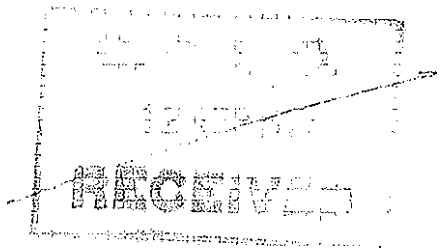
Bulletin No. 31



MALAWI
MINISTRY OF AGRICULTURE
AND
NATURAL RESOURCES

GEOLOGICAL SURVEY DEPARTMENT

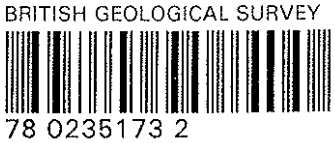
THE GEOLOGY OF THE DWANGWA AREA

by
J. KEMP,
M.Sc., M.I.M.M.

PRICE K4.00

1974

PUBLISHED BY THE GOVERNMENT PRINTER, ZOMBA, MALAWI



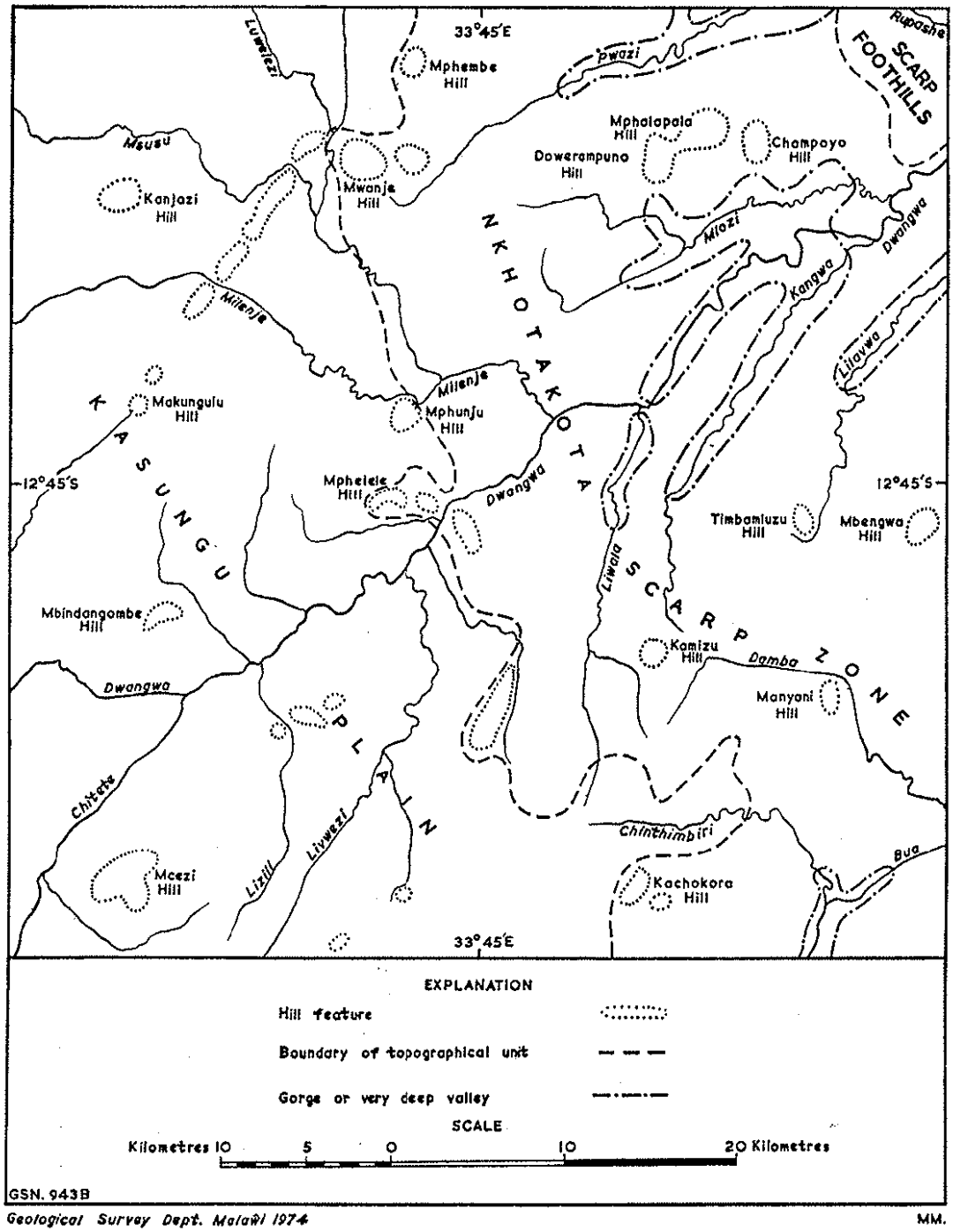


FIG. 2. Topographical units in the Dwanga Area.

II. PHYSIOGRAPHY

(a) Relief

The area is readily divisible (Brown and Young 1965) into the three topographical units shown in Figure 2. The Kasungu Plain, an undulating surface of low relief with altitudes generally between 915 m (3000 ft) and 1220 m (4000 ft), merges eastwards with an area of increasingly deep dissection, the Nkhotakota Scarp Zone, in which relief exceeds 300 m (1000 ft) in the northeast part of the area. The interfluves maintain the general altitude of the plain (Plate IIB) as far as the escarpment edge which crosses the northeast corner of the map. Beyond this, the Scarp Foothills with altitudes of 580 m (1900 ft) to 760 m (2500 ft) represent an abrupt decrease in relief.

