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THE GEOLOGY OF THE SOUTH VIPHYA AREA

by
E. R. PETERS,
B.Sc., M.I.M.M.

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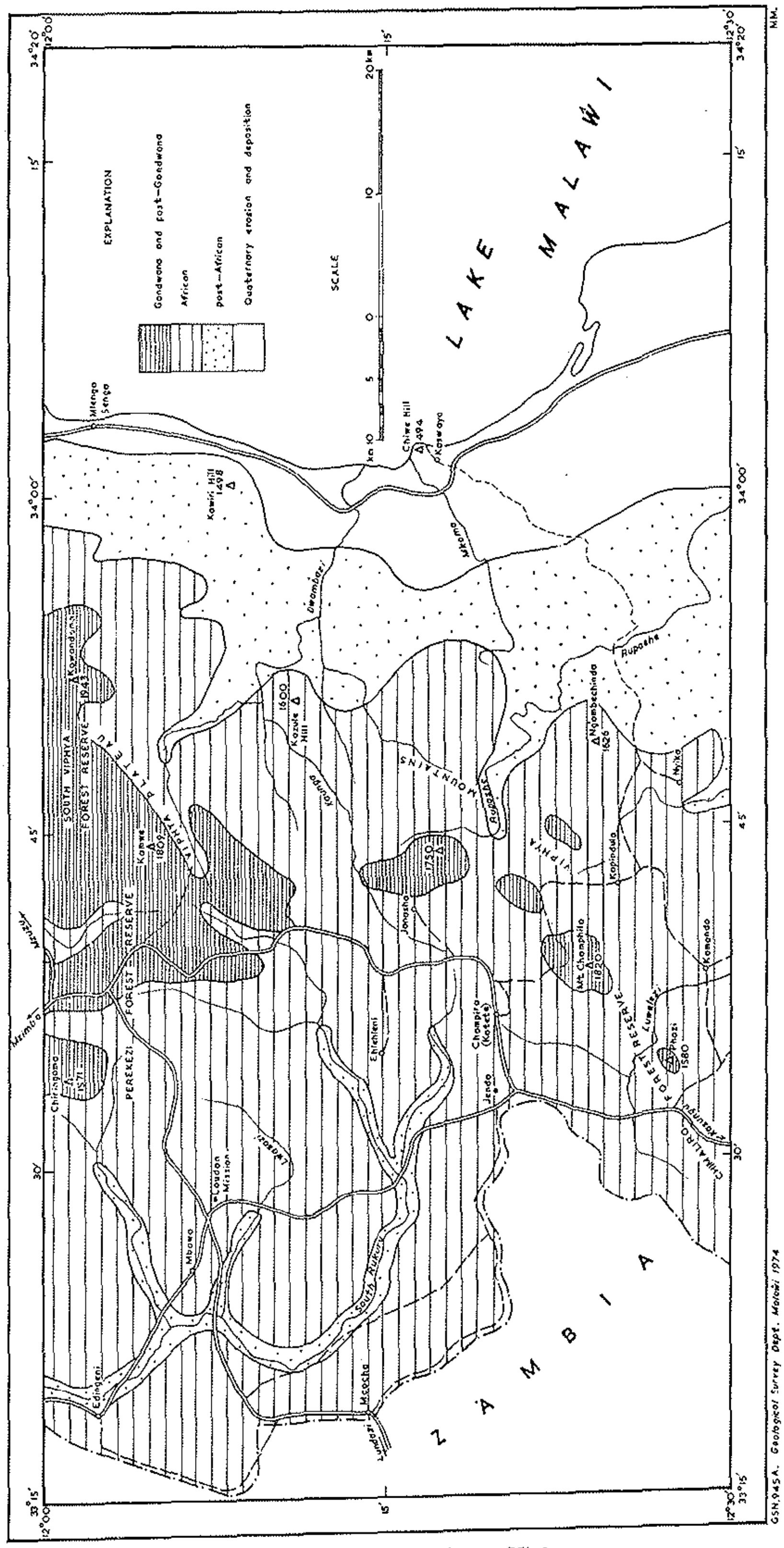

FIG. 2. Erosion surfaces in the South Viphya area.

