of northeast Africa and Arabia. Precambrian Research 27:277–300.
Vail, J.R. 1988. Tectonics and evolution of the Proterozoic Basement of northeastern Africa. In S. El Gaby & O.R. Greiling (eds): The Pan-African belt of northeast Africa and adjacent areas, p. 195–226. Wiesbaden: Vieweg.

Evolution of the Keraf Back-Arc Basin: Constraints on the Nubian Shield margin

Abdel Rahman, E. M. , Harms, U. , Schandelmeier, H. , Franz, G. Darbyshire, D. P. F. , Horn, P. and Muller-Sohnius, D. 1990. A new ophiolite occurrence in NW Sudan: constraints on Late Proterozoic tectonism. Terra Nova, 2, 363–376.

Abdel Rahman, E. M. 1993. Geochemical and Geotectonic control of the Metallogenic Evolution of Selected Ophiolite Complexes from the Sudan. Berl.. Geowiss. Abh. 145, 175 pp.

Ahmed, S. A. , Idris, M. A. , El Sir, M. and Suliman, A. 1980. Preliminary geological report on Abu Hamad Area, Northern Sudan. Geol. and Miner. Res. Dept. Unpubl. Report, 18 pp.

Almond, D. C. and Ahmed, F. 1987. Ductile shear zones in the northern Red Sea Hills, Sudan and thier implication for crustal collision. Geol. Jour., 22, 175–184,

Berhe, S. M. 1990. Ophiolites in northeast and east Africa: Implications for Proterozoic crustal growth. J. Geol. Soc. Lond., 147, 41–57.

Coleman, R. G. 1977. Ophiolites ancient oceanic lithospher?– 229 pp., Berlin (Springer).

Gansser, A. 1974. The ophiolite mélange, a world-wide problem on Tethyan examples. Eclogae Geol. Helv., 67, 479–507.

Pearce, J. A. and Cann, J. R. 1973. Tectonic setting of basic volcanic rocks determined using trace element analyses. Earth Planet Sci. Lett., 19, 290–300.

Ries, A. C. , Shackleton, R. M. and Dawoud, A. S. 1985. Geochronology, geochemistry and tectonics of the NE Bayuda Desert N Sudan: Implication for the western margin of the late Proterozoic fold belt of NE Africa. Precambrian Res., 30, 43–62,

Saunders, A. D. , Fornari, D. J. and Morrison, M. A. 1982. The composition and emplacement of basaltic magmas produced during the development of continental-margin basins: the Gulf of California, Mexico.– J. Geol. Soc. Lond., 139, 335–346.

Saunders, A. D. and Tarney, J. 1984. Geochemical characteristics of basaltic volcanism within backarc basins. In: Kokelaar, B. P. and Howells, M. F. (eds.), Marginal Basins Geology. Geol. Soc. Lond., Spec. Paper Publ., Vol. 16, 59–76.

Sun, S. S. and McDonnough, W. F. 1989. Chemical and isotopie systematics of oceanic basalts: implications for mantle composition and processes. In: Saunders, A. D. and Norry, M. J. (eds.), Magmatism in Ocean Basins, 313–345 Oxford (Blackwell).

Vail, J. R. 1983. Pan-African crustal accretion in north-east Africa.– J. Afr. Earth Sci., 1 (3–4), 285–294,

Wilson, M. 1989. Igneous Pedogenesis.– 446 pp., London (Unwin Hyman).

Timing of events along the Nakasib suture and the Oko shear zone, Sudan

Abdelsalam, M.G. & R.J. Stern In press. Tectonic evolution of the Nakasib suture, Red Sea Hills, Sudan: evidence for a late Precambrian Wilson Cycle. J. Geol. Soc. London.

Almond, A.C. , D.P.F. Derbyshire & F. Ahmed 1989. Age limits for major shearing episodes in the Nubian Shield of NE Sudan. J. Afr. Earth Sci. 9: 89–496.

Kroner, A. P. Linnebacher, R.J. , Stern, T. , Reischmann, W.I. Manton & L.M. Hussein 1991. Evolution of Pan-African island arc assemblages in southern Red Sea Hills, Sudan, and in southwestern Arabia as exemplified by geochemistry and geochronology. Precamb. Res. 53: 99–118.

Stern, R.J. , A. Kroner , W.I. Manton , T. Reischmann , M. Mansour , & I.M. Hussein 1989. Geochronology of the late Precambrian Hamisana shear zone, Red Sea Hills, Sudan and Egypt. J. Geol. Soc. London. 146: 1017–1030.

Vail, J.R. 1985. Pan-African (late Precambrian) tectonic terranes and reconstruction of the Arabian-Nubian Shield. Geology. 13: 839–842.

Metamorphic grade in the western part of Ariab Nakasib Belt detected by VMS ore paragenesis, Red Sea Hills, NE – Sudan

Abdel Rahman, E.M. (1993) Geochemical and geotectonic controls of the metallogenic evolution of selected ophiolite complexes from the Sudan. Berl. Geowiss. Abh. 145: 175 pp.

Abdel Rahman, E.M. , H. Schandelmeier , A. Utke , G. Matheis , (1993) Subduction polarity in the late proterozoic SW-Nakasib Suture (Red Sea Hills, Sudan): Evidence from lithostratigraphic zonation and ophiolite

geochemistry. (In prep.)
Abdel Salam, M.G. , R.J. Stern , Perspectives on structural styles of the Arabian Nubian Shield sutures: The Nakasib Suture, Red Sea Hills, Sudan. Submitted to the J. Geol. Soc., Lon. (Aug. 1992)
Aye, F. , Y. Cheze , M. Abbass El Hindi , (1985) Discovery of a major massive sulfide province in northeastern Sudan. Proceed. "Conf. on prospecting in areas of desert errains, Rabat, Maroco" Inst. Min. & Metall. London. 43–48
Bakheit, A.K. (1991) Geochemical and tectonic control of sulfide-gold mineralization in Ariab Mineral District, Red Sea Hills – Sudan. Diss., Techn. Univ. Berlin, 157 p.
Barton, P.B. , P. Toulmin, (1966), Phase relations involving sphalerite in the Fe-Zn-S system. Econ. Geol. 61: 815–849
Clark, L.A. (1960a) The Fe-As-S system: Phase relations and applications. Econ. Geol. 55: Part I, 1345–1381, part II, 1631–1652
Hannington, M.D. , S.D. Scott , (1989) Sulfidation equilibria as guides to gold mineralization in volcanogenic massive sulfides: Evidence from sulfide mineralogy and the composition of sphalerite. Econ. Geol. 84:1978–1995
Huston, D.L. , R.R. Large , (1989) A chemical model for the concentration of gold in volcanogenic massive sulphide deposits. Ore Geol. Rev. 4: 171–200
Hutchinson, M.N. , S.D. Scott , (1980) Sphalerite geobarometry applied to metamorphosed sulfide ores of the Swedish Caledonides and U. S. Appalachians.Norges Geol. Underssøkelse 360: 59–71
Hutchinson, M.N. , S.D. Scott , (1981) Sphalerite geobarometry in the Cu-Fe-Zn-S system. Econ. Geol. 76: 143–153
Kretschmer, U. , S.D. Scott (1976) Phase relations involving arsenopyrite in the system Fe-As-S and their application. Can. Min. 14: 364–386
Scott, S.D. (1973) Experimental calibration of the sphalerite geobarometer. Econ. Geol. 68: 466–474
Scott, S.D. (1976) Applications of the sphalerite geobarometer to regionally metamorphosed terrains. Am. Mineral. 71: 661–670
Scott, S.D. (1983) Chemical behaviour of sphalerite and arsenopyrite in hydrothermal and metamorphic environments. Mineral. Mag. 47: 427–435
Stern, R.J. , A. Kröner , (1993) Late precambrian crustal evolution in the NE Sudan: Isotopic and geocronologie constraints. J. Geology . (In print)

Evolution of Pan-African granitoid magmatism along the southwestern Nakasib suture zone, Red Sea Hills, Sudan

Almond, D.C. , Darbyshire, D.P.F. & Ahmed, F. 1989. Age limits for major shearing episodes in the Nubian Shield of NE Sudan. J. Afr. Earth Sci. 9:489–496.
Kröner, A. , Greiling, R. , Reischmann, T. , Hussein, I. M. , Stern, R.J. , Dürr, S. , Krüger , & Zimmer, M. 1987. Pan-African Crustal Evolution in the Nubian Segment of Northeast Africa. In A. Kröner (ed.), Proterozoic Lithospheric Evolution, p.235–257. Washington: American Geophysical Union.
Lameyre, J. & Bowden, P. 1982. Plutonic rock type series: discrimination of various granitoid series and related rocks. J. Volcan. Geotherm. Res. 14:169–186.
Pearce, J.A. , Harris, N.B.W. & Tindle, A.G. 1984. Trace Element Discrimination Diagrams for the Tectonic Interpretation of Granitic Rocks. J. Petrol. 25:956–983.
Vail, J.R. , Almond, D.C. , Hughes, D.J. , Klemenic, P.M. , Poole, S. Nour, S.E.M. & Embleton, J.C.B. 1984. Geology of the Wadi Oko – Khor Hayet area, RedSea Hills, Sudan. GMRD Bull. 34: 20p.

Geomathematical optimization of Landsat-TM satellite data for geological mapping in an island arc/ophiolite environment of the Red Sea Hills, Sudan

Abdel Rahman, E.M. 1993. Geochemical and geotectonic controls of the metallogenic evolution of selected ophiolite complexes from the Sudan. Berliner geowiss. Abh. Berlin, 145:175 pp.
Abdel Rahman, E.M. , Schandelmeier H. , Utke, A. , Koch, W. & Matheis, G. (in prep.) Subduction polarity in the south-western part of the late proterozoic Oshib-Nakasib suture (Red Sea Hills, Sudan). Evidence from lithostratigraphic zonation and ophiolite geochemistry.
Aye, F. , Cheze, Y. & El Hindi, M.A. 1985. Discovery of major a massive sulphide province in northeastern Sudan. Symposium on prospecting in desert areas, Rabat, Morocco. Extended abstracts, Institute of Mining and Metallurgy, London, 43–48.

Chavez, P.S. , Berlin, G.L. & Sowers, L.B. 1982. Statistical method for selecting Landsat MSS ratios. J. of Appl. Photographic Eng. 8, 1:23–30.
Kaufmann, H. & Pfeiffer, W. 1986 Image optimization versus classification – An application oriented comparison of different methods by use of Thematic Mapper data. In: Damen, M.C.J. , Smit, G.S. & Verstappen, H.Th. (eds.) Remote Sensing for Resources Development and Environmental Management, Balkema, Rotterdam 1:31–35,.
Pontual, A. . 1989. Lithological information in enhanced Landsat Thematic Mapper images of arid regions. Proceed. 7th Thematic Conference on Remote Sensing for exploration, Calgary, Canada, 379–393.
Rothery, D.A. 1987. Improved discrimination of rock units using Landsat Thematic Mapper imagery of the Oman ophiolite. J. of Geol. Soc. London, 144:587–597.

Structural evolution of the Oko shear zone, Sudan

Abdelsalam, M.G. & A.S. Dawoud 1991. The late Precambrian Kabus ophiolitic melange, Sudan, and its bearing on the western boundary of the Nubian Shield. J. Geol. Soc. London. 148: 83–92.
Abdelsalam, M.G. & R.J. Stern 1991. Discussion of ophiolites in northeast and east Africa: implication for Proterozoic crustal growth. J. Geol. Soc. London. 148: 600–606.
Abdelsalam, M.G. & R.J. Stern In press. Tectonic evolution of the Nakasib suture, Red Sea Hills, Sudan: evidence for a late Precambrian Wilson Cycle. J. Geol. Soc. London.
Abdelsalam, M.G. & R.J. Stern Submitted. Structural styles of sutures in the Arabian Nubian Shield: the Nakasib suture, Red Sea Hills, Sudan. J. Geol. Soc. London.
Abdelsalam, M.G. & R.J. Stern This volume. Timing of events along the Nakasib suture and the Oko shear zone, Sudan.
Almond, A.C. , D.P.F. Derbyshire & F. Ahmed 1989. Age limits for major shearing episodes in the Nubian Shield of NE Sudan. J. Afr. Earth Sci. 9: 489–496.
Berhe, S.M. 1990. Ophiolites in northeast and east Africa: implication for Proterozoic crustal growth. J. Geol. Soc. London. 147: 41–57.
Davis, B.F. 1984. Strain analysis of wrench faults and collision tectonics of the Arabian Shield. J. Geol. 92: 37–53.
Fleck, R.J. , W.R. Greenwood , D.G. Hadley , R.E. Anderson & D.L. Schmidt 1980. Age and evolution of the southern part of the Arabian Shield. Inst. Applied Geol. Bull., King Abdulaziz University, Jeddah. 3: 1–19.
Kroner, A. , R. Greiling , T. Reischmann , I.M. Hussein , R.J. Stern , S. Durr , J. Kruger & M. Zimmer 1987. Pan-African crustal evolution in northeast Africa. In A. Kroner (ed.), Proterozoic lithospheric evolution, American Geophysical Union, Geodynamic Series. 17: 235–257.
Pallister, J.S. , J.S. Stacy , L.B. Fischer & W.R. Premo 1989. Precambrian ophiolites of Arabia: geologic settings, U-Pb geochronology, Pb-isotope characteristics, and implication for continental accretion. Precamb. Res. 38: 1–54.
Quick, J.E. 1991. Late Proterozoic transpression on the Nabitah fault system – implications for the assembly of the Arabian Shield. Precamb. Res. 38:1–54.
Stern, R.J. , A. Kroner , W.I. Manton , T. Reischmann , M. Mansour , & I.M. Hussein 1989. Geochronology of the late Precambrian Hamisana shear zone, Red Sea Hills, Sudan and Egypt. J. Geol. Soc. London. 146: 1017–1030.
Stern, R.J. , K.C. Nielsen , E. Best , M. Sultan , R.E. Arvidson & A. Kroner 1990. Orientation of late Precambrian sutures in the Arabian-Nubian Shield. Geology. 18: 1103–1106.
Stern, R.J. & A. Kroner In press. Geochronologic and isotopic constraints on the late Precambrian crustal evolution in NE Sudan. J. Geol .
Vail, J.R. 1985. Pan-African (late Precambrian) tectonic terranes and reconstruction of the Arabian-Nubian Shield. Geology. 13: 839–842.

The dyke swarms of the north-eastern Sudan

Almond, D.C. & F. Ahmed . 1987. Ductile shear zones in the northern Red Sea Hills, Sudan. In P. Bowden & J.A. Kinnaird (eds.), African Geology Reviews, p. 175–184. Chichester: Wiley.
Bernau, R. , D.P. Darbyshire , G. Franz , U. Harms , A. Huth , N. Mansour , P. Pasteels & H. Schandelmeier . 1987. Petrology, geochemistry and structural development of the Bir Safsaf-Aswan uplift, southern Egypt. J.African Earth Sci., 6: 79–90.
GRAS . 1988. Geological map of the Sudan. Geological Research Authority of Sudan and Robertson Research International, UK

Hassan, A.G.S. 1991. Cainozoic volcanic rocks and intraformational sediments from the Red Sea Hills, Sudan. MPhil thesis, Univ. Portsmouth, UK
Nour, S.E.M. 1983. The geology of dyke swarms of the Khor Sagesota area, northern Red Sea Hills, Sudan. MPhil thesis, Univ. Portsmouth, UK
Vail, J.R. 1971. Geological reconnaissance in part of Berber District, Northern Province, Sudan. Bull. Geol. Surv. Sudan, 18: 1–76.
Vail, J.R. 1972. Pre-Nubian tectonic trends in northeastern Sudan. J. geol. Soc. London, 128: 21–31.
Vail, J.R. 1988.Lexicon of geological terms for the Sudan. Rotterdam: Balkema.
Vail, J.R. 1989. Ring complexes and related rocks in Africa. J.African Earth Sci., 8: 19–40.
Vail, J.R. 1990. Geochronology of the Sudan. Overseas Geol. Miner. Resources, 66: 1–58.
Vail, J.R. , D. Almond , D.J. Hughes , P. Klemenic , S. Poole & S. Nour. 1984. Geology of Wadi Oka-Khor Hayet, Red Sea Hills. Bull. Geol. Miner. Resour. Dept. Sudan, Khartoum, 34: 1–20.
Vail, J.R. & D.J. Hughes . 1977. Tholeiite derivative dyke swarms near Erkowit, Red Sea Hills, Sudan. Geol. Rundschau, 66: 228–237.

Reconnaissance Pb-Pb zircon ages from Precambrian rocks in eastern and southern Ethiopia and an attempt to define crustal provinces

Abraham, A. Hassen, N. Yemane, T. Genzebu, W. Seyid, G. Mehari, K. and Alemu, T. 1992. Geological evolution of the Proterozoic of Southern Ethiopia. 29th. Internat. Geol. Congr., Kyoto, Japan, Abstr. vol. 2: 272.
Ayalew, T. Bell, K. Moore, J.M. and Parish, R.R. 1990. U-Pb and Rb-Sr geochronology of the Western Ethiopia Shield. Geol. Soc. America Bull., 102:1309–1316.
Ayalew, T. and Gichile, S. 1990. Preliminary U-Pb ages from southern Ethiopia. Extended abstracts, 15th Colloquium African Geol., Nancy, France, 127–130.
Barker, F. 1979. Trondhjemite: definition, environment and hypotheses of origin. In: Barker, F. (ed.), Trondhjemite, dacites and related rocks. Elsevier, Amsterdam, 1–12.
Berhe, S.M. 1981. The geology of the Dire Dawa area (explanatory notes for Dire Dawa mapsheet, NC 37–12). Ethiopian Institute of Geological Survey, Memoir.
Berhe, S.M. 1990. Ophiolites in northeast and east Africa: implications for Proterozoic crustal growth. J. Geol. Soc. 147: 41–57.
Burke, K. and Dewey, J. 1971. Orogeny in Africa. In: T.F.J. Dessauvagie and A.J. Whiteman (eds.) African Geology. Univ. Ibadan, Nigeria, 538–608.
Chappell, B.W. and White, A.J.R. 1974. Two contrasting granite types. Pacific. Geol. 8: 173–174.
DeWit, M.J. and Chewaka, S. 1981. Plate tectonic evolution of Ethiopia and the origin of its mineral deposits: an overview: In Chewaka, S. and DeWit, M.J. (eds.) Plate tectonics and Metallogenesis: Some Guidelines to Ethiopian Mineral Deposits. Ethiopian Institute of Geological Survey, Bulletin 2:115–129.
Hine, R. Williams, I.S. Chappell, B.W. and White, A.J.R. 1978. Contrasts between I-and S-type granitoids of the Kosciusko Batholith. J. Geol. Soc. Aust. 25: 219–234.
Holmes, A. 1951. The sequence of Precambrian orogenic belts in south and central Africa. Proc. 18th Internat. Geol. Congr., London, 254–269.
Hughes, C.J. 1973.Spilites, keratophyres and the igneous spectrum. Geol. Magazine 109:513–527.
Kazmin, V. 1975. Explanation of the geological map of Ethiopia. Ethiopian Institute of Geololgical Survey Bulletin 1.
Kazmin, V. Shiferaw, A. and Balcha, T. 1978. The Ethiopian Basement: stratigraphy and possible manner of evolution. Geol. Rundschau 67: 531–546.
Key, R.M. Charsley, T.J. Hackman, B.D. Wilkinson, A.F. and Rundle, C.C. 1990. Superimposed Upper Proterozoic collision-controlled orogenesis in the Mozambique orogenic belt of Kenya. Precambrian Res. 44:197–225.
Kober, B. 1987. Single-zircon evaporation combined with Pb+ emitter-bedding for 207Pb/206Pb-age investigations using thermal ion mass spectrometry, and implications to zirconology. Contrib. Mineral. Petrol. 96: 63–71.
Kröner, A. Greiling, R. Reischmann, T. Hussein, I.M. Stern, R.J. Dürr, S. Krüger, J. and Zimmer, M. 1987. Pan-African crustal evolution in the Nubian segment of northeast Africa. Am. Geophys. Union, Geodynamics. Series 17: 235–257.
Kröner, A. Eyal, M. Eyal, F. Sassi, F. and Teklay, M. 1989. Extensions of the Arabian-Nubian Shield into Southern Israel, Ethiopia and Northern Somalia. Terra Abstracts 1:363.
Kröner, A. Byerly, G.R. and Lowe, D.R. 1991a. Chronology of early Archean granite-greenstone evolution in the Barberton Mountain Land, South Africa, based on precise dating by single zircon evaporation. Earth Plan. Sci. Letters 103:41–54.
Kröner, A. Linnebacher, P. Stern, R.J. Reischmann, T. Manton, W. and Hussein, I.M. 1991b. Evolution of Pan-African island arc assemblages in the southern Red Sea Hills, Sudan, and southwestarn Arabia as exemplified

by geochemistry and geochronology. Precambrian Res. 53: 99–118.
Pearce, J.A. and Gale, G.H. 1979. Identification of ore-deposion environment from trace element geochemistry of associated igneous host rocks. In: Volcanic processes in ore genesis. Inst. Min. Metall. and Geol. Soc. London, Spec. Publ., 14–24.
Pearce, J.A. Harris, N.B.W. and Tindle, A.G. 1984. Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. J. Petrol. 25:956–983.
Shackelton, R.M. 1986. Precambrian collision tectonics in Africa. In: Coward, M.P. and Ries, A.C. (eds.) Collision tectonics. Geol. Soc.London, Spec. Pupl. 19: 329–349.
Stæser, D.B. and Camp, V.E. 1985. Pan-African microplate accretion of the Arabian Shield. Geol. Soc. America Bull. 96: 817–826.

Structural geology and tectonic setting of the Adola Belt (Southern Ethiopia)

Beraki, W.H. , Bonavia, F.F. , Getachew, T. , Schmerold, R. , and Tarekegn, T. 1989. The Adola fold and thrust belt, Southern Ethiopia:a re-examination with implications for Pan-African evolution. Geol. mag. 126 (6), 647–657.
Berhe, S.M. , 1990. Ophiolites in northeast and east Africa: implications for Proterozoic crustal growth: Jour. Geol. Soc. London, 147, 41–57.
Key, R.M. , Charseley, T.J. , Hackmann, B.D. , Wilkinson, A.F. and Rundle, C.C. 1989. Supperimposed Upper Proterozoic collusion-controlled orogenesis in the Mozambique orogenic belt of Kenya. Precamb. Res.,44, 197–225.
Kröner, A. 1984.Late Precambrian Plate tectonics and Orogeny: a need to redefine the term Pan-African. In: Klerkx, J. , and Michot, J. , eds., African Geology, Tervuren, Belgium, 23–26.
Shackleton, R.M. 1979. Precambrian Tectonics of northeast Africa. In: Tahoun, S.A. Evolution and mineralization of the Arabian-Nubian shield, Vol. 1 Pergmon press, oxford, 97–107.
Stern, R.J. and Dawoud A.S. 1991. Late Precambrian (740 Ma), Charnokite, enderbite, and granite from Jabel Moya, Sudan: A link between the Mozambique Belt and the Arabian-Nubian Shield? Journal of Geology, 99, 648–659.
Tolessa, S. , Bonavia, F.F. , Solomon, M. , Haile-Meskel, A. and Tefera, E. 1991. Structural pattern of Pan-African rocks around Moyale, Southern Ethiopia, Precamb. Res., 52, 179–186.
Worku, H. and Kinetebeb, Y. 1989. The tectonic evolution of the Precambrian metamorphic rocks of the Adola Belt (Southern Ethiopia) and its implication on gold mineralzation, Ethiopian Institute of Geological Surveys, unpub. report.

Geodynamic significance of contrasting Pan-African granitoid types in Somalia

Berhe, S.M. 1990. Ophiolites in Northeast and East Africa: implications for Proterozoic crustal growth. J. Geol. Soc. London. 147:41–57.
D'Amico, C. , Ibrahim, H.A. & Sassi, F.P. 1981. Outline of the Somalian Basement. Geol. Rdsch. 70:882–896.
Haider, A. 1989. Géologie de la formation ferrifère précambrienne et du complexe encaissant de Buur. Ph.D. thesis, INPL.,Nancy, France.
Kröner, A. , Eyal, M. , Eyal, Y. , Sassi, F. & Teklay, M. 1989. Extensions of the Arabian-Nubian shield into southern Israel, Ethiopia and northern Somalia. Terra Abstracts, EUG, Strasbourg, p.363.
Küster, D. , Utke, A. , Leupolt, L. , Lenoir, J.L. & Haider, A. 1990. Pan-African granitoid magmatism in northeastern and southern Somalia. Berliner geowiss. Abh., Berlin, 120: 519–536.
Lenoir, J.L. & Haider, A. 1990. Contribution to the knowledge of the petrogenesis and geochronology of the Basement Complex of southern Somalia. Abstr. Vol. 15th Coll. of African Geol., p.269.
Lenoir, J.L. , Küster, D. , Liégeois, J.P. , Utke, A. , Haider, A. & Matheis, G. . (in prep.). 650 to 470 Ma Late granitoids in Somalia: Transition between the Arabian-Nubian shield and the Mozambique belt. Geol. Rdsch.
Utke, A. , Huth, A. , Matheis, G. . & Hawa, H.H. 1990. Geological and structural setting of the Maydh and Inda Ad basement units in northeast Somalia. Berliner, geowiss. Abh., Berlin, 120:537–550.
Vidal, P. , Cocherie, A. & Lefort, P. 1982. Geochemical investigations on the origin of the Manaslu leucogranite (Himalaya, Nepal). Geochim. Cosmochim. Acta, 46:2279–2292.
Warden, A.J. 1981. Correlation and Evolution of the Precambrian of the Horn of Africa and Southwestern Arabia. Ph.D. thesis, Mont. Univ., Leoben.
Warden, A.J. & Horkel, A.D. 1984. The geological evolution of the NE branch of the Mozambique belt (Kenya, Somalia, Ethiopia). Mitt. österr. Geol. Ges.,77:161–184.

PT conditions of Pan-African granulite facies metamorphism in Sabaloka inlier, north of Khartoum, Sudan

Almond, D.C. 1977. The Sabaloka igneous complex Sudan. Philosoph-Transactions of the Royal Society of London, A, 287: 596–633.

Almond, D.C. 1980. Precambrian events at Sabaloka near Khartoum and their significance in the chronology of the basement complex of northeast Africa. Precambrian Research. 13: 43–62.

Curri, K.L. 1971. The reaction 3 cordierite = 2 garnet + sillimanite + 5 Quartz as a geological thermometer in the Ipinieon lake region. Ontario. Contributions to Mineralogy and Petrology. 33: 215–226.

Dawoud, A.A. 1971. Geological and geophysical study of the area southeast of Qerri station, eastern Sabaloka, Sudan. M.Sc. thesis, University of Khartoum, Sudan (unpubl.).

Ferry, J.M. & F.S. Spear . 1978. Experimental caliberation of the partitioning of Fe and Mg between biotite and garnet. Contributions to Mineralogy and Petrology. 66: 113–117.

Harley, S.L. 1984. An experimental study of the partitioning of Fe and Mg between garnet and orthopyroxene. Contributions to Mineralogy and Petrology. 86: 359–373.

Harley, S.L. & D.H. Green 1982. Garnet-orthopyroxene barometry for granulites and garnet peridotites. Nature, 300: 697–700.

Hensen, B.J. & D.H. Green 1971. Experimental study of the stability of cordierites and garnets in pelitic compositions at pressures and temperatures. Contributions to Mineralogy and Petrology, 33: 309–330.

Hutcheon, I. , E. Froese & M.T. Gordon 1974. The assemblage quartz-sillimanite-garnet-cordierite as an indicator of metamorphic conditions in the Daly Bay Complex NWT. Contributions to Mineralogy and Petrology. 44: 29–34.

Kröner, A. , R.J. Stern , A.S. Dawoud , W. Compston & T. Reischmann 1987. The Pan-African continental margin in northeastern Africa: evidence from a geochronological study of granulites at Sabaloka, Sudan. Earth and Planetary Science Letters. 85: 91–104.

Martignoli, J. & J.C. Sisi 1981. Cordierite garnet H2O equilibrium: A geological thermometer, barometer and water fugacity indicator. Contributions to Mineralogy and Petrology. 77: 38–46.

Thompson, A.B. 1976. Mineral reactions in pelitic rocks II. Calculations of some PTX (Fe-Mg) phase relations. American Hournal of Science 276: 425–450.

Wells, P.R.A. 1977. Pyroxene thermometry in simple and complex systems. Contributions to Mineralogy and Petrology 62: 129–139.

Wood, B.J. & S. Banno 1973. Garnet-orthopyroxene and orthopyroxene-clinopyroxene relationships in simple and complex systems. Contributions to Mineralogy and Petrology 42: 109–124.

PT conditions and geochemistry of the Late Precambrian charnockites, enderbites and granites of J. Moya, Sudan

Dahl, P. S. 1980. The thermal-compositional dependence of Fe2+-Mg distributions between coexisting garnet and pyroxene: applications to geothermometry. Am. Mineral. 65:854–866.

Ellis, D. T. & D. H. Green 1979. An experimental study of the effect of Ca upon garnet-clinopyroxene Fe-Mg exchange equilibria. Contrib. Mineral. Petrol. 71:13–22.

Ferry, J. M. & F. S. Spear 1978. Experimental calibration of the partitioning of Fe and Mg between biotite and garnet. Contrib. Mineral. Petrol. 66:113–117.

Harley, S. L. 1984. An experimental study of partitioning of Fe and Mg between garnet and orthopyroxene. Contrib. Mineral. Petrol. 86:359–373.

Perkins, D. & R. C. Newton 1981. Charnockite barometers based on coexisting garnet-pyroxene-plagioclase-quartz. Nature 292:144–146.

Powell, M. & R. Powell 1977. Plagioclase-alkali feldspar thermometry revisited. Mineral Mag. 41:253–256.

Powell, R. 1978. The thermodynamics of pyroxene geothermometers. Phil. Trans. R Soc. London A 288:457–469.

Stern. R. J. & A. S. Dawoud 1991. Late Precambrian (740 Ma) charnockite, enderbite and granite from Jebel Moya, Sudan: A link between the Mozambique Belt and the Arabian-Nubian Shield. Journal of Geology 99:648–659.

Stormer, J. C. 1977. A practical two-feldspar-geothermometer. Am. Min. 60:667–674.

Thompson, A. B. 1976. Mineral reactions in pelitic rocks. Calculation of some P-T-X (Fe-Mg) phase relations. Amer. Journal of Science 276:425–454.

Wells, P. R. A. 1977. Pyroxene thermometry in simple and complex systems. Contrib. Mineral. Petrol. 62:129–139.

Wells, P. R. A. 1979. Chemical and thermal evolution of Archean sialic crust, Southern Western Greenland. J. Petrol. 20:187–226.

Whitney, J. A. & J. C. Stormer 1977. The distribution of NaAlSi3O8 between coexisting microcline and plagioclase and its effect on geothermometric calculations. Am. Mineral. 62:687–691.
Wood, B. J. & S. Banno 1973. Garnet-orthopyroxene and orthopyroxene-clinopyroxene relationships in simple and complex systems. Contrib. Mineral. Petrol. 42:109–124.

Metamorphic evolution of the Panafrican basement in the Meidob volcanic field (Darfur Dome, Sudan)

Abdel Rahman, E.M. , U. Harms , H. Schandelmeier , G. Franz , D.P.E. Darbyshire , P. Horn & D. Müller-Sohnius 1990. A new ophiolite occurrence in NW Sudan -constraints on Late Proterozoic tectonism. Terra Nova 2:363–376.
Berman, R.G. 1988. Internally- consistent thermodynamic data for stoichiometric minerals in the system Na2O-K2O-CaO-MgO-FeO-Fe2O3-Al2O3-SiO2-TiO2-H2O-CO2 . J. of Petrology 29:445–522
Berman, R.G. 1990. Mixing properties of Ca-Mg-Fe-Mn garnets. Am. Mineralogist 75:328–344.
Berman, R.G. 1991. Thermobarometry using multiequilibrium calculations: a new technique with petrologic applications. Can. Mineralogist 29:833–855.
Brown, T.H. , R.G. Berman & E.H. Perkins 1988. GEO-CALC: software package for calculation and display of pressure-temperature-composition phase diagrams using an IBM or compatible personal computer. Computers and Geosciences 14:279–289.
Davidson, J.P. & I.R. Wilson 1989. Evolution of an alkali basalt-trachyte suite from Jebel Marra volcano, Sudan, through assimilation and fractional crystallization. Earth Planet. Sci. Lett. 95:141–160.
Graham, C. & R. Powell 1984. A garnet-hornblende geothermometer: calibration, testing, and application to the Pelona Schist, Southern California. J. metamorphic geology 2:13–31.
Massonne, H.J. & W. Schreyer 1987. Phengite geobarometry based on the limiting assemblage with K-feldspar, phlogopite, and quartz. Contrib. Mineral. Petrol. 96:212–224.

Pan-African assembly of terranes in the Tuareg shield

For references not listed, see Boullier 1991.
Black, R. & J.P. Liégeois 1992. Cratons, mobile belts, alkaline rocks and the continental lithospheric mantle: the Pan-African testimony. J. Geol. Soc. Lond., 149: in press.
Boullier, A.M. 1991. The Pan-African Trans-Saharan belt in the Hoggar shield (Algeria, Mali, Niger). A new review. In R.D. Dallmeyer & J.P. Lécorché (eds), The West African orogens and Circum Atlantic correlatives, Springer Verlag, 85–105.
B.R.M.A. (Bureau de Recherches Géologiques et Minières de l'Algérie) 1955–1962. Unpublished reports and geological maps.
Cottin, J.Y. , M. Guiraud & J.P. Lorand 1990. Le magmatisme et le métamorphisme panafricains témoin d'amincissement crustal dans la région de Laouni (Hoggar central, Algérie)? C. R. Acad. Sci. Paris, 311: 1345–1351.
Guérangé, B. 1966. L'Antécambrien deTemasint. B.R.G.M., O.C.I., ALG.66.A1.
England, P.C. & G.A. Houseman 1988. The mechanics of the Tibetan plateau. Phil. Trans. Roy. Soc. Lond., A326: 301–320.
Liégeois, J.P. , R. Black , J. Navez & L. Latouche 1993. Pan-African Cryogenian and Vendian coupled orogenies in Aïr (Niger). Precambrian continental lithospheric delamination and subsequent assembly of terranes in the Eastern Tuareg shield. Precambr. Res., submitted.