(b) Drainage

The Dwangwa area lies in the central part of the Lake Malawi catchment area and is drained by representatives of the two main drainage systems, the Plateau System and the Rift Margin Consequent Rivers (Pike and Rimmington 1965). The boundary between these systems corresponds to that between the Kasungu Plain and the Nkhotakota Scarp Zone (Fig. 2). The plateau rivers, in this area the Dwangwa and to the southeast the Bua, are typically mature to senile, with broad dendritic drainage patterns, often including *dambo**, and having a general north-easterly course. When they cross the escarpment zone however they develop the youthful characteristics of steep gradients, deep valleys and greatly reduced lateral drainage areas. Within the escarpment zone the Dwangwa is joined by Rift Margin Consequent Rivers Pwazi, Mlozi, Kangwa and Lilavwa (which incidentally become its tributaries) each with a deeply incised course and a narrow drainage area.

(c) Geomorphology

The gently undulating Kasungu Plain (Plate IIA) which extends over much of the western half of the area (Fig. 2), is an expression of the very mature 'African' erosion surface of late Cretaceous to Miocene age (King 1963; Lister 1967). This surface has been modified by shallow 'post-African' dissection of late Tertiary age promoted by the extensive rift-fault movements which eventually gave rise to the down-faulted trough of Lake Malawi and the high escarpments overlooking it. These movements apparently included a slight upwarping of the African surface both northwards and also eastwards towards the plateau edge.

The general north-easterly courses of such plateau rivers as the Dwangwa and Bua had become firmly established during the African erosion cycle and possibly reflect a drainage dating back to the 'Gondwana' (Jurassic) peneplanation as suggested by Pike and Rimmington (1965). Down-cutting of the escarpment edge by these rivers and their consequent tributaries during the post-African and subsequently the Quarternary erosion cycles, and the westward spread of the area of dissection, resulted in the formation of the Nkhotakota Scarp Zone which features the gorges of the Rivers Pwazi, Mlozi, Dwangwa, Liwala, Kangwa, Lilavwa and Bua.

---

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

The view across a portion of the dissected plateau is shown in Plate IIB. The prominent concordant summits of Dowerampuno, Mphalapala and Champoyo, together with Mwanje and Mphembe further to the west, probably represent remnants of the 'post-Gondwana' (Cretaceous) land surface.

Some low hill features with concordant summit levels appear to be African surface residuals isolated by post-African erosion, for example the long ridge extending north-eastwards from Makungulu (Fig. 2) which is crossed by the 'plateau rivers' Luwelezi, Msusu and Milenje. The same process has enlarged a few of the scattered pre-African inselbergs such as Mcezi (Plate IIA) leaving concordant 'shoulders' as residuals of the African surface.

(d) Climate

The main factor controlling climatic variations in the Dwangwa area is the rise in altitude from the Scarp Foothills in the extreme northeast, at 580 m to 760 m (1900 ft to 2500 ft), to the level of the Kasungu Plain in the west, at 916 m to 1220 m (3000 ft to 4000 ft). The mean annual temperature over most of the area is between 18° and 21°C, slightly exceeding 21°C only in the extreme northeast. The mean annual variation in temperature however decreases from west to east. In the east the November mean maximum is between 32° and 35°C and in July the mean minimum is about 13°C; in the west the November mean maximum is between 26° and 32°C and the July mean minimum between 4° and 7°C.

Rainfall is seasonal and almost all precipitation occurs in the period November to April. The mean annual rainfall varies from about 1525 mm in the extreme northeast to 890 mm in the west. The climate can thus be described as varying from semi-arid in the west through sub-humid in the east towards humid in the extreme northeast.

(e) Vegetation

The natural vegetation is dominantly *Brachystegia-Julbernardia* woodland and includes the plateau, hill and scarp-foothill types, the last named appearing only in the extreme northeast of the area. A little *Combretum*, *Piliostigma* and *Acacia* woodland occurs, mainly in the southwest. Bamboo brakes(*Oxytenanthera abyssinica*) are abundant in some hill areas, chiefly south of the Dwangwa in the east-centre of the area. Over most of the Kasungu Plain widespread cultivation has removed or modified the natural plateau woodland.

(Carter *et al.* 1973). The following summarizes the main points of interest which emerged from this survey.

An arsenic anomaly of low intensity was found to coincide roughly with the area in which most gold traces were recorded in the prospecting activities mentioned above. There is no particular correspondence between the higher gold and arsenic values however. This is consistent with observations made elsewhere in the world on the relationship between these two metals. They occur in the same field sufficiently frequently for arsenic to be used as a pathfinder to gold deposits, but within any such field their concentrations do not necessarily follow the same pattern.

Scattered, weakly anomalous nickel and chromium values generally occur, as would be expected, in the vicinity of metagabbro and amphibolite outcrops. A good example of a group of such values occurs where a strong development of metagabbros crosses the Luwelezi River around grid reference WB 720 050.

An arcuate belt of slightly anomalous copper values corresponds roughly to the outcrop of the hornblende gneisses, with associated calc-silicate rocks, in the southeast quadrant of the area. The local occurrence of pyrrhotite as an accessory mineral in some of the calc-silicate rocks suggests that traces of copper sulphides might also occur locally. One specimen of pyroxene granulite was found to contain 1500 ppm of copper, but there is no reason to believe that this level of copper mineralization is other than exceptional.

(d) Groundwater

Traditional water supplies from rivers and from wells in *dambo* have had to be supplemented from underground water resources in the main agricultural developments