BRITISH GEOLOGICAL SURVEY—LIBRARY SERVICES
Serial No. KW 9506
can | Display
copy | Geosystems
Map Lib. | Min. Int.
at. | Min. Stats.
irculate to: Return to KW Library

Bulletin No. 42

MALAŴI
MINISTRY OF AGRICULTURE
AND
NATURAL RESOURCES

GEOLOGICAL SURVEY DEPARTMENT

THE GEOLOGY OF THE CHITIPA-KARONGA AREA

by
G. E. RAY,
B.Sc., Ph.D., M.I.M.M.

PRICE K10.00

1975
PUBLISHED BY THE GOVERNMENT PRINTER, ZOMBA, MALAŴI

The level ground around James Kameme is also a component of this platform. These inland plains are mostly underlain by alluvium and poor sandy ferralitic soils; the broad marshy valleys contain *dambo** soils. These soils overlie gneisses and intrusions of the Misuku Belt which are exposed in small isolated hills rising above the plain surface as to the northeast of Chitipa and around James Kameme.

South of the Chitipa Plain the Mafingi Hills rise about 800 m above the plain surface to a maximum of 2164 m on Namitawa Peak and are formed by the Proterozoic Mafingi Group metasediments.

Northwest of the Chitipa Plain the Ruwenya Hills have elevations between about 1292-1950 m (4000-7650 ft) with Ruwenya (Nangankulu) Hill forming the highest point in the area. The Ruwenya Hills are mainly underlain by cataclastic gneisses of the Misuku Belt.

(b) Drainage

All the rivers in the area ultimately drain into Lake Malaŵi. The major rivers are perennial and include the Songwe, North Rukuru, Sere, Kyungu, Lufira, or Lufilia, Mbalise and Kaseye rivers. The remaining rivers including the Chambo, Nkamasi and Kasisi are seasonal.

The minor streams and the rivers, particularly in the Misuku Hills, are strongly controlled by the northwest regional strike and form a reticulate drainage pattern. However, many of the larger rivers cut acutely across the regional strike. Such rivers, like the Kaseye, Kanga and North Rukuru, appear to be controlled by faults or jointing. Other rivers, including the Lufira, Chambo and Kasisi, have incised meanders and probably follow superimposed drainage courses that were established before the uplift and subsequent downcutting.

(c) Geomorphology

Erosion surfaces in the area are briefly described by Lister (1967). The most extensive erosion surface is the late-Cretaceous to early-Miocene African surface (Fig. 3). This is best developed on the undulating inland Chitipa and James Kameme Plains. In the Misuku Hills, Ruwenya Hills and in the Plateaux and Hills of the Upper Lufira Valley, the African surface is distinctly uneven and contains numerous residuals of the Post-Gondwana surface.

The Post-Gondwana surface of early- to mid-Cretaceous age, occurs in the Mafingi, Mugesse and Misuku Hills where it contains minor residuals of the Gondwana (Jurassic) surface. In the northwest relics of these two surfaces occur in the Ruwenya Hills and represent a north-westerly rise in elevation of these surfaces relative to their more extensive development to the south on the Nyika Plateau. This height rise was probably caused by post-Jurassic tilting.

The Post-African erosion surface of late-Miocene to Pliocene age is present in the Rift Scarp zone and extends northwards to the Songwe river. Tertiary and later faulting, including renewed movement along earlier faults is responsible for the scarp features in this area. Post-African erosion by the Chambo, Kalenje, Lufira and Mbalizi rivers has dissected the African surface east of Kapoka and Chisenga. To the north Post-African erosion by the Songwe and Kaseye rivers has dissected the African surface even further to the west.

The Lakeshore Plain marks the Quarternary retreat of Lake Malaŵi to its present shoreline and is mainly of Quaternary depositional origin, though in Recent times erosion has predominated. Quaternary erosion of the Post-African surface has been caused by the Mwesia river and by the Songwe river as far as the Makeye confluence.

* Chichewa. broad, grass covered swampy valley(s).

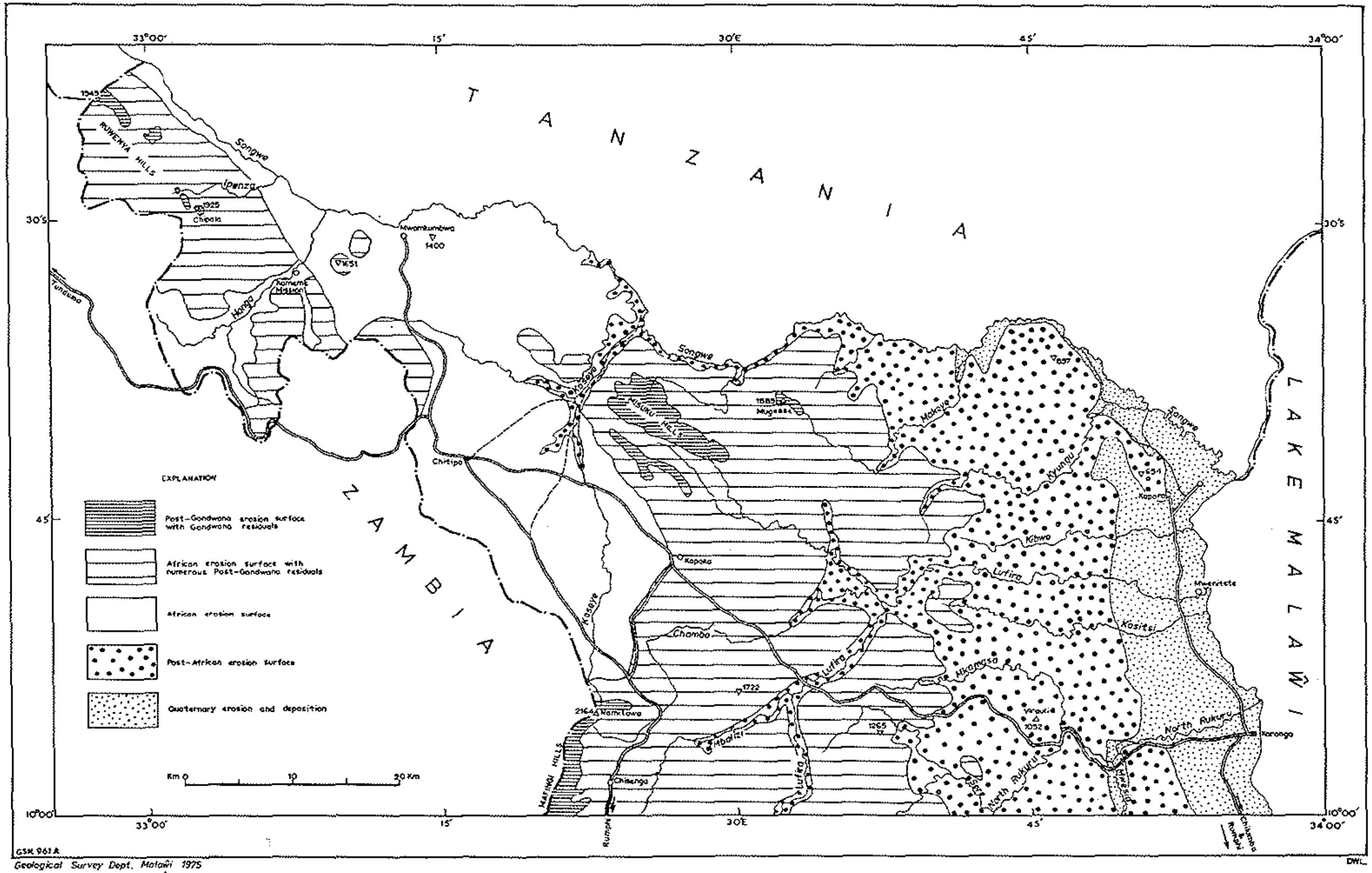

FIG. 3. Erosion surfaces in the Chitipa–Karonga area.

Analyses by the Atomic Energy Division of the Geological Survey of Great Britain (Mineralogical Report No. 630) gave an average radiometric assay of 0,03 per cent $eThO_2$ and showed that monazite was the principle radioactive constituent. Monazite formed less than 0,4 per cent of the heavy mineral sand the bulk of which (81 per cent) was formed of haematite and titaniferous haematite.

(iv) *Mica*

120 lbs of muscovite from the Misuku Hills were submitted to the Government Geologist R. M. Craig in 1918 (Report No. 2). The exact location of the sample, probably collected from a pegmatite, is not recorded. The muscovite consisted of crystals of about one square foot in area of black spotted quality. Fresh plates showed converging systems of points and crystalline and dendritic inclusions of metallic oxides. These defects limited the grades or sizes of mica recoverable to between sizes 4 and 6.