Granulite facies metamorphism and P-T evolution in the Mozambique Belt of Tanzania

Bagnall, P.S. (1963): he geology of the North Pare mountains. – Tang. Geol. Surv. Recs., 10: 7–16
Bohlen, S.R. (1987): Pressure-temperature-time paths and a tectonic model for the evolution of granulites. – J. Geol., 95: 617–632
Coolen, J.J.M.M.M. (1980): Chemical petrology of the Furua granulite complex, southern Tanzania. – GUA papers of geology, series 1,13
Coolen, J.J.M.M.M. ; Priem, H.N.A. ; Verdurmen, E.A.Th. & Verschure, R.H. (1982): sPossible zircon U-Pb evidence for Pan-African granulite-facies metamorphism in the Mozambique Belt of southern Tanzania. – Prec.

Res., 17: 31–40
Eckert, J.O. ; Newton, R.C. & Kleppa, O.J. (1991): The dH of reaction and recalibration of garnet-pyroxene-plagioclase-quartz geobarometer in the CMAS system by solution calorimetry. – Am. Mineral., 76: 148–160
Ellis, D.J. & Green, D.H. (1979): An experimental study of the effect of Ca upon garnet-clinopyroxene Fe-Mg exchange. –Contrib. Mineral. Petrol., 71: 13–22
Ferry, J.M. & Spear, F.S. (1978): Experimental calibration of the partitioning of Fe and Mg between biotite and garnet. –Contrib. Mineral. Petrol., 66: 113–117
Green, D.H. & Ringwood, A.E. (1967): An experimental investigation of the gabbro to eclogite transformation and its petrological applications. –Geochim. Cosmochim. Acta, 31:767–833
Harley, S.L. (1984): An experimental study of the partitioning of Fe and Mg between garnet and orthopyroxene. – Contrib. Mineral. Petrol., 86: 359–373
Koziol, A.M. & Newton, R.C. (1988): Redetermination of the anorthite breakdown reaction and improvement of the plagioclase-garnet-Al2SiO5-quartz geobarometer. – Am. Mineral., 73:216–223
Kröner, A. (1977): Precambrain mobile belts of S and E Africa – ancient sutures or sites of ensialic mobility? A case for crustal evolution towards plate tectonics. – Tectonophys., 40: 101–135
Kröner, A. (1980): Panafrican crustal evolution. – Episodes, Vol. 1980, No. 2: 3–8
Muhongo, S. (1989): Tectonic setting of the proterozoic metamorphic terrains in eastern Tanzania and their bearing on the evolution of the Mozambique Belt. – IGCP No. 255 Newsletter/Bulletin, 2: 43–50
Perkins, D. & Chipera, S.J. (1985): Garnet-orthopyroxene-plagioclase-quartz barometry: refinement and application to the English River subprovince and the Minnesota River valley. – Contrib. Mineral. Petrol, 89: 69–80
Perkins, D. & Newton, R.C. (1981): Charnockite geobarometers based on coexisting garnet-pyroxene-plagioclase-quartz. – Nature, 292: 144–146
Sampson, D.N. & Wright, A.E. (1964): The geology of the Uluguru Mountains. – Geol. Surv. Tanz., Bull No. 37
Shackleton, R.M. (1976): Pan-African structures. – Phil. Trans. Roy. Soc. London, A280: 491–497
Watson, J. (1976): Vertical movements in Proterozoic structural provinces. – Phil. Trans. Roy. Soc. London, A280: 620–640
Wendt, I. ; Besang, C. ; Harre ; Wells, W. ; Kreuzer, H. ; Lenz, H. & Müller, P. (1972): Age determinations of granitic intrusions and metamorphic events in the Early Precambrian of Tanzania. – 24th Int. Geol. Congr., Montreal, section 1, 295–314
Whittingham, J.K. (1959): The geology of the Nyanzwa Area. – Geol. Surv. Tanz., Bull. No.29

The Proterozoic mobile belts of northern Malawi and southern Tanzania: Tectonic significance and age

Andersen, L.S. and Unrug, R. , 1984. Geodynamic evolution of the Bangweulu block, northern Zambia. Precambr. Res., 25: 187–212.
Cahen, L. and Snelling, N.J. 1966. The geochronology of equatorial Africa. North Holland Publishing, Amsterdam, 195 p.
Coward, M.P. and Daly, M.C. , 1984. Crustal lineaments and shear zones in Africa: their relationship to plate movements. Precambr. Res., 24: 27–45.
Daly, M.C. , 1986. The intracratonic Irumide belt of Zambia and its bearing on collision orogeny during the Proterozoic of Africa. In: M.P. Coward and A.C. Ries (editors), Collison Tectonics. Geol. Soc Lond. Spec. Publ., 19, pp.321–328.
Dalziel, I.W.D. , 1992. Late Precambrian rifted margins, the origin of the Iapetus and Pacific ocean basins, and Gondwana amalgamation: Time and space considerations. EOS, 73 (14): 364.
Dodson, M.H. , Cavanagh, B.J. , Thatcher, E.C. and Aftalion, M. , 1975. Age limits for the Ubendiam metamorphic episode in Northern Malawi. Geol. Mag., 112: 403–410.
Fitches, W.R. , 1971. Sedimentation and tectonics at the northeast end of the Irumide orogenic belt, N. Malawi and Zambia. Geol. Rdschau, 60: 589–619.
Haslam, H.W. , Brewer, M.S. , Davies, A.E. and Darbyshire, D.F.P. , 1980. Anatexis and high-grade metamorphism in the Champira dome, Malawi: petrological and Rb-Sr studies. Min. Mag., 43: 701–714.
Haslam, H.W. , Darbyshire, D.F.P. and Davies, A.E. , 1983. Irumide and post-Moçambique plutonism in Malawi. Geol. Mag., 120: 21–35.
Hoffman, P.F. , 1992. Relative timing of Rodinia breakup and Gondwanaland assembly: Critical test of Laurentiacentric models for the Neoproterozoic supercontinent. EOS, 73 (14), 364.
Ray, G.E. , 1974: The structural and metamorphic geology of northern Malawi. J. Geol. Soc. Lond., 130: 427–440.

Changes in plate motions and their control on the subsidence of rifted basins in the African plate

Binks, R.M. & J.D. Fairhead 1992. A plate tectonic setting for Mesozoic rifts of West and Central Africa. Tectonophysics 213: 141–151.

Bosellini, A. 1989. The continental margins of Somalia: their structural evolution and sequence stratigraphy. Mem. Sci. Geol. 41: 373–458. Padova.

Cloetingh, S. 1992. Intraplate stress and sedimentary basin evolution. In G.C. Brown , C.J. Hawkesworth & C. Wilson (eds.) Understanding the earth: 415–434. Cambridge: Cambridge Univ. Press.

Cloetingh, S. , A.C. Lankreijer , M. de Wit & I. Martinez 1992. Subsidence history analysis and forward modelling of the Cape and Karoo Supergroups. In M.J. de Wit & I.G.D. Randsome (eds.), Inversion tectonics of the Cape fold belt, Karoo and Cretaceous basins of Southern Africa: 239–248. Rotterdam: Balkema.

Favre, P. & G.M. Stampfli 1992. From rifting to passive margin: The example of the Red Sea, Central Atlantic and Alpine Tethys. Tectonophysics 215: 69–97.

Genik, G.J. 1992. Regional framework, structural and petroleum aspects of rift basins in Niger, Chad and the Central African Republic (C.A.R.). Tectonophysics 213: 169–185.

Guiraud, R. , R.M. Binks , J.D. Fairhead & M. Wilson 1992. Chronology and geodynamic setting of Cretaceous-Cenozoic rifting in West and Central Africa. Tectonophysics 213: 227–234.

Guiraud, R. & J.C. Maurin 1992. Early Cretaceous rifts of Western and Central Africa: an overview. Tectonophysics 213: 153–168.

Lambiase, J.J. 1989. The framework of African rifting during the Phanerozoic. J. Afr. Earth Sci. 8: 183–190.

Mascle, J. , M. Marinho & J. Wannesson 1986. The structure of the Guinean continental margin: implications for the connection between the Central and the South Atlantic Oceans. Geol. Rundsch. 75: 57–70.

McHargue, T.R. , T.L. Heidrick & J. Livingstone 1992. Tectonostratigraphic development of the Interior Sudan Rifts, Central Africa. Tectonophysics 213: 187–202.

Rabinowitz, P.D. & J. Labrecque 1979. The Mesozoic South Atlantic and evolution of its continental margins. J. Geophys. Res. 84: 5973–6002.

Rosendahl, B.R. , E. Kilembe & K. Kaczmarick 1992. Comparison of the Tanganyika, Malawi, Rukwa and Turkana rift zones from analyses of seismic reflection data. Tectonophysics 213: 235–256.

Ziegler, P.A. 1992. Plate tectonics, plate moving mechanisms and rifting. Tectonophysics 215: 9–34.

Pangean depositional sequences between Karoo and Lut

Afshar, A. , Eshgi , M. & Odouli, K. . 1976. Geological history and stratigraphy of Iran. Schlumberger well evaluation conference Iran: 9–25, Serv. Techn. Schlumberger, Paris.

Al-Laboun, A.A. 1987. Unayzah Formation: A new Permian Carboniferous unit in Saudi Arabia. American Assoc. Petroleum Geologists Bull. 71: 29–38.

Archbold, N.W. 1983. Permian marine invertebrate provinces of the Gondwana realm. Alcheringa 7: 59–73.

Blendinger, W. , Van Vliet, A. & Hughes Clarke, M.W. 1990. Updoming, rifting and continental margin development during the Late Palaeozoic in northern Oman. Geological Society London, Special Publication 49: 27–37.

Cliquet, P.L. 1957. La tectonique profonde du sud Bassin de Morandava. Rep. 2nd Meeting East-Central & South Reg. Comm. Geol. C.C.T.A. Tananarive: 199.

Gaetani, M. & Garzanti, E. 1991. Multicyclic History of the Northern India Continental Margin (Northwestern Himalaya) Am. Assoc. Petroleum Geol. Bull. 75: 1427–1446.

Glennie, K.W. , Botuf, G.A. , Hugues, M.W. , Stuart, M.M. , Pilaar, W.F.H. & Reinhardi, B.M. 1974. Geology of the Oman Mountains. Transactions of the Dutch Geological and Mining Society, 31: 423.

Hudson, R.G.S. & Sudbury, M. 1959. Permian brachiopoda from south–east Arabia. Museum National d'Histoire Naturelle, VII: 19–55, Paris.

Kreuser, T. , Wopfner, H. , Kaaya, C.Z. , Markwort, S. , Semkiwa, P.M. and Aslanidis, P. 1990. Depositional evolution of Permo-Triassic Karoo Basins in Tanzania with reference to their economic potential. Journal of African Earth Sciences 10: 151–167.

Kummel, B. & Teichert, C. 1970. year . Stratigraphy and Paleontology of the Permo-Triassic Boundary Beds, Salt Range and Trans-Indus Ranges, West Pakistan. Dept. of Geology Spec. Publ. 4. University Press Kansas: 110.

Levell, B.K. , Braakman, J.H. & Rutten, K.W. 1988. Oil-bearing sediments of Gondwana glaciation in Oman. Am. Assoc. Petroleum Geologists Bull. 72: 775–796.

Metcalfe, I. 1988. Origin and assembly of Southeast Asia continental terranes. Geological Society of London, Special Publication, 37: 101–118.

Powell, C.McA. , Veevers, J.J. , Collinson, J. , Conaghan, P.J. & Lopez Gamundi, O.R. 1991. Late Carboniferous to Early Triassic foreland basin behind the Panthalassa margin of Gondwanaland. 8th

International Symposium on Gondwana, Abstracts: 67, Hobart.
Schindewolf, O.H. 1967. Zur permischen Vereisung der Salt Range (W.-Pakistan). Geologische Rundschau 56: 914–918.
Sengör, A.M.C. , Altmer, D. , Cin, A. , Ustaömer, T. & Hsü, K.J. 1988. Origin and assembly of the Tethyside orogenic collage at the expense of Gondwana Land. Geological Society of London Special Publication 37: 119–181.
Stöcklin, J. 1968. Structural history and tectonics of Iran: A review. American Assoc. Petroleum Geologists Bull. 52: 1229–1258.
Teichert, C. 1967. Nature of Permian glacial record, Salt Range and Khisor Range, West Pakistan. N. Jb. Geol. Paläont. Abh. 129, 2: 167–184.
Teichert, C. 1970. Marine fossil invertebrate faunas of the Gondwana region. Proceedings and Papers, Second Gondwana Symposium: 125–138, South Africa.
Veevers, J.J. 1990. Tectonic-climatic supercycle in the billion year plate-tectonic eon: Perman Pangean icehouse alternates with Cretaceous dispersed-continents greenhouse. Sedimentary Geology, 68: 1–16.
Wopfner, H. . 1989. Palaeoclimate and depositional control of the Karoo sequence in southern Tanzania. XIe Congres International de Stratigraphie et de Geologie du Carbonifere Beijing 1987, Compte Rendu 4: 89–95.
Wopfner, H. . 1990. Rifting in Tanzanian Karoo basins and its economic implications. Etudes recentes sur la Geologie de l'Afrique: 217–220, CIFEG 1990/22, Orleans.
Wopfner, H. . in press. Structural development of Tanzanian Karoo Basins and the break-up of Gondwana. Proc. 8th Gondwana Congress, Hobart 1991, Balkema, Rotterdam, 9 p.
Wopfner, H. & Diekman, B. 1991. Neue Ergebnisse aus der spätpaläozoischen Abfolge in der Karoo Tansanias. Zentralbl. Geol. Paläont., Teil 1: 2689–2701.
Wopfner, H. & Kaaya, C.Z. 1991. Stratigraphy and morphotectonics of Karoo deposits of the northern Selous Basin – Tanzania. Geological Magazine 128: 319–334.

Geochemistry and pedogenesis of Permo-Jurassic oversaturated alkaline complexes of northern Kordofan, central Sudan

Davidson, J.P. & Wilson, I.R. 1989. Evolution of an alkali basalt – trachyte suite from the Jebel Marra volcano, Sudan, through assimilation and fractional crystallization. Earth Planet. Sci. L., 95:141–160.
Macdonald, R. , Davies, G.R. , Bliss, C.M. , Leat, P.T. , Bailey, D.K. & Smith, R.L. 1987. Geochemistry of High-silica Peralkaline Rhyolites, Naivasha, Kenya Rift Valley. Journal Petrol., 28: 979–1007.
Schandelmeier, H. and Richter, A. 1991. Brittle shear deformation in Northern Kordofan, Sudan: late Carboniferous to Triassic reactivation of Precambrian fault systems. Journ. Struc. Geol., 13:711–720.
Vail, J.R. 1985. Alkaline ring complexes in Sudan. J. Afr. Earth Sci., 3:51–59.
Vail, J.R. 1989. Ring complexes and related rocks in Africa. J. Afr. Earth Sci., 8:19–40.
Vail, J.R. , Höhndorf, A. & Meinhold, D. 1990. Petrological and isotopic studies of selected anorogenic alkaline complexes from the Sudan. Abstr. Vol. 15. Coll. Afr. Geol., 15 Nancy: p411.
Wilson, M. 1989. Igneous Petrogenesis. Unwin Hyman, London: 466p.

Cretaceous rifting and basin inversion in Central Africa

Benkhelil, J. , 1988. Structure et évolution géodynamique du bassin intracontinental de la Bénoué (Nigéria). Bull. Cent. Rech. Explor. –Prod. Elf-Aquitaine, 12 (1): 29–128.
Binks, R.M. and Fairhead, J.D. , 1992. A plate tectonic framework for the evolution of the Cretaceous rift basins in West and Central Africa. In P.A. Ziegler (Editor), Geodynamics of Rifting, Volume II. Case History studies on Rifts: North and South America, Africa-Arabia. Tectonophysics, 213: 141–151.
Bosworth, W. , 1992. Mesozoic and Early Tertiary rift tectonics in East Africa. Tectonophysics, 209: 115–137.
Boccaletti, M. , Dainelli, P. , Angelucci, A. , Arush, M.A. , Cabdulqaadir, M.M. , Nafissi, P. , Piccoli, G. and Robba, E. , 1988. Folding of the Mesozoic cover in SW Somalia: a compressional episode related to the early stages of Indian Ocean evolution. J.Petrol. Geol., 11 (2): 157–168.
Dingle, R.V. , Siesser, W.G. and Newton A.R. , 1983. Mesozoic and Tertiary geology of Southern Africa. Balkema, Rotterdam, 375 pp.
Genik, G.J. , 1992. Regional framework and structural aspects of rift basins in Niger, Chad and the Central African Republic. In P.A. Ziegler (Editor), Geodynamics of Rifting, Volume II. Case History studies on Rifts: North and South America, Africa-Arabia. Tectonophysics, 213 (1–2): 169–185.
Guiraud, R. and Maurin, J.C. , 1991. Le rifting en Afrique au Crétacé inférieur: synthèse structurale, mise en évidence de deux phases dans la genèse des bassins, relations avec les ouvertures océaniques péri-

africaines. Bull. Soc. géol. France, 162, (5): 811–823.
Guiraud, R. and Maurin, J.C. , 1992. Early Cretaceous Rifts of Western and Central Africa: an overview. In P.A. Ziegler (Editor), Geodynamics of Rifting, Volume II. Case History studies on Rifts: North and South America, Africa-Arabia. Tectonophysics, 213 (1–2): 153–168.
Guiraud, R. , Bellion, Y. , Benkhelil, J. and Moreau, C. , 1987. Post-Hercynian tectonics in Northern and Western Africa. In: P. Bowden and J. Kinnaird (Editors), African Geology Reviews, Geol. J., 22: 433–466.
Mascle, J. , Blarez, E. and Marinho, M. , 1988. The shallow structures of the Guinea and Ivory Coast-Ghana transform margins: their bearing on the Equatorial Atlantic Mesozoic evolution. Tectonophysics, 188; 193–209.
Maurin, J.C. and Guiraud, R. , 1990. Relationships between tectonics and sedimentation in the Barremo-Aptian intracontinental basins of Northern Cameroon. In: C.A. Kogbe and J. Lang (Editors), African Continental Phanerozoic sediments. J. Afr. Earth. Sci., 10 (1/2): 331–340.
Mc Hargue, T.R. , Heidrick, T.L. and Livingstone, J. , 1992. Tectonostratigraphic development of the Interior Sudan Rifts, Central Africa. In P.A. Ziegler (Editor), Geodynamics of Rifting, Volume II. Case History studies on Rifts: North and South America, Africa-Arabia. Tectonophysics, 213 (1–2): 187–202.
Olivet, J.L. , Bonnin, J. , Beuzart, P. and Auzende, J.M. , 1984. Cinématique de l'Atlantique Nord et Central. Rapports Sci. Tech. CNEXO, 54: 1–108.
Reeves, C.V. , Karanja, F.M. and Mac Leod, I.N. , 1986/87. Geophysical evidence for a failed Jurassic rift and triple junction in Kenya. Earth Planet. Sci. Lett., 81: 299–311.
Schull, T.J. ,1988. Oil exploration in the non-marine rift basins of Interior Sudan. Am. Assoc. Petrol. Geol., 72 (10): 1128–1142.

Plate tectonic aspects of continental rift basin formation in Central and West Sudan

Assefa, G. 1988. Potential hydrocarbon-generating rock units within the Phanerozoic sequence of the Ogaden basin, Ethiopia: a preliminary assessment using the Lopatin model. J. Petrol. Geol. 11: 461–472.
Awad, M. Z. & E. Schrank 1992. Palynostratigraphy and palynofacies of Late Jurassic to mid-Tertiary non-marine sediments, Blue Nile Rift Basin, Sudan. 8th Int. Palynol. Congr., Aix-en-Province, Abstr.: 7.
Besse, J. & V. Courtillot 1988. Paleogeographic maps of the Indian Ocean bordering continents since the Upper Jurassic. J. Geophys. Res. 93: 11791–11808.
Bosellini, A. 1989. The continental margins of Somalia: their structural evolution and sequence stratigraphy. Mem. Sci. Geol. Univ. Padova XLI: 373–458.
Bosworth, W. 1992. Mesozoic and early Tertiary rift tectonics in East Africa. In: C.J. Ebinger , H.K. Gupta & I.O. Nyambok (eds.), Seismology and Related Sciences in Africa. Tectonophysics 209: 115–137.
Bussert, R. , H. Brasse , T. Radic & P.-O. Reynolds 1990. Sedimentation and structural style of a rift-structure in northern Sudan: the Humar Basin. Berliner geowiss. Abh.(A) 120. 1: 89–108.
Coffin, M.F. & P.D. Rabinowitz 1988. Evolution of the conjugate East African-Madagascan margins and the western Somali Basin. Geol. Soc. Am. Spec. Pap. 226: 1–78.
Fairhead, J.D. & R.M. Binks 1991. Differential opening of the Central and South Atlantic Oceans and the opening of the West African Rift System. Tectonophysics 187: 191–203.
Guiraud, R. , R.M. Binks , J.D. Fairhead & M. Wilson 1992. Chronology and geodynamic setting of Cretaceous-Cenozoic rifting in West and Central Africa. In: P.A. Ziegler (ed.), Geodynamics of Rifting, Vol. II. Case History Studies on Rifts: North and South America and Africa. Tectonophysics 213: 227–234.
Kaska, H.V. 1989. A spore and pollen zonation of Early Cretaceous to Tertiary nonmarine sediments of central Sudan. Palynology 13: 79–90.
Mann, D.C. 1989. Thick-skin and thin-skin detachment faults in continental Sudanese rift basins. J. Afr. Earth Sci. 8: 307–322.
Masele, J. , M. Marinho & J. Wannesson 1986. The structure of the Guinean continental margin: implications for the connection between the central and the South Atlantic Oceans. Geol. Rundsch. 75: 57–70.
Maycock, I.D. 1988. Oil Exploration and Development in Marib/Al Jawf Basin, Yemen Arab Republic. Bull. Am. Assoc. Petrol. Geol. 72: 218–219.
Millegan, P.S. 1990. Aspects of the interpretation of Mesozoic rift basins in northern Sudan using potential field data. Soc. Explor. Geophys., 60th Annu. Int. Meet., San Francisco, Sept. 1990, Gravity and Magnetic Case Histories, GM2.1: 605–607.
Mills, S.J. 1992. Oil discoveries in the Hadramaut: how CanadianOxy scored in Yemen. Oil & Gas J., OGJ Spec. Mar. 9: 49–52.
Rabinowitz, P.D. & J. LaBrecque 1979. The Mesozoic South Atlantic Ocean and evolution of its continental margin. J. Geophys. Res. 84: 5973–6002.
Reeves, C.V. , F.M. Karanja & I.N. MacLeod 1986/87. Geophysical evidence for a failed Jurassic rift and triple junction in Kenya. Earth Planet. Sci. Lett. 81: 299–311.
Reynolds, P.-O. & H. Schandelmeier 1992. Influence of Precambrian basement structures on the architecture of the Mesozoic/Cenozoic Sudanese Rift System. Annales Geophysicae, Part I – Solid Earth Geophysics &

Natural Hazards, Suppl. I to Vol. 10: C 89.
Schandelmeier, H. , P.-O. Reynolds & D. Küster 1993. Spatial and temporal relationship between alkaline magmatism and early rifting in north/central Sudan. In: U. Thorweihe & H. Schandelmeier (eds.), Geoscientific Research in northeastern Africa, Balkema, this volume.
Schull, T.J. 1988. Rift basins of interior Sudan: petroleum exploration and discovery. Bull. Amer. Assoc. Petrol. Geol. 72: 1128–1142.
Schulz-Bödeker, K.-U. (in prep.). Structural and stratigraphic evolution of the Khartoum basin, central Sudan. Berliner geowiss. Abh..
Wycisk, P. , E. Klitzsch , C. Jas & O. Reynolds 1990. Intracratonal sequence development and structural control of Phanerozoic strata in Sudan. Berliner geowiss. Abh. (A) 120.1: 45–86.
Ziegler, P.A. 1992. Plate tectonics, plate moving mechanisms and rifting. In: P.A. Ziegler (ed.), Geodynamics of Rifting Vol. III. Thematic Discussions. Tectonophysics 215: 9–34.

Structural style and tectonic evolution of the rift basins of northeast Africa

Angelier, J. 1985. Extension and rifting: the Zeit region, Gulf of Suez. J. Struct. Geol. 7: 605–612.
Armstrong, R.L. 1972. Low-angle (denudation) faults, hinterland of the Sevier orogenic belt, eastern Nevada and western Utah. Geol. Soc. Amer. Bull. 83: 1729–1754.
Bosworth, W. 1985. Geometry of propagating continental rifts. Nature 316: 625–627.
Bosworth, W. 1992. Mesozoic and early Tertiary rift tectonics in East Africa. Tectonophys. 209: 115–137.
Bosworth, W. , J. Lambiase & R. Keisler 1986. A new look at Gregory's Rift: The structural style of continental rifting. EOS (Amer. Geophys. Union Trans.) 67: 577, 582, 583.
Browne, S.E. & J.D. Fairhead 1983. Gravity study of the Central African Rift System: a model of continental disruption 1. The Nagoundere and Abu Gabra Rifts. Tectonophys. 94: 187–203.
Buck, W.R. , F. Martinez , M.S. Steckler & J.R. Cochran 1988. Thermal consequences of lithospheric extension: Pure and simple. Tectonics 7: 213–234.
Cochran, J.R. 1983. A model for development of the Red Sea. Bull. Amer. Ass. Petrol. Geol. 67:41–69.
Garfunkel, Z. & Y. Bartov 1977. The tectonics of the Suez rift. Geol. Surv. Israel 71:1–41.
Jackson, J.A. & N.J. White 1989. Normal faulting in the upper continental crust: Observations from regions of active extension. J. Struct. Geol. 11: 15–36.
Kröner, A. 1979. Pan-African plate tectonics and its repercussions on the crust of northeast Africa. Geol. Rundschau 68: 565–583.
Lambiase, J.J. 1989. The framework of African rifting. J. Afr. Earth Sci. 8: 183–190.
Morley, C.K. 1988. Variable extension in Lake Tanganyika. Tectonics 7: 785–801.
Morley, C.K. , W.A. Wescott , D.M. Stone , R.M. Harper , S.T. Wigger , & F.M. Karanja 1992. Tectonic evolution of the northern Kenyan Rift. J. Geol. Soc. London 149: 333–348.
Perry, S.K. & S. Schamel 1990. The role of low-angle normal faulting and isostatic response in the evolution of the Suez rift, Egypt. Tectonophys. 174: 159–173.
Pollard, D.D. & A. Aydin 1984. Propagation and linkage of oceanic ridge segments. J.Geophys. Res. 89: 10,017–110,028.
Rosendahl, B.R. 1987. Architecture of continental rifts with special reference to east Africa. An. Rev. Earth & Planet. Sci. 15: 445–503.
Scott, R.J. & G.S. Lister 1992. Detachment faults: Evidence for a low-angle origin. Geology 20: 833–836.
Spencer, J.E. 1984. Role of tectonic denudation in uplift and warping of low-angle normal faults. Geology 12: 95–98.
Wernicke, B. 1981. Low-angle normal faults in the Basin and Range province: Nappe tectonics in an extending orogen. Nature 291:645–648.
Wernicke, B. 1985. Uniform-sense normal simple shear of the continental lithosphere: Canadian J. Earth Sci. 22: 108–125.
Yin, A. & J.F. Dunn 1992. Structural and stratigraphie development of the Whipple-Chemehuevi detachment fault system, southeastern California: Implications for the geometrical evolution of domal and basinal low-angle normal faults. Geol. Soc. Amer. Bull. 104: 659–674.

Spatial and temporal relationship between alkaline magmatism and early rifting in north/central Sudan

Awad, M.Z. & E. Schrank 1988. Palynostratigraphy and palynofacies of Late Jurassic to mid-Tertiary non-marine sediments, Blue Nile rift basin, Sudan. 8th Int. Palynol. Congress, Aix-en-Provence, Abstracts: 7.

Bosworth, W. 1992. Mesozoic and early Tertiary rift tectonics in East Africa. In: C.J. Ebinger , H.K. Gupta & I.O. Nyambok (eds.), Seismology and related sciences in Africa. Tectonophysics 209: 115–137.

Cox, K.G. 1992. Karoo igneous activity, and the early stages of the break-up of Gondwanaland. In: B.C. Storey , T. Alabaster & R.J. Pankhurst (eds.), Magmatism and the causes of continental break-up. Geol. Soc. Spec. Pub. 68: 137–148.

Fairhead, J.D. & R.M. Binks 1991. Differential opening of the Central and South Atlantic Oceans and the opening of the West African Rift System. Tectonophysics 187: 191–203.

Gealey, W.K. 1988. Plate tectonic evolution of the Mediterranean-Middle East region. Tectonophysics 155: 285–306.

Guiraud, R. , R.M. Binks , J.D. Fairhead & M. Wilson 1992. Chronology and geodynamic setting of Cretaceous-Cenozoic rifting in West and Central Africa. In: P.A. Ziegler (ed.), Geodynamics of rifting, Vol. 11. Case History Studies on Rifts: North and South America and Africa. Tectonophysics 213: 227–234.

Reynolds, P.O. 1993. Plate tectonic aspects of continental rift basin formation in Central and West Sudan. This volume.

Sengör, A.M.C. , D. Altmer , A. Cin , T. Ustaömer & K.J. Hsü 1988. Origin and assembly of the Tethyside orogenic collage at the expense of Gondwana Land. In: M.G. Audley-Charles & A. Hallam (eds.), Gondwana and Tethys. Geol. Soc. Spec. Pub. 37: 119–182.

Storey, B.C. , T. Alabaster , M.J. Hole , R.J. Pankhurst & H.E. Wever. 1992. Role of subduction-plate boundary forces during the initial stages of Gondwana break-up: evidence from the proto-Pacific margin of Antarctica. In: B.C. Storey , T. Alabaster & R.J. Pankhurst (eds.), Magmatism and the causes of continental break-up. Geol. Soc. Spec. Pub. 68: 149–164.

Vail, J.R. 1985. Alkaline ring-complexes in Sudan. J. Afr. Earth Sci. 3: 51–59.

Wilson, M. & R. Guiraud 1992. Magmatism and rifting in Western and Central Africa, from Late Jurassic to Recent times. In: P.A. Ziegler (ed.), Geodynamics of rifting, Vol. 11. Case History Studies on Rifts: North and South America and Africa. Tectonophysics 213: 203–225.

Late Cretaceous igneous activity in the Delgo uplift (Northern Province, Sudan)

Franz, G. , H. Puchelt & P. Pasteels 1987. Petrology, geochemistry and age relations of Triassic and Tertiary volcanic rocks from SW Egypt and NW Sudan. J. Afric. Earth Sci. 6:335–352.

Saradeth, S. , H. C. Soffel , P. Horn , D. Müller-Sohnius & A. Schult 1989.Infra-cambrian and phanerozoic pole positions and potassium-argon ages from the East Sahara craton. Geophys. J. 97:209–221.

Satir, M. , G. Morteani , A. Fuganti & V. von Drach 1991. K-Ar ages, Sr-isotopic compositions and chemistry of late Cretaceous-Tertiary basalts from the Nubian Desert (northern Sudan). Europ. J. Miner. 3:943–956.

Schandelmeier, H. , A. Huth , U. Harms , G. Franz & R. Bernau 1987. The East Saharan craton in southern Egypt and northern Sudan. Berliner geowiss. Abh. (A) 75:25–48.

Vail, J. R. 1989.Ring complexes and related rocks in Africa J. Afric. Earth Sci. 8:19–40.

Recent advances on the geology of northeast Libya

AGoCo Exploration Staff 1980–90 Geological Reports on Northeast Libya. Arabian Gulf Oil Co. Benghazi (Unpublished)

Duronio, P. Dakshe, A. Bellini, E. 1992, Stratigraphy of the offshore Cyrenaica, Libya. Third Symposium of Geology of Libya vol. IV p.1589 – 1620. Elsevier Publicating Company.

Rohlich, P. 1979 Geological Development of Jabal Al-Akhdar, Libya. Geol. Rundsch; vol. 67 (2), p.401 – 412.

The palaeogeography of the Sirt basin (Libya) from Upper Cretaceous to Eocene

Benfield, A.C. & E.P. Wright 1980. Post-Eocene sedimentation in the Eastern Sirt Basin, Libya. In: M.J. Salem and M.T. Busrevil (Eds.), The Geology of Libya, Vol. II, p.907–922.

El-Batroukh, I.S. & A.S. Zentani 1980. The geological interpretation of a gravity map of the northern part of the Maradah graben (Sirt Basin, Libya). In: M.J.. Salem and M.T. Busrevil (Eds.), The Geology of Libya, Vol. III, p.965–978.

Exploration staff of the Arabian Gulf Oil Company 1980. Geology of a stratigraphic giant – the Messlah oil field. In: M.J. Salem and M.T. Busrevil (Eds.), The Geology of Libya, Vol. II, p.521–536.

Klitzsch, E. 1971. The structural developments of parts of North Africa since the Cambrian time. In: C. Gray (Editor), Symposium on the Geology of Libya, p.253–262.

Röhlich, P. 1980. Tectonic development of Al Jabal al Akhdar. In: M.J. Salem and M.T. Busrevil (Eds.), The Geology of Libya, Vol. III, p.923–931.

Schäfer, K. , K.-H. Kraft , H. Hausler & J. Erdmann 1980. In situ stresses and palaeostresses in Libya. In: M.J. Salem and M.T. Busrevil (Eds.), The Geology of Libya, Vol. III, p.907–922.