II. PHYSIOGRAPHY

(a) Relief

A prominent feature of the area is the range of hills which extends from the high Viphya Plateau (Plate IIA) in the north through the centrally situated Viphya Mountains to join the west-south-westerly sweep of the Chimaliro Hills which cross the Zambian border in the southwest extremity of the area (Plate III).

West of the Viphya Plateau a broad stretch of uplands, covered in part by the Perekezi Forest Reserve, extends southwards through the headwaters area of the South Rukuru River. It represents the southern continuation of the Central Mzimba Hills. West of this, the wide peneplain of the South Rukuru Valley, the southern extension of the Mzimba Plain, extends to the Zambian border in the west (the watershed of this drainage system) and to the Chimaliro Hills in the south. The southern limit of these hills is the prominent Chimaliro Escarpment (Plate IIB) south of which stretches the Kasungu Plain.

To the east of the mountain range the entire area as far as the Lakeshore plain consists of the deeply dissected Escarpment zone flanking the downfaulted rift valley of Lake Malawi.

(b) Drainage

The drainage pattern is essentially radial from the Viphya Plateau area. At the northern margin of the area some headwaters of the Mzimba River drain northwards. The headwaters of the South Rukuru River flow southwards and then curve eastwards and to the north to drain the Mzimba Plain. The Dwambazi system drains southwards and to the east, cutting deeply into the Rift Escarpment zone. This zone, further north, is drained by the fault-controlled Mtazi and Mlowe Rivers which run in deep gorges, and by numerous consequent streams on the steep scarp extending north from Kuwiri Hill. Further south the Rift Escarpment is drained by the Mkoma, Luluzi and Kaungozi Rivers and also by the Rupashe and Luwelezi Rivers which are major tributaries of the Dwangwa River in the area to the south.

(c) Geomorphology

The present topography is fundamentally the result of the deep dissection of the mid-Tertiary ('African') peneplanation promoted by the progressive development of the Lake Malawi rift trough, whereby the erosion base-level was lowered by some 610 m (2000 ft).

The African surface (King 1963) of late Cretaceous to early Miocene age, modified by shallow post-African (late Miocene and Pliocene) erosion is preserved (Lister 1967) at altitudes around 1220 m (4000 ft) in the Mzimba and Kasungu plains. The Perekezi-Chimaliro hill area is thought to be an upwarped portion of the same surface, the movements concerned having elevated the surface by some 150 m (500 ft) on the northern side of the Chimaliro Escarpment fault.

The Viphya Plateau, with heights generally between 1680 m and 1800 m (5500 ft and 6000 ft) and isolated summits reaching a maximum within the area of 1943 m (6374 ft) at Kawandama Hill, is a remnant of the 'post-Gondwana' (early to mid-Cretaceous) planation, now represented by a distinct bevel at an altitude of about 1770 m (5800 ft). Certain summits in the Viphya Mountains and Chimaliro Hills to the south may also be post-Gondwana residuals.

African and post-African dissection of the post-Gondwana surface in the Viphya Plateau area was already advanced when step faults of the rift system rejuvenated the drainage on the east side of the area and gave rise to the deeply

dissected Escarpment zone. A feature of this zone is the formation of deep gorges notably those of the fault-controlled Mlowe and Mtazi Rivers.

In the southeast part of the area the Lakeshore plain is interrupted by the 'Kaungozi Block', a strip of ground tilted between two northerly rift faults to form a low west-facing escarpment along the line of the Kaungozi tributary of the Rupashe River.