(h) Construction materials

There has only been a moderate demand for construction materials in the area and the only specific assessment was in 1959 by F. Habgood (unpublished report FH/28) who advised on a new site for the Karonga District Headquarters.

(i) *Sand and gravel*

Sands and gravels are well represented in the Lakeshore Plain. Such alluvial and lacustrine sands and gravels are particularly suitable for concrete making because of their cleanness.

The Chitimwe Beds and the Dwangwa Gravels are also useful sources of concrete aggregate.

Elsewhere in the area alluvial and colluvial sands and gravels are generally easily accessible in quantities suitable for local needs.

(ii) *Building stone*

At the present only the colitic limestone band in the Mwesia Beds is quarried for building purposes though it is also suitable for lime making (section (f)).

In most parts of the area stone suitable for construction purposes is available close to main roads or tracks. The Chambo Gneisses are suitable for quarrying where free of shear zones and cataclasis, and dolerite and metadolerite dykes could be sources of concrete aggregate and roadstone. The nepheline syenite at Ilomba Hill might also provide a source of construction stone. The Cordierite Gneisses could provide suitable concrete aggregate.

(iii) *Brick clay*

Brown alluvial clays in the bed of the North Rukuru river north of Karonga are used for brick making and there are no doubt many other suitable alluvial clay localities in the Lakeshore Plain. These clays are very uniform in composition but are very plastic so that small amounts of sand have to be added to make crack free bricks.

Elsewhere in the area residual clays provide local sources of brick clay.

(i) Water supply

In the hill zones the needs of the local population are served by perennial surface waters. In the inland plains the minor streams and *dambo* dry up for long periods in the dry season. In the Lakeshore Plain, where the bulk of the population live, surface waters are usually unobtainable outside the wet season. Due to the high permeability of the lakeshore sands and gravels eastward flowing streams and

TABLE XVII

BOREHOLES DRILLED FOR WATER SUPPLY IN THE CHITIPA–KARONGA AREA UP TO AUGUST 1975

Reference No.	Locality	Grid Reference	Depth (m)	Depth (ft)	Yield (g.p.h.)	Year drilled	Rocks penetrated
A89	Wenela, Chitipa	WE 300286	41	135	260	1961	Sand
A91	Katalolo	XD 005993	34	110	1056	1961	Alluvium
A140	Green Nyirenda	XD 008961	25	82	130	1963*	Lakeshore sediments
A311	Kaporo Police Post	WE 957204	26	85	not known	1964*	Sediment
A312	Kaporo Police Post	WE 957206	38	125	300	1964	Sediment
A313	Kasyata	WE 965235	9	31	not known	1963*	Lakeshore sediments
A314	Gwelewata	WE 966200	20	64	not known	1964*	Sediment
A315	Mwenewisa	WE 925200	14	47	not known	1964*	Sediment
A316	Mwakisulu	WE 940184	12	38	not known	1963*	
DP34	Kaporo Market	WE 936235	40	130	360	1971	Weathered gneiss
DP35	Ilengo Dispensary	WE 143453	32	105	720	1971	Weathered gneiss
DP168	Mwaulambo	WE 902146	37	122	720	1972	Weathered gneiss
DP169	Mwawembe	WD 929965	37	123	400	1972	Terrace sands
DP174	Mwanzonde	WE 271508	43	140	720	1972	Weathered gneiss
DP175	Kasowa School	WE 934103	41	133	770	1972	Weathered gneiss
DP177	Kapenda Dispensary	WE 271503	34	113	675	1972	Weathered gneiss
DP178	Musyambe	WE 269469	54	176	465	1972	Weathered gneiss
DP181	Lufira Scheme	WE 361226	43	140	550	1972	Weathered gneiss
DP182	Lufira Scheme	WE 376264	46	150	320	1972	Fractured gneiss
DP183	Lufira Scheme	WE 378252	66	215	385	1972	Fractured gneiss
E270	Chitipa T.C.	WE 301281	29	96	1080	1958	Gneiss
E271	Samuel Nyani	WE 442144	28	92	540	1958	Gneiss
GK48	Nkhagwa	WE 280438	27	90	300	1973	Fractured gneiss
GK50	Mpata Scheme	WD 909987	40	130	620	1973	Terrace sands
GK51	Lupembe Scheme	XD 078884	38	125	600	1973	Terrace sands and gravels
GK59	U.T.M. Karonga	WE 987003	61	200	480	1973	Terrace sands and gravels
GK60	Mbwiri	WE 943006	46	150	600	1973	Terrace sands and gravels
GK61	Karonga L.D. Area	WE 959010	76	250	600	1973	Terrace sands and gravels
GK62	Karonga L.D. Area	WE 965010	77	253	1160	1973	Terrace sands and gravels
GK177	Mwenitete	WD 907994	46	150	510	1974	Terrace sands
GK178	Mwakasangula	WE 987005	47	152	600	1974	Terrace gravels
GK179	Mwangalwa II	WE 969206	40	130	250	1974	Terrace gravels

GK180	Mwangalwa I	WE 968034	40	130	460	1974	Terrace gravels
GK181	Chilumba hospital	XD 374468	40	130	520	1974	Terrace gravels
GK182	Mwenenguwe	WD 911963	41	133	420	1974	Terrace gravels
GK184	Mwenitete School	WE 957157	43	140	460	1974	Terrace gravels
GK185	Mwenitete	WE 942170	43	140	240	1974	Terrace gravels
GK186	U.T.M. Depot, Karonga	WE 980006	56	184	480	1974	Terrace gravels
GK189	Chesa	WE 288239	25	81	360	1974	Weathered gneiss
GK190	Chitipa Trading Centre	WE 310276	39	126	500	1974	Weathered gneiss
H156	Chitipa Customs	WE 279282	43	141	1300	1966	Colluvium/gneiss
H157	Chitipa Customs	WE 278281	39	128	1384	1966	Colluvium/gneiss
H158	Chitipa Secondary School	WE 294288	52	171	1200	1966	Colluvium/gneiss
Q50B	Kaporo M.Y.P.	WE 951236	37	121	1350	1966	Colluvium
Q140	Karonga Airport	WE 980002	50	163	480	1968	Lakeshore deposits
Q141	Karonga C.C.A.P.	WE 966010	49	162	370	1968	Lakeshore sediments
Q143	Mwenenguwe	WD 914867	31	103	480	1968	Lakeshore deposits
Q377	Mwankumbwa	WE 259453	23	74	360	1971	Weathered gneiss
Q379	Nyami	WE 459139	31	101	500	1969	Weathered gneiss
Q380	Zambwe	WE 488132	31	101	300	1969	Weathered gneiss
Q381	Chipwera School	WE 579198	34	111	500	1969	Weathered gneiss
Q382	Lufita	WE 387262	31	103	320	1969	Weathered gneiss
Q383	Kasova	WE 947072	49	161	750	1969	Lakeshore deposits
Q384	Mwakwama	WE 947047	40	131	1200	1969	Lakeshore deposits
Q385	Bwiba School	WE 977002	50	164	500	1969	Lakeshore deposits
Q450	Kaporo Market	WE 945237	32	105	460	1971	Weathered gneiss
Q453	Karonga Station	WD 982998	78	255	300	1972	Clayey sand
Q454A	Lufilya Scheme	WE 901185	93	305	560	1972	Terrace gravels
Q455	Ngerenge dip tank	WE 897157	46	150	480	1972	Weathered gneiss
R200	Chendo	WE 449078	37	120	700	1970	Colluvium/gneiss
R201	Lodge Ng'ambi	WE 364188	40	130	276	1970	Colluvium/gneiss
R206	Kaporo Customs	WE 959206	43	142	1384	1970	Alluvium/colluvium
W66	Chitipa Boma	WE 286278	71	234	600	1959	Weathered gneiss
W67	Chitipa Boma	WE 291277	69	226	1100	1959	Weathered gneiss
W70	Ibanda	WE 379235	49	160	440	1961	Weathered gneiss
W77	Mwenengune	WE 913961	37	121	900	1960	Sands and gravels
W221	Mwangweo	XD 017956	32	104	440	1961	Alluvium

Depths in metres calculated to nearest whole metre.
* Drilled by hand rig.

rivers are soaked away before they enter the lake. At the height of the dry season even the larger rivers, including the North Rukuru, are affected in this manner.

In recent years to alleviate the water problems in the more populous areas of the Lakeshore and inland plains a total of nearly seventy boreholes, the majority of which have been sited and drilled by the Geological Survey, have been drilled to tap groundwater supplies. The locations of boreholes are shown on the accompanying geological maps and their details in Table XVII. Some of the best yields have been obtained from boreholes tapping the sediment/gneiss interface in the inland plains. In the Lakeshore Plain adequate and sometimes similar yields have been obtained from ground waters in the Lakeshore sands and gravels. In this area the movement of the groundwater is towards the lake.

(j) Hot springs

Five natural thermal springs are known in the area (Kirkpatrick 1969) which are all in the proximity of rift faults (Fig. 12). Some analyses and partial analyses of the spring waters are shown in Table XVIII. Four out of the five springs occur in

TABLE XVIII
CHEMICAL ANALYSES OF THERMAL SPRINGS

Spring name	Chinuka		Mwankenja			Vungu stream	Mpata	
Lab. ref. no.	W440[a]	454[a]	450[a]	GA 10/6/67;	HS 12;	GA 11/6/67;	GA 12/6/67[b]	HS 13[c]
Total solids	410	360	440	482		474	392	
Total hardness	48	63	21	43		28	8	
Ca	16,0	18,0	5,0	6,8	<1	3,2	1,6	<1
Mg	1,9	3,5	12,0	6,2	7	4,8	1,0	2
Na	132	134	108	324	150	327	312	145
K	6,6	10,5	3,1	4,0	3,1	3,1	2,7	2,2
Fe				n.d.	<0,2	n.d.	n.d.	<0.2
Mn				n.d.		n.d.	n.d.	
Cu				n.d.		n.d.	n.d.	
Li					<0,2			<0,2
Al					<0,2			<0,2
CO_3	0	0	6,0		21			22
HCO_3	199	171	226		271			193
SO_4	13,4	27	37	10	75	15	15	93
SiO_2				70	42	70	70	44
P_2O_5				0,02		0,02	0,02	
Cl	57	57	32	22	22	22	18	24
F				4	3,6	5	5	5,0
Conductivity (μmhO/m $\times 10^2$)	8,4	6,8	6,4	6,20	7,4	6,1	5,6	6,9
pH	7,5	8,1	8,2	7,8	8,5	8,6	8,7	9.0
Temp. (°C)	29[d]			53,4[e]	50,1[f]	38,2[e]	46,0[c]	50,1[f]
Av. flow (litres/ min)					97[f]			83[f]
Map reference (sheet)	0933 C2		0933 D4			0933 D4	0933 D4	
(locality)	WE 381339		WE 85100			WD 85099	WE 923001	

NOTES ON TABLE

Chemical values in parts per million (ppm)
n.d. = not detected

Analysts. [a]Agricultural chemist, Bvumbwe Tung and Agricultural Experiment station 1958 and 1959.
[b]A. Morgan, Government Analyst, 1967
[c]M. Bergen, Geological Survey, 1973

Measurements. [d]K. Bloomfield, 1957
[e]I. M. Kirkpatrick (1969)
[f]T. Shaeffer, 1973.

the Mpata Gap area about 10 km west of Karonga; the fifth occurs about 10 km northeast of Chitipa near Cinuka.

The Cinuka spring, first described in 1895, occurs just to the north of a track parallel to the Mwambuchilo river. Its temperature in 1957 when measured by K. Bloomfield was 35,3 °C; in 1967 it was 29,0 °C. This spring has a strong sulphurous smell and has been polluted by human and animal usage. The rocks near by contain breccias and quartz veins and the spring would appear to be sited on a minor fault parallel to the Kaseye fault.

Near Mwankenja two springs (Dixey 1927C) are present east of the North Rukuru river which issue along the line of a major northsouth fault which downthrows Karroo sediments against gneisses. The main spring lies at the foot of a low cliff with a well developed slickenslided rock surface. Gas bubbles with a highly sulphurous smell are emitted from the spring and the surrounding rocks are encrusted with a pale green deposit. The Vungu stream spring is situated about one kilometre south of the Mwankenja spring along the plane of the same fault.

The Mpata spring emanates in the bed of a small stream, a tributary of the North Rukuru river about 250 m northeast of the Karonga road bridge over the Mkungwe river. This spring appears to lie on the plane of a northsouth fault which downthrows Dinosaur and Sungwa Beds against gneisses.

None of the springs in the area are used except for local purposes nor would they appear to have any geothermal or other potential on account of their low temperatures and compositions.