Basin evolution of the northern margins of the Arabo-Nubian craton during Maastrichtian-Paleocene times

Almogi-Labin, A. , A. Flexer , A. Honigstein , A. Rosenfeld & E. Rosenthal . 1990. Biostratigraphy and tectonically controlled sedimentation of the Maastrichtian in Israel and adjacent countries. Rev.Espan. Paleont. 5: 41–52.

Delaloye, M. & J.J. Wagner . 1984. Ophiolites and volcanic activity near the western edge of the Arabian plate. In: J.E. Dixon & A.H.F. Robertson (eds.). The Geological Evolution of the Eastern Mediterranean. Blackwell scientific Publications, Oxford, London, pp. 225–233.

Delaney, M.L. & A. Boyle . 1988. Tertiary paleoceanic chemical variability: Unintended consequence of simple geochemical models. Paleoceanogr. 3: 137–156.

Flexer, A. 1971. Late Cretaceous palaeogeography of northern Israel and its significance for the Levant Geology. Palaeogog. Palaeoclimat. Palaeoecol. 10: 293–316.

Flexer, A. , A. Rosenfeld , S. Lipson-Benitah & A. Honigstein . 1986. Relative sealevel changes during the Cretaceous in Israel. Bull. Am. Ass. Petrol. Geol., 70, 1685–1699.

Hirsch, F. , A. Flexer & A. Rosenfeld 1992. The eastern Mediterranean Mesozoic history: to what extent was it oceanic and how passive its margins? First Intern. Sympos. on Eastern Mediterranean Geology. Adana, Turkey. pp. 342–351.

Ilani, S. , A. Rosenfeld , Y. Nathan , A. Flexer , L. Grossowicz , A. Honigstein , M. Dvorachek & S. Ehrlich . 1989. Iron concretions in the Paleocene marls of Israel – a case study from the Judean foothills. N. Jb. Miner. Mh. H12: 529–540.

Ilani, S. , A. Rosenfeld , J. Kronfeld & A. Flexer . 1990. Geochemical signature of the Cenomanian to Eocene rocks in Israel – a palaeoenvironmenental indicator. Terra Nova, 3: 195–202.

Reiss, Z. , A. Almogi-Labin , A. Honigstein , Z. Lewy , S. LipsonBenitah , S. Moshkovits & Y. Zaks .1985. Late Cretaceous multiple stratigraphic framework of Israel. Isr. J. Earth-Sci., 34: 147–166.

Robertson, A.H.F. 1978. The sedimentary evolution of the Troodos Ocean: an excursion guide to the sedimentary geology of southern Cyprus. Tenth International Congress on Sedimentology, Jerusalem, 1978. Part III, Turkey and Cyprus. pp. 23–75.

Rosenfeld, A. , A. Flexer , A. Honigstein , A. Almogi-Labin & M. Dvorachek . 1989. First report on a Cretaceous/Tetiary boundary section at Makhtesh Gadol, southern Israel. N. Jb. Geol. Palaont. Mh. H8: 474–488.

New constraints on Red Sea rifting

Cochran, J.R. , 1981, The Gulf of Aden: Structure and evolution of a young ocean basin and continental margin, Journal Geophysical Research, v. 86, p. 263–288.

Dixon, T.H. , Stern, R.J. and Hussein, I.M. , 1987, Control of Red Sea rift geometry by Precambrian structures1: Tectonics, v. 6, p. 551–571.

Freund, R. , Plate tectonics of the Red Sea and East Africa, 1970: Nature, v. 228, 453.

Gaulier, J.M. , Le Pichon, X. , Lyberis, N. , Avedik, F. , Geli,L. , Moretti, I. , Deschamps, A. , Hafez, S. , 1988, Seismic study of the crust of the northern Red Sea and Gulf of Suez: Tectonophysics, v. 153, p. 55–88.

Girdler, R.W. , and Darracott, B.W. , 1972, African poles of rotation, Comments Earth Sci. Geophysics, v. 2, p. 131–138.

Joffe, S. , and Garfunke Z. , 1987, Plate kinematics of the circum Red Sea – a re-evaluation: Tectonophysics, v. 141, p. 5–22.
Le Pichon, X. , and Gaulier, J.-M. , 1988, The rotation of Arabia and the Levant fault System: Tectonophysics, v. 153, p. 271–294.
Markis, J. and Rihm, R. , 1991. Shear-controlled evolution of the Red Sea: pull apart model: Tectonophysics, v. 198, p. 441–446.
McKenzie, D.P. , Davies, D. , and Molnar, P. , 1970, Plate tectonics of the Red Sea and east Africa: Nature, v. 226, p. 243–248.
Omar, G.I. , 1992, New evidence for propagation of the opening of the Red Sea: an apatite fission-track study: Geological Society of America Abstracts with Programs, v. 24, p. A280.
Shimron, A.E. , 1990, The Red Sea line – a Late Proterozoic transcurrent fault, Journal African Earth Sciences, v. 11, p. 95–112.
Sultan, M. , Becker, R. , Arvidson, R.E. , Shore, P. , Stern, R.J. , El Alfy, Z. , and Guinness, E.A. , 1992, Nature of the Red Sea crust: Geology, v. 20, p. 593–596.

Uplift kinematics of Jebel Dirurba sedimentary complex, Red Sea Hills, Sudan

Bender, F. 1963. Stratigraphie der “Nubischen Sandsteine” in Süd-Jordanien. Geol. Jb. 81:237–276.
Embleton, J.C.B. , D.J. Hughes , P.M. Klemenic , S. Poole & J.R. Vail 1982. A new approach to the stratigraphy and tectonic evolution of the Red Sea Hills, Sudan. Precambrian Res. 16. A19.
Helal, A.H. 1968. Stratigraphy of outcropping Paleozoic rocks around the northern edge of the Arabian Shield (within Saudi Arabia). Z. dt. geol. Ges. 117:506–543.
Kabesh, M.L. 1962. The geology of the Mohamed Qol Sheet. Mem. Geol. Surv. Sudan. 3:61 pp.
Klitzsch, E. , J. Almond , N. Barazi , A. El Hassan , N. Mansour & A. Semtner 1990. Short note on recently discovered Paleozoic strata of NE Sudan (Red Sea Hills). Berliner geowiss. Abh. (A) 120.1: 87–88.
Seilacher, A. 1969. Sedimentary rhythms and trace fossils in Paleozoic sandstones of Libya. In W.H. Kanes (ed.) Geology, archaeology and prehistory of the southwestern Fezzan, Libya. Petrol. Explor. Soc. of Libya. 117–119.
Selley, R.C. 1970. Ichnology of Paleozoic sandstones in the southern desert of Jordan: a study of trace fossils in their sedimentologic context. In T.P. Crimes & J.C. Harper (eds.), Trace fossils, Geol. J., Spec. Issue. 3:477–488.
Vail, J.R. , D.C. Almond , D.J. Hughes , P.M. Klemenic , S. Poole , S.E.M. Nour & J.C.B. Embleton 1984. Geology of Wadi Oko-Khor Hayet area, Red Sea Hills, Sudan. Bull. geol. Miner. Resour. Dept. Sudan. 34:1–20.

Plio-Quaternary tectonics and sedimentation in the SW Gulf of Suez and N. Red Sea

Baltzer, F. , O. Conchon & P. Freytet 1992. Climatic and tectonic evolution recorded by sedimentary terraces of the Egyptian Coast of the NW Red Sea. Int. Symposium on Sedimentation and Rifting in The Red Sea and Gulf of Aden, Cairo, Jan. 1992 (Abstracts).
El Moursi, M. 1992. Late Quaternary Evolution of the Red Sea Coastal Plain between Hurghada and Marsa Alam, Egypt. Doctoral thesis, Univsersity of Marseille.
Hassouba, M. 1992. Synrift depositional style in the Gulf of Suez, Int. Symposium, Red Sea-Gulf of Aden, Cairo, January 1992 (Abstracts).
Jackson, P. A. & C. Vendeville 1991. Decline and Subsidence of salt diapirs in distensive settings, Summary Geol.Soc.France, Oct. 1991.
Philobbos, E.R. & al. 1992. Pliocene sedimentary evolution and its relationships to the tectonic framework of the Egyptian red Sea Coastal area, Int Symposium Red Sea and Gulf of Aden, Cairo, Jan. 1992.
Plaziat, J.-C. , B.H. Purser & E. Philobbos 1990. Seismic deformation structures (seismites) in the syn-rift sediments of the NW Red Sea (Egytp). Bull. Soc. Geol. France, t VI, N° 3, 419–4341.
Taviani, M. & al 1992. Evidence for gravity-flow deposits in the technically active segment of the Red Sea Rift. Int. Symposium, Red Sea and Gulf of Aden, Cairo, January 1992 (Abstracts).

Evaporitic sedimentation and its relation to rifting in the NW part of the Egyptian Red Sea coast

Cita M.B. 1973. Mediterranean evaporites: paleontological arguments for a deep-sea basin desiccation model. Messinian event, Koninklijke Nederlands Akad.Van Weten. Amsterdam, 206–224

Heybroek F. 1965. The Red Sea Miocene evaporite basin. Salt basin around Africa, The Institute of Petroleum London, The Elsevier Publishing Company, 17–40

Hsü K.J. , L. Montadert , D. Bernouilli et al. 1978. History of the Mediterranean salinity crisis. Initial Report of the DSDP, Leg 42A, 1053–1078.

Montenat C. (ed.).1986. Etudes géologiques des rives du Golfe de Suez et de la Mer Rouge Nord Occidentale. Doc.et Trav.IGAL, Paris, n°10, 192p.10 pl.h.t.

Orszag-Sperber F. & J.C. Plaziat 1990. La sédimentation continentale (Oligo-Miocene) des fossés du proto-rift du NW de la Mer Rouge. Bull.Soc.Géol.France, (8),t.VI, n°3, 385–396.

Origin and evaluation of hydrocarbons in the Gulf of Suez basin, Egypt

Hutton, A. C. , Cook, A. C. , Kanstler, A. J. & Mckirdy, D. M. 1980. Organic matter of oil shales. APEA Journal, 20(1), 44–67, Sydney.

Murris, R. K. 1984. Petroleum Geochemistry and Basin Evaluation-Introduction. AAPG, Memoir 35, Tulsa.

Tissot, B. P. , Welte, D.H. & Durand, B. 1987. The role of geochemistry in exploration risk evaluation and decision making. – Proc. 12th World Pet. Cong., 2, 99–112. London: Wiley.

Application of paleobathymetric analysis in oil exploration of the Miocene sequence in the central Gulf of Suez, Egypt

Albers, C.C. , M.R. Bane , J.H. Dorman , J.B. Dunlap , J.M. Lampton , D. Macomber , G.B. Martin , B.S. Parrott , H.C. Skinner , R.K. Sylvester and W.P.S. Ventress . 1966. Foraminiferal ecological zones of the Gulf Coast: Gulf Coast Association of geological societies Transactions, V. 16, PP.345–348.

Azazi, G. 1990. Recent Sea Floor Benthonic foraminiferal analysis from the Gulf of Suez. Fourth international symposium on Benthic Foraminifera. Sandi, Japan, p. 19, text figs. 14, plat 2.

Be', A.W.H. 1959. Ecology of recent planktonic foraminifera: Part I- Areal distribution in the western North Atlantic. Micro-paleontology, v.5, no.1, pp.77–100, pls.1–2.

Cherif, O.H. 1972. Some aspects of the paleoecology of the lower Miocene of the northern part of the Gulf of Suez, Egypt. Eighth Arab Petroleum Congress, paper no. 82 (B-3), Algers.

Hassouba, M. 1992. Synrift depositional style in the Gulf of Suez as model for hydrocarbon accumulation in the Red Sea. International Symposium on the Sedim. and Rifting in the Red Sea and Gulf of Aden, Cairo, March, 1991.

Kerdany, M. and S. Fahmy . 1965. Paleoenvironmental trends in G. Zeit area (an appraisal of paleoecological studies for oil exploration). 5th Petr. Cong., Cairo, Serial no.32 (B-3), pp. 1–7, text figs. 1–3.

Macfadyen, W.A. 1931. Miocene foramimiera from the clysmic area of Egypt and Sinai. Cairo: Govt. Press. Egypt, Geol. Surv., pp. 1–49, pls. 1–4, 2 maps.

Rateb, R. 1988. Miocene planktonic foraminiferal analysis and its stratigraphic application in the Gulf of Suez region. Ninth E. G. P.C.Exploration and Production Conference.

Rine, J.M. , L. Shishkevish , M. Hassouba , A., Shafy , H. Nashaat , G. Azazi , A. Badawy and Z. El-Sisi , 1984, Paleoenvironment and depositional history of the Miocene clastics within central Gulf of Suez, Egypt., unpublished Gupco report ER 84–63 (GS).

Rine, J.M. , M. Hassouba , L. Shishkevish , A. Shafy , H. Nashaat , G. Azazi , A. Badawy and Z. El-Sisi . 1988. Evolution of a Miocene fan delta : a giant oil field in the Gulf of Suez, Egypt. Fan Deltas: Sedimentology and Tectonic Settings, Eds. W. Nemec and R. J. Steel , 1988 Balckie and Son, P. 239–250.

Said, R. and M. A. Bassiouni . 1958. Miocene formaminifera of the Gulf of Suez region, Egypt. Amer. Assoc. Petr. Geol. Bull. v. 42, no. 8, pp. 1958–1977, pl. 1., text figs. 1–5.

Stainforth, R.M. 1949. Foraminifera in the upper tertiary of Egypt. Jour. Paleon. v.23, no. 4, pp. 419–422.

Souaya, F. J. 1966. Miocene foraminifera of the Gulf of Suez region, U.A.R., part 4- paleoecology and Age, Micropaleontology, v. 12, no.4, pp. 493–504, text figs. 1–2.

Stratigraphic Sub-committee of the National Committee of Geological Sciences. 1974. Miocene rock Stratigraphy of Egypt. Jour. Geol. no.181, pp.1–69.

Structures related to Red Sea evolution in northern Eritrea

Drury, S.A. and Berhe, S.M. in press. Accretion tectonics in northern Eritrea revealed by remotely sensed imagery. Geol. Mag.

Mohr, P. 1979. Lithology and structure of the Precambrian rocks of Eritrea. In: Evolution and mineralisation of the Arabian Shield. Bull. Fac. Earth Sci. King Abdul Aziz Univ., 2, p.7–15.

Ollier, C.D. 1978. Early landform evolution. In: J.N. Jeans (ed.), Australia: a physical geography. Sydney: Sydney University Press, p 85–98

Tertiary basins in the Northern Somalia continental margin: Their structural significance in the Gulf of Aden rift system

Abbate, E. , Bruni, P. , Fazzuoli, M. and Sagri, M. 1986. The Gulf of Aden continental margin of Northern Somalia: Tertiary sedimentation, rifting and drifting. Mem. Soc. Geol. Ital. 31:427–445.

Beydoun, Z.R. 1970. Southern Arabia and Northern Somalia comparative geology. Phil. Trans. Roy. Soc. London, Ser.A 267: 267–292.

Bohannon, R.G. , 1989. Style of extensional tectonism during rifting, Read Sea and Gulf of Aden. Jour. African Earth Sc. 8: 589–602.

Bruni, P. , Abbate, E. , Abdi Salah Hussein , Fazzuoli, M. and Sagri, M. 1987. Geological map of the Daban Basin, Northern Somalia. S.E.L.C.A. Firenze.

Gellatly, D.C. 1960. Report on the geology of the Las Dureh Area, Burao di strict. Somali Republic Geol. Survey, Rep.6. 40 p.

Greenwood, J.E.G.W. , 1960. Report on the geology of the Las Khorey-Elayu area. Geol. Surv. Somaliland, Rep. 3, 36p.

Hunt, J.A. 1960. Report on the geology of the Berbera-Sheikh area, Berbera and Burao districts. Geol. Surv. Somaliland, Rep. 4, 27 p.

Macfadyen, W.A. 1933. The geology of British Somaliland with a geological map 1:1.000.000. Crown Agents, London, 87p.

Merla, G. , Abbate, E. , Azzaroli, A. , Bruni, P. , Canuti, P. , Fazzuoli, M. , Sagri, M. and Tacconi, P. 1979. A geological map of Ethiopia and Somalia (1973) 1:2.000.000 and comment with a map of major landforms. CNR Italy, Centro Stampa Firenze, 95p.

Osman, S.H. 1992. Miocene alluvial to marine facies transition of the Mait Group in the Bosaso Basin (Migiurtinia, Northern Somalia). Giornale di Geolo gia 54:67–76.

Rosendahl, B.R. , Reynolds D.J. , Lorber, P.M. , Burgess, C.F. , McGill, J. Scott, D. , Lambiase, J.J. & Derksen S.J. 1986. Structural expressions of rifting: lessons from Lake Tanganyika, Africa. In: Frostick L.E. , Renaut R.W. , Reid I. & Tiercelin J.J. (eds.): Sedimentation in the African Rifts. Geol. Soc. Lon don, Spec.Publ. 25: 29–43.

Scott, D.L. , Ng'ang'a, P. , Johnson, T.C. & Rosendahl, B.R. 1991. High-resolu tion acoustic character of Lake Malawi (Nyasa), East Africa and its relations hip to sedimentary processes. In: Anadon P. , Cabrera L. & Kets K. (eds.): Lacustrine Facies Analysis. Int. Ass. Sedimentologist, Spec.Publ. 13: 129–145.

The Meidob volcanic field, Darfur Dome, Sudan

Bermingham,P.M. , Fairhead, J.D. & Stuart, G.W. 1983. Gravity study of the Central African Rift System: A model of continental disruption. 2. The Darfur domal uplift and associated canoizoic volcanism. Tectonophysics. 94:205–222.

Hill, R.J. 1991. Starting plumes and continental break-up. Earth and Planetary Science Letters. 104:398–416.

Pearce, J.A. & Norry, M.J. 1979. Petrogenetic Implications of Ti, Zr, Y, and Nb Variations in Volcanic Rocks. Contrib. Mineral. Petrol. 69:33–47.

Wycisk,P. , Klitzsch, E. , Jas, C. & Reynolds, O. 1990. Intercratonal sequence development and structural control of Phanerozoic strata in Sudan. Berl. Geow. Abh.120A: 45–86.

Volcanism and extension between the Main Ethiopian and Gregory rifts

Bosworth, W. , 1992. Mesozoic and Tertiary rifting in East Africa, Tectonophysics. 209: 172–195.

Davidson, A. , compiler, 1983. The Omo River Project, reconnaissance geology and geochemistry of parts of Ilubabor, Kefa, Gemu Gofa, and Sidamo: Ministry of Mines and Energy, Ethiopian Institute Geological Surveys Bull. 2: 1–89.

Morley, C. K. , W. A. Wescott , D. M. Stone , R. M. Harper , S. T. Wigger , and F.M. Karanja , 1992. Tectonic evolution of the northern Kenya rift, Geol. Soc. London 149:333–348, 1992.

Basement anisotropies along the western shoulder of the Kenya Rift and their relationship to Cenozoic rift structures

Burke, K. & Sengör, A.M.C. 1986. Tectonic Escape in the evolution of the continental crust. Reflection Seismology: The Continental Crust. Geodynamics Series 14: 41–53.

Charsley, T.J. 1987. Geology of the Laisamis area. Geol. Surv. Kenya Rep. 106.

Daly, M.C. , Chorowicz, J. & Fairhead, J.D. 1989. Rift basin evolution in Africa: the influence of reactivated steep basement shear zones. Spec. Publ. geol. Soc. Lond. 44: 309–334.

Geological Map of Kenya , 1987. Ministry of Energy and Development of Kenya.

Key, R.M. , Charsley, T.J. , Hackman, B.D. , Wilkinson, A.F. & Rundle, C.C. 1989. Superimposed Upper Proterozoic collision-controlled orogenies in the Mozambique Orogenic Belt of Kenya. Precambrian Research 44: 197–225.

King, B.C. 1978. Structural and volcanic evolution of the Gregory rift valley. Geol. Soc. London Spec. Publ. 6: 29–54.

KRISP, 1991. Large-scale variation in lithospheric structure along and across the Kenya Rift. Nature 354: 223–227.

Lippard, S.J. 1972. The stratigraphy and structure of the Elgeyo Escarpment, Southern Kamasia Hills and adjoining regions, Rift Valley Province, Kenya. Unpub. Ph. D. thesis, University of London.

McConnell, R.B. 1972. Geological development of the Rift System of Eastern Africa. Geol. Soc. Am. Bull. 83: 2549–2572.

Shackleton, R.M. 1986. Precambrian collision tectonics in Africa. Geol. Soc. London Spec. Publ. 19: 329–349.

Smith, M. & Mosley, P. in press. Crustal heterogeneity and basement influence on the development of the Kenya Rift, East Africa. Tectonics.

Quaternary stress evolution in East Africa from data of the western branch of the East African rift

Bothworth, W. , M.R. Strecker & P.M. Blisniuk 1992. Integration of East African Paleostress and Present-Day Stress Data: Implications for Continental Stress Field Dynamics. – J. Geophys. Res., 97 (B8): 11851–11865.

Delvaux, D. , K. Levi , R. Kajara & J. Sarota 1992. Cenozoic paleostress and kinematic evolution of the Rukwa – North Malawi rift valley (East African rift system). – Bull. Centres Rech. Explor.-Prod. Elf Aquitaine, 16, (2).

Dypvik, H. , H. Nestby , F. Rudent , P. Aagaard , T. Johansson , J. Msindai & C. Massay 1990. Upper Paleozoic and Mesozoic sedimentation in the Rukwa- Tukuyu Region, Tanzania. J. Afr. Earth Sci., 11: 437–456.

Ebinger, C.J. , A.L. Deino , R.E. Drake & A.L. Thesa 1989. Chronology of volcanism and rift basin propagation : Rungwe volcanic provinces, East Africa. J. Geophys. Res., 94: 15783–15803.

Ebinger, C.J. , A.L. Deino , A.L. Tesha , T. Becker & U. Ring (submitted). Regional tectonic controls on rift basin geometry: Evolution of an East African Lake Basin. J. Geophys. Res.

Morley, C.K. , S.M. Cunningham , R.M. Harper & W.A. Wescott 1992. Geology and geophysics of the Rukwa rift, East Africa. – Tectonics, 11: 68–81.

Ring, U. & C. Betzler (submitted). Architecture, Tectonics and Sedimentation of the Malawi Rift (East Africa). Zeitschritt Deutsche Geologische Gesellschaft.

Ring, U. , C. Betzler & D. Delvaux 1992. Normal vs. strike-slip faulting during rift development in East Africa: the Malawi rift. Geology, 20 (12).

Strecker, M.R. , P.M. Blisniuk & G.H. Eisbacher 1990. Rotation of extension direction in the central Kenya rift. Geology, 18: 299–302.

Zoback, M.L. 1992. First- and Second-Order Patterns of Stress in the Lithosphere: the World Stress Map Project. J. Geophys. Res., 97 (B8): 11703–11728.

Uplift history of Rukwa Rift, SW Tanzania: Apatite Fission Track analysis

Ebinger, C.J. 1989. Tectonic development of the western branch of the East African Rift System. Geol. Soc. Am. Bull. 101. 885–903.

Ebinger, C.J. , T.D. Bechtel , D.W. Forsyth & C.O. Bowin 1989. Effective Elastic Plate Thickness Beneath the East Africa and Afar Plateaus and Dynamic Compensation for the uplifts. J. Geophy. Res. 94, 83. 2883–2901.

Green, P.F. , I.R. Duddy , A.J.W. Gleadow & J.F. Lovering (1989). Apatite fission track analysis as a paleotemperature indicator for hydrocarbon exploration. In: Thermal history of sedimentary basins: Methods and case histories. Nasser, N.D. & T.H. McCullah (Eds). Springer Verlag, 1–22, New York.

Hurford, T.P. & P.F. Green 1982. A users' guide to fission track dating calibration. Earth Plant. Sci. Lett. 59. 343–354.

Kilembe, E.A. & B.R. Rosendahl 1992. Structure and stratigraphy of the Rukwa Basin. Tectonophys. 209. 143–158.

Mbede, E.I. , A. Hurford , C.J. Ebinger & H. Schandelmeir 1993. Constraint on the uplift history of Rukwa Rift, SW Tanzania: A reconnaissance apatite fissio-track analysis. in press.

Nanyaro, J.T. 1989. Proterozoic gold-base metal veins in the Mpanda mineral field, Western Tanzania. Mus. Roy. de l'Afrique- Cent., Belgigue Annales Serie 8. Sciences Geologiques, no 97. Tervuren, Belgium.

Omar, G.I. , M.S. Steckler , W.R. Buck , & B.P. Kohn 1989. Fission- track analysis of basement apatite at the western margin of the Gulf of Suez rift, Egypt: evidence for synchroneity of uplift and subsidence. Earth Plan. Sci. Lett. 94. 316–328,

Tiercelin, J.J. , J. Chorowicz , H. Bellon , J.P. Richert , J.T. Mwambene , & F. Walgenwitz 1988. East African Rift System: Offset, age and tectonic significance of the Tanganyika-Rukwa- Malawi intracontinental transcurrent fault zone. Tectonophys. 148. 241–252.

Wopfner, H. 1990. Rifting in Tanzania Karoo basins and its economic implications, CIFEG, Occasional Pub. 20. 217–220.

Wescott, W.A. , W.N. Krebs , D.W. Engelhardt & S.M. Cunningham , 1991. New biostratigraphic age dates from the Lake Rukwa rift basin in western Tanzania. AAPG Bull. 75, 7. 1255–1263.

Plio/Pleistocene nearshore lacustrine record of Lake Malawi (East Africa)

Bromage, T.G. & F. Schrenk 1986. A Cercopithecoid tooth from the Pliocene of Malawi. J. Human. Evol. 15:497–500.

Delvaux, D. , K. Levi , R. Kajara , J. Sarota in press. Cenozoic paleostress and kinematic evolution of the Rukwa-North Malawi Rift Valley (East African rift system). Bull. Centres Rech. Xplor.-Prod. Elf Aquitaine.

Ebinger, C.J. , A. Deino , R..Drake , A.L. Tesha 1989. Chronology of volcanism and rift propagation: Rungwe Volcanic Province. J. geophys. Res. 94:15785–15803.

Ebinger, C.J. , A.L. Deino, A.L. Tesha, T. Becker , U. Ring in press. Regional tectonic controls on rift basin geometry: Evolution of an East African lake basin. J. Geophys. Res.

Johnson, T.C. & P..Ng'ang'a 1990. Reflections on a rift lake. Amer. Assoc. Petrol. Geol., Mem. 50:113–135.

Ring, U. , C. Betzler , D. Delvaux 1992. Normal vs. strike-slipfaulting during rift development in East Africa: The Malawi Rift. Geology 20:1015–1018.

Rosendahl, B.R. 1987. Architecture of continental rifts with special reference to East Africa. Ann. Rev. Earth Planet. Sci. 15:445–503.

Schrenk, F. & T.G. Bromage 1986. Evidence of Late Pliocene Papio from Malawi, Central Africa. Primate Rep. 14:52.

Schrenk, F. , T.G. Bromage , C. Betzler , U. Ring , A. Gorthner in press: First Pliocene hominid from the Malawi Rift and southeast Africa. Nature.

Specht, T. D. , B.R. Rosendahl 1989. Architecture of the Lake Malawi Rift, East Africa. J. African Earth Sci. 8:355–382.

Problems of correlation in the Nubian Sandstone Facies

Bergström,J. & Peel,J.S. 1988. Lower Cambrian trace fossils from Northern Greenland. Rapp Gronlands geol. Undersogelse 137: 43–53.

El-Baz, F. 1992. Origin and evolution of sand seas in the Great Sahara and implications to petroleum and ground water exploration. In A. Sadek (ed.) Geology of the Arab World, vol. 2: 3–17. cairo.

Magwood,J.P.A. & Pemberton,S.G. 1990. Stratigraphic significance of Cruziana: New data concerning the Cambrian-Ordovician ichnostratigraphic paradigm. Geology, 18:729–732

Seilacher,A. 1970. Cruziana stratigraphy of “non-fossiliferous” Paleozoic sandstones. In Crimes, T.P. & Harper, J.C. (eds.), Trace fossils. Geol. J.,Spec. Iss. No.3: 447–476, Liverpool.
Seilacher,A. 1990. Palaeozoic trace fossils. In R.. Said (ed.), The Geology of Egypt, 1565–1581, Rotterdam: Balkema.
Seilacher, A. 1992. An updated Cruziana Stratigraphy of Gondwanan Palaeozoic sandstones. In M.J. Salem ,(ed.), The Geology of Libya, part 8. Amsterdam: Elsevier.
Wycisk, P. , Klitzsch, E. , Jas, C. & Reynolds, O. 1990. Intracratonal sequence development and structural control of Phanerozoic strata in Sudan. Berliner geowiss. Abh., A 120.1: 45–86.

Cambro-Ordovician bauxitic laterites of NW-Sudan

Abdel Rahman, E.M. , Harms, U. , Schandelmeier, H. , Franz, G. , Darbyshire, D.P.F. , Horn, P. & Muller-Sohnius, D. 1990. A new ophiolite occurence in NW-Sudan – constraints on Late Proterozoic tectonism. Terra Nova 2:363–376.
Bardossy, G. & Aleva, G.J.J. 1990. Lateritic Bauxites. Developments in Economic Geology, Vol. 27, 624 pp., Amsterdam – Oxford – New York – Tokyo.
Fabre, J. & Mainguet, M. 1991. Continental sedimentation and palaeoclimates in Africa during the Gondwanian Era (Cambrian to Lower Cretaceous): The importance of wind action. J. Afr. Earth Sci. 12:107–115.
Fischer, K. 1989. Prozesse und Produkte lateritischer Verwitterung in oberkretazischen Sedimenten Oberägyptens und des Nordsudan. Berliner geowiss. Abh. (A) 115:123 pp..
Fischer, K. , Germann, K. & Schwarz, T. 1991. Origin and properties of laterite-derived deposits in continental basins in Upper Egypt and Northern Sudan. Proc. 7th Euroclay Conf. Dresden ’91 1:357–362.
Floyd, P.A. & Winchester, J.A. 1978. Identification and discrimination of altered and metamorphosed volcanic rocks using immobile elements. Chem. Geol. 21:291–306.
Frakes, L.A. 1979. Climates Throughout Geological Time. 310 pp., Amsterdam–Oxford – New York.
Germann, K. , Fischer, K. & Schwarz, T. 1990. Cretaceous and Tertiary ironstones, kaolins and bauxitic laterites in sedimentary basins of Northern Sudan. C.I.F.E.G. Occ. Publ. 22:271–275.
Germann, K. , Fischer, K. & Schwarz, T. 1990. Accumulation of lateritic weathering products (kaolins, bauxitic laterites, ironstones) in sedimentary basins in northern Sudan. Berliner geowiss. Abh. (A) 120.1:109–148.
Germann, K. , Fischer, K. , Schwarz, T. & Wipki, M. in press. Early Paleozoic lateritic weathering of Proterozoic basement rocks in the northwestern Sudan. Travaux ICSOBA 27:9 pp..
Schandelmeier, H. , Richter, A. , Harms, U. & Abdel Rahman, E.M. 1990. Lithology and structure of the Late Proterozoic Jebel Rahib Fold-and-Thrust Belt (NW Sudan). LBerliner geowiss. Abh. (A) 120.1:15–30.
Tardy, Y. 1992. Diversity and terminology of lateritic profiles. In: Martini, L.P. & Chesworth, W. (eds.), Weathering, Soils & Paleosols, Vol. 15, 379–401, Amsterdam.
Wycisk, P. , Klitzsch, E. , Jas, C. & Reynolds, O. 1990. Intracratonal sequence development and structural control of Phanerozoic strata in Sudan. Berliner geowiss. Abh. (A) 120.1:45–86.

Silurian paleogeography of NE Africa and Arabia – An updated interpretation

Bellini, E. & D. Massa 1980. A stratigraphic contribution to the Paleozoic of the southern basins of Libya. In M.J. Saleem & M.T. Busrewil (eds.), The Geology of Libya. London Academic Press. V1:3–56.
De Lestang, J. 1968. Das Palaozoikum am Rande des Afro-Arabischen Gondwana Kontinentes. Z. dtsch. Geol. Ges. 117:479–488.
Klitzsch, E. 1968. Die Gotlandium Transgression in der Zentralsahara. Z. deutsch.geol. Ges.117:492–501.
Klitzsch, E. 1970. Die Strukturgeschichte der Zentralsahara. Geol. Rdsch. 59. 2:459–527.
Klitzsch, E. , J. Almond , N. Barazi , A. El Hassan , A. Mansour & A. Semtner . 1990. Short note on recently discovered Paleozoic strata of NE Sudan (Red Sea Hills). Berliner geowiss. Abh. (A) 120.1:87–89.
Mahmoud, N.D. , D. Vaslet & M.I. Husseini . 1992. The Lower Silurian Qalibah Formation of Saudi Arabia: an important hydrocarbon source rock. AAPG Bull. 76. 10:1491–1506.
McGillivray, J.G. & M.J. Husseini . 1992. The Paleozoic petroleum geology of Central Arabia. AAPG Bull. 76. 10:1473–1490.
Plauchut, B. 1960. Notice explicative sur la Carte geologique du Bassin Djado 1:500.000. Bureau de Rech. Geol. et Min., 38 p.
Semtner, A. (this volume). Uplift kinematics of Jebel Dirurba sedimentary complex, Red Sea Hills, Sudan.

Diagenesis related to unconformities in Late Carboniferous/Permo-Triassic sediments of Northern Galala, Gulf of Suez, Egypt

Abdallah, A.M. & A. Adindani 1963. Stratigraphy of the Upper Paleozoic rocks, western side of the Gulf of Suez: Paper No. 25. 18 PP. A.R.E.: Geological survey and mineral resource department.

Darwish, M. 1992. Facies development of the Upper Paleozoic-Lower Cretaceous sequences in the Northern Galala plateau and evidences for their hydrocarbon reservoir potentiality, Northern Gulf of Suez region, Egypt. 1st ICGAW: Abstract. Cairo: Cairo University.

El-Barkooky, A.N. 1992.Stratigraphic framework of the Paleozoic in the Gulf of Suez region, Egypt. 1st ICGAW: Abstract. Cairo: Cairo University.

Klitzsch, E. 1990. Paleozoic. In R. Said (ed.), The Geology of Egypt: p.393–406. Rotterdam: Balkema.

Kuss, J. 1989. Facies and Paleogeographic importance of the pre-rift limestones from the NE Egypt / Sinai: Geologische Rundschau 75(2): 487–498.

Retallack, C.J. 1990. Soils of the past. *An introduction to paleopedology*. 520 PP. Boston – London: Unwin Hywan Inc.

Depositional cycles and palynostratigraphy of the Permo-Triassic and Early to Middle Jurassic of East Africa and Madagascar

Angelucci, A. , F. Barbieri , C.M. Maxamed , F.C. Caynab , F. Franco , M.C. Carush & G. Piccoli 1983. The Jurassic stratigraphic series in Gedo and Bay regions (southwestern Somalia). Mem. Sc. Geol. 36: 73–94.

Backhouse, J. 1991. Permian palynostratigraphy of the Collie Basin, Western Australia. Rev. Palaeobot. Palynol. 67: 237–314.

Balduzzi, A. , E. Msaky , E. Trincianti & S.B. Manum . Mesozoic Karoo and post-Karoo formations in the Kilwa area, southeastern Tanzania. J. Afr. Earth Sc., in press.

Bosellini, A. 1989. The continental margins of Somalia: their structural evolution and sequence stratigraphy. Mem. Sc. Geol. 41: 373–458.

Chen, Y. 1978. Jurassic and Cretaceous palynostratigraphy of a Madagascar well., Ph.D. thesis, University of Arizona.

Davidson, A. & D.C. McGregor 1976. Palynomorphs indicating Permian rocks in Ethiopia. Nature 262: 371–373.

Foster, C.B. & J.B. Waterhouse 1988. The Granulatisporites confluens Oppel-zone and Early Permian marine faunas from the Grant Formation on the Barbwire Terrace, Canning Basin, Western Australia. Austr. J. Earth Sc. 35: 135–157.

Geleta, S. 1990. Depositional environment analysis of some formations from Shillabo-1 well, Ogaden Basin, Ethiopia. Ethiopian Inst. Geol. Surv., unpubl. report.

Goubin, N. 1965. Description et repartition des principaux pollenites permiens, triasiques et jurassiques des sondages du bassin de Morondava (Madagascar). Rev. Inst. Fr. Pet. 20: 1415–1461.

Hankel, O. 1987. Lithostratigraphic subdivision of the Karoo rocks of the Luwegu Basin (Tanzania) and their biostratigraphic classification based on microfloras, macrofloras, fossil woods and vertebrates. Geol. Rdsch. 76: 539–565.

Hankel, O. 1990. Lower Triassic spores and pollen from a borehole in the Lower Mariakani Formation (Karoo) of Kenya. Berliner geowiss. Abh. A 120.2: 639–678.

Hankel, O. 1991. Early Triassic plant microfossils from the Kavee Quarry section of the Lower Mariakani Formation, Kenya. Rev. Palaeobot. Palynol. 68: 127–145.

Hankel, O. 1992a. Late Permian to Early Triassic microfloral assemblages from the Maji ya Chumvi Formation, Kenya. Rev. Palaeobot. Palynol. 72: 129–147.

Hankel, O. 1992b. Phytogeographic evidence for the palaeoposition of Madagascar. Proc. 8th Gondwana Symp., 8 pp. Rotterdam: Balkema.

Hankel, O. Early Triassic plant microfossils from Sakamena sediments of the Majunga Basin, Madagascar. Rev. Palaeobot. Palynol., in press.

Hart, G.F. 1960. Microfloral investigation of the Lower Coal Measures (K2); Ketewaka-Mchucguma Coalfield, Tanganyika. Bull. Geol. Surv. Tanganyika 30: 18 pp.

Hart, G.F. 1963. Microflora from the Ketewaka-Mchuchuma Coalfield, Tanganyika. Bull. Geol. Surv. Tanganyika 36: 27 pp.

Hart, G.F. 1965. Miospore zones in Karroo sediments of Tanzania. Palaeont. Afr. 9: 139–150.

Helby, R. , R. Morgan & A.D. Partridge 1987. A palynological zonation of the Australian Mesozoic. Mem. Assoc. Australas. Paleontol. 4: 1–94.

Kreuser, T. 1983. Stratigraphie der Karroo-Becken in Ost-Tanzania. Sonderveroffentlichung Geol. Inst. Univ. Koln 45: 217 pp.
Kreuser, T. 1990. Permo-Trias im Ruhuhu-Becken (Tansania) und anderen Karoo-Becken von SE-Afrika. Sonderveroffentlichung Geol. Inst. Univ. Koln 75: 131 pp.
Liao, K. 1980. Palaeozoic sporo-pollen assemblages from the Songwe-Kiwira Coalfield, Tanzania. Abstr. 5th Intern. Palyn. Conf., p. 225. Cambridge.
Maheshwari, H.K. & S.C. Srivastava 1979. Permian palynofloras from Tanzania. Proc. Symp. Evolutionary Botany and Biostratigraphy: 407–423. New Delhi.
Manum, S.B. & N. Due Tien 1973. Palyno-stratigraphy of the Ketewaka Coalfield (Lower Permian), Tanzania. Rev. Palaeobot. Palynol. 16: 213–227.
Radelli, L. 1975. Geology and oil of Sakamena Basin, Malagasy Republic (Madagascar). AAPG Bull. 59: 97–114.
Rakotoarivelo, H. 1960. Etude palynologique de quelques echantillons de houille du bassin de la Sakoa (Madagascar). Serv. Geol. Madagascar, 60 pp. Tananarive.
Rakotoarivelo, H. 1970. Palynostratigraphic review of the coal basin of the Sakoa-Sakamena (Madagascar). Proc. 2nd Gondwana Symp.: 537–540.
Veevers, J.J. 1989. Middle/Late Triassic (230+5 Ma) singularity in the stratigraphic and magmatic history of the Pangean heat anomaly. Geology 17: 784–787.
Verniers, J. , P.P. Jourdan , R.V. Paulis , L. Frasca-Spada & F.R. De Bock 1989. The Karoo Graben of Metangula, northern Mozambique. J. Afr. Earth Sc. 9: 137–158.
Wescott, W.A. , W.N. Krebs , D.W. Engelhardt & S.M. Cunningham 1991. New biostratigraphic age dates from the Lake Rukwa Rift Basin in western Tanzania. AAPG Bull. 75: 1255–1263.
Wopfner, H. 1992. Riftphasen und deren EinfluB auf das 01–und Gas-Potential tansanischer Karoo-Becken. Zbl. Geol. Palaont., I, 1991, 11: 2703–2712.
Wopfner, H. & C.Z. Kaaya 1991. Stratigraphy and morphotectonics of Karoo deposits of the northern Selous Basin, Tanzania. Geol. Mag. 128: 319–334.
Wright, R.P. & R.A. Askin 1987. The Permian-Triassic boundary in the southern Morondava Basin of Madagascar as defined by plant micro-fossils. Proc. 6th Gondwana Symp., Geophysical Monograph 41: 157–166. Washington.

Stratigraphy and depositional style of the continental Lakia Formation (Permo-Triassic – Early Jurassic, NW Sudan)

Bellini, E. , Giori, I. , Ashuri, O. & Benelli, F. (1992). Geology of the Al Kufrah Basin (Libya). Third Symposium on the Geology of Libya, Tripoli, 1987.
Demathieu, G. & Wycisk, P. 1990. Tetrapod trackways from southern Egypt and northern Sudan. J. Afr. Earth Sci. 10: 435–443.
Klitzsch, E. & Léjal-Nicol, A. 1984. Flora and Fauna from strata in southern Egypt and northern Sudan. Berliner geowiss. Abh., A, 50: 47–79.
Klitzsch, E. & Wycisk, P. 1987. Geology of the sedimentary basins of northern Sudan and bordering areas. Berliner geowiss. Abh., A, 75: 97–136.
Léjal-Nicol, A. 1987. Flores nouelles du Paleozoique et de Mesozoique d'Egypte et du Soudan septentrional. Berliner geowiss. Abh., A, 75:151–248.
Mansour, N. 1990. Geochemisch-sedimentologische und tektonische Untersuchungen am Uweinat-Safsaf-Aswan-Schwellensystem (Sudagypten / Nordsudan). Berliner geowiss. Abh., A, 122: 115 pp.
Miall, A.D. 1981. Analysis of fluvial depositional systems. AAPG Course Note Ser. 20: 75 pp.
Schandelmeier, H. , Klitzsch, E. , Hendriks, F. & Wycisk, P. 1987. Structural development of north-east Africa since Precambrian times. Berliner geowiss. Abh., A, 75: 5–24.
Van Houten, F.B. , Bhattacharyya, D.P. & Mansour, S.E.J. 1984. Cretaceous Nubia Formation and correlative deposits, eastern Egypt: Major regressive – transgressive complex. Geol. Soc. America Bull. 95: 397–405.
Wycisk, P. 1984. Depositional environments of Mesozoic strata from northwestern Sudan. Berliner geowiss. Abh., 50: 81–97.
Wycisk, P. 1990. Aspects of cratonal sedimentation: Facies distribution of fluvial and shallow marine sequences in NW Sudan / SW Egypt since Silurian time. J. Afr. Earth Sci. 10: 215–228.

The Jurassic of Northern Somalia: Stratigraphy and facies

Abbate, E. , Abucar Moallim Hasan , Bruni, P. & Sagri, M. 1987. The Mesozoic section of Bihendula. Intern. Meeting: “Geology of Somalia and surrounding regions”, Excursion B Guidebook: 77–88, Somali Nat. Univ., Deptm. Geology, Mogadishu.

Abbate, E. , Ficcarelli, G. , Pirini Radrizzani, C. , Salvietti, A. , Torre, D. & Turi, A. 1974. Jurassic sequences from the Somali coast of the Gulf of Aden. Riv. Ital. Paleont. Stratigr. 80 (3): 409–478. Mailand.

Barnes, S.U. 1976. Geology and oil prospects of Somalia, East Africa. A.A.P.G. Bull. 60 (3): 389–413. Tulsa.

Bosellini, A. 1989. The continental margins of Somalia: their structural evolution and sequence stratigraphy. Memorie di Scienze Geologiche, vol. XLI: 373–458. Padua.

Bott, W. F. , Smith, B.A. , Oakes, G. , Sikander, A. H. & Ibraham, A.I. 1992. The tectonic framework and regional hydrocarbon prospectivity of the Gulf of Aden. J. Petrol. Geol. 15 (2): 211–243. Beacensfield, Bucks.

BuBmann, M. (in prep.). Sedimentologische Untersuchungen im Jura von Nordsomalia unter besonderer Berücksichtigung der Tonmineralogie und der Geochemie. Berliner geowiss. Abh. Reihe A.

Bruni, P. & Fazzuoli, M. 1987. Sedimentary sequence of the Luuq-Mandera Basin. Intern. Meeting: “Geology of Somalia and surrounding regions”, Excursion A Guidebook: 4–43, Somali Nat. Univ., Deptm. Geology, Mogadishu.

Dingle, R.V. 1988. Marine ostracod distributions during the early breakup of Southern Gondwanaland. In: Hanai, T. et al. (Eds.): “Evolutionary Biology of Ostracoda”. Developments in Palaeont. and Stratigr., 11: 841–853, (Elsevier) Amsterdam-New York.

Haq, B.U. , Hardenbol, J. & Vail, P. R. 1987. Chronology of fluctuating sea levels since the Triassic. Science 235: 1156 – 1167. Washington.

Luger, P. , Hendriks, F. , Arush, M. , BuBmann, M. , Mette, W. & Strouhal, A. 1990. The Jurassic and the Cretaceous of Northern Somalia: Preliminary results on the sedimentologic and stratigraphic framework. In: Klitzsch, E. & Schrank, E. (eds.): Research in Sudan, Somalia, Egypt and Kenia. Results of the Special Research Project “Geoscientific Problems in Arid and Semiarid Areas” (Sonderforschungsbereich 69) Period 1987–1990. Berliner geowiss. Abh. Reihe A: 571–595.

Luger, P. , Wilke, H. G. & Wunderlich, H. (in prep.). On the occurrence of calpionel-lids in the basal conglomerate of the Tisje Formation in Northern Somalia.

Mette, W. (in prep.). Stratigraphie und Fazies des Jura von Nordsomalia. Berliner geowiss. Abh. Reihe A.

Riccardi, A. C. 1991. Jurassic and Cretaceous marine connections between the Southeast Pacific and Tethys. Palaeogeogr., Palaeoclimatol., Palaeoecol. 87 (1991): 155–189.

Saint-Marc, P. 1978. Arabian Peninsula. In: Moullade, M. & Nairn, A.E.M. (Eds.): “The Phanerozoic Geology of the World. The Mesozoic. A”: 435–462, (Els.) Amsterdam.

Palaeoecology of Late Jurassic to mid-Cretaceous of the central and western Sudan

Awad, M. Z. 1987. Facies interpretation and stratigraphy of the central Darfur region and some flora from northwestern Sudan. M.Sc. thesis, University of Khartoum, Khartoum.

Awad, M. Z. 1993. Age and correlation of palynoflora of the newly defined Idd el Kheil Formation (Late Cretaceous), Sudan. Geol. Rund. (in press).

Awad, M. Z. & E. Schrank 1992. Palynostratigraphy and palynofacies of Late Jurassic to mid-Tertiary non-marine sediments, Blue Nile Rift Basin, Sudan. 8th International Palynological Congress, Aix-en-Province. Abstr.: 7.

Awad, M. Z. & E. Schrank 1990. Macrofloral and palaeoecological study of the Albian-Cenomanian Omdurman Formation (Sudan). In: G. Rocci & M. Deschamps (eds.),Recent data in African earth sciences, p. 277–280, CIFEG occational publication 1990/22: Orleans.

Axelrod, D. I. & P. H. Raven 1978. Late Cretaceous and Tertiary vegetation history of Africa. In: M. J. A. Werger (ed.), Biogeography and ecology of Southern African, p. 77–127, Den Haag.

Batten, D.J. 1984. Palynology, climate and the development of Late Cretaceous floral provinces in the Northern Hemisphere; a review. In: P. J. Brenchley (ed.), Fossils and Climate, Geol. J. Spec. Iss.: 127–164.

Boltenhagen, E. 1980. Palynologie du Cretace superieur du Gabon. Com. Trav. Inst. Sci., Mem. Sec. Sci., Paris, 7: 1–191.

Brenner, G. J. 1976. Middle Cretaceous floral provinces and early migrations of angiosperms. In: C. B. Beck (ed.), Origin and early evolution of angiosperms, p. 23–47, Columbia University Press: New York and London.

Crane, P. R. 1987. Vegetational consequences of angiosperm diversification. In: E. M. Friis & P. R. Crane (eds.), The origins of angiosperms and their biological consequences, p. 107–144, Cambridge University Press: Cambridge, New York, New Rochelle, Melbourne & Sydney.

Dualeh, A. H. A. , C. -D. Reuther & P. Scheck 1990. Basement structure and sedimentary cover of Somalia. Berliner Geowiss. Abh. Reihe A 120 (2): 505–518.

Edwards, W. N. 1926. Fossil plants from Nubian Sandstone of Eastern Darfur. Quarterly J.Geol. Soc. London 82: 94–100.
Germann, K. , K. Fischer & T. Schwarz 1990. Accumulation of lateritic weathering products (kaolins, bauxitic laterites, ironstones) in sedimentary basins of the northern Sudan. Berliner Geowiss. Abh. Reihe A 120 (1): 109–148.
Hallam, A. 1984. Continental humid and arid zones during the Jurassic and Cretaceous. Palaeogeogr. Palaeocl. Palaeoecol. 47: 195–223.
Hassan, H. M. 1973. Fossil flora of Umm Badda, Omdurman. Sudan Notes and Records 54: 153–167.
Herngreen, G. F. W. , & A. F. Chlonova 1981. Cretaceous microfloral provinces. Pollen et Spores 23: 441–556.
Horrel, M. A. 1991. Phytogeography and paleoclimatic interpretation of the Maestrichtian. Palaeogeogr. Palaeocl. Palaeoecol. 86: 87–138.
Mauseth, J. D. 1991. Botany: An introduction to plant biology, Saunders College Publishing: Philadelphia, Ft. Worth, Chicago, San Francisco, Montreal, Toronto, London, Sydney, Tokyo.
Nicolas, J. & P. Bildgen 1979. Relations between the location of the karst bauxites in the Northern Hemisphere, the global tectonics and the climatic variations during geological time. Palaeogeogr. Palaeocl. Palaeoecol. 28: 205–239.
Schrank, E. & M. Z. Awad 1990. Palynological evidence for the age and depositional environment of the Cretaceous Omdurman Formation in the Khartoum area, Sudan. Berliner Geowiss. Abh. Reihe A 120 (1): 169–182.
Srivastava, S. K. 1983. Cretaceous phytogeoprovinces and paleogeography of the Indian Plate based on palynological data. In: Cretaceous of India (Proceedings of the Symposium on ‘Cretaceous of India: palaeoecology, palaeogeography and time boun-daries; Lucknow, 1982), p. 141–157. Indian Association of Palynostratigraphers, Lucknow (India).
Watson, F. L. S. Joan 1983. A new species of conifer Frenelopsis from the Cretaceous of Sudan. Linn. Soc. London (1983): 161–167.
Watson, J. & K. L. Alvin 1976. Silicone rubber casts of silicified plants from the Cretaceous of Sudan. Paleont.19 (4): p. 96–99.
Webb, L. J. 1959. A physiognomic classification of Australian rain forests. J. Ecology 47: 551–570.
Wolfe, J. A. & G. R., Jr. Upchurch 1987. North American nonmarine climates and vegetation during the Late Cretaceous. Palaeogeogr. Palaeocl. Palaeoecol. 61: 33–77.

Cretaceous palaeoecology, palaeoclimatology and palaeogeography of the northern Western Desert of Egypt

Abdel-Kireem, M.R. & M.I.A. Ibrahim 1987. Late Cretaceous biostratigraphy and palaeobathymetry of the Betty Well No. 1, Western Desert, Egypt. In G. Matheis & H. Schandelmeier (eds.), Curr. Res. Afr. Earth Sci, p. 165–169. Rotterdam: Balkema.
Batten, D.J. 1989. Cretaceous freshwater dinoflagellates. Cretaceous Res. 10: 271–273.
Batten, D.J. & Li Wenben 1987. Aspects of palynomorph distribution, floral provinces and climate during the Cretaceous. Geol. Jb. A 96:219–237.
Batten, D.J. & J.K. Lister 1988a. Evidence of freshwater dinoflagellates and other algae in the English Wealden (Early Cretaceous). Cretaceous Res. 9: 71–179.
Batten, D.J. & J.K. Lister 1988b. Early Cretaceous dinoflagellate cysts and chlorococcalean algae from freshwater and low salinity palynofacies in the English Wealden. Cretaceous Res. 9:337–367.
Brenner, G.J. 1976. Middle Cretaceous floral provinces and early migration of angiosperms. In C.B. Beck (ed.), Origin and early evolution of angiosperms, p.23–47. New York: Columbia Univ. Press.
Herngreen, G.F.W. 1974. Middle Cretaceous palynomorphs from northeastern Brazil. Sci. Geol. Bull. 27: 101–116.
Herngreen,G.F.W. & A.F. Chlonova 1981. Cretaceous microfloral provinces. Pollen et Spores 23:241–555.
Méon, H. 1990. Palynologic studies of the Cretaceous-Tertiary boundary interval at El Kef outcrop: northwestern Tunisia: paleogeographic implications. Rev. Palaeobot. Palynol. 65: 85–94.
Tappan, H. , 1980. The paleobiology of plant protists, 1028 pp. San Francisco: W. H.Freeman.

Palynofloristic changes and Cretaceous climates in northern Gondwana (NE Africa) and southern Laurasia (Kazakhstan)

Awad, M.Z. & E. Schrank 1993. Palaeoecology of the Late Jurassic to mid-Cretaceous strata of central and western Sudan. Proc. Internat. Conf. “Geoscientific Research in northeastern Africa”, Berlin, June 17–19, 1993. Rotterdam: Balkema [in print].

Batten, D.J. & A.M. MacLennan 1984. The paleoenvironmental significance of the conifer family Cheirolepidiaceae in the Cretaceous of Portugal. In Reif, W.-E. & F. Westphal (eds.), Third Symposium on Mesozoic Ecosystems, Short Papers, p. 7–12. Tubingen: Attempto Verlag.

Courtinat, B. & A. Algouti 1985. Caracterisation probable du Sinemurien pres de Telouat (Haut-Atlas, Maroc): datation palynologique. Geobios 18:857–864.

Doyle, J.A. , S. Jardine & A. Doerenkamp 1982. Afropollis, a new genus of early angiosperm pollen, with notes on the Cretaceous palynostratigraphy and paleoenvironments of northern Gondwana. Bull. Centres Rech. Explor.-Prod. Elf-Aquitaine 6:39–117.

Dualeh, A.H.A. , C.-D. Reuther & P. Scheck 1990. Basement structure and sedimentary cover of Somalia. Berliner geowiss. Abh., Reihe A 120.2:505–518.

El-Shamma, A.E. 1988. Aptian and Albian miozones of the Western Desert, Egypt. In 9th Petroleum Conference for Exploration and Production, E.G.P.C., p. 1–17. Cairo: Petroleum Research Institute.

Funnell, B.M. 1990. Global and European Cretaceous shorelines, stage by stage. In R.N. Ginsburg & B. Beaudoin (eds.), Cretaceous resources, events and rhythms, p. 221–235. Dordrecht, Boston, London: Kluwer Academic Publishers.

Hendriks, F. & E. Schrank 1991. The marine Abu Ballas Formation of southern Egypt: a clay-mineralogic and microfloral reconstruction of the Aptian paleoclimate.- J. Afr. Earth Sci. 10:471–481.

Herngreen, G.F.W. & A.F. Chlonova 1981. Cretaceous microfloral provinces. Pollen et Spores 23:441–555.

Klitzsch, E. & P. Wycisk . 1987. Geology of the sedimentary basins of northern Sudan and bordering areas. Berliner geowiss. Abh., Reihe A 75.1:97–136.

Nesterova, E.V. , Z.K. Ponomarenko & P.V. Shilin 1990. Mid- to Late Cretaceous floras of the northern Turgaj plains. In Continental Cretaceous of the USSR. Collection of research papers, p. 51–61. Vladivostok: USSR Academy of Sciences, Far Eastern Branch [in Russian].

Parrish, J.T. (1987): Global palaeogeography and palaeoclimate of the Late Cretaceous and early Tertiary. In E.M. Friis , W.G. Chaloners & P.R. Crane (eds.), The origins of angiosperms and their biological consequences, p. 51–73. Cambridge: University Press.

Penny, J.H.J. 1991. Early Cretaceous angiosperm pollen from the borehole Mersa Matruh 1, north west desert, Egypt. Palaeontographica Abt. B 222:31–88.

Petrosjanc, M.A. & N.M. Bondarenko 1983. Characteristic and correlative taxa of gymnosperm pollen (Upper Cretaceous -Palaeogene). Pollen of the Cheirolepidiaceae. 77 p. Moscow: Nauka [in Russian].

Ruffell, A.H. & D.J. Batten 1990. The Barremian-Aptian arid phase in western Europe. Palaeogeogr., Palaeoclimatol., Palaeoecol. 80:197–212.

Saad,S.I. & G. Ghazaly 1976. Palynological studies in Nubia Sandstone from Kharga Oasis. Pollen et Spores 18:407–470.

Salard-Cheboldaeff, M. & E. Boltenhagen 1992. La palynologie des evaporites d’Afrique equatoriale et ses rapports avec le paléoenvironnement. – J. Afr. Earth Sci. 14:191–195.

Salard-Cheboldaeff, M. & J. Dejax 1991. Evidence of Cretaceous to Recent West African intertropical vegetation from continental sediment spore-pollen analysis. J. Afr. Earth Sci. 12:353–361.

Schrank, E. 1992. Nonmarine Cretaceous correlations in Egypt and northern Sudan: palynological and palaeobotanical evidence. Cretaceous Research 13:351–368.

Sultan, I.Z. 1985. Palynological studies in the Nubia Sandstone Formation, east of Aswan, southern Egypt. N. Jb. Geol. Palaont. Mh. 1985(10):605–617.

Vakhrameev, V.A. 1991. Jurassic and Cretaceous floras and climates of the earth. 318 p. Cambridge: Cambridge University Press.

Vakhrameyev, V.A. 1982. Classopollis pollen as an indicator of Jurassic and Cretaceous climate. Internat. Geology Rev. 24:1190–1196.

Wang Da-Ning , Sun Xiu-Yu & Zhao Ying-Niang 1990. Late Cretaceous to Tertiary palynofloras in Xinjiang and Qinghai, China. Rev. Palaeobot. Palynol. 65:95–104.

Source rock evaluation of the pre-Aptian section at some wells, Matruh sub-basin, northern western Desert Egypt

Abdel Fattah, T.H.A. & H. Rushdi 1992. Geological and petrophysical strudies of the area to the northwest of Qattara depression, Western Desert Eovot, Jour. of the Faculty of Science, Qena Univ. in press.

Hood, A.D. , C.C. Gutgehr and R. Heacock , 1975. Organic metamorphism and the generation of Petroleum. AAPG Bull., V.59,
Meyer, B.L. and M.H. Nederlof ,1984. Identification of source rocks wireline logs by density/resistivity and sonic transite time/resistivity crossplot. AAPG Bull. V.68, p.121–129.
Schmoker, J.W. . 1979. Determination of organic content of Appalacian Devonian shale from formation density log. AAPG Bull. V.63, p.1504–1537.
Schmokr, J.W. & T.C. Hester 1983. Organic carbon in Bakken formation, United state Portion of Williston Basin. AAPG.Bull. V.67, p.2165–2174.

Sedimentology and maturity evaluation of the NW Muglad and Nile Rift Basins, Sudan

Abdullatif, O.M. 1992. Sedimentology of Late Jurasic/Cretaceous – Tertiary strata of the NW Muglad and the Nile rift basins, Sudan Ph.D. Thesis, Univ. of Khartoum, unpublished.
Abdullatif, O.M. and Barazi N. 1992. Sedimentology, burial diagenesis and organic maturation of the Muglad rift basin, Sudan. Inter. Geol. Cong., Japan. Abs. Awad, M.Z. 1993. Paleoecologic evolution of the Late Jurassic to mid-Cretaceous Sediments, Central Sudan, Conference of Geoscientific Research in northeastern Africa, Berlin, Germany.-This volume.
Chamley, H. 1989. Clay Sedimentology. Springer Verlag.
Dualeh, A.H. , Reuther, C. and scheck, P. 1990. Basement structure and sedimentology cover of Somalia. Berl. geowiss. Abh. (A9) 120.2, 505–518. Berlin.
Fairhead, J.D. 1988. Mesozoic plate tectonic reconstructions of the Central South Atlantic Ocean: The role of the west and central African rift system. Tectonophysics, 155. p. 181.195.
Germann, K. Fischer, K. and Schwarz, T. 1990. Accumulation of lateritic weathering products (kaolins, bauxitic laterites, ironstones) in sedimentary basins of the northern Sudan. Berl. geowiss. Abh. (A) 120.1 p. 109–148 Berlin.
Hower, J. , Elsinger, E.V. Hower, M.E. and Perry, E.A. 1976. Mechanism of burial metamorphism of argillaceous sediments: 1, mineralogical and chemical evidence. Geol. Society of America Bull., V. 87, p. 725–737.
Klitzsch, E. 1986. Plate tectonics and cratonal geology in northeast Africa (Egypt and Sudan). Geol. Rundschau,75,3, p. 755–768, Stuttgart.
McHargue, T.R. , Heidrick, T.L. and Livingstone, J.E. 1992. Tecton- ostratigraphic development of the Interior Sudan rifts, Central Africa, Tectonophysics, 213, p. 87–202, Amsterdam.
Millot, G. Geology of Clays. 1970. Berlin- New York-Masson- Heidelberg- Paris, 429 p. (Springer-Verlag).
Schandelmeier, H. Klitzsch, E. , Hendricks, F. and Wycisk, P. 1987. Structural development of northeast Africa since Precambrian times. Berl. geowiss. Abh., (A) 75.1 p. 5–24, Berlin.
Schull, T. 1988. Rift basins of interior Sudan, petroleum exploration and discovery, AAPG, V. 72, No. 10, p. 1128–1147.

Late Cretaceous continental vertebrate faunas of Niger and Northern Sudan

Broin, de F. , Buffetaut, E. , Koeniguer, J.-C. , Rage, J.-C. , Russell D. , Taquet, P. Vergnaud-Grazzini, C. & Wenz, S. 1974. La faune de Vertebres continentaux du gisement d'In Beceten (Senonien du Niger). C.R. Acad.Sc. Paris, D 279: 469–472.
Buffetaut, E. , Bussert, R. & Brinkmann, W. 1990. A new nonmarine vertebrate fauna in the Upper Cretaceous of Northern Sudan. Berliner geowiss. Abh. A 120.1: 183–202.
Gayet, M. & Meunier, F.J. 1983. Ecailles actuelles et fossiles d'Ostéoglossiformes (Pisces, Teleostei). C. R. Acad. Sc. Paris, II 297: 867–870. Gayet, M. , Meunier, F.J. & Levrat-Calviac, V. 1988. Mise en evidence des plus anciens Polypteridae dans le gisement senonien d'In Becetem (Niger). C.R.Acad.Sc. Paris, II 307: 205–210.
Michard, J.-G. , Broin, F. de , Brunet, M. & Hell, J. (1990): Le plus ancien crocodilien neosuchiens spécialise a caracteres "eusuchiens" du continent africain (Cretace inférieur, Cameroun). C.R. Acad. Sci. Paris, 311 II: 365–371.
Moody, R.T.J. & Sutcliffe, P.J.C. 1991. The Cretaceous deposits of the Iullemmeden Basin of Niger, central West Africa. Cretaceous Research: 137–157.
Rage, J.-C. 1984a. Are the Ranidae (Anura, Amphibia) Known proior to the Oligocene?. Amphibia-Reptilia, 5 (1984): 281–288. Leiden, E.J. Brill.

Rage, J.-C. 1984b. Serpentes. In P. Wellenhofer (ed.), Encyclopedia of Paleoherpetology, Part 11. Stuttgart, New York: Gustav Fischer.
Rage, J.-C. 1988. Un serpent primitif (Reptilia, Squamata) dans le Cenomanien (base du Cretace superieur). C.R. Acad. Sci. Paris, II 307: 1027–1032.
Schaal, S. 1984. Oberkretazische Osteichthyes (Knochenfische) aus dem Bereich von Bahariya und Kharga, Agypten, und ihre Aussagen zur Palökologie und Stratigraphie. Berliner geowiss. Abh. A 53: 79 p..
Stromer, E. 1933. Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wusten Agyptens. II. Wirbeltierreste der Baharije-Stufe (unterstes Cenoman). 12. Die procölen Crocodilia. Abh. bayer. Akad. Wiss., math.-nat. Abt., N.F. 15: 55 p..
Stromer, E. (1936): Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wusten Agyptens. VII. Baharije-Kessel und -Stufe mit deren Fauna und Flora. Eine erganzende Zusammenfassung. Abh. bayer. Akad. Wiss., math.-nat. Abt., N.F. 33: 102p..
Werner, C. 1991. Aspects on terrestrial Upper Cretaceous ecosystems of Egypt and Northern Sudan. Contr. paleont. Mus., Univ. Oslo, 364, 71–72.
Werner, C. in press. Contributions to the first Late Cretaceous terrestrial vertebrate fauna of Northern Sudan. Mitt. Geol.-Paläont. Inst. Univ. Hamburg.

Evolution of Cretaceous continental basins in northern Sudan

Awad, M.Z. & E. Schrank 1990. Macrofloral and palaeoecological study of the Albian-Cenomanian Omdurman Formation, Sudan. In G. Rocci & M. Deschamps (eds.), Recent data in African earth sciences. 15 th Colloquium of African Geology: 277–280. Orleans.
Buffetaut, E. , R. Bussert & W. Brinkmann 1990. A new nonmarine vertebrate fauna in the Upper Cretaceous of Northern Sudan. Berl. geowiss. Abh (A) 120.1: 183–202.
Jas, C. , E. Klitzsch , H. Schandelmeier & P. Wycisk 1988. Geological Map of NW Sudan and SW Egypt, 1:1 Mill., Sheet El Atrun, Technische Fachhochschule Berlin.
Jorgensen, G.J. & W. Bosworth 1989. Gravity modeling in the Central African Rift System, Sudan: rift geometries and tectonic significance. J. Afr. Earth Sci. 8: 283–306.
Lejal-Nicol, A. 1987. Flores nouvelles du Paleozoique et du Mésozoique de l'Egypte et du Soudan septentrional. Berl. geowiss. Abh. (A) 75.1: 151–248.
Miall, A.D. 1978. Lithofacies types and vertical profile models in braided river deposits: a summary. In A.D. Miall (ed.), Fluvial sedimentology. Can. Soc. Pet. Geol., Mem. 5: 597–604.
Schandelmeier, H. & D. Pudlo 1990. The Central African Shear Zone (CAFZ) in Sudan – a possible continental transform fault. Berl. geowiss. Abh. (A) 120.1: 31–44.
Schrank, E. 1987. Biostratigraphic importance of microfloras from the Late Cretaceous clastic series of northwestern Sudan. Cretaceous Research 8: 29–42.
Schrank, E. 1990. Palynology of the clastic Cretaceous sediments between Dongola and Wadi Muqaddam, Northern Sudan. Berl. geowiss. Abh. (A) 120.1: 149–168.
Schrank, E. & M.Z. Awad 1990. Palynological evidence for the age and depositional environment of the Cretaceous Omdurman Formation in the Khartoum area, Sudan. Berl. geowiss. Abh. (A) 120.1: 169–182.
Smith, D.G. 1987. Meandering river point bar lithofacies models: modern and ancient examples compared. In F. G. Ethridge et al. (eds.), Recents developments in fluvial sedimentology. SEPM Spec. Publ. 39: 83–91.
Stear, W.M. 1983. Morphological characteristics of ephermal stream channel and overbank splay sandstone bodies in the Permian Lower Beaufort Group, Karoo Basin, South Africa. In J.D. Collinson & J. Lewin (eds.), Modern and ancient fluvial systems. Spec. Publs. Int. Ass. Sediment. 6: 405–420.
Turnbridge, I.P. 1984. Facies model for a sandy ephermal stream and clay playa complex: the Middle Devonian Trentishoe Formation of North Devon, U.K.. Sedimentology 31: 697–716.
Werner, C. 1991. Aspects on terrestrial Upper Cretaceous ecosystems of Egypt and Northern Sudan. Contr. paleont. Mus., Univ. Oslo. 364: 71–72.
Werner, C. (this volume). Late Cretaceous continental vertebrate faunas of Niger and Northern Sudan.
Whiteman, A.J. 1971. The geology of the Sudan Republic. Oxford:Clarendon.
Wycisk, P. , E. Klitzsch , C. Jas & O. Reynolds 1990. Intracratonal sequence development and structural control of Phanerozoic strata in Sudan. Berl. geowiss. Abh. (A) 120.1:45–86.

The Albian-Cenomanian palaeoclimate in northern Sudan

Ahmad, N. 1983. Vertisols. In L.P. Wilding et al. (eds.), Pedogenesis and soil taxonomy. II. The Soil Orders. New York: Elsevier.

Awad, M.Z. & E. Schrank 1990. Macrofloral and palaeoecological study of the Albian-Cenomanian Omdurman Formation, Sudan. In G. Rocci & M. Deschamps (eds.), Recent data in African earth sciences. 15 th Colloquium of African Geology: 277–280. Orleans.

Awad. M.Z. & E. Schrank (this volume). Paleoecology of the Late Jurassic to mid-Cretaceous of the central and western Sudan.

Blodgett, R.H. 1985. Paleovertisols as indicators of climate (abstract). AAPG Bull. 69: 239.

Blokhuis, W.A. , T. Pape & S. Slager 1968/9. Morphology and distribution of pedogenic carbonate in some Vertisols of the Sudan. Geoderma 2: 173–200.

Buffetaut, E. , R. Bussert & W. Brinkmann 1990. A new nonmarine vertebrate fauna in the Upper Cretaceous of Northern Sudan. Berl. geowiss. Abh (A) 120.1: 183–202.

Bussert, R. (this volume). Evolution of Cretaceous continental basins in northern Sudan.

Giraud, B. , R. Bussert & E. Schrank 1992. A new Theacean wood from the Cretaceous of northern Sudan. Rev. Palaeobot. Palynol. 75: 289–299.

Goudie, A.S. 1983. Calcrete. In A.S. Goudie & K. Pye (eds.), Chemical Sediments and Geomorphology, p. 93–131. London: Academic Press.

Gray; M.B. & Nickelsen, R.P. 1989. Pedogenic slickensides, indicators of strain and deformation processes in redbed sequences of the Appalachian foreland. Geology 17: 72–75.

Hassan, H.M. 1973. Fossil flora of Umm Badda, Omdurman. Sudan Notes and Records 54: 153–167.

Horrel, M.A. 1991. Phytogeography and paleoclimatic interpretation of the Maastrichtian. Palaeogeography, Palaeoclimatology, Palaeoecology 28: 205–239.

Jas, C. , E. Klitzsch , H. Schandelmeier & P. Wycisk 1988. Geological Map of NW Sudan and SW Egypt, 1:1 Mill., Sheet El Atrun, Technische Fachhochschule Berlin.

Lejal-Nicol, A. 1987. Flores nouvelles du Paleozoique et du Mesozoique de l'Egypte et du Soudan septentrional. Berl. geowiss. Abh. (A) 75.1: 151–248.

Medani, A.H. 1972. Evaporite facies in Nubian sandstone Formation of Sudan. AAPG Bull. 56: 1560–1563.

Reeves, C.C. 1976. Caliche: Origin, Classification, Morphology and Uses. Lubbock, Texas: Estacado Books.

Schrank, E. 1990. Palynology of the clastic Cretaceous sediments between Dongola and Wadi Muqaddam, Northern Sudan. Berl. geowiss. Abh. (A) 120.1: 149–168.

Schrank, E. & M.Z. Awad 1990. Palynological evidence for the age and depositional environment of the Cretaceous Omdurman Formation in the Khartoum area, Sudan. Berl. geowiss. Abh. (A) 120.1: 169–182.

Schwarz, T. 1992. Produkte und Prozesse exogener Fe-Akkumulation: Eisenoolithe und lateritische Eisenkrusten im Sudan. Berl. Geowiss. Abh. 142. Berlin.

Segal, J.L. & J.C. Bhattacharjee 1988. Typic Vertisols of India and Iraq – their characterization and classification. Pedologie 38: 67–95.

Smoot, J.P. & T.K. Lowenstein (1991). Depositional environments of non-marine evaporites. In J.L. Melvin (ed.), Evaporites, Petroleum and Mineral Resources. Developments in Sedimentology 50: 189–347. Amsterdam: Elsevier.

Todd, S.P. & D.J. Went 1991. Lateral migration of sand-bed rivers: examples from the Devonian Glashabeg Formation, SW Ireland and the Cambrian Alderney Sandstone Formation, Channel Islands. Sedimentology 38: 997–1020.

Werner, C. 1991. Aspects on terrestrial Upper Cretaceous ecosystems of Egypt and Northern Sudan. Contr. paleont. Mus., Univ. Oslo. 364: 71–72.

Werner, C. (this volume). Late Cretaceous continental vertebrate faunas of Niger and Northern Sudan.

Whiteman, A.J. 1971. The geology of the Sudan Republic. Oxford: Clarendon.

Wolfe, J.A. & G.R. Upchurch 1987. North American nonmarine climates and vegetation during the Late Cretaceous. Palaeogeography, Palaeoclimatology, Palaeoecology 61: 33–77.

Wycisk, P. , E. Klitzsch , C. Jas & O. Reynolds 1990. Intracratonal sequence development and structural control on Phanerozoic strata in Sudan. Berl. geowiss. Abh. (A) 120.1: 45–86.

Stratigraphic and tectonic significance of Late Cretaceous sediments in Bagbag Basin, central Sudan

Barazi, N. 1985. Sedimentologie und Stratigraphie des Abyad-Beckens (NW Sudan). Berliner Geowiss. Abh., A, 64: 85 pp.

Browne, S. E. , Fairhead, J. D. & Mohamed, I.I. 1985. Gravity study of White Nile Rift, Sudan, and its regional tectonic setting. Tectonophysics, 113, 123–137.

Bussert, R. , Brasse, R. , Radic, H. & Reynolds, P.-O. 1990. Sedimentation and structural style of a rift-structure in northern Sudan: The Humar Basin. Berliner Geowiss. Abh, A, 120: 89–108.
Elsik, W. C. 1964. A new sporomorph genus from eastern Peru. Pollen et Spores, 6: 601–604.
Jan du Chene, R. 1980. Palynological study of the Tar Sand, upper Maastrichtian of the south-west Nigeria. Proc. 4th Int. Palyn. Conf. (Lucknow, 1976–77), 2: 794–799.
Jardine, S. , & Magloire, L. 1965. Palynologie et stratigraphie du Cr, tac, des Bassins du Senegal et de Crete d'Ivoire. Premier Colloq. Afric. Micropal,ont., Dakar, 1963; M,m. Bur. Rech. G,ol. Min., 32: 187–245.
Klitzsch, E. 1984. Northwestern Sudan and bordering areas: geological development since Cambrian time. Berliner geowiss. Abh., A, 50: 23–45.
Lawal, O. , & Moullade, M. 1986. Palynological biostratigraphy of Cretaceous sediments in the Upper Benue Basin, N.E. Nigeria . Rev. Micropal,ont., 29: 61–83.
McHargue, T. M. , Heidrick, T. L. & Livingston, J. E. 1992. Tectonostratigraphic development of the Interior Sudan rifts, Central Sudan. In: P. A. Ziegler (edt.), Geodynamic of Rifting, Vol. II. Case History Studies on Rifts: North and South America and Africa. Tectonophysics, 213: 187–202.
Muller, J. , de Di Giacomo, E. , & van Erve, A. W. 1987. A palynological zonation for the Cretaceous, Tertiary and Quaternary of northern South America. Amer. Assoc. Strat. Palyn. Contr. Ser. 19: 7–76.
Schandelmeier, H. & Pudlo, D. 1990. The Central African Fault Zone (CAFZ) in Sudan – a possible continental transform fault. Berliner geowiss. Abh., A 120: 31–44.
Schrank, E. 1984. Organic-walled microfossils and sedimentary facies in the Abu Tartur Phosphates (Late Cretaceous, Egypt). Berliner geowiss. Abh. (A), 50: 177–187.
Schrank, E. 1987. Paleozoic and Mesozoic palynomorphs from northeast Africa (Egypt and Sudan) with special reference to Late Cretaceous pollen and dinoflagellates. Berliner geowiss. Abh. (A), 75: 249–310.
Schull, T. J. 1988. Rift basins of interior Sudan: Petroleum exploration and discovery. AAPG Bull., 72 (10): 1128–1142, Tulsa.

Geology of the area west of the White Nile

Mula, A. Hafiz . 1973 A geophysical Survey of J. Aulia region, Sudan Notes and Records vo 53;
William M.A.J. Medani, A.H. , Talent J.A. & Maussor R. 1974. A note on upper Quaternay sub fossil Mollusca west of Jebel Aulia, Sudan Notes and Records. 54; 168–172

Extension of the Late Cretaceous transgression to North Kordofan, central Sudan

Aquater S.P.A. 1989. Rural water supply in North Kordofan Province, final report, NRWC, Sudan.
Awad, M.Z. 1987. Facies interpretation and stratigraphy of central Darfur region and some flora from northwestern Sudan, M. Sc. thesis, Univ. of Khartoum.
Awad, M.Z. (in press) Age and correlation of palynoflora from the newly defined Idd el Kheil Formation, Sudan. Paper submitted to the Cretaceous Research for publication.
Barazi, N. 1985, Sedimentologie und Stratigraphie des Abyad Beckens (NW-Sudan). Berliner gewiss. Abh. A, 64, 85 pp., Berlin.
Barazi, N. 1989, The sedimentary rocks around Khartoum area. 4 th. inter. conf. of fluvial sedimentology, programme and abstracts, Barcelona.
Barazi, N. (in press). Sedimentary rocks of the Abyad basin and adjacent area in NW. Sudan, Stratigraphy, Facies and Palaeogeography, Sudan Journal of Science, Faculty of Science, Univ. of Khartoum, 32 pp.,Sudan.
Brasse, H. Burkhardt, H. Fiedler-Volmer, R. Rath,V. & Schuster, K. 1993. Geophysical and geological investigations in the Es Safya Basin, NW Sudan: this volume.
G.M.R.D. , 1981. Geological map of the Sudan (1 : 2.000.000), GRAS Khartoum, Sudan.
GRAS , 1988. Geological map of the Sudan (1:1.000.000), GRAS, Khartoum, Sudan.
Klitzsch, E. Harms, J.G. , Lejal-Nicol, A. & List, F.K. 1979. Major Subdivision and Depositional Environments of Nubian strata, southwest Egypt. AAPG Bull., 63, No. 6, 967–974 pp. Tusla.
Klitzsch, E. & Lejal-Nicol, A. 1984. Flora and fauna from strata southern Egypt and northern Sudan (Nubia surrounding areas). Berliner geowiss. Abh. A, 50, 47–80 pp. Berlin.
Klitzsch, E. & Wycisk, P. 1987. Geology of the sedimentary basins of northern Sudan and bordering areas. Berliner geowiss. Abh., A, 75, 97–195 pp. Berlin.
Kogbe, C.A. 1980. The Trans-saharan seaway during the uppermost Cretaceous. Geology of Libya, Vol. 1, 91–96 pp., Proceeding of the second Symposium of the Geology of Libya (sept. 1978), Eds.: Salim & Busrevil , Academic press London.

Lejal-Nicol, A. 1987. New Paleozoic and Mesozoic flora from Egypt northern Sudan, Berliner geowiss. Abh. A, 75, 151–248 pp. Berlin
Passega, R. 1964. Grain size representation by CM pattern as a geological tool. Jpur. Sed. Petrol. 34, 4, 830–847 pp. Menasha, Wisconsin.
Schrank, E. & Awad, M.Z. 1990. Palynological evidence for the age and depositional environment of the Cretaceous Omdurman Formation in the Khartoum area, Sudan. Berliner geowiss. Abh. A, Band 120.1 169–179 pp. Berlin.
Seilacher, A. 1967. Bathymetry of trace fossils. mar. Geol. 5, 413–428 pp., Amesterdam.
Wycisk, P. 1984. Depositional environments of Mesozoic strata from northwestern Sudan. Berliner geowiss. Abh. A, 50, 81–97 pp. Berlin.
Wycisk, P. 1991. Stratigraphic undate of the nonmarine Cretaceous from SW Egypt and NW Sudan. Cretaceous Research, 12, 185–200 pp. London.

Late Cretaceous to basal Tertiary shallow-water sedimentation in Northern Somalia

Azzaroli, A. (1979): The Mesozoic of Somalia. In: Merla, G. , Abbate, E. , Azzaroli, A. , Bruni, P. , Canuti, P. , Fazzuoli, M. Sagri, M. & Taconi, P. , A geological map of Ethiopia and Somalia (1973) 1:2.000.000 and comment with a map of major landforms, p. 33–36. Florence: Cons. Naz. Ric. Italy.
Bosellini, A. 1989. The continental margins of Somalia: Their structural evolution and sequence stratigraphy. Mem. Sci. Geol. 1st. Geol. Min. Univ. Padova 41: 373–458.
Bruni, P. & Fazzuoli, M. 1979: The Mesozoic of the Aualitic coast. In Merla, G. , Abbate, E. , Azzaroli, A. , Bruni, P. , Canuti, P. , Fazzuoli, M. Sagri, M. & Taconi, P. , A geological map of Ethiopia and Somalia (1973) 1:2.000.000 and comment with a map of major landforms, p. 38–43. Florence: Cons. Naz. Ric. Italy.
Deloffre, R. , Fleury, J.J. and Mavrikas, G. 1991. Les Algues calcaires du Maastrichtien-Paléocène de la plate-forme de Gavrovo-Tripolitza (Grèce): Une floraison liee a un Diastrophisme. Geobios 24 (5):515–536.
Fleury, J.J. , Mavrikas, G. and Baudin, F. 1990. Paléobiogéographie du genre Loftusia. foraminifère du Crétacé terminal de la Téthys. Bull. Soc. géol. France (8) 6 (3): 487–495.
Luger, P. , Hendriks, F. , Arush, M. , BuBmann, M. , Kallenbach, H. , Mette, W. and Strouhal, A. 1990. The Jurassic and the Cretaceous of Northern Somalia: Preliminary results on the sedimentologic and stratigraphic framework. Berliner geowiss. Abh. A 120 (2): 571–594.
Mette, W. 1993. Stratigraphie und Fazies des Jura von Nordsomalia. Berliner geowiss. Abh. (in press).
Pons, J.M. , Schroeder, J.H. , Höfling, R. and Moussavian, E. 1992. Upper Cretaceous rudist assemblages in Northern Somalia. Geologica Rom. 28: 219–241.

Sedimentological and geochemical aspects of the Taleh Formation (Eocene) in North Somalia

Abbate, E. , Abdi Salah Hussein , P. Bruni , & P. Sagri 1987. Geology of the Duban Basin. GEOSOM 1987, Int. Meeting: Geology of Somalia and surrounding regions, Mogadishu, Excursion Guidebook, B: 43–63.
Azzaroli, A. 1952. I macroforaminiferi della Serie del Carcar (Eocene medio e superiore) in Somalia. Paleont. Ital. 47: 99–131.
Barnes, S. U. 1976. Geology and oil prospects of Somalia. Bull. Am. Assoc. Petrol. Geol. 60: 389–413.
Boeckelmann, K. & W. Schreiber 1990. Sedimentology and stratigraphy of Taleh and Karkar Formations, Eocene, N Somalia. Berliner Geowiss. Abh. (A) 120.2: 595–620.
Bott, W. F. , B. A. Smith , G. Oakes , A. H. Sikander & A. J. Ibraham 1992. The tectonic framework and regional hydrocarbon prospectivity of the Gulf of Aden. J. Petrol. Geol. 15: 211–243.
Fliigel, E. 1978. Mikrofazielle Untersuchungsmethoden von Kalken. Berlin: Springer.
Langbein, R. 1968. Zur Petrologie des Anhydrits. Chem. d. Erde 27: 1–38.
MacFadyen, W. A. 1933. The Geology of British Somaliland with a geological map 1 : 1.000.000. London: Crown Agents.
Merla, G. , E. Abbate , A. Azzaroli , P. Bruni , P. Canuti , M. Fazzuoli , M. Sagri & P. Tacconi 1979. A Geological Map of Ethiopia and Somalia (1973) 1 :2.000.000 and coment with a map of major landformes. Firenze: Consiglio Naz. delle Ricerche.
Shinn, E. 1983. Tidal flat environment. In: P. D. Scholle , G. Bebout & C. H. Moore , (eds.) Carbonate Depositional Environments. Am. Assoc. Petrol. Geol. Mem. 33: 171–210.
Stefanini, G. 1925. Description of fossils from South Arabia and British Somaliland. In: O. H. Little (ed.), The geography and geology of Makalla (South Arabia). Egypt Geol. Surv. : 143–250.

Comparison of lithofacies of the Miocene Dubar Limestone in the Bosaso and Lasqoray Basins, Northern Somalia

Abbate, E. , P. Bruni & M. Fazzuoli . 1983. Fan-delta sedimentation and coral reefs during the main rifting phase (Miocene) of the Gulf of Aden. 2nd Geol. Congress Middle East, Baghdad, Abstracts, 1.

Abbate, E. , P. Bruni , M. Fazzuoli & M. Sagri . 1986. The Gulf of Aden continental marginof Northern Somalia: Tertiary sedimentation, rifting and drifting. Mem. Soc. Geol. It. 31:427–445.

Azzaroli, A. 1958. L'Oligocene e il Miocene della Somalia. Stratigrafia, Tettonica, Paleontologia (Macroforaminiferi, Coralli, Molluschi). Paleont. Italica. 52:1–142.

Bosollini, A. 1989. The continental margins of Somalia: Their structural evolution and sequence stratigraphy. Mem. Sci. Geol. 41:373–458.

Buchbinder, B. 1979. Facies and environments of Miocene reef limestones in Israel. Jour. Sed. Petrology. 49:1323–1344.

Dawans, M.J. & K.P. Swart . 1988. Textural and geochemical alteration in Late Cenozoic Bahamian dolomites. Sedimentology. 35:385–403.

Greenwood, J.E.G.W. 1960. Report on the geology of the Las Khoreh – Elayu area, Erigavo district. Somaliland Protectorate Geological Survey. Report 3.

Humphrey, D.J. & M.Q. Terrence . 1989. Coastal mixing zone dolomite, forward modeling, and massive dolomitization of platform-margin carbonates. Jour. Sed. Petrology. 59:438–454.

Macfadyen, W.A. 1933. Geology of British Somaliland. Crown Agents. London, U.K.

Osman, S. H. 1989. I sedimenti Post-Eocenici delle zone di Bosaso e Lasqoray (Somalia Settentrionale) e l'apertura del Golfo di Aden. Ph.D. thesis, Universities of Parma, Florence, Ferrara & Pavia (Italy).

Osman, S.H. 1992. Miocene alluvial to marine facies transition of the Mait Group in the Bosaso Basin (Migiurtinia, Northern Somalia). Giornale di Geologia. Ser.3. 54(1):67–76. Bologna.

Read, J.F. 1982. Carbonate platforms of passive (extensional) continental margins: types, characteristics and evolution. Tectonophysics. 81:195–212.

Shell Petroleum Development Company of Somalia. 1984. Dab Qua-1 well, offshore Lasqoray. Unpubl. Report. Ministry of minerals & water resources. Mogadishu, Somalia.

Somaliland Oil Exploration Company (SOEC) 1954. A geological reconnaissance of the sedimentary deposits of the protectorate of British Somaliland. Crown Agents. London, U.K.

Diagenesis of corals in Miocene clastics of the Sudanese Red Sea coast

Butler, G. P. 1969. Modern evaporite and geochemistry of coexisting brines, the sabkha, Trucial coast, Arabian Gulf: Journal of Sedimentary Petrology, 39. 70–89.

Carella, R. , and Scarpa, N. 1962. Geological results of exploration in Sudan by Agip mineraria: Fourth Arab petroleum congress, Beirut: 5–23.

Pichon, M. 1981. Dynamic aspects of coral reef benthic structures and zonation: Proceedings of the Fourth International Coral Reef Symposium, Manila, 1: 581–594.

Schreiber, B. C. 1986. Arid shorelines and evaporites: in Reading, H. G. : Sedimentary environments and facies, 2nd edition: 189–228. Oxford: Blackwell.

Schroeder, J. H. 1985. Eolian dust in the coastal desert of the Sudan: aggregates cemented by evaporites: Journal of African Earth Sciences, 3, 371–380.

Turner, P. 1980. Continental Red Beds: Developments in Sedimentology, 29: 265–379.

Walker, T. R. 1967. Formation of red beds in modern and ancient deserts: Bull. Geol. Soc. Am., 78: 353–368.

Oligo-Miocene to Quaternary palaeoenvironment in Gezira area, central Sudan

Abdel Salam, Y. 1966. The ground water geology of the Gezira. Unpublished M. Sc.thesis, University of Khartoum.

Adamson, D. A. , Williams, M. A. & R. Gillespie 1982. Palaeogeography of the Gezira and the lower Blue and White Nile Valleys. In M. A. Williams & D. A. Adamson (eds.), A land between two Niles, Quaternary geology and biology of the central Sudan, p. 165–219. Rotterdam: A. A. Balkema.

Andrew, G. 1948. The geology of the Sudan. In J. D. Tothill (ed.), Agriculture in the Sudan, p. 84–128. Oxford University Press.

Andrews, P. & J. A. H. Van Couvering 1975. Palaeoenvironment in the East African Miocene. In Szalay & N. Y. New York (eds.), Approaches to primate paleobiology, p.62–103. S. Karger, Basel, MOnchen, Paris London, New York Sydney.

Awad, M. Z. & E. Schrank 1992. Palynostratigraphy and palynofacies of Late Jurassic to mid-Tertiary non-marine sediments, Blue Nile Rift Basin, Sudan. 8th Intern. Palynol. Cong., Aix-en-province. Abstr.: 7.
Axelrod, D. I. & P. H. Raven 1978. Late Cretaceous and Tertiary vegetation history of Africa. In M. J. A. Werger (ed.), Biogeography and ecology ofSouth Africa. Junk: The Hague.
Coetzee, J. A. 1978. Late Cainozoic palaeoenvironment of southern Africa. In E. M. Van Zinderen Bakker (ed.), Antarctic glacial history and world palaeoenvironments, A. A. Balkema: Rotterdam.
Elboushi, I. M. & Y. Abdel Salam 1982. Stratigraphy and groud-water geology of the Gezira Plain, central Sudan. in M. A. Williams & D. A. Adamson (eds.), A land between two Niles, Quaternary geology and biology of the central Sudan, p. 65–164. Rotterdam: A. A. Balkema.
Robert, C. & H. Chamley 1987. Cenozoic evolution of continental humidity and paleoenvironrnent, deduced from the kaolinite content of oceanic sediments. Palaeogeogr. Palaeoclimat. Palaeoecol. 60: 171–187.
Robert, C. 1987. Clay mineral association and structural evolution of the South Atlantic: Jurassic to Eocene. Palaeogeogr. Palaeoclimat. Palaeoecol. 58: 87–108.
Sah, S. C. D. 1967. Palynology of an Upper Neogene profile from Rusizi Valley (Burundi). Mus. Roy. Afr. Cent. Tervuren Belg., Ann. Ser. Oct. Sci. Geol., 57: 1–173.
Whiteman, A. J. 1971. The geology of the Sudan. Oxford University Press.
Yemane, K. , Robert, C. & R. Chamley 1987. Pollen and clay mineral assemblages of a late Miocene lacustrine sequence from the northwestern Ethiopian highlands. Palaeogeogr. Palaeoclimat. Palaeoecol. 60: 123–141.

The Malawi Rift and vertebrate paleobiogeography of the African Rift Valley

Bromage, T.G. & Schrenk, F. (1987). A cercopithecoid tooth from the Pliocene in Malawi. Journal of Human Evolution 15:497–500.
Clark, J.D. & Haynes, C.V. (1970). An elephant butchery site at Mwanganda's Village, Karonga, Malawi and its relevance of Palaeolithic Archaeology. World Archaeology 1:390–411.
Clark, J.D. , Stephens, E.A. & Coryndon, S.C. (1966). Pleistocene fossiliferous lake beds of the Malawi (Nyasa) Rift: A prelimi nary report. American Anthropologist 68:59–66.
Kaufulu, Z.M. , Vrba, E.S. & White, T.D. (1981). Age of the Chiwondo Beds, northern Malawi. Annals of the Transvaal Museum 33:1–8.
Schrenk, F. , Bromage, T.G. , Betzler, C.G. , Ring, U. & Gorthner, A. (submitted). First early hominid of the Malawi Rift, southeast Africa. Nature.

Rare-metal province Central Eastern Desert, Egypt -1. Tectonic setting of magmatism

Bally, A.W. , 1984. Structural styles and the evolution of sedimentary basins. Amer. Ass. of Petr. Geol., a course for 1984 Fossil fuels of Europe Conference and Exhibition: 238p., Houston
El-Gaby, S. , F.K. List , R. Tehrani , 1988. Geology, evolution and metallogenesis of the Pan-African belt in Egypt. In S. El-Gaby & R.O. Greiling (eds.), The Pan-African Belt of Northeastern Africa and adjacent Areas. Vieweg & Sohn, Braunschweig: 17–68
Greiling, R.O. , A. Kröner , M.F. El-Ramly & A.A. Rashwan , 1987. Structural relationships between the Southern and the Central parts of the Eastern Desert of Egypt: Details of a fold and thrust belt. In S. El-Gaby & R.O. Greiling (eds.), The Pan-African Belt of Northeastern Africa and adjacent areas. Vieweg & Sohn, Braunschweig: 121–145.
Greiling, R.O. , M.F. El Ramlay , H. El Akhal & R.J. Stern 1988. Tectonic evolution of the northwestern Red Sea margin as related to basement structures. In : X.. Le Pichon & J.R. Cochran (eds.), The Gulf of Suez and Red Sea rifting, Tectono physics, 153: 179–191
Sabet, A.H. & V. Tsogoev , 1973. Problems of geological and economic evaluation of tantalum deposits in apogranites during stages of prospecting and exploration. Ann. Geol. Surv. Egypt, vol. III: 87–107, Cairo.
Shackleton, R.M. 1986. Precambrian collision tectonics in Africa. In: M.P. Coward & A.C. Ries (eds.), Collision tectonics, Spec. Publ. Geol. Soc. London, Nr. 19: 329–349
Stern, R.J. & C.E. Hedge , 1985. Geochronology and isotopic constraints on late Prec-cambrian crustal evolution in the Eastern Desert of Egypt. Amer. Jour. Sci., 285: 97–127
Sultan, M. , R.E Arvidson, N.C. Sturchio & E.A. Guinness , 1987. Lithologic mapping in arid regions with Landsat thematic mapper data: Meatiq dome, Egypt. Geol. Soc. Amer. Bull., vol.99: 748–762

Rare-metal province Central Eastern Desert, Egypt — II. A-type granites of Abu Dabbab, Igla and Nuweibi

Beus, A.A. , E.A. Severov , A.A. Sitinin & K.D. Subbotin 1962. Al´bitizirovannye i grejzenizirovannye granity (apogranity). Moskva: Izdatel´stvo Akademii Nauk SSSR.

Dergachev, V.B. 1991. Ongonity i El 'vanity. Izv. Akad. Nauk SSSR Ser. Geol. № 10:-34–43.

Eby, G.N. 1990. The A-type granitoids: A review of their occurences and chemical characteristics and speculations on their petrogenesis. Lithos 26: 115–134.

Harris, N.B. W. & G.F. Marriner 1980. Geochemistry and petrogenesis of a peralkaline granite complex from the Midian Mountains, Saudi Arabia. Lithos 13: 325–337.

Kinnaird, J. A. 1985. Hydrothermal alteration and mineralization of the alkaline anorogenic ring complexes of Nigeria. Journ. Afr. Earth Sc. 3: 229–251

Sabet, A.H. & V. Tsogoev 1973. Problems of geological and economic evaluation of tantalum deposits in apogranites during stages of prospecting and exploration. Ann. Geol. Surv. Egypt III: 87–107.

Schwartz, M.O. 1992. Geochemical criteria for distinguishing magmatic and metasomatic albite-enrichment in granitoids – examples from the3 Ta-Li granite Yichun (China) and the Sn-W deposit Tikus (Indonesia). Min. Dep. 27: 101–108

Stanek, K.-P. , Pohl, T. , Li, Z. & G. Shedit 1993. Rare-metal province, Central Eastern Desert, Egypt III. Tectonic setting of magmatism. (this volume).

Turner, S.P. , J.D. Foden & R.S. Morrison 1992. Derivation of some A-type magmas by fractionation of basaltic magma: An example from Padthway Ridge, South Australia. Lithos 28: 151–179.

Whalen, J.B. , K.L. Currie & B.W. Chappel 1987. A-type granites: geochemical characteristics, discrimination and petrogenesis. Contr. Min. Petrol. 95: 407–419.

Rare-metal province Central Eastern Desert, Egypt — III. Geochemical indicators of rare-metal potentials (a contribution to IGCP 282 'Rare-metal mineralization')

Beus, A.A. , Severov, E.A. et al. 1962. Al'lbitizirovannye i grejzenizierovannye graniti (apograniti). Moskva: Izdatel'stvo Akademii Nauk SSSR.

Mohamed, F. & G. Matheis 1989. Pan-African apogranites of the Eastern Desert, Egypt: geotectonic setting, geochemistry and rare-metal potential. Geol.Surv.Finland Spec.pap. 8:91.

Renno, A. , Schmidt, W. et al. 1993. Rare-metal province, Eastern Desert, Egypt. II.A-type granites of Abu Dabbab, Igla and Nuweibi.(this volume)

Sabet, A.H. & V. Tsogoev 1973. Problems of geological and economic evaluation of tantalum deposits in apogranites during stages of prospecting and exploration. Ann. Geol. Surv. Egypt III:87–107.

Stanek, K.-P. , Pohl, T. et al. 1993. Rare-metal province, Eastern Desert, Egypt. I. Tectonic setting of magmatism.(this volume)

Emerald formation during regional metamorphism: The Zabara, Sikeit and Umm Kabo deposits (Eastern Desert, Egypt)

Brocci, G. B. 1841. Giornale delle Osservazione fatte ne'Viaggi in Egitto. Cited in : Schneider, O. & A. Arzruni . 1892. Der aegyptische Smaragd. Zeitschr. f. Ethnol. 24: 41–100.

Fersman, A. E. 1929. Geochemische Migration der Elemente. Abh. Prakt. Geologie u. Bergwirtschaftslehre. 18 (1): 74–116.

Grundmann, G. & G. Morteani 1989. Emerald mineralization during regional metamorphism: The Habachtal (Austria) and Leydsdorp (Transvaal, South Africa) deposits. Economic Geology. 84: 1835–1849.

Hume, W. F. 1934. Geology of Egypt. Vo. 2, part 1, The metamorphic rocks: 107–125. Cairo: Government Press. 300.

Kröner, A. 1979. Pan African plate tectonics and its repercussion on the crust of northeast Africa. Geol. Rundschau. 68 (2): 565–583.

MacAlister, D. A. 1900. The emerald mines of Northern Etbai. The Geographical J. 16: 537–549.

Sinkankas, J. 1981. Emerald and other beryls. Radnor, Pennsylvania: Chilton Book C.

Soliman, M. M. 1986. Ancient mines and beryllium mineralization associated with Precambrian stanniferous granites in the Nugrus-Zabara area, Southeastern Desert, Egypt. Arab Gulf J. scient. Res. 4 (2): 529–548.

Oolitic ironstones in continental sediments of northern Sudan

Barazi, N. 1985. Sedimentologie und Stratigraphie des Abyad-Beckens (NW-Sudan). Berliner geowiss. Abh. (A) 64:85 pp..

Bhattacharyya, D. 1980. Sedimentology of the Late Cretaceous Nubia Formation at Aswan, Southeast Egypt, and Origin of the Associated Ironstones. 122 pp., Princeton Univ..

Forbes, E.A. , Posner, A.M. & Quirk, J.P. 1976. The specific adsorption of divalent Cd, Co, Cu, Pb, and Zn on goethite. J. Soil Sci. 27:154–166.

Fuganti, A. , Morteani, J. & Grundmann, G. 1987. Oolithic iron ore deposits in the Nubian Formation of the Wadi Halfa Area (northern Sudan). In: Matheis, G. & Schandelmeier, H. (eds.), Current Research in African Earth Sciences, 379–382, Rotterdam.

Germann, K. & Fischer, K. 1988. Lateritische Verwitterungsprodukte in der Nubischen Gruppe Oberagyptens und des Nordsudans. Nachr. dt. geol. Ges. 39:18–19.

Germann, K. , Fischer, K. & Schwarz, T. 1990. Accumulation of lateritic weathering products (kaolins, bauxitic laterites, ironstones) in sedimentary basins in northern Sudan. Berliner geowiss. Abh. (A) 120.1:109–148.

Germann, K. , Mücke, A. , Doering, T. & Fischer, K. 1987. Late Cretaceous laterite-derived sedimentary deposits (oolitic ironstones, kaolins, bauxites) in Upper Egypt. Berliner geowiss. Abh. (A) 75.3:727–758.

Grimme, H. 1968. Die Adsorption von Mn, Co, Cu und Zn durch Goethit aus verdünnten Lösungen. Z. Pflanzenernähr. Bodenkd. 121:58–65.

Harder, H. 1964. Geochemische Unterscheidung genetisch verschiedener marin-sedimentärer Eisenerzlagerstätten. Ber. Geol. Ges. DDR 9:475–478.

Jorgenson, G.J. & Bosworth, W. 1989. Gravity modelling in the Central African Rift System, Sudan: Rift geometry and tectonic significance. J. Afr. Earth Sci. 8:283–306.

Kleinsorge, H. , Kreysing, K. , Eckhardt, F.J. , Fesser, H. & Gundlach, H. 1960. Über ein Vorkommen von oolithischen Eisenerzen in der Nubischen Serie der Provinz Kordofan, Republik Sudan. Z. dt. geol. Ges. 112:267–277.

Linck, G. & Becker, W. 1925. Über einen Eisenoolith (Minette) von Wadi Halfa. Chem. Erde 2:134–136.

Schwarz, T. 1992. Produkte und Prozesse exogener Fe-Akkumulation: Eisenoolithe und lateritische Eisenkrusten im Sudan. Berliner geowiss. Abh. (A) 142:186 pp..

Schwarz, T. , Fischer, K. & Germann, K. 1990. Untersuchungen zur Verbreitung und Genese lateritischer Eisenanreicherungen in Sedimenten der “Nubischen Gruppe” Oberägyptens und des Nord-Sudans. Zbl. Geol. Palaont. 1989:1479–1493.

Schwertmann, U. & Taylor, R.M. 1989. Iron oxides. In: Dixon, J.B. & Weed, S.B. (eds.), Minerals in Soil Environments, Ch. 8, 379–438, Madison.

Siehl, A. & Thein, J. 1987. Origin of minette-type ironstones. Phanerozoic Ironstones, Symposium, 44–45, Sheffield.

Wycisk, P. , Klitzsch, E. , Jas, C. & Reynolds, O. 1990. Intracratonal sequence development and structural control of Phanerozoic strata in Sudan. Berliner geowiss. Abh. (A) 120.1:45–86.

Zitzmann, A. 1976. The iron ore deposits of the Arab republic of Egypt. In: Zitzmann, A. (ed.), The Iron Ore Deposits of Europe and Adjacent Areas, Vol. 1, 129–133, Hannover.

Alunitic kaolins of the Gedaref region (NE-Sudan)

Anonymous 1980. Kaolin find in Gedarif district. Ind. Min., 153:13–14.

Grasty, R. , J.A. Miller & P.A. Mohr 1963. Preliminary results of potassium argon age determinations on some Ethiopian Trap Series basalts. Geophys. Obs. Addis Abbaba, 6:97–101.

Hall, R.B. 1978. World Nonbauxite Aluminium Resources – Alunite, Geol. Surv. Prof. Pap., 1076-A:1–33.

Hall, R.B. & C.W. Bauer 1983. Alunite, in S.J. Lefond (ed.), Ind. Min. & Rocks, 1:417–434, New York: Port City Press.

Hallberg, J.A. 1984. A geochemical aid to igneous rock type identification in deeply weatherd terrain.- J. Geochem. Exploration, 20:1–8.

Meunier, M. , G. Collo & P. Boisset 1985. Onshore Soudan Block G – Geological Field Survey, Total Soudan, Khartoum. Unpubl. report, 1–26.

Nrwc – National Rural Water Corporation 1992. Geohydrological Databank Khartoum, Dept. of Groundwater Research.

Schmidt, D. & M. Storr 1991. Prognosis for the industrial use of Sudanese kaolin deposits. Unpubl. report, Ernst-Moritz-Arndt-Universitat, Greifswald.
Schmidt, D. 1992. Zusammmenhange zwischen Bildungsbedingungen und nutzungsrelevanten Eigenschaften sudanesischer Kaoline. Unpubl. report, Ernst-Moritz-Arndt-Universitat, Greifswald.
Whiteman, A.J. 1971. The Geology of the Sudan Republic. Oxford: Clarendon

Interaction of tectonic evolution and lateritization in central Sudan

Alley, N.F. 1977. Age and origin of laterite and silcrete duricrusts and their relationship to episodic tectonism in th mid-north of South Australia. J. geol. Soc. Aust. 24:107–116.
Ambrosi, J.P. & Nahon, D. 1986. Petrological and geochemical differentiations of lateritic iron-crust profiles. Chem. Geol. 57:371–393.
Bermingham, P.M. , Fairhead, J.D. & Stuart, G.W. 1983. Gravity study of the Central African Rift System: a model of continental disruption, 2. The Darfur domal uplift and associated Cainozoic volcanism. Tectonophysics 94:205–222.
Boulange, B. 1983. Les formations bauxitiques latéritiques de Côte D'Ivoire – Les faciès, leur transformation, leur distribution et 1'evolution du modele. 341 pp., Univ. Paris.
Bourman, R.P. , Milnes, A.R. & Oades, J.M. 1987. Investigations of ferricretes and related surficial ferruginous materials in parts of southern and eastern Australia. Z. Geomorph. N.F. 64:1–24.
Browne, S.E. , Fairhead, F.D. & Mohamed, I.I. 1985. Gravity study of the White Nile Rift, Sudan, and its regional tectonic setting. Tectonophysics 113:123–137.
Bruckner, W.D. 1957. Laterite and bauxite profiles of West Africa as an index of rhythmical climate variations in the tropical belt. Eclogae Geol. Helv. 50:239–256.
Buckle, C. 1982. Weathering and the movement of material in slopes. In: Buckle, C. (ed.), Landforms in Africa, Ch. 4, 69–77, London.
Fölster, H. , kalk, E. & Moshrefi, N. 1971. Complex pedogenesis of ferrallitic savanna soils in South Sudan. Geoderma 6:135–149.
Jorgenson, G.J. & Bosworth, W. 1989. Gravity modelling in the Central African Rift System, Sudan: Rift geometry and tectonic significance. J. Afr. Earth Sci. 8:283–306.
Kleinsorge, H. , Zscheked, J.G. , Eckhardt, F.J. , Fesser, H. & Gundlach, H. 1959. Eisenerze im westlichen Kordofan, Republik Sudan. Geol. Jb. 77:121–142.
Maignien, R. 1958. Le cuirassement des sols en Guinée, Afrique Occidentale. Mém. Serv. Carte Géol. Als. Lorr. 16:223 pp..
McFarlane, M.J. 1991. Some sedimentary aspects of lateritic weathering profile development in the major bioclimatic zones of tropical Africa. J. Afr. Earth Sci. 12:267–282.
Milnes, A.R. , Bourman, R.P. & Northcote, K.H. 1985. Field relationships of ferricretes and weathered zones in southern South Australia: a contribution to 'laterite' studies in Australia. Aust. J. Soil Res. 23:441–465.
Nahon, D. 1971. Genèse et évolution des cuirasses ferrugineuses quaternaires surgrès: exemple du Massif de Ndias (Sénégal Occidental). Bull. Serv. Carte geol. Als. Lorr. 24:219–241.
Nahon, D. , Janot, C. , Karpoff, A.M. , Paquet, H. & Tardy, Y. 1977. Mineralogy, petrography and structures of iron crusts (ferricretes) developed on sandstones in the western part of Senegal. Geoderma 19:263–277.
Ollier, C.D. & Galloway, R.W. 1990. The laterite profile, ferricrete and unconformity. Catena 17:97–109.
Reynolds, P.O. & Schandelmeier, H. 1992. Influence of Precambrian basement structures on the architecture of the Mesozoic/Cenozoic Sudanese rift system.. Ann. Geophys. 10:C89.
Schandelmeier, H. , Klitzsch, E. , Hendriks, F. & Wycisk, P. 1987. Structural development of North-East Africa since Precambrian times. Berliner geowiss. Abh. (A) 75.1:5–24.
Schull, T.J. 1988. Rift basins of interior Sudan: Petroleum exploration and discovery. Amer. Ass. Petr. Geol. Bull. 72:1128–1142.
Tardy, Y. , Kobilsek, B. & Paquet, H. 1991. Mineralogical composition and geographical distribution of African and Brazilian periatlantic laterites. The influence of continental drift and tropical paleoclimates during the past 150 million years and implications for India and Australia. J. Afr. Earth Sci. 12:283–295.
Valeton, I. 1983. Paleoenvironment of lateritic bauxites with vertical and lateral differentiation. In: Wilson, R.C.L. (ed.), Residual Deposits: Surface Related Weathering Processes and Material, 77–90, Oxford – London – Edinburgh – Boston – Melbourne.
Wycisk, P. , Klitzsch, E. , Jas, C. & Reynolds, O. 1990. Intracratonal sequence development and structural control of Phanerozoic strata in Sudan. Berliner geowiss. Abh. (A) 120.1:45–86.

Geochemical criteria to prospect for mineral deposits in crystalline basement of the Sudan

Badr El Din Khalil (1972). Lithochemical methods in mineral exploration in the Sudan, Record of Research No.1, Dept. of Geology Univ.of Khartoum, Sudan.

Solovov, A.P. (1987). geochemical prospecting for mineral deposits. Mir Publishers, Moscow.

A geological overview and genetic constraints of Jebel Dumbeir fluorites mineralization, Kordofan State, Sudan

Deux, T. W. & C. O. Henry 1985. Uranium mobility in late magmatic and hydrothermal processes – evidence from fluorite deposits, Texas and Mexico – Uranium deposits in volcanic rocks. Proc. Tech. Commit. Meeting, El Paso, Texas (1985), IAEV, Vienna.

El Rba'a, S. M. & M. El Shargawi 1972. On the occurrence of fluorite in J. Dumbeir, Kordofan Province, Western Sudan. Dept. of Geology Faculty of Science, Univ. of Khartoum, no 1: 18–20.

Harris, N. P. , Mohammed, A. E. & M. Z. Shaddad 1983. Geochemistry and perogenesis of a nepheline-syenite-carbonatite complex from the Sudan. Geol. ag., 120 (2): 115–127.

Hassan, A. K. 1989. Prospecting method for uranium and associated mineralization in the Nuba Mountain, Sudan. Unpubl. M. Sc. thesis, Univ. of Khartoum, Khartoum.

Qureshi, I. R. & A. A. Saddig 1976. Earthquakes and associted faulting in Central Sudan. Nature, 215: 263–265

Gold-productive volcanogenic sulphide mineralization in the Ariab Belt, Red Sea Hills/Sudan: Evidences for Late Proterozoic seafloor hydrothermal systems

Aye, F. , Cheze, Y. & El Hindi, M.A. 1985. Discovery of a major massive sulphide province in NE Sudan. Proc. Conf. on prospecting in areas of desert terrains, Rabat, Moroco:43–48. London: Inst.Min.& Metall.

Bakheit, A.K. 1991. Geochemical and tectonic control of sulphide-gold mineralization in Ariab mineral district, Red Sea Hills/Sudan. Ph.D. thesis: Techn.Univ.Berlin, 157 p.

Cottard, F. , Baux, C. , Cortial, P. et al. 1986. Les amas sulfurés polymétalliques et les mineralisations auriferes du district d'Ariab (Red Sea Hills, Soudan). Historique de la decouverte, cadre geologique et principaux caracteres des gisements. Chron.rech.min. 483:19–40.

Halbach P. , Nakamura, K. , Wahsner, M. et al. 1989. Probable modern analogue of Kuroko-type massive sulphide deposits in the Okinawa Trough back-arc basin. Nature 338:496–499.

Hannington, M.D. , Peter, J.M. & Scott, S.D. 1986. Gold in seafloor polymetallic sulphide deposits. Econ. Geol. 81:1867–1883.

Hannington, M.D. , Thompson, G. , Rona, P.A. & Scott, S.D. 1988. Gold and native copper in supergene sulphides from the Mid-Atlantic Ridge. Nature 333:64–66.

Hannington, M.D. & Scott, S.D. 1988. Mineralogy and geochemistry of hydrothermal silica-sulphide-sulphate spire in the caldera of Axial Seamount, Juan de Fuca Ridge. Can.Mineral. 26:603–626.

Hannington, M.D. , Herzig, P.M. & Scott, S.D. 1991. Auriferous hydrothermal precipitates on the modern seafloor. In R.P. Foster (ed.), Gold Metallogeny and Exploration, p.249–282. Glasgow & London: Blackie.

Herzig, P.M. 1991. Marine Rohstoffvorkommen – Polymetallische Sulfidmineralisationen am Meeresboden. Die Geowissenschaften 9/6:169–178.

Herzig, P.M. , Hannington, M.D. , Scott, S.D. et al. 1991. Gold-rich seafloor gossans in the Trodos ophiolite and on the Mid-Atlantic ridge. Econ.Geol. 86:1747–1755.

Kröner, A. , Greiling, R. , Reischmann, T. et al. 1987. Pan African crustal evolution in the Nubian segment of the NE Africa. American Geophys. Union Geodyn.Ser. 17:235–257.

Lydon, J.W. 1984. Volcanogenic massive sulphide deposits, part 1: A descriptive model. Geosc.Canada Repr.Ser. 3:145–153.

MacGeehan, P.J. & MacLean, W.H. 1980. An Archean sub-seafloor geothermal system, calc-alkaline trends and massive sulphide genesis. Nature 286:767–771.

Pearce, J.A. & Gale, G.H. 1977. Identification of ore-deposition environment from trace-element geochemistry of associated igneous host rocks. In: Volcanic Process in Ore Genesis, Spec.Publ.Geol.Soc.Lond. 7:14–24.

Rona, P.A. , Klinkhammer, G. , Nelson, T.A. et al. 1986. Blacksmokers, massive sulfides and vent biota at Mid-Atlantic Ridge. Nature 321:33–37.
Thompson, G. , Humphris, S.E. , Schroeder, B. et al. 1988. Hydrothermal mineralization on the Mid-Atlantic Ridge. Can.Mineralogist 26:697–711.

Implication of the structural evolution of the Adola Belt on shear zone-hosted gold mineralization

Kozyrev, V. , Girma, K. , Safonov, T. , Bekele, W.m. , Tuliankin, V. , Bestujev, A. , Baijapov, A. , Towelde, M.T. , Gurbanvich, G. , Kaitukov, M. And Arijapov, A. 1985. Regional Geological and exploration work for gold and other minerals in the Adola Goldfields. Ethiopian Mineral Resources Development Corporation
Sibson, R.H. , Robert, F. and poulsen, H. 1988. High angle reverse faults, fluid pressure cycling, and Mesothermal gold-quartz veins. Geologyy, 16, 551–555.
Training for Mineral Exploration project , 1988. Geological Maps of the Adola Belt. EIGS/UNDP, project ETH/86/034, Unpubl.
Worku, H. and Kinetebeb, Y. 1998 The tectonic evolution of the Precambrian metamorphic rocks of the Adola Belt (southern Ethiopia) and its implications on gold mineralizations, Ethiopian Institute of Geological Surveys, Unpubl. report.

Past global climatic changes and the tropical arid/semi-arid belt in the North of Africa

An Z.S. , Porter S. , Kukla G. , Xiao J.L. (1990) – Evidence of magnetic susceptibility for monsoon changes over the Loess Plateau during the last 130 000 years. Kexue Tongbao (Science Bulletin) 35 :529–532.
Bard E. , Hamelin B. , Fairbanks R.G. (1990) – U-Th ages obtained by mass spectrometry in corals from Barbados: sea level during the past 130,000 years. Nature, 346 : 456–458.
Berger A. (1992) – Le climat de la Terre. Un passé pour quel avenir? De Boeck- Wesmael. (Eds). 447p.
Chapellaz J. , Barnola J.M. , Raynaud D. , Korotkevich Y.S. , Lorius C. (1990). Ice record of atmospheric methane over the past 160 000 years. Nature, 345 :127–131.
Charney J.G. (1975). Dynamics of deserts and drought in Sahel. Quat. J. Royal Meteorological Soc. 101 :193.
Commelin D. , Petit-Maire N. , (1979). Chronologie isotopique saharienne pour les derniers 10 000 ans. Essai d'interprétation : migrations humaines et paleoclimatologie. Bulletin du Musée d'Anthropologie préhistorique de Monaco, 23 :37–88.
Demarée G.R. (1990). Did an abrupt global climatic warming occur in the 1920s ? In : "Contributions a l'étude des changements de climat". Institut Royal Météorologique de Belgique, A, 124 :32–37.
Démaree G.R. , Nicolis C. (1990). Onset of Sahelian drought viewed as a fluctutation-induced transition. Quat. J. Royal Meteorological Soc., 116 : 221–238.
Durand A. (1982). Oscillations of lake Chad over the past 50 000 years : New data and new hypothesis. Palaeogeography, Palaeoclimatology, Palaeoecology, 39 : 37–53.
Durand A. , Lang J. (1986). Approche critique des methodes de reconstitution paléoclimatique : le Sahel nigero-tchadien depuis 40 000 ans. Bull. Soc. Geol. de France, 8 : 267–278.
Edgell H.S. (1989). Evolution of the Rub' al Khali Desert. Earth Science, 3 :109–126.
Fabre J. (1983). Le Sahara malien septentrional (22°-24° N) : Taoudenni – Trhaza.- Esquisse stratigraphique preliminaire des dépôts lacustres quaternaires. *In:* N. Petit-Maire et J. Riser (Eds).- Sahara ou Sahel ? Quatemaire recent du Bassin de Taoudenni (Mali).: 421–441- LGQ-CNRS, Marseille, France.
Fabre J. (1991). Le lac holocene de Taoudenni – Agorgott- Cadre geologique et Evolution. *In* : Petit-Maire et al (Ed). Paleoenvironnements du Sahara. Lacs holocenes a Taoudenni (Mali). : 117–127. Marseille/Paris (FR): CNRS.
Fabre J. , Petit-Maire N. (1988) – Holocene climatic evolution from two palaeolakes near Taoudenni, Mali (22°-23°N). Palaeogeography, Palaeoclimatology, Palaeoecology, 65:133–148.
Fairbanks R.G. (1989) – A 17.000 years glacio-eustatic sea level record: Influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation. Nature, 342: 637–642.
Faure H. (1969) – Lacs quaternaires du Sahara. Mitt. Intern. Verein. Limnol., 17: 131–146. Stuttgart.
Fu C.B. , Wang Q. (1991). The synchroneousness of the 1920s' warming and the strengthening of the south Asian monsoon activity. Science in China B, (6).
Gaven C. , Hillaire-Marcel C. , Petit-Maire (1981) – A Pleistocene lacustrine episode in southeastern Libya. Nature, 290:131–133.

Goetz C. , Erlenkeuser H. (1991). Les isotopes stables de l'oxygène et du carbone. *In* : Petit-Maire N. (Ed) – Paleoenvironnements du Sahara. Lacs holocenes a Taoudenni (Mali). : 103–106. – Marseille/Paris (FR): CNRS.

Goossens C. , Berger A.L. (1987). How to recognize an abrupt climatic change, Berger W.H. and Labeyrie L.D. (Eds): Abrupt Climatic Change. Riedel Publ, Dordrecht: 31–45.

Guerin C. , Faure M. (1983). Mammiferes. *In* : Petit-Maire N. , Riser J. (Eds). – Sahara ou Sahel ? Quaternaire recent du Bassin de Taoudenni (Mali) : 239–272.- LGQ-CNRS. Marseille.

Hagedorn H. , Pachur H. (1969). Observations on Climatic Geomorphology and Quaternary Evolution of Landforms in South Central Libya. 1st Symp. Geol. Libya, 1967 : 387–400.

Haynes C.V. Jr , Mead A.R. (1987) – Radiocarbon dating and Paleoclimatic significance of subfossil *Limicolaria* in northwestern Sudan. Quaternary Research, 28 : 86–99.

Hillaire-Marcel C. (1989). Paleohydrologie isotopique des lacs de l'Erg Ine-Sakane. In : Petit-Maire N. , Riser J. (Eds). – Sahara ou Sahel? Quatemaire recent du Bassin de Taoudenni (Mali). : 87–96. Marseille (Fr) LGQ-CNRS.

Hooghiemstra H. , Stalling H. , Agwu C. , Dupont L. (1992). Vegetational and climatic changes at the northern fringe of the Sahara 250 000 – 5 000 years BP : Evidence from 4 marine pollen records located between Portugal and the Canary Islands. Rev. Palaeobotany, Palynology, 74 :1–53.

Ji J.J. , Petit-Maire N. , Yan Z.W. (1992). The last 1 000 years : climatic change in arid Asia and Africa. Palaeogeography, Palaeoclimatology, Palaeoecology. (Global and Planetary Change Section, in press.)

Johnson D.H. ,, Daniels S.M. (1954). Rainfall in relation to the jet stream. Quat.J. Royal Meteorological Soc., 80:212–217.

Jones P.D. , Raper S.C.B. , Bradley R.S. , Diaz H.F. , Kelly P.M. Wigley T.M.L. (1986). Northern Hemisphere surface air temperature variations : 1851–1984. J. Climate and Applied Meteorology,25:161–179.

Kröpelin S. (1987). Palaeoclimatic evidence from Early to Mid-Holocene playas in the Gilf Kebir (southwest Egypt). Palaeoecology of Africa, 18 :189–208.

Leroux M. , (1983).' Le climatde l'Afrique tropicale'. Paris : 636 p.

Lezine A.-M. (1989) – Late Quaternary Vegetation and Climate of the Sahel. Quaternary Research, 32:317–334.

Lin Z.Y. , Wu X.D. (1986). A preliminary analysis of the regularity in flood, froughts and snowstorms in Tibetan Plateau during the historical times. Acta Meteorologica Sinica, 44 : 257–264 (in Chinese).

Mchugh W.P. , Mccauley J.F. , Haynes C.V. , Breed C.S. , Schaber G.G. (1988). Paleorivers and Geoarchaeology in the Southern Egyptian Sahara. Geoarchaeology, 1 :1–40.

Michel P. (1973). Les bassins des fleuves Senegal et Gambie. Etude géomorphologique. These d'Etat. Strasboura. 1970- Memoire ORSTOM- Paris, 752p.

Morel A. , Tillet Th , Poupeau G. (1991). Le Bassin de Taoudenni. *In* : Abstracts. Colloque de Solignac (IGCP 252), 2B, 19p.

Moore P.D. (1990). Ups and downs in the Sahel. Nature, 343 : 414.

Neumann K. (1989) – Vegetations geschichte der OstSahara im Holozan. in: Africa praehistorica, 2. Heinrich-Barth Institut – Köln: 13–182.

Nicholson S.E. , Flohn H. , (1980). African environmental and climatic changes and the general atmospheric circulation in late Pleistocene and Holocene. Climatic Change, 2 :313–348.

Pachur H.J. , Hoelzmann . (1991). Palaeoclimatic implications of Late Quaternary lacustrine sediments in Western Nubia, Sudan. Quaternary Research, 36 : 257–276.

Pachur H.J. , Kropelin S. , Hoelzmann , Goshin H. , Altmann H. (1990). Late quaternary fluviolacustrine environments of western Nubia. Berliner Geowiss. Abh. 120.1: 203–260.

Parthasarathy B. , Sontake N.A. , Monot A.A. , Kothawale D.R. (1987). Drought / floods in the summer monsoon season over different meteorological subdivisions of India for the period 1871–1984. J.Climatology, 7 :57–70.

Pastouret L. , Chamley H. , Delibrias G. , Duplessy J.C. , Thiede J. (1978). Late Quaternary climatic changes in the Western tropical Africa deduced from deep sea sedimentation off the Niger delta. Oceanologica Acta, 1 :217–232.

Petit-Maire N. , Casta L. , Delibrias G. , Gaven C. (1980). Preliminary data on quaternary paleolacustrine deposits in the Wadi ash Shati, Libya. *In* : M.J. Salem , M.T. Busrewil (Eds). The Geology of Libya, 3 : 797–807. London (GB) : Academic Press.

Petit-Maire N. (Ed.) (1982). "Le Shati, lac pléistocene du Fezzan". CNRS -118 p.

Petit-Maire N. (1986). Paleoclimates in the Sahara of Mali. A multidisciplinary study. Episodes, 9/1: 7–16.

Petit-Maire N. (1987). Local response to recent global climatic change: hyperarid central Sahara and coastal Sahara. Current Res. in African Earth Sciences, Matheis and Schandlemeier (Eds). Balkema. Rotterdam: 431–434.

Petit-Maire N. , Rosso J.-C. , Delibrias G. , Meco J. , Pomel R. (1987). Paléoclimats de l'île de Fuerteventura (Archipel Canarien). *In:* Coetzee J.A. (Ed.). Palaeoecology of Africa, 18 : 351–356.

Petit-Maire N. , Riser J. (1988). Le Sahara a l'Holocène: Mali. Paris, C.C.G.M., Institut Geographique National. 1 carte 1/1 000 000.

Petit-Maire N. (1989). Interglacial environments in presently hyperarid Sahara: paleoclimatic implications. In: Palaeoclimatology and Palaeometeorology. Modern and Past Patterns of Global Atmospheric Transport. M. Leinen , M. Sarnthein M. (Eds) Kluwer. Dordrecht.: 637–661.

Petit-Maire N. , (Dir.Pub.) (1991) – Paleoenvironnements du Sahara. Lacs Holocènes a Taoudenni (Mali). Editions du CNRS, Paris – Marseille: 242 p.

Petit-Maire N. , Fontugne M. , Rouland C. (1991). Atmospheric methane ratio and environmental changes in the Sahara and Sahel during the last 130 kyrs. Palaeogeography, Palaeoclimatology, Palaeoecology, 86 :197–204.

Petit-Maire N. , Page N. (1992). Remote sensing and past climatic changes in tropical deserts : Example of the Sahara. Episodes 15 :113–117.

Pokras E.M. , Mix A.C. (1987). Earth's precession cycle and Quaternary climatic change in tropical Africa. Nature, 326: 486–487.

Prell W.L. , Kutzbach J.E. (1987). Monsoon variability over the past 150 000 years. J. Geophys. Res. 92 (D7) : 8411-8425.

Riser J. , Hilaire-Marcel C. , Rognon P. (1983). Les phases lacustres holocenes. In : Petit-Maire N. , Riser J. (Eds). Sahara ou Sahel? Quatemaire recent du Bassin de Taoudenni (Mali). : 65–86. Marseille (FR) : LGQ-CNRS.

Rossignol-Strick M. (1985). Mediterranean quaternary sapropels, an immediate response to hte African monsoon to variation of insolation. Palaeogeography, Palaeoclimatology, Palaeoecology. 49:237–263.

Rossignol-Strick M. , Duzer D. (1980). Late Quaternary West African climate infered from palynology of Atlantic deep sea cores. In : Sarnthein M. , Seibold E. , Rognon P. (Eds). Sahara and the surrounding seas, Palaeoecology of Africa : 227–228.

Sanlaville P. (In Press). Changements climatiques dans la Peninsule arabique durant le Pléistocène supérieur et l'Holocène. Paleorient.

Sarnthein M. , Tetzlaff G. , Koopmann B. , Wolter K. , Pflaumann U. (1981). Glacial and interglacial wind regimes over the eastern subtropical Atlantic and North -West Africa. Nature, 293 : 193–196.

Schulz E. (1991). The Taoudenni Agorgott pollen record and the Holocene vegetation history of the Central Sahara. In: Paleoenvironnements du Sahara. Lacs holocènes a Taoudenni (Mali) : 143–160.

Servant M. , Servant Vildary S. (1980). L'Environnement quatemaire du Bassin du Tchad. *In* : Williams M.A.J. , Faure H. (Eds). The Sahara and the Nile : 133–162. Rotterdam (NL) : Balkema.

Singhvi A.K. , Kar A. (Eds). (1992). The Thar desert in Rajasthan : land, man and environment. Geological Society of India, Bangalore.

Szabo B.J. , Mchugh W.P. , Schaber G.G. , Haynes C.V. Jr , Breed C.S. (1989). Uranium-series dated authigenic carbonates and acheulian sites in southern Egypt. Science, 243 :1053–4056.

Talbot M. (1984). Late Pleistocene rainfall and dune building in the Sahel. *In:* Coetzee J.A. , Van Zinderen Bakker E.M. (Eds). – Palaeoecology of Africa, 16 : 203–214. Rotterdam (NL) : Balkema.

Tiedemann R. , Sarnthein M. , Stein R. (1989) – Climatic changes in the Western Sahara: Aeolomarine sediment record of the last 8 million years. Proceedings of the Ocean Drilling Program, Scientific Results, 108: 241–278.

Tillet T. (1989). L'Atérien saharien. Essai sur le comportement d'une civilisation paleolithique face à l'accroissement de l'aridité. Bull. Soc. Geol. France, 8 : 91–97.

Van Campo E. , Duplessy J.C. , Rossignol-Strick M. (1982). Climatic conditions deduced from a 150 kyr isotopic pollen record from the Arabian Sea. Nature, 296 : 56–59.

Vernet R. , Aumassip G. (1992). Le Sahara et ses marges. Paleoenvironnements et occupation humaine à l'Holocène. Inventaire des datations 14C. Universite de Niamey, CNRS, Paris : 107p.

Voigt B. , Gabriel B. , Lassonczy K. , Ghod M. (1990). Quaternary events at the Horn of Africa. Berl.eowiss. Abh., 120 : 679–694.

Walker J. , Rowntree P.R. (1977). The effect of soil moisture on circulation and rainfall in a tropical model. Quat. J. Royal Meteorological Soc, 103 : 29–46.

Wendorf F. , Close A. , Schild R. (1987). Recent work on the Middle Paleolithic of the eastern Sahara. African Archaeological Rev., 5 :49–63.

Winstanley D. (1973). Rainfall trends in Africa, Middle-East and India. Nature, 243 : 464–465.

Yan Z.W. , Ji J.J. , Ye D.Z. (1990). Northern Hemispheric summer climatic jump during the 1960s, part I, rainfall and temperature. Science in China B, 33 :1092–1102.

Yan Z.W. , Petit-Maire N. (In Press.). The last 150 ka in the Afro-Asian climatic transitional zone. Zhang M.L. (1989). Rainfall changes in East China during the recent 100 years. Kexue Tongbao (Science Bulletin), 34 : 605–607.

Zhu F.K. (1980). Southern Asian High. Science Press. Beijing.

Environmental change in the southeastern Sahara and the proposal of a Geo-Biosphere Reserve in the Wadi Howar area (NW Sudan)

Altmann, N. 1990. Distribution and floristic composition of the ‘gizzu’ vegetation 1988/89. Berliner geowiss. Abh. (A) 120.1: 209–212.

Bagnold, R.A. . 1990. The Stone Age Legacy of the Desert. Sahara 3: 111.

Christian, D. 1990. EinfluB von Addax-Antilopen und Schafen auf aride Weiden – dargestellt am Beispiel Bou Hedma, Süd-Tunesien. Diplomarb. Giessen: Institut fur Pflanzenbau und Pflanzenzüchtung II, FB Agrarwissenschaften der Justus Liebig Universitat.

Gabriel, B. , S. Kröpelin , J. Richter & E. Cziesla 1985. Parabeldünen am Wadi Howar – Besiedlung und Klima in neolithischer Zeit im Nordsudan. Geowissenschaften in unserer Zeit 3:105–112.

GTZ 1992. Handlungsfelder der Technischen Zusammenarbeit im Naturschutz. Eschborn: Schriftenreihe der Deutschen Gesellschaft fur Technische Zusammenarbeit 228.

Haynes, C.V. . 1987. Holocene Migration Rates of the Sudano-Sahelian Wetting Front, Arba’in Desert, Eastern Sahara. In A.E. Close (ed.), Prehistory of Arid North Africa, p. 69–84. Dallas: Southern Methodist Univ. Press.

Kröpelin, S. 1989. Untersuchungen zum Sedimentationsmilieu von Playas im Gilf Kebir (SW-Agypten) – Investigations of playa sedimentation in the Gilf Kebir. Africa Praehistorica 2: 183–305.

Kröpelin, S. 1990. Lower Wadi Howar. Berliner geowiss. Abh. (A) 120.1: 223–234, 256–259.

Kröpelin, S. 1993a. Zur Rekonstruktion der spätquartären Umwelt am unteren Wadi Howar (Südöstliche Sahara / NW-Sudan). Berliner Geogr. Abh. 54, 250 p. (in print).

Kröpelin, S. 1993b. Geomorphology, Landscape Evolution and Paleoclimates of Southwest Egypt. In B. Meissner & P. Wycisk (eds.), Geopotential and Ecology of the Western Desert, Egypt. Catena Suppl. (in print).

Kröpelin, S. & I. Soulié-Marsche 1991. Charophyte-remains from Wadi Howar as Evidence for Deep Mid-Holocene Freshwater Lakes in the Eastern Sahara of Northwest Sudan. Quatern. Res. 36: 210–223.

Kuper, R. 1981. Untersuchungen zur Besiedlungsgeschichte der östlichen Sahara. Beitr. Allg. Vergl. Archaol. 3: 215–275.

Kuper, R. 1988. Neuere Forschungen zur Besiedlungsgeschichte der Ost-Sahara. Archaol. Korrespondenzbl. 18: 127–142.

Lamprey, H. 1976/1988. Report on the Desert Encroachment Reconnaissance in Northern Sudan: 21 October to 10 November 1975. UNEP Desertification Control Bulletin 17: 1–7 (reprint of 1976).

Neumann, K. 1989. Zur Vegetationsgeschichte der Ostsahara im Holozan. Holzkohlen aus prahistorischen Fundstellen (Mit einem Exkurs uber die Holzkohlen von Fachi-Dogonboulo / Niger). Africa Praehistorica 2: 13–181.

Pachur, H.-J. . & P. Hoelzmann 1991. Paleoclimatic Implications of Late Quaternary Lacustrine Sediments in Western Nubia, Sudan. Quatern. Res. 36: 257–276.

Pachur, H.-J. . & S. Kröpelin 1987. Wadi Howar: Paleoclimatic Evidence from an Extinct River System in the Southeastern Sahara. Science 237: 298–300.

Pachur, H.-J. . & S. Kröpelin 1991. Outline of the proposed project of a National Park in the Wadi Howar region (Northwestern Sudan). Unpubl. Ms.

Rhotert, H. 1952. Libysche Felsbilder. Darmstadt: Wittich.

Palaeoecology of Holocene lacustrine sediments in Western Nubia, SE Sahara

Baumhauer, R. 1986. Zur jungquartaren Seenentwicklung im Bereich der Stufe von Bilma (NE-Niger). Ph.D. thesis, Universitat Würzburg, Würzburg.

Callot, Y. 1987. Géomorphologie et paléoenvironnements de l’Atlas Saharien au Grand Erg Occidental. Dynamique éolienne et paléolacs holocènes. Ph.D. thesis, Université P. et M. Curie, Paris.

Gabriel, B. & S. Kröpelin 1984. Holocene lake deposits in NW-Sudan. PaLAfrica 16:295–299.

Goschin, M. 1988. El’Atrun – ein holozäner See in Nordwest Sudan. Ph.D. thesis, Berlin.

Haynes, C.V. 1982. Great Sand Sea and Selima Sand Sheet: Geochronology of desertification. Science 217:629–633.

Haynes, C.V. , C.H. Eyles , L.A. Pavlish , J.C. Ritchie & M. Rybak 1989. Holocene Paleoecology of the Eastern Sahara; Selima Oasis. Sci.Rev. 8:109–136.

Hoelzmann, P. 1992a. Holozäne Limnite im NW-Sudan. Ph.D. thesis, Berlin.

Hoelzmann, P. 1992b. Palaeoecology of Holocene Lacustrine Sediments within the West-Nubian-Basin, SE-Sahara. Würzb. geogr. Abh. 83: in print.

Pachur, H.J. & H.P. Röper 1984. The Libyan (Western) Desert and Northern Sudan during the Late Pleistocene and Holocene. Berl. geowiss. Abh. (A) 50:249–284.

Pachur, H.J. & P. Hoelzmann 1991. Paleoclimatic Implications of Late Quaternary Lacustrine Sediments in Western Nubia, Sudan. Quat.Res. 36:257–276.

Pachur, H.J. & S. Kröpelin 1987. Wadi Howar: Paleoclimatic evidence of an extinct river system in the southeastern Sahara. Science 237:298–300.
Pachur, H.J. , H.P. Röper , S. Kröpelin & M. Goschin 1987. Late Quaternary hydrography of the Eastern Sahara. Berl. geowiss. Abh.(A) 75.2:331–384.
Petit-Maire, N. & J. Riser 1981. Holocene lake deposits and palaeoenvironment in central Sahara, North-eastern Mali. Palaeoclim.,Palaeoecol.,Palaeogeogr. 35:45–61.
Petit-Maire, N. & J. Riser 1983. Sahara où Sahèl? Quaternaire récent du Bassin de Taudenni. Librairie du Muséum nat., d'Histoire nat, Paris.
Ritchie, J.C. & C.V. Haynes 1987. Holocene vegetation zonation in the Eastern Sahara. Nature 330:645–647.

Diversity of Quaternary aquatic environments in NE Africa as shown by fossil Charophytes

Burne, R. V. , J. Bauld , & P. De Deckker . 1980. Saline lake Charophytes and their geological significance. J. sedim. Petrol. 50 (1): 281–293.
Gabriel, B. 1986. Die östliche libysche Wüste im Jungquartär. Berlin. geogr. Studien 19: 1–219.(1)
Gabriel, B. & S. Kröpelin . 1983. Jungquartäre limnische Akkumulationsphasen im NW Sudan. Z. Geomorph., N. F. suppl. 48: 131–143. (2)
Gabriel, B. , B. Voigt , & M. M. Ghod . 1988. Quaternary climate and landscape of northern Somalia. DEUQUA – Wiirzburg, 16 p. (3)
Goschin, M. 1988. El Atrun (Nubien) – ein frähholozänzeitlicher See. Thesis, 222 p., Berlin.(4)
Huckriede, R. & H. Venzlaff . 1962. Über eine pluvialzeitliche Molluskenfauna aus Kordosan (Sudan). Paläontol. Z., H. Schmidt Festband: 93–109.
Kröpelin, S. & I. Soulié-Märsche . 1991. Charophyte remains from Wadi Howar as evidence for deep Mid-Holocene freshwater lakes in eastern Sahara (NW Sudan). Quatern. Res. 36: 210–223. (5)
Mawson, R. & M. A. Williams . 1984. A wetter climate in eastern Sudan, 2 000 years ago ? Nature 308 (5963): 49–51.
Pachur, H. J. & P. Hoelzmann . 1991. Paleoclimatic implications of late Quaternary lacustrine sediments in Western Nubia, Sudan. Quatern. Res. 36: 257–276. (6)
Pachur, H. J. & S. Kröpelin . 1987. Wadi Howar: paleoclimatic evidence from an extinct river system in the southeastern Sahara. Science 237: 298–300. (7)
Pachur, H. J. , S. Kröpelin , P. Hoelzmann , M. Goschin & N. Altmann . 1990. Late Quaternary fluvio-lacustrine environments of western Nubia. Berl. geowiss. Abh. (A) 120 (1): 203–260.(8)
Pachur, H. J. , & H. P. Röper . 1984. Die Bedeutung palaoklimatischer Befunde aus den Flachbereichen der ostlichen Sahara und des nordlichen Sudan. Z. Geomorph., N.F., suppl. 30: 59–78. (9)
Pachur, H. J. , H. P. Röper , S. Kröpelin & M. Goschin . 1987. Late Quaternary hydrogeography of the eastern Sahara. Berl. geowiss. Abh. (A) 75 (2): 331–384. (10)
Soulié-Märsche, I. 1982. Charophytes. In N. Petit-Maire (ed.) Le Shati, lac pléistocène au Fezzan (Libye). p. 80–85, CNRS, Marseille.
Soulié-Märsche, I. 1989. Etude comparée de gyrogonites de Charophytes actuelles et fossiles et phylogénie des genres actuels. 237 p., Millau (France): Impr. des Tilleuls.
Soulie-Marsche, I. 1991. Charophytes as lacustrine biomarkers during the Quaternary in North Africa. J. of Afric. Earth Sci. 12 (1/2): 341–351.
Soulié-Märsche, I. 1993. Apport des Charophytes fossiles à la recherche de changements climatiques abrupts. Bull. Soc. geol. France 164 (1): in press. (11)
Stroede, W. 1931. Okologie der Characeen. Thesis, 119 p., Berlin: P. Funck.

Soil development and climatic changes during Quaternary in the north eastern part of the Red Sea Hills (Sudan)

Alaily, F. (1990): Soils of the Darror Valley (Northeast Somalia). CATENA, 17, 13–24, Cremlingen.
Bresler, E. , B.L. Mcneal & D.L. Carter (1982): Saline and Sodic Soils. Springer-Verlag, 236 p., Berlin, Heidelberg and New York.
El-Nadi, A.H. (1989): Late Precambrian volcanism in NE Sudan and the evolution of the Nubian Shield. Journal of African Earth, Vol. 9, No. 3/4, 467–475.
FAO-UNESCO (1988): Soil map of the world.- Revised Legend, Rome. Fuchtbauer, H. & G. Müller (1977): Sedimente und Sedimentgesteine. E. Schweizerbart'sche Verlagsbuchhandlung, 3. Aufl., Teil II, 783 S., Stuttgart.

Schlichting, E. & H.-P. Blume (1966): Bodenkundliches Praktikum. Paul Parey, 209 p., Hamburg und Berlin.
Trask, P.D. (1932): Origin and environment of source sediments of petroleum. Gulf Publ. Co., 32–35, Honston.
Whitemann, A.J. (1971): The geology of the Sudan Republic. Clarendon press, 273 p., Oxford.

Relictic soil characteristics as witness of climatic change in the Red Sea Hills of Sudan

Ahrendt, I. 1993. Unpublished internal report.
Alaily, F. 1986. Indicators of recent and subrecent soil moisture in the full arid part of the Sahara. Berliner geowiss. Abh. (A), 72:68–75. Berlin.
FAO-Unesco. 1990. Soil map of the world. Revised Legend. Rome
Lassonczyk, B. 1990. Characteristics of a fossil soil developed on the basement complex in Northeast Somalia. Berliner geowiss. Abh. (A), 120.2:713–718. Berlin.
Munsell – Soil color charts. 1990. Edition Revised. New York
Kevie, V.D. 1976. Climatic zones in the Sudan. Soil Survey Administration, Wad Medani.
Schlichting, E. & H. P. Blume . 1966. Bodenkundliches Praktikum. Paul Parey Verlag. Hamburg und Berlin.
Schwarzbach, M. 1988. Das Klima der Vorzeit. Ferdinand Enke Verlag. Stuttgart.
Schwertmann, U. 1959. Die fraktionierte Extraktion der freien Eisenoxyde in Böden, ihre mineralogischen Formen und ihre Entstehungsweisen. Z. Pflanzenern., Düng., Bodenkunde 84:194–204.
Volk, O.H. & E. Geyger . 1970. “Schaumböden” als Ursache der Vegetationslosigkeit in ariden Gebieten. Zeitschr. f. Geomorph. 14:79–95. Berlin.
Whiteman, A. J. 1971. The geology of the Sudan Republic. Clarendon Press. Oxford.

Geo-morphodynamics and climatic development in Sudan

Akhtar, M. 1991. Das Naturpotential verschiedener ökosystemeinheiten im sudanesischen Sahel. -In: Göttinger Forschungsprojekte im Sudan. Ed. Horst G. Mensching & Horst Seifert, Göttingen. Publication: Akad. d. Wiss. Göttingen: 15–23.
Akhtar, M. & H.G. Mensching 1993. Desertification in the Butana. GeoJournal, vol. 28, forthcoming.
Frenzel, B. 1988. Projektgruppe, Terrestrische Paläoklimatologie1, Jahresbericht. -In: Jahrbuch d. Akad. d. Wiss. u. d. Lit. Mainz: 195–218.
Gießner, K. 1991. Jebel-Marra-Region: Relief, Formenschatz und Morphodynamik. -In: Göttinger Forschungsprojekte im Sudan. Ed. Horst G. Mensching & Horst Seifert, Göttingen. Publication: Akad. d. Wiss. Gottingen: 25–74.
Gläser, B. 1987. Altdünen und Liminite in der nördlichen Republik Sudan als morphogenetisch-paläoklimatische Anzeiger. Publication: Akad. d. Wiss. Göttingen.
Haarmann, V. 1986. Naturpotential und Grenzen der Landnutzung im Südsahel des südöstlichen Jebel-Marra-Vorlandes (Darfur/Republik Sudan). Publication: Akad. d. Wiss. Göttingen.
Ibrahim, F. N. 1980. Desertification in Nord-Darfur -Untersuchungen zur Gefahrdung des Naturpotentials durch nicht angepaßte Landnutzungsmethoden in der Sahelzone der Republik Sudan. Hamburger geographische Studien, vol. 35.
Mensching, H.G. 1984. Das Relief der Jebel-Marra-Achse und des Vorlandes – Eine Einführung in das morphodynamische Prozeßgefüge. – In: Beiträge zur Morphodynamik im Reliefdes Jebel-Marra-Massivs und in seinem Vorland (Darfur/Republik Sudan). Publication: Akad. d. Wiss. Göttingen: 17–31.
Mensching, H.G. & H. Pflaumbaum 1989. Zur quantitativen Palaoklimatologie des Jungquartars im Nordsudan und im mittleren Niltal -In: Klimaforschungsprogram Status-seminar, München: 477–478.
Pflaumbaum, H. 1987. Waditerrassen- und Fußflächengenese in der Bayuda-Wüste (Republik Sudan). Publication: Akad. d. Wiss. Göttingen.
Pörtge, K.-H. & H. Pflaumbaum 1991. Satellitenbildgestlitzte Analyse von Veränderungen der Entwässerungssysteme im Nordsudan. Z. Geomorphl N.F., Suppl. vol. 89: 111–123.

Continental humidity and marine upwelling strength of Arabia during the early Holocene

Clemens, S. , Prell, W.L. , Murray, D. , Shimmield, G. & Weedon, G. (1991) Nature 353, 720–725.
Kutzbach, J.E. and Guetter, P.J. (1986). The influence of changing orbital parameters and surface boundary conditions on climate simulations for the past 18 000 years. Journal of the Atmospheric Science, 43, No. 16, 1726–1759.
McClure, H.A. (1976). Radiocarbon chronology of late Quaternary lakes in the Arabian Desert. Nature, 263, 755–756.
Prell, W.L. , Hutson, W.H. , Williams, D.F. , Be, A.W. , Geitzenauer, K. and Molfino, B. (1980). Surface circulation of the Indian Ocean during the last glacial maximum, approximately 18,000 yr B.P., Quaternary Research, 14, 309–336.
Sirocko, F. (1991): Deep-Sea sediments of the Arabian Sea: a paleoclimatic record of the Southwest Asian summer monsoon. Geologische Rundschau., 80, 557–566.
Sirocko, F. and Sarnthein, M. (1989). Wind-borne deposits in the Northwestern Indian Ocean: record of Holocene sediments versus modern satellite data. In: M. Leinen and M. Sarnthein (Eds.), 401–433. NATO ASI Series C 282, Kluwer Academic Publishers, Dordrecht, Boston, London.
Sirocko F. , Sarnthein, M. , Lange, H. & Erlenkeuser, H. (1991): Atmospheric summer circulation and coastal upwelling in the Arabian Sea during the Holocene and the last glaciation, Quaternary Research, 36,72–93.
Sirocko, F. , Sarnthein, M. , Erlenkeuser, H. , Lange, H. & Arnold, M. , Duplessy, J.C. , 24,000 year chronology of monsoonal climate on secular scales (subm.).
Street-Perrot, F.A. , Mitchell, J.F.B. , Marchand, D.S. & Brunner, J.S. (1990). Milankovitch and albedo forcing of the tropical monsoons: a comparison of geological evidence and numerical simulations. Transactions of the Royal Society of Edinburgh: Earth Sciences, 81,407–427.
van Campo, E. , Duplessy, J.C. and Rossignol-Strick, M. (1982). Climatic conditions deduced from a 150-kyr oxygen isotope-pollen record from the Arabian Sea. Nature, 296, 56–59.

The antropogenic nature of the Sahel

Gauthier, A. 1987.Prehistoric man and cattle in North Africa. A dearth of data and a surfait of models In: Close, A. (eds.) Prehistory of arid North Africa, Dallas, p.163–187.
Grebenart, D. 1985. Le neolithique final et les debuts de la metallurgie. Etudes nigeriennes 49, Niamey 418 p.
Haynes. C.V. , Eyles, C.H. , Pavlist, L.A. Ritchie, J.C. & M. Rybak . 1989. Holocene palaeoecology of the eastern Sahara: Selima oasis. Quaternary Science Review, 8, p.100–136.
Neumann, K. (1988).Die Bedeutung von Holzkohleuntersuchungen fur die Vegetationsgeschichte der Sahara – das Beispiel Fachi/Niger. -Wurzburger Geogr. Arb., 69, p. 71–85.
Pomel, S. , Pomel-Rigaud, F. & E. Schuiz , 1992. Indicateurs anthropogènes de la végétation et des sols de quelques savanes de 1 Afrique de l'Ouest. Publ. CEGET. in press.
Pomel. S. Schulz, E. , Baumhauer, R. Schultze & B. Sponholz ,1992, Changing andscapes near the boundary of savannas during the Holocene.: Segedim (Kawar,NE-Niger) Human and climatic interaction. In prep.
Schulz E. , 1991.Holocene environments in the central Sahara.Hydrobio-logia, 214, p. 359–365.
Schuiz, E. & A. Adamou . 1992 Leben am Sudrand der Sahara. Die Vegetation des Air-Gebirges (Nord-Niger) und ihre traditionelle Nutzung. AbschluBbericht. VW-Stiftung. Wurzburg 188 p
Schulz, E. , Joseph, A. Baumhauer R. Schultze, E. & B. Sponholz , B 1990.Upper Pleistocene and Holocene history of the Bilma region (Kawar.NE-Niger).Recent data in African earth sciences. CIFEG Occ. Publ. 22, p.281–284.
Servant, M. 1983 Sequences continentales et variations climatiques. Evolution du bassin du Tchad au Cénocoiques superieur. Trav. et Doc. de l'ORSTOM 159, 573 p.
Smith.S. , 1980: The environmental adaptation of nomads in the West African Sahel. A key to understanding prehistoric pastoralists. In: Williams M.J. and Faure, H. (eds): The Sahara and the Nile. Rotterdam, p. p.476–488.

Environment and culture: The adaptation paradigm in the study of the Holocene Saharan societies

Barich, B.E. 1987. Adaptation in archaeology an example from the Libyan Sahara. In A.E. Close (ed.), Prehistory of Arid North Africa,p.189–210,Dallas:SMU.
Brandt, S.A. 1988. Early Holocene mortuary practices and hunter-gatherer adaptations in southern Somalia. World Archaeology 20/1:40–56.

Hassan, F.A. 1988. The Predynastic of Egypt. Journal of World Prehistory 2/2:135–185.
Hassan, F.A. & G.T. Gross 1987. Resources and subsistence during the early Holocene at Siwa oasis, northern Egypt. In A.E. Close (ed.),Prehistory of Arid North Africa,p.85–103, Dallas:SMU.

Holocene prehistoric economies in the Eastern Sahara and their impact on vegetation

Close, A. 1992. Holocene occupation of the Eastern Sahara. In F. Klees & R. Kuper (eds.), New Light on the Northeast African Past, p. 155–183. Cologne: Heinrich-Barth-Institut.
Gautier, A. 1987. Prehistoric man and cattle in North Africa. In A. Close (ed.), Prehistory of Arid North Africa, p. 163–187. Dallas: Southern Methodist Univ. Press.
Le Houerou, H.N. 1989. The grazing land ecosystems of the African Sahel. Berlin: Springer.
Neumann, K. 1989. Holocene vegetation of the Eastern Sahara: charcoal from prehistoric sites. Afr. Arch. Rev. 7: 97–116.
Neumann, K. in press. Wirtschaftsweisen im Neolithikum der Ostsahara und ihr Einfluß auf die Vegetation. In H. Bollig & F. Klees (eds.), Uberlebensstrategien in Afrika. Cologne: Heinrich-Barth-Institut.
Ritchie, J.C. & C.V. Haynes 1987. Holocene vegetation zonation in the Eastern Sahara. Nature 3 30: 645–647.
Smith, A.B. 1984. The origins of food production in Northeast Africa. Palaeoecology of Africa 16: 317–324.

The evolution of the Nile Delta

Attia, M.J. 1954. Deposits in the Nile Valley and Delta. Geological Survey Egypt, Cairo.
Coutelier, U. & D.J. Stanley . 1987. Late Quaternary stratigraphy and paleogeography of the eastern Nile delta, Egypt. Marine Geology. 77:257–275.
Wunderlich, J. 1987. Investigations on the development of the Western Nile Delta in Holocene times. In: The Archaeology of the Nile Delta, Egypt. Netherlands Foundation Archeological Research Egypt. 251–257.

Stratigraphy, geochronology, and origin of the Selima Sand Sheet, eastern Sahara, Egypt and Sudan

Bagnold, R.A. 1931. Journeys in the Libyan Desert. Geographical Journal 78: 13–39, 524–535.
Haynes, C.V., Jr. 1982. Great Sand Sea and Selima Sand Sheet: Geochronology of desertification. Science 217: 629–633 (on the cross section of Fig. 4 the north and south should be reversed).
Haynes, C.V., Jr. 1985. Quaternary studies, Western Desert, Egypt and Sudan-1979–1983 field seasons. National Geographic Society Research Reports 16: 269–341.
Haynes, C.V., Jr. 1986. Geochronology and paleoclimate reconstruction, eastern Sahara: A summary report to the General Petroleum Company, Egypt. Unpublished manuscript, 34 pp.
Haynes, C.V., Jr. 1989. Bagnold's barchan: A 57-yr record of dune origin and paleoclimate since Neolithic times. Quaternary Research 32: 153–167.
Haynes, C.V., Jr. & D.L. Johnson . 1984. A provisional soil chronosequence for the Quaternary of the eastern Sahara. Geological Society of America Abstracts with Programs 16: 534–535.
Maxwell, T.A. & C.V. Haynes, Jr. 1987. Sand transport rates measured from large scale bedforms in the sand sheet environment of western Egypt and northern Sudan. Geological Society of America Abstracts with Programs 19: 762–763.
McCauley, J.F. , G.G. Schaber , C.S. Breed , M.J. Grolier , C.V. Haynes, Jr., B. Issawi , C. Elachi & R. Blom . 1982. Subsurface valleys and geoarchaeology of the eastern Sahara revealed by Shuttle radar. Science 218: 1004–1020.
McCauley, J.F. , C.S. Breed , G.G. Schaber , W.P. McHugh , B. Issawi , C.V. Haynes, Jr. , M.J. Grolier & A. El Kilani . 1986. Paleodrainages of the eastern Sahara—The radar rivers revisited (SIR-A/B Implications for a Mid-Tertiary trans-African drainage system). Institute of Electrical and Electronics Engineers Transactions on Remote Sensing GE-24, p. 624–648.
McHugh, W.P. , J.F. McCauley , C.V. Haynes, Jr. , C.S. Breed & G.G. Schaber . 1988. Paleorivers and geoarchaeology in the southern Egyptian Sahara. Geoarchaeology 3: 1–40.
Pachur, H.J. , H.P. Röper , S. Kröpelin & M. Goschin . 1987. Late Quaternary Hydrography of the Eastern Sahara. Berliner Geowissenschaftliche Abhandlungen, Reihe, A/B/ and 75.2, p. 331–384.

Szabo, B.J. , W.P. McHugh , G.G. Schaber , C.V. Haynes, Jr. & C.S. Breed . 1989. Uranium-series dated authigenic carbonates and Acheulian sites in southern Egypt. Science 243: 1053–1056.
Szabo, B.J. , C.V. Haynes, Jr. & T.A. Maxwell . n.d. Ages of Quaternary pluvial episodes determined by uranium-series and radiocarbon dating of lacustrine deposits of eastern Sahara. Manuscript in preparation.
Wendorf, F. & R. Schild . 1980. Prehistory of the Eastern Sahara. New York: Academic Press.
Wendorf, F. , A.E. Close , R. Schild , A. Gautier , H.P. Schwarz , G.H. Miller , K. Kowalski , H. Krolic , A. Bluszcz , D. Robins , R. Grun R . & C. McKinney . 1989. Chronology and stratigraphy of the middle Paleolithic at Bir Tarfawi, Egypt. In Lower and Middle Paleolithic of Africa (edited by J.D. Clark). Proceedings of the XIth Congress of the International Union of Pre- and Protohistoric Sciences.
Wendorf, F. , A.E. Close , R. Schild & K. Wasylikowa . 1991. The Combined prehistoric Expedition: Results of the 1990 and 1991 seasons. Newsletter of the American Research Center in Egypt 154: 1–8.

Late Pleistocene basinal sediments, Dakhla Oasis region, Egypt: A non-interglacial pluvial

Berger, A.L. 1978. Long-term variations of caloric insolation resulting from Earth's orbital elements. Quat. Res. 9: 139–167.
Brookes, I.A. 1989. Early Holocene basinal sediments of the Dakhleh Oasis region, south-central Egypt. Quat. Res. 32: 139–152.
Brookes, I.A. in review. Geomorphology and Quaternary geology, Dakhla Oasis region, Egypt. Quat. Sci. Revs.
Klitszch, E. , F.K. List & G. Pöhlmann . 1987. Geological Map of Egypt, Sheet NG35SE -Dakhla, 1:500,000. Cairo: Conoco Coral – Egyptian General Petroleum Company.
Magee, J.W. 1991. Late Quaternary lacustrine, groundwater, aeolian and pedogenic gypsum in the Prungle Lakes, southeastern Australia. Palaeogeog., Palaeoclim., Palaeoecol. 84: 3–42.
Short, D.A. , J.G. Mengel , T.J. Crowley , W.T. Hyde & G.R. North . 1991. Filtering of Milankovitch cycles by Earth's geography. Quat.Res. 35: 157–173.
Wendorf, F. & 11 others. 1991. Chronology and stratigraphy of the Middle Palaeolithic at Bir Tarfawi, Egypt. Romisch-Germanisches Zentralmuseum (Bonn), Monographs 19:197–208.

Calcretes in the Western Desert of Egypt

Goudie, A.S. 1973. Duricrusts in tropical and subtropical landscapes. 174 pp., Oxford (Clarendon Press).
Issawi, B. 1978. Quaternary geology of Bir Sahara, Western Desert, Egypt. Ann. Geol. Surv. Egypt, 8:295–304.
Machette, M.N. 1986. Cited in: McCauley, J.F. , C.S. Breed , G.G. Schaber , W.P. McHugh , B. Issawi , C.V. Haynes , M.J. Grolier & A. El Kilani 1986. Paleodrainages of the eastern Sahara – The radar rivers revisited. IEEE Transactions on Geoscience and Remote Sensing GE-24, 4: 624–648.
McHugh, W.P. , J.F. McCauley , C.V. Haynes , C.S. Breed & G.G. Schaber 1988. Paleorivers and geoarchaeology in the Southern Egyptian Sahara. Geoarchaeology 3,1: 1–40.
Pachur, H.-J. , H.-P. Röper , S. Kröpelin & M. Goschin 1987. Late Quaternary hydrography of the Eastern Sahara. Berliner geowiss. Abh. (A) 75.2: 331–384.
Pachur, H.-J. , S. Kröpelin , P. Hoelzmann , M. Goschin & N. Altmann 1990. Late Quaternary fluvio-lacustrine environments of Western Nubia. Berliner geowiss. Abh. (A) 120.1:203–260.
Reeves, C.C. Jr. 1976. Caliche. Origin, classification, morphology and uses. 233 pp. Lubbock/Texas (Craftsman).
Röper, H.-P. 1985. Calcareous crusts in Southwest Egypt. Paper presented at the Workshop "Limnic sedimentation as indicators of the late Pleistocene and early Holocene climatic conditions", Special Research Project 69, 9.12.1985, Technical Univ. Berlin.
Röper, H.-P. 1988. Kalkkrusten in Sädwest-Agypten. Bochumer geol. u. geotechn. Arb. 29: 163–166.
Said, R. 1980. The Quaternary sediments of the South Western Desert of Egypt: An overview. In: Prehistory of the Eastern Sahara, F. Wendorf & R. Schild , 281–284.
Szabo, B.J. , W.P. McHugh , G.G. Schaber , C.V. Haynes, Jr. & C.S. Breed 1989. Uranium-series dated authigenic carbonates and Acheulian sites in Southern Egypt. Science. 243: 1053–1056.
Wendorf, F. & R. Schild 1980. Prehistory of the eastern Sahara. 414 pp. New York (Academic Press).

Quaternary ferricretes in Northwestern Sudan

Mally, J. 1981. Etudes palynologiques dans le hassin du Tschad et paléoclimatologie de l'Afrique nord-tropicale de 30000 ans à l'édpoque actuelle. Traveaux et documents de l'O.R.S.T.O.M. 129: 150–158.
Schwarz, T. 1992. Produkte und Prozesse exogener Fe-Akkumulation: Eisenoolithe und lateritische Eisenkrusten im Sudan. Berliner Geowiss. Abh. 142.
Pachur, H.-J. , & S. Kröpfilin & P. Hoelzmann & M. Goschin & N. Altmann . 1990. Late Quaternary fluvio-lacustrine environments of Western Nubia. Berliner Geowiss. Abh. 120.1: 206–260.

Desiccation cracks in sandy desert soils

Alaily, F. 1985. Nicht-hydrogene und hydrogene Bodenmerkmale in der Zentral-Sahara. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft 43 (2): 705–710.
Alaily, F. 1986. Cracks in Sandy Soils of the Extreme Arid Part of the Sahara. Transactions of the XIII. Congress of the International Society of Soil Science, Hamburg. Vol. III: 1023–1024.
Alaily, F. 1987. Genesis of Cracks in Sandy Soils of Central East Sahara: A Hypothesis. Catena 14 (4): 345–357.
Bhrnatzik, W. 1947. Baugrund und Physik. Zurich: Schweizer Druck- und Verlagshaus.
Blume, H.-P. 1986. Zur Bildung sandgefällter Spalten in sandigen Wästenböden. Zeitschrift fur Pflanzenernahrung und Bodenkunde 149: 347–349.
Blijme, H.-P. & T. Petermann . 1979. Yermosol-Solonchak-Bodenschaft des Fezzan. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft 29: 799–820.
Hartge, K. H. & R. Horn . 1991. Einfuhrung in die Bodenphysik. Stuttgart: Enke.
Pachur, H.-J. & G. Braun . 1982. Aspekte paläoklimatischer Befunde in der östlichen Zentralsahara. Geomethodica 7: 23–54.
Ravina, I. 1983. The influence of vegetation on moisture and volume changes. Géotechnique 33 (2): 151–157.

Dust formation and transport in the Sahara and adjacent regions

Coude-Gaussen, G. & Rognon, P. 1983. Les poussieres sahariens. La Recherche, 147, p. 1050–1061.
Cour, P. & Duzer, D. 1976. Persitence d'un climat hyperaride du Sahara central et meridional au cours de l'Holocéne. Rev. de Geogr. phys et de Géol dyn., 2, 18, p. 175–198.
Schulz, E. 1990 Zwischen Syrte und Tschad. Der aktuelle Pollenniederschlag in der Sahara. Berliner Geogr. Studien, 30, p. 193–220.
Schulz, E. , & Pomel. S. 1992.- Feuer und Staub. Kamerun in der Trockenzeit. Mitteil. Univ. Würzburg. in press.

Holocene fulgurite formation in the southern Central Sahara (Niger)

Durand, A. & J. Lang 1986. Approche critique des méthodes de reconstitution paléoclimatique: le Sahel nigéro-tchadien depuis 40.000 ans. Bulletin de la Societé geologique de France 8 (II/2): 267–278.
Grunert, J. 1988. Klima- und Landschaftsentwicklung in Ost-Niger während des Jungpleistozäns und Holozäns. Würzburger Geographische Arbeiten 69: 289–304.
Julien, A.A. 1901. A study of the structure of hlgurites. Journal of Geology 9: 289–304.
Neumann, K. 1988. Die Bedeutung von Holzkohleuntersuchungen fär die Vegetationsgeschichte der Sahara – Das Beispiel FachiNiger.- Wurzburger Geographische Arbeiten 69: 71–86.
Schulz, E. 1987. Die holozane Vegetation der zentralen Sahara (N-Mali, N-Niger, SWLibyen). Palaeoecology of Africa 18: 143–161.
Servant, M. 1983. Sequences du Bassin du Tchad au Cenozoique Superieur. Travaux et Documents de l'ORSTOM 159: 1–573.
Völkel, J. 1989. Geomorphologische und pedologische Untersuchungen zum jungquartaren Klimawandel in den Dunengebieten Ost-Nigers (Sudsahara und Sahel). Bonner Geographische Abhandlungen 79: 1–258.

Preliminary observations concerning the genesis of high fluoride contents in the Ethiopian Rift

Chernet, T. 1982 Hydrogeology of the Lakes Region. Ministry of Mines and Energy, Ethiopian Institute of Geological Surveys, memoir n°.1.

Gueddari, M. 1984 Géochimie et thermodynamique des évaporites continentales. Etude du lac Natron en Tanzanie et du Chott El Jerid en Tunisie. Sci. Géol., mémoire n° 76, 143p.

Scripps Institution of Oceanography 1977 Isotope geochemistry and hydrology of geothermals waters in the Ethiopian rift Valley.Isotope laboratory, University of California, SIO ref. number 77–14, 140p.

Travi, Y. 1988 Hydrogéochimie et hydrologie isotopique des aquifères fluorurés du bassin du Sénégal. Origine et conditions de transport du fluor dans les eaux souterraines. Thèse Doct. ès Sciences, Univ. Paris XI, 198p.

UNDP 1973 Geology, geochemistry and hydrology of hot springs of the East Africain Rift System Within Ethiopia. Technical report, 180p.

Wenner, C. G. 1973 A master plan for water ressources and supplies in the Chilalo awraja. Cades publication n° 89, Assela.

Comparison of the mineral composition of the lakes of the East African Rift system (Gregory Rift and Western Rift)

Baker, B. H. , Mohr, P. A. & L. A. Williams . 1972. Geology of the Eastern Rift System of Africa. Geol. Soc. America Spec. Pap. 136: 1–67.

Beadle, L. C. 1981. The inland waters of tropical Africa. 476 ps,London and New York: Longman.

Cerling, T. E. 1979. Paleochemistry of Plio-Pleistocene Lake Turkana, Kenya. Palaeogeogr., Palaeoclimat., Palaeoecol. 27: 247–285.

Kilham, P. & R. E. Hecky . 1973. Fluoride: Geochemical and ecological significance in East African waters and sediments. Limnol. Oceanogr. 18: 932–945.

Tailing, J. F. & I. B. Tailing . 1965. The chemical composition of African lake waters. Int. Rev. Ges. Hydrobiol. 50: 421–463.

Yuretich, R. F. Possible influences upon lake development in the East African rift valleys. J. Geol. 90: 329–337.

Isotopes and chemistry in ground water of Western Sudan and Eastern Chad (Geneina and Adré region)

Blavoux, B. 1978. Etude du cycle de l‘eau au moyen de l‘oxygène-18 et du tritium. Possibilités et limites de la méthode des isotopes du milieu en hydrologie de la zone tempérée. Thèse d‘Etat. Université Pierre et Marie Curie, Paris 6.

B.R.G.M. et Aquater , 1986. La charge naturelle des aquifères de socle sous climat sahèlien et soudanien. Rapport d‘ètude expèrimental du Burkina Faso-86-BFA177-EAU.

N.W.C. TNO-DGV , 1985. Geneina water resources study. (N.W.C : National Water Corporation-Sudan, TNO-DGV : Institute of Applied Geoscience-Netherlands).

Ousmane, B. , Fontes, J-Ch. , Aranyossy, F.-F. , Joseph, M. , 1983. Hydrologie isotopique et hydrochimie des aquifères discontinus de la bande sahélienne et de l‘;Aïr (Niger). I.A.E.A. SM-270759. Vienne.

Paces, T. , 1972. Chemical characteristics and equilibration in natural water gelsic rock-CO2 system. Geochim. et Cosmochim. Acta. 37, 217–240.

Sonntag, C. et al., 1979. Paleoclimatic information from deuterium and oxygen-18, in carbon-14 dated North Saharian ground waters : ground water formation in the past. In : isotope Hydrology 1978 Vienna, Austria, 1979.

Vail, J.R. , 1978. Outline of the Geology and Mineral deposits of the Demecratic Republic of the Sudan and Adjacent Areas. Inst. of Geological Sciences, London, UK.

Isotopic evidence for extremely low groundwater recharge in the Sahel zone of Sudan

Dubief, J. 1959. Le climat du Sahara. Bd.l. Algier : I.R.F. Memoires.

Mazor, E. 1972. Paleotemperatures and other hydrological parameters deduced from noble gases dissolved in groundwaters, Jordan Rift Valley, Israel. Ge-ochimicaet Cosmochimica Acta, 36 : 1321–1336.

Rodis, H.G. , Hassan, A. , Wahadan, L. 1963. Ground water geology of Kordofan province. Ministry of Mineral Resources of Sudan, Geological Survey Department, Bulletin No. 14.
Thorvveihe, U. . Brinkmann. J. , Ileinl, M. . Sonntag, C. 1990. Hydrological and hydrogcological investigations in the Darfur area, Western Sudan. Berliner geowiss. Abh.. 120.1 : 279 326. Berlin.

Ground water recharge in the Umm Kedada Basin, NW-Sudan, derived from environmental isotopes of soil moisture in samples collected from deep dug wells

Christmann, D. 1986. Grundwasser-Verdunstung aus unbewachsenen Böden ostsaharischer Senken anhand von Deuterium und Sauerstoff-18 in der Bodenfeuchte. *Dissertation am Institut für Umweltphysik, Heidelberg*.
Christmann, D. & C. Sonntag 1987. Ground water evaporation from East-Saharan depressions by means of Deuterium and Oxygen-18 in soil moisture. IAEA-SM-299/37, Vienna, 1987, pp. 189–204.
Edmunds, W.M. , C.B. Gaye , J.C. Fontes 1991. A Record of Climatic and Environmental Change Contained in Interstitial Waters from the Unsaturated Zone of Northern Senegal. IAEA-SM-319/35, Vienna, 1992.
Gröning, M. , C. Sonntag , A. Suckow , U. Thorweihe 1993. Isotopic evidence for extremely low ground water recharge in the Sahel Zone of Sudan. *This meeting.*
Sonntag, C. 1992. Environmental isotopes and noble gases in brines from the Konrad iron mine, Salzgitter. IAEA-SM-319/14, Vienna, 1992.
Thorweihe, U. , P.J. Brinkmann , M. Heinl , C. Sonntag 1990. Hydrological and Hydrogeological Investigations in the Darfur Area, Western Sudan. Berliner geowissenschaftliche Abhandlungen, A, 120.1, 1990, pp. 279–326.

Groundwater balance of the sedimentary aquifer in Darfur, Upper Nile area, Sudan

Abdel Razig Mukhtar (Mohamed) (1975): Hydrogeology of Shagera Basin with Reference to the Water-Supply of El Fasher town, M.Sc. thesis, unpublished, University of Khartoum.
BRGM (Bureau de Recherches Geologiques et Minières) (1984): Rural Water Supply Project in Western Sudan, Water resources and requirements study, Final report, unpublished, Orleans.
Brinkmann , Paul J. (1991): Niederschlagsverhältnisse und Grundwasserneubildung in Darfur (Sudan). Mitt. Nr. 121, Inst.f.Wasserbau u. Wasserwirtsch. TU Berlin.
Chan , Siu-On , Eagleson Peter S. (1980): Water Balance Studies of the Bahr El Ghazal Swamp. MIT R.M.Parsons Lab. Rep.No.261 (AID, USDS), Cambridge, Mass.
Howard Humphreys & Partners (1983): El Fasher Water Supply, Final Report, Draft, unpublished, Leatherhead.
Hunting Geology & Geophysics Ltd. , Sir M. Macdonald & Partners (1969-70): Water Survey and Development Project in Darfur Province, unpublished, London.
Hunting Technical Services Ltd. (1976): Sag el Na'am Evaluation and Preinvestment Study, unpublished, Herts, England.
Hunting Technical Services Ltd. , Sir M. Macdonald & Partners (1974): Southern Darfur Land-Use Planning Survey, unpublished, London.
Hunting Technical Services Ltd. , Sir M. MacDonald & Partners (1976): Savanna Development Project, unpublished, London.
Hunting Technical Services Ltd. , Sir M. MacDonald & Partners (1977): Agricultural Development in the Jebel Marra Area, unpublished, London.
Ibrahim , Fouad N. (1984): Ecological Imbalance in the Republic of the Sudan – with Reference to Desertification in Darfur, Bayreuth.
Kaskous , Hassan M. (1991): Hydrogeology of Sag el Naam Basin, Western Sudan. M.Sc.-Thesis, University of Khartoum.
NWC-WADS (National Water Corporation – Water resources Assessment and Development Project in the Sudan) (1992): Data Bank of Water Wells in Sudan, unpublished, Khartoum.
PRC Engineering Consultants, Inc. (1980): Western Sudan Water Supply Project, unpublished, Denver.
REGWA (Gen.Co.f. Research & Ground Water) (1969-72): Sudan Antithirst Project, Vol. 1–4, unpublished, Cairo.
Rodis, Harry G. , Hassan, Abdulla & Wahadan, Lutfi (1964): Ground water geology of Kordofan province, Geol. Surv. Sudan, Bull. No. 14, Khartoum.
Rural Water Corporation (1990): Daily precipitation for 10 stations in Darfur for the years 1963–1979, unpublished, Khartoum.
Shahin, Mamdouh (1985): Hydrology of the Nile Basin, Amsterdam. Strojexport (1969–76): Geophysical-Hydrogeological Research in Kordofan, Darfur and Upper Nile Provinces. unpublished, Prague.

Sudan Meteorological Service (1990): Daily precipitation for 25 stations in Darfur for the years 1917–1990, unpublished, Khartoum.
Sudan Meteorological Department (1985): Annual Meteorological Report, 35, 1984, Khartoum.
Thorweihe, U. , Brinkmann, P.J. , Heinl, M. & Sonntag, C. (1990): Hydrological and Hydrogeological Investigations in Darfur area, Sudan. in: Berliner Geow. Abh. (A), 120.1, pp.279–326, Berlin.
WAPS 2 (Water resources Assessment Program in the Sudan) , NWC (National Water Corporation) (1985): Geneina Water Resources Study, Final Report, unpublished, Khartoum.
WAPS 2 (Water resources Assessment Program in the Sudan) , NWC (National Water Corporation) (1985): Nyala Water Resources Study, Final Report, unpublished, Khartoum.

Hydrogeology of the Wadi El Milk – Wadi Muqaddam area, northern Sudan

International Atomic Energy Agency 1992. Statistical treatment of data on environmental isotopes in precipitation. Technical reports series no. 331. Vienna.
Jacob, H. 1990. Groundwater research in selected areas of the Northern Sudan using environmental isotopes (2H, 3H, 180). Technical report to the IAEA, unpublished. Vienna.
Kheir, O.M. 1986. Hydrogeology of Dongola area, northern Sudan. Berliner geowiss. Abh., (A), 74 , 81 p., 30 fig., 7 tab.; Berlin.
Krampe, K.-D. , Zaepke, J. Hobler, M. et al. 1979. Sudanese German exploration project technical report, part II, volume A-C: Groundwater resources in Khartoum province. unpublished report. Hannover: GMRD.
Liebermann, L. 1990. Geofaktoren und ein solares Wasserstoff-Energiekonzept in NE-Afrika. Berliner geowiss. Abh., (A), 116 , 81 p., 51 fig., 13 tab.; Berlin.
Saeed, E.M. 1976. Hydrogeology of Khartoum province and northern Gezira area. – Geol. & Min. Res. Dept. Bull. no. 29, 138 p., 36 fig., 14 tab., 6 pla.; Sudan.
Thorweihe, U. & Brinkmann, P.J. & Heinl, M. & Sonntag, C. 1990. Hydrological and hydrogeological investigations in the Darfur area, western Sudan. Berliner geowiss. Abh., (A), 120.1 : 279–326, 21 fig., 9 tab.; Berlin.
Vrbka, P. 1992. Hydrogeologische Untersuchungen im nördlichen Sudan mit Hilfe von Umweltisotopen. Zeitsch. Deu. Geol. Ges., 143: [in press].

Hydrologie drought risk modelling for agricultural areas

Dracup, J.A. , K.S. Lee & E.G. Paulson Jr. 1980. On the definition of droughts. Water Res. Res. 16:297–302.
Hurst, H.E. & P. Phillips 1932a. The Nile Basin, Vol. II, Measured discharges of the Nile and its tributaries (12 supplements 1933–1989). Ministry of Public Works, Egypt, Physical Dept. Paper No. 28, Cairo (Government Press).
Hurst, H.E. & P. Phillips 1933. The Nile Basin, Vol. IV, Ten-day mean discharges of the Nile and its tributaries (12 supplements 1933–1990). Ministry of Public Works, Egypt, Physical Dept. Paper No. 30, Cairo (Government Press).
Klitzsch, E. & E. Schrank (ed.) 1987. Research in Egypt and Sudan, Results of the Special Research Project Arid Areas (Sonderforschungsbereich 69), Period 1984–1987. Berliner Geowiss. Abh., series A, 3 volumes, Berlin.
Klitzsch, E. & E. Schrank (ed.) 1990. Research in Sudan, Somalia, Egypt and Kenya, Results of the Special Research Project “Geoscientific problems in arid and semiarid areas”; (Sonderforschungsbereich 69), Period 1987–1990. Berliner Geowiss. Abh., series A, 2 volumes, Berlin.
McDonald, M.G. & A.W. Harbaugh 1987. A modular three-dimensional finite-difference groundwater flow model. U.S. Department of the Interior, U.S. Geological Survey, Government Press, Reston, Virginia.
NWC, National Water Corporation 1986. Hydrogeological studies and investigations in Northern Sudan, detailed studies of Seleim-Khowi-Qa’ab area. Bonifica Geoexpert, unpublished, Rome.
Reusing, G. 1993. Contribution to the risk analysis of hydrologic droughts based on hydrologic time series of the river Nile. Ph.D. thesis, Technical University of Berlin, Berlin (in preparation).

Nile groundwater interaction modeling in the northern Gezira Plain for drought risk assessment

Al Kabir, M.E.A. & Yakup, El T. (1992): Rural Water Resources in Sudan.- Intern report for the Sudan Investment Map Committee, National Water Corporation, 100/76, Khartoum.

Alim, H.N. , Malk, A.I. & Sinnary, Z.A. (1989): Draft Report of White Nile New Bridge Site Investigation.- Min. of Energy & Mining, Geol. Research Authority of the Sudan, Eng. Geology & Geotechniques Adm., unpublished report, Khartoum.

BGR , (1979): Groundwater Resources in Khartoum Province.- Sudanese German Cooperative Project, Fed. Inst. for Geos. and Nat. Res. (BGR), Hannover.

Bousni, J.M. (1972): The shallow groundwater of the Gezira Formation at Khartoum and the northern Gezira area, Sudan.- Sudan Notes and Records vol.53, pp. 154 – 163. Khartoum.

El Din, G.A. & Omer, M.K. (1966): The Blue Nile Bridge Project – Geol. Report.-Geol. Research Authority of the Sudan, unpublished report, Khartoum.

Kheiralla, M.K. (1966): A study of the Nubian sandstone Formation of the Nile Valley between latitudes 14° N and 14°45' N with reference to the groundwater geology.- Thesis Geol. Dept., Univ. Khartoum, 311 p., Khartoum.

Klitzsch, E. & Wycisk, P. (1987): Geology of the sedimentary basins of Northern Sudan and bordering areas.- Berliner geowiss. Abh., (A), 75.1, 97–136, Berlin.

McDonald, M.G. & Harbaugh, A.W. (1987): A Modular Three-Dimensional Finite-Difference Groundwater Flow Model.- U.S. Department of the Interior, U.S. Geological Survey, 528 pp., Reston, Virginia.

Mula, H.G. (1971): A Geophysical Survey of Jebel Aulia Region.- Sudan Notes and Records, Khartoum.

Qureshi, I.R. , Almond, D.C. and Sadig, A.A. (1966): On unusually shaped basalt intrusion in the Sudan.- Bollettino do geofisica teorica ed applicata, vol. 8, No. 30, pp. 151–160, Trieste.

Reusing, G. & Niestlé, A. (1990): An approach for drought risk assessment based on hydrologic records of the River Nile in connection with a groundwater flow model-Berliner geowiss. Abh., (A), 120.2, 1041–1072, Berlin.

Saeed, T.M. (1976): Hydrogeology of Khartoum Province and northern Gezira area.- Geological and Mineral Resources Dept., Bull. No. 29, Khartoum.

Whiteman, A.J. (1971): The geology of the Sudan Republic- 290p., 84 fig., 48 tab., 22 pl., (Clarendon) Oxford.

The groundwater rise in the east of Cairo and its impact on historic buildings

Abd El-Salam, M. 1984. Prevailing characteristics of the Greater Cairo aquifer.- M. Sc. Thesis, Faculty of Engineering, Irrigation and Hydraulics Dept., Cairo University, 220 pp.; Cairo [unpublished].

Abdel Aal, M. E. 1982. Hydrogeological evaluation of the groundwater resources in Cairo district (A.R.E.).- M. Sc. Thesis, Ain Shams University, 140 pp.; Cairo [unpublished].

Amer, A. W. [ed.] 1992. Groundwater effects on Greater Cairo antiques.- Final Report, Faculty of Engineering, Cairo University, 188 pp; Cairo [unpublished].

El-Hatab, I. 1990. Drainage and sewage effects on monuments.- Scientific Statements in Protecting the Egyptian Monuments, Symposium Abstracts: 8; Cairo University; Cairo [unpublished].

El-Kiky, F. 1990. Groundwater effect at Pyramids location.- Scientific Statements in Protecting the Egyptian Monuments, Symposium Abstracts: 9; Cairo University; Cairo [unpublished].

El Sohby, M. A. & Ossama Mazen, S. 1988. Historical development of Greater Cairo subsoil.- In: Marinos, P. G. & Koukis, G. C. [eds.]: The Engineering Geology of Ancient Works, Monuments and Historical Sites, 3: 1427–1434; Rotterdam, Brookfield: Balkema.

Elliot, I. H. & Spolton, R. L. 1985. Greater Cairo wastewater project: design of east bank stage 1 works tunnels.- Proceedings – Institution of Civil Engineers; Part 1. Design and Construction, 78/4: 807–829; London.

Hefny, K. [ed.] 1982. Groundwater studies project for Greater Cairo.- Internal Report, in Arabic and annexes in English. Research Institute for Groundwater and Academy of Research and Technology, 190 pp.; Cairo [unpublished].

Hefny, K. [ed.] 1988. Explanatory notes to the hydrogeological map of Egypt.-RIGW/IWACO, Technical Note No. 70.120–88–04; Cairo.

Korany, E. A. & Abdel Aal, M. E. 1988. Groundwater response in the urban sectors of Cairo environs, Egypt.- In: Hydrological Processes and Water Management in Urban Areas. Urban Water '88: Proceedings of the Conference: 429–436; Duisburg.

Sabry, M. A. 1990. Antique mechanical stability and supporting soil.- Scientific Statements in Protecting the Egyptian Monuments, Symposium Abstracts: 18; Cairo University; Cairo [unpublished].

Shahin, M. M. A. 1987. Groundwater resources in Egypt: potentials and limitations. - IAHS-AISH-Publ., 164: 179–192; Wallingford.

Shata, A. A. 1988. Geology of Cairo, Egypt.- Bull. Assoc. Eng. Geologists, XXV/2: 149–183.

Sherif, M. M. 1992. Effect of groundwater on Greater Cairo antiques.- In: Amer, A. [ed.] Groundwater effects on Greater Cairo antiques.- Final Report, Faculty of Engineering, Cairo University, IV.1–IV.22; Cairo [unpublished].

Estimating the groundwater balance of the Eastern Sahara stimulated by isotope studies

Ahmad, M.U. 1983. A quantitative model to predict a safe yield for well fields in Kufra and Sarir Basins, Libya. Ground Water, 21, 1, 58–66.

Christmann, D. & C. Sonntag 1987. Groundwater evaporation from East Saharian depressions by means of deuterium and oxygen-18 in soil moisture. Proc. Symp. on Isotope Techniques in Water Resources Development, IAEA, Vienna, 189–204.

Kontny, J. 1992. Grundwasserverdunstung in ostsaharischen Senkengebieten unter besonderer Berücksichtigung der Transpiration wild wachsender Vegetation. Dissertation, Fachbereich 16, TU Berlin.

Schneider, M. 1986. Hydrogeologie des Nubischen Aquifersystems am Südrand des Dakhla-Beckens, Südägypten/Nordsudan. Berliner geowiss. Abh., (A), 71, 1–66. Berlin.

Sonntag, C. et al. 1978. Palaoklimatische Information im Isotopengehalt 14C-datierter Saharwässer: Kontinentaleffekt in D und 180. Geol. Rdsch., 67, 2, 413–423, Stuttgart.

Sonntag, C. 1986. A time-dependent groundwater model for the Eastern Sahara. In: U. Thorweihe (ed.): Proc. Workshop on Impact of Climatic Variations on East Saharian Groundwaters – Modelling of large scale Flow Regimes. Berliner geowiss. Abh., (A), 72, 124–134, Berlin.

Thorweihe, U. 1988. Nubian Aquifer System. In: R. Said & C. Squyres (eds.): The Geology of Egypt, 2nd Edition, Elsevier, Amsterdam 1990.

Comparisons between the Nile River, Egypt and the Colorado River, USA

Blackwelder, E. , 1934. Origin of the Colorado River. Bull. Geol. Soc. America 45: 551–566.

Breed, C.S. , 1969. A century of conjecture on the Colorado in Grand Canyon: Guidebook, Arizona Four Corners Geol. Soc. 5th Field Conf.: 63–67.

Dickinson, W.R. , 1989. Tectonic setting of Arizona through geologic time. In Jenney, J.P. , and Reynolds, S.J. , Geologic evolution of Arizona, Tucson, Arizona Geol. Soc. Digest 17: 1–16.

Elston, D.P. , and R.A. Young , 1991. Cretaceous – Eocene (Laramide) landscape development and Oligocene-Pliocene drainage reorganization of Transition Zone and Colorado Plateau, Arizona. J. Geophys. Res. 96 (B7): 12, 389–1312, 406.

Hunt, C.B. , 1969. Geologic history of the Colorado River. U.S. Geological Survey Prof. Paper 669-C.

Issawi, B. , and J.F. McCauley , 1992. The Cenozoic rivers of Egypt: The Nile problem. In Friedman, R. , and Adams, B. (Eds.), Followers of Horus: Studies in Ancient Egypt dedicated to M.A. Hoffman. Oxbow, Oxford: 1–18.

Longwell, C.R. , 1936. Geology of the Boulder Reservoir floor, Arizona-Nevada, Bull. Geol. Soc. America 47: 1393–1476.

Longwell, C.R. , 1946. How old is the Colorado River? American J. Science 244: 817–835.

Lucchitta, I. , 1989. History of the Grand Canyon and of the Colorado River in Arizona. In Jenney, J.P. , and Reynolds, S.J. (Eds.), Geologic evolution of Arizona, Tucson, Arizona Geol. Soc. Digest 17: 701–715.

Lucchitta, I. , 1984. Development of the landscape in northwest Arizona: The country of plateaus and canyons. In Smiley, T.L. et al. (Eds.), Landscapes of Arizona-The geological story. University Press, London: 269–301.

McCauley, J.F. , G.G. Schaber , C.S. Breed , M.J. Grolier , C.V. Haynes , B. Issawi , C. Elachi , and R. Blom , 1982. Subsurface valleys and geoarchaeology of the Eastern Sahara revealed by Shuttle Radar. Science 218 (4516): 1004–1020.

McKee, E.D. , R.F. Wilson , W.J. Breed , and C.S. Breed (Eds.), 1967. Evolution of the Colorado River in Arizona. Bull. Museum North. Arizona: 44.

Said, R. , 1981. The geological evolution of the River Nile. Springer-Verlag: New York.

Water ponding and groundwater contamination in the Nile Delta villages, Egypt

Canadian Council of Resource and Environment Ministry , March 1, 1987. Canadian Water Quality Guidelines, vol. 2, 76–82, Canada.
Fraser, P. and Chilvers, C. 1981. Health aspects of nitrate in drinking water. Science Total Environment, Vol. 18, 103–116.
Hegesh, E. and Shiloah, J. 1982. Blood nitrates and Methemoglobinemia. Clinica Chimica. Act. Vol. 125, pp. 178–189.
Health, R. C. , 1982. Basic Groundwater Hydrology, U.S.Geological survey water-Supply Paper 2220.
EPEA Office of Drinking Water , August 1988. Amended baced on May 22, 1989, fed. Register Vol.54, No.79, 22062.
U.S.Environmental Protection Agency 1984. National Statistical Assessment of Rural Condition, Exective Summary. Office of drinking water.
World Health Organization , 1984. Guidelines for Drinking. Water quality, Vol. 1.

Groundwater and water security in the future of Salalah region

American Society of Civil Engineers & Water Pollution Control Federation , 1986. Design and contribution of sanitary and storm sewers. ASCE Manuals and reports on engineering practice number 37 and WPCF manual of practice number 9.
Atkines, W.S. international 1990. Southern Land use plans for the southern region. Final report PCDESR Sultanate of Oman: Salalah.
Carruthers, I. & Stoner, R. 1981. Economic aspects and policy issues in groundwater development. World bank staff. Working paper number 496.
Food & Agriculture Organization 1984. Crop water requirements. FOA irrigation and drainage paper number 24.
Macdonald, Sir M. & Partners , 1989. Groundwater recharge schemes for Salalah plain. Ministry of Agriculture & Fisheries. Sultanate of Oman Salalah.
Temperley, T.G. 1990. Water desalination report. (various issues) 1987-1990.
U.S. Geological Survey , 1971. A procedure for evaluating environmental impact. 1 Circular 645.

Paired gravity anomalies in the Arabian Shield and their tectonic significance

Al Shanti, A.M.S. and A.H.G. Mitchell 1976. Late Precambrian subduction and collision in the Al-Amar-Idsas region, Arabian Shield, Kingdom of Saudi Arabia. Tectonophysics 30: T41–T47.
Badri , Mohammed 1991. Crustal structure of central Saudi Arabia determined from seismic refraction profiling. Tectonophysics :357–374.
Gettings, M.E. , H.R. Black , W.D. Mooney Jr and J.H. Healy 1986. Crustal structure of southwestern Saudi Arabia. J. Geophys. Res. 91: 6491–6512.
Gibb, R.A. and M.D. Thomas 1976. Gravity signature of fossil plate boundaries in the Canadian Shield. Nature 262: 199–200.
Kröner, A. 1985. Ophiolites and the evolution of tectonic boundaries in the Late Proterozoic Arabian-Nubian Shield of Northeastern Africa and Arabia. Precambrian Res. 27: 277–300.
Makris, J. , C.H. Henke , F. Egloff and T. Akamaluk 1991. The gravity field of the Red Sea and East Africa. Tectonophysics 198: 369–381.
Mooney, W. , M.E. Gettings , H.R. Blank and J.H. Healy 1985. Saudi Arabia seismic deep refraction profile: a traveltime interpretation of crustal and upper mantle structure. Tectonophysics 111: 173–246.
Nawab, Z.A. 1979. Geology of the Al Amar-Idsas region of the Arabian Shield. In S.A. Tahun (edt.), Evolution and mineralization of the Arabian Nubian Shield. King Abdulaziz University, Inst. Appl. Geology Bull. 3: 29–39.
Pallister, J.S. , J.S. Stacy , L.B. Fisher and W.R. Permo 1988. Precambrian ophiolites of Arabia: geologic setting U-pb geochronology, pb-isotope characteristics and implication for continental acceration. Precambrian Res. 38: 1–54.
Sadig, A.A. , D.C. Almond and F. Ahmed 1987. A gravity and magnetic traverse from Port Sudan to Abu Hamad, NE Sudan, J. Afr. Earth Sci. 6: 823–832.
Schmidt, D.L. , D.G. Hardley and D.B. Stoeser 1979. Late Proterozoic crustal history of the Arabian Shield, Southern Najd province, Kingdom of Saudi Arabia. Bull. Ins. Appl. Geology. 3 (2): 41–58.
Stacy, J.B. and A. Agar 1985. U-pb isotopic evidence for the acceration of a continental microplate in Zalm region of the Saudi Arabian Shield. J. Geol. Soc. London 142. 1189–1204.
Stoeser, D.B. and V.E. Camp 1985. Pan-African microplate acceration of the Arabian Shield. Geol. Soc. Amer. Bull. 96: 817–826.

Thomas, M.D. 1983. Tectonic significance of paired gravity anomalies in the southern and central Appalachians. Geol. Soc. Amer. Memoir 158: 113–124.
Thomas, M.D. and R.A. Gibb 1985. Proterozoic plate subduction and collision: Processes for reactivation of Archean crust in Churchhill province. Geol. Assoc. of Canada Spec. Papers 28: 263–279.

Geophysical and geological investigations in the Es Safya Graben, NW Sudan

Aquater (1989): Rural water supply in North Kordofan Province, Final Report, Rome.
Barazi, N. &, Fiedler-Volmer, R. (1993): Extension of the Late Cretaceous transgression to North Kordofan, Central Sudan: this volume.
Bussert, R. , Brasse, H. , Radić, T. & Reynolds, O. (1990): Sedimentation and structural style of a rift-structure in northern Sudan: The Humar Basin, in: Research in Sudan, Somalia, Egypt and Kenya (eds. E. Klitzsch & E. Schrank), Berliner geowiss. Abh. (A), 120: 89–108.
Schandelmeier, H. & Pudlo, D. (1990): The Central African Fault Zone (CAFZ) in Sudan, a possible continental transform fault, in: Research in Sudan, Somalia, Egypt and Kenya (eds. E. Klitzsch & E. Schrank), Berliner geowiss. Abh. (A), 120: 31–44.
Schandelmeier, H. & Richter, A. (1991): Brittle shear deformation in Northern Kordofan, Sudan: late Carboniferous to Triassic reactivation of Precambrian fault systems, J. of Structural Geology, Vol. 13, No. 6: 711–720.
This work was conducted by subproject *Geophysics* of the Special Research Project Geoscientific Research in Arid and Semiarid Areas, funded by the Deutsche Forschungsgemeinschaft, Bonn.

The Cairo Earthquake of October 1992

Al-Ghoneim, A.Y. 1992. Historical record of the earthquakes in Egypt. Al-Ahram Newspaper, 9.11.1992 (in Arabic).
Ambraseys, N.H. 1961. On the seismicity of southwest Asia (from a XV Century Arabic manuscript). Rev. pour l'etude des Calamites (Geneva). p. 37.
Boulos, F.K. 1990. Notes on the geophysical regime in Egypt. In Said, R. (ed.). The Geology of Egypt. 61–90. Balkema.
Dugget, P.H. et al. Seismicity and active tectonics of the Egyptian Red Sea margin and the northern Red Sea. Tectonophysics. 125: 313–324.
Ismail, A. 1960. Near and local earthquakes of Helman (1903–1950). Bull. Helwan Observatory, Egypt. 49: 33pp.
Maamoun, K. 1979. Macroseismic observations of principal earthquakes in Egypt. Bull. Helwan Inst. Astronomy & Geophysics. 183: 12pp.
Maamoun, K. , A. Allam & A. Megahed . 1984. Seismicity of Egypt. Bull. Helwan Inst. Astronomy & Geophysics. 4 (B). 19pp.
Morgan, P. 1990. Egypt in the frame of global tectonics. In Said, R. (ed.). The Geology of Egypt. 91–112. Balkema.
Pollitz, F.F. 1991. Two-stage model of African absolute motion during the last 30 million years. Tectonophysics. 194: 91–106.
Ragab, A.I. & El-Kallouby . 1992. Geodynamic of the Gulf of Suez-Red Sea rifting and origin within plate magmatism. Journal African Earth Sciences. 14: 351–360.
Said, R. 1962. The Geology of Egypt. Elsevier.
Said, R. 1963. Structural setting of Gulf of Suez, Egypt. Sixth World Petroleum Congress, Frankfurt.
Said, R. 1990. Cenozoic. In Said, R. (ed.). The Geology of Egypt, 451–486, Balkema.
Sieberg, G. 1932. Erdbebengeographie. Handbuch der Geophysik. Bd IV, Berlin.
Woodward Clyde Consultants. 1985. Earthquake activity and dam stability for the Aswan High Dam. Ministry of Irrigation, Cairo.

Subsurface mapping with imaging radar in deserts of Africa and Arizona

Berlin, G.L. , M.A. Tarabzouni , A. Al-Naser , K.M. Sheikha , and R.W. Larson 1986. SIR-B subsurface imaging of a sand-buried landscape: Al Labbah Plateau, Saudi Arabia. IEEE Trans. on Geosci. and Remote Sensing, GE-24:595–602.

Blom, R.G. , R.E. Crippen , and C. Elachi 1984. Detection of subsurface features in Seasat radar images of Means Valley, Mojave Desert, California. Geology, 12:346–349.

Breed, C.S. , G.G. Schaber , J.F. McCauley , M.J. Grolier , C.V. Haynes , C. Elachi , R. Blom , B. Issawi , and W.P. McHugh 1983. Subsurface geology of the Western Desert in Egypt and Sudan revealed by Shuttle Imaging Radar (SIR-A): First Spaceborne Imaging Radar Symposium, Jet Propulsion Laboratory Pub. 83–11, Pasadena, Calif. 10–12.

Breed, C.S. , J.F. McCauley , W.J. Breed , C.K. McCauley , and A.S. Cotera 1984. Eolian (wind-formed) landscapes. In Smiley, T.L. et al. (Eds.). Landscapes of Arizona. University Press, London.

Breed, C.S. , J.F. McCauley , G.G. Schaber , A.S. Walker , and G.L. Berlin 1982. Dunes on SIR-A images, In Cimino, J.B. , and C. Elachi (Eds.). Shuttle Imaging Radar-A (SIR-A) Experiment. NASA JPL Publ. 82–77:4–52–4–87.

Breed, C.S. , J.F. McCauley , and P.A. Davis 1987. Sand sheets of the Eastern Sahara and ripple blankets on Mars. In Frostick, L. , and I. Reid (Eds.). Desert sediments: Ancient and Modern. Geol. Sci. Special Publ. 35:337–359 London.

Davis, P.A. , C.S. Breed , J.F. McCauley , and G.G. Schaber 1993. Surficial geology of the Safsaf region, south-central Egypt, derived from remote-sensing and field data. Remote Sensing of Environment:in press.

Farr, T.G. , C. Elachi , P.H. Hartl , and K. Chowdhury 1986. Microwave penetration and attenuation in desert soil: A field experiment with the Shuttle Imaging Radar. IEEE Trans, on Geosci. and Remote Sensing, GE-24:590–594.

Guo, Haudong , G.G. Schaber , C.S. Breed , and A.J. Lewis 1986. Shuttle imaging radar response from sand and subsurface rocks of Alashan Plateau in north-central China: Intern. Symp. on Remote Sensing for Resources Development and Environmental Management, 7th, Proceed: ISPRS Comm. VII, p. 137–143. Enschede, Netherlands: Balkema, Boston.

Henning, D. , and H. Flohn 1977. Climate aridity index map. United Nations Environment Programme: Nairobi.

McCauley, J.F. , G.G. Schaber , C.S. Breed , M.J. Grolier , C.V. Haynes , B. Issawi , C. Elachi , and R. Blom 1982. Subsurface valleys and geoarchaeology of the eastern Sahara revealed by Shuttle radar. Science 218:1004–1020.

McCauley, J.F. , C.S. Breed , G.G. Schaber , W.P. McHugh , B. Issawi , C.V. Haynes , M.J. Grolier , and A. El-Kilani 1986. Paleodrainages of the eastern Sahara-The radar rivers revisited (SIR-A/B implications for a mid-Tertiary trans-African drainage system). IEEE Trans, on Geosci. and Remote Sensing GE-24: 624–648.

Robison, W.C. 1954. Analogs of Yuma climate in northeast Africa: Research Study Rept., U.S. Army Corps of Engineers Environmental Analog Project: (7–83–03–005A).

Schaber, G.G. , J.F. McCauley , C.S. Breed , and G.R. Olhoeft 1986. Shuttle imaging radar: Physical controls on signal penetration and subsurface scattering in the eastern Sahara. IEEE Trans, on Geosci. and Remote Sensing GE-24:603–623.

Ulrich, G.E. , G.H. Billingsley , R. Hereford , E.W. Wolfe , L.D. Nealey , and R.L. Sutton 1984. Map showing geology, structure, and uranium deposits of the Flagstaff 1 degree × 2 degree quadrangle. U.S. Geol. Survey Misc. Invest. Ser. Map 1–1446 (1), 1:250,000.

Van Lopik, J.R. , C.R. Kolb , and J.H. Shamburger 1965. Analogs of Yuma terrain in the northwest African desert. U.S. Army Engineer Waterways Exper. Sta. Tech. Rept. 3–630: Vicksburg, Mississippi.

Von Hippel , Ed. 1954. Dielectrics and waves. New York: Wiley.