(d) Climate

The wide range of altitudes in the area and the variety of topographical features entail corresponding variations in climate. In common with the rest of Malaŵi the area experiences a tropical continental climate with a single rainy season which extends from October to March in the west and to June in the east.

The following climatic zones can be distinguished (Brown and Young 1965):

(i) *Warm, dryish:* The Mzimba and Kasungu Plains and the central Mzimba Hills fall within this zone. Rainfall varies from 760 mm to 1020 mm and average temperatures from 18,3°C to 21,1°C.

(ii) *Cold, wettish:* This zone includes the Vipha Plateau, the Viphya Mountains and the Chimaliro Hills. Rainfall varies from 1020 mm to 1270 mm and average temperatures from 12,8°C to 18,3°C.

(iii) *Warm to hot, wettish:* This zone covers the Dwambazi Valley and the dissected 'African' erosion surface along all but the northern part of the rift valley Escarpment. The rainfall is within the range 1020 mm to 1525 mm and mean temperatures range from 18,3°C to 23,9°C.

(iv) *Cool to warm, wet:* This describes the climate of the northern part of the rift valley Escarpment where rainfall varies within the range 1525 mm to 2030 mm, and average temperatures range from 15,6°C to 21,1°C. This zone has a winter rainfall, in May and June, of 125 mm to 225 mm.

(v) *Hot, wet:* The northern part of the Lakeshore plain, which also receives 125 mm to 255 mm of rainfall in May and June, falls within this climatic zone which features rainfall between 1525 mm and 2030 mm and mean temperature between 23,3°C and 24,4°C.

(vi) *Hot, wettish:* The remainder of the Lakeshore area, notably the Bana Swamp, has this kind of climate. Rainfall varies from 1370 mm to 1525 mm and average temperature from 23,3°C to 24,4°C.

(e) Vegetation

The prevailing natural vegetation (Brown and Young, *op. cit.*) shows considerable variation over the area, corresponding to the variations in topography and climate.

Montane grassland covers the Viphya Plateau and the higher parts of the upland areas to the south of it. Some montane evergreen forest survives in the valley floors and valley heads of these areas.

On the western plains the natural vegetation, which has been extensively modified by cultivation and by the selective use of species, is *Brachystegia* plateau woodland.

The Perekezi-Chimaliro upland areas and the dissected ground along the rift valley Escarpment are characterized by *Brachystegia* hill and savanna types of woodland, moist woodland becoming more prominent in the area of higher rainfall in the north.

The *dambo** developed along river courses in the plains and along the Lakeshore feature marsh grassland. Lakeshore sands are typically colonized by grasses followed by savanna woodland and thicket.

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

in a selected area between 3 km and 8 km south of Katete in the Champira Dome showed a clear relationship between the anomalous indications and the numerous dolerite dykes in the area (Smith 1970, unpublished report SHS/1).

(c) Groundwater supply

The 85 boreholes drilled to supplement traditional water supplies (from rivers and from wells mostly in *dambo*) are listed in Table II with details of their locations, depths and yields. Their positions are shown on the geological maps.

The great majority of the boreholes are sited on the plains in the west of the area where generally satisfactory supplies of water were encountered usually at depths of between 30 and 50 m. Most of the holes tap slightly confined aquifers in the thick layer of weathered gneiss which was widely developed here during the mid-Tertiary peneplanation.

TABLE II

BOREHOLES DRILLED FOR WATER SUPPLY IN THE SOUTH VIPHYA AREA UP TO DECEMBER 1973

Ref. No.	Locality	Grid reference	Depth (m)	Depth (ft)	Yield (g.p.h.)	Year drilled
A367	Malembo School	WB 458387	24,4	80	264	1963
DP52	Foster Jere	WB 501585	42,7	140	675	1971
DP53	Kamataba School	WB 578415	35,1	115	800	1971
DP95	Dwambazi Health Unit	XB 079482	61,0	200	330	1972
E93	Katete Mission	WB 666354	24,7	81	1020	1957
E94	Kawale Chirwa	WB 468466	44,8	147	638	1957
E95	Emchakachakeni Court	WB 579578	37,5	123	270	1958
E290	Ehlehleni	WB 636453	41,2	135	900	1959
E292	Katete T.C.	WB 655365	40,6	133	900	1959
E293	Levi Jere	WB 609321	42,7	140	1200	1959
H2	Katondo	WB 420644	48,8	160	900	1965
H3	Ejebwa	WB 436652	61,0	200	1384	1965
H4	Handire	WB 493674	59,5	195	300	1965
H5	Handire	WB 498674	52,5	172	800	1965
H6	Mbobo	WB 514674	63,1	207	720	1965
H7	Katambala	WB 474692	35,4	116	782	1965
H36	William	WB 356704	18,3	60	720	1965
H50	Kasichi Mvula	WB 348520	32,0	105	1200	1965
H51	Chimusewozo	WB 385606	23,8	78	300	1965
H52	Isaac	WB 373519	32,3	106	530	1966
H53	Kampotoko	WB 383578	35,1	115	200	1965
H54	Mdima	WB 478371	34,8	114	1200	1965
H55	Malembo	WB 450386	35,4	116	1200	1965
H56	Mabamba	WB 425401	36,0	118	1400	1965
H57	Kanyolokera	WB 398384	42,1	138	1200	1965
H58	Vakanza	WB 399462	42,7	140	1200	1965
H59	Dulu Nkunga	WB 453457	43,9	144	1400	1965
H60	Hanock	WB 508379	32,0	105	1200	1965
H61	Zebedia	WB 541433	32,9	108	1200	1965
H62	Mlamba	WB 450519	33,6	110	1440	1965
H64	Mabvutuza	WB 508442	39,7	130	1400	1965
H65	Aaron	WB 477465	37,8	124	300	1965
H66	Mapupo	WB 468475	32,0	105	400	1965
H67	Kabinga	WB 416528	41,2	135	600	1965
H68	Matekenya	WB 400498	40,9	134	720	1965
H69	Chiromba	WB 387523	23,5	77	?	1965
H70	Bori	WB 388537	20,7	68	?	1965
H71	Kapoli	WB 386545	34,2	112	200	1965
H72	Bengoya	WB 428556	31,7	104	860	1965
H73	Elia Kim	WB 417513	31,1	102	650	1965
H74	Mpezeni	WB 420523	32,0	105	720	1965
H75	Malepa	WB 457570	30,5	100	1130	1965

TABLE II—*continued*

Ref. No.	Locality	Grid reference	Depth (m)	Depth (ft)	Yield (g.p.h.)	Year drilled
H76	Dimi	WB 439574	41,2	135	750	1965
H80	Mposa	WB 498596	39,7	130	1400	1965
H81	Mtezi	WB 467600	32,3	106	200	1965
L105	Mbawa Agricultural Stn.	WB 455615	52,5	172	330	1955
L413	Mbawa Agricultural Stn.	WB 447614	41,2	135	880	1957
L414	Edingeni	WB 340689	36,9	121	1200	1957
L415	Loudon	WB 513578	28,1	92	1428	1957
L417	Jenda Agricultural Stn.	WB 595348	50,6	166	545	1957
Q150	Mgoca Customs Post	WB 341467	30,5	100	720	1968
Q151	Kapopo Customs Post	WB 419356	34,8	114	720	1968
R178	Mbawa School	WB 457603	42,7	140	750	1970
R179	Chibeku Ngulube	WB 306654	42,7	140	720	1970
R216	Moses Chilenje	WB 438687	46,1	151	450	1970
RB60	Dema School	XB 184270	42,7	140	530	1972
RB63A	Kakwale School	WB 584182	39,7	130	550	1972
RB77	Mbawa Agricultural Stn.	WB 430612	33,6	110	360	1972
RB78	Kalikumbe School	WB 361516	58,9	193	180	1972
W65	Mgoca	WB 366449	42,7	140	900	1959
W80	Kapopo	WB 476379	36,6	120	500	1959
W83	Chimutu	WB 484714	29,0	95	576	1962
W87	Chinsolo	WB 575387	30,5	100	440	1960
W88	Nchawaka	WB 613188	30,5	100	264	1960
W89	Kamando	WB 697198	43,9	144	440	1960
W163	Mbawa Agricultural Stn.	WB 455615	44,8	147	1320	1960
W192	Champira Police Post	WB 661368	45,8	150	264	1960
W213	Gondwe	WB 452665	25,0	82	900	1960
W214	Mzukuzuku	WB 502538	36,6	120	440	1960
W215	Swaswa	WB 469501	51,9	170	264	1960
W216	Vibangalala	WB 512493	51,9	170	528	1960
W218	Jere	WB 368543	52,2	171	440	1960
W219	Mzamu School	WB 361597	36,6	120	440	1960
W273	Mbawa Agricultural Stn.	WB 455607	47,3	155	132	1961
W292	Edingeni	WB 344687	45,1	148	540	1961
W293	Nkosikazi	WB 423524	48,8	160	440	1961
W294	Duni	WB 450556	35,1	115	528	1961
W295	Thoza	WB 581631	53,4	175	900	1961
W297	Echieni	WB 478648	50,3	165	900	1961
W298	Mzoma School	WB 383567	45,8	150	528	1961
W299	Maraunda School	WB 517682	47,3	155	576	1962
W302	Kathundu	WB 719472	51,5	169	900	1961
W303	Lodjwa T.C.	WB 577286	32,3	106	900	1961
Z206	Mzukuzuku	WB 454612	?	?	?	?

(d) Hot springs

The hot springs at Kalali, on the Lakeshore about 1 km southeast of the mouth of the Mkoma River, were mentioned by Dixey (1927), and a brief account of them was given by Kirkpatrick (1969) as follows:

> 'Two springs occur at Karali, one rising in the beach sand on the shore of Lake Malawi, the other welling up in the lake about 10 metres offshore. It is probable that these springs issue from the fracture zone of a NNW-trending fault which is postulated to lie in the lake parallel to and a short distance from, the shoreline.'

The spring on the beach has a temperature of 78°C, being one of the hottest in Malawi. No analysis of its water is on record, but there are no hydrothermal deposits of calcite or silica and no smell of sulphur associated with the spring water so the springs are probably not mineralized. The springs lie near the intersection of the line of the Kaungozi Fault with the lines of the Mkoma II and Khuyu Faults (see Chapter VII (b)(ii) above).

Kirkpatrick (*op. cit.*) also mentions a hot spring near the Tukombo Stream on

the Lakeshore plain about 7 km north-northeast of the hilltop of Kuwiri. He remarks: 'The spring rises in swampy ground in the valley of the Tukombo Stream. It lies on a NNE-trending fault which belongs to the Rift Valley fault-system.' No analysis of the water of this spring is on record, nor has its temperature been recorded.

(e) Gravity survey

A recent gravity anomaly map of Malawi compiled by E. M. Andrew shows a pronounced anomaly over the Champira Dome. In his report on field work and processing Andrew (1974) observes: 'At about 12° 30'S there is a positive anomaly apparently related to the outcrop of charnockites. The anomaly gradients are associated with the wrench faulting. Several samples of the charnockitic basement were collected for density determination but the results did not suggest a density significantly different from that of other basement granulites and gneisses. The anomaly must, therefore, be due to some body underlying the charnockites, and because of the steep gradients on the southern margin, it will not be very deep here. It may be a massive feeder for the basic dykes which are common in the area. It is unlikely to be a sill since, even assuming a density contrast as large as 0,5 g/cm^3, its thickness would have to be about 4000 ft. to account for the anomaly of some 25 mgal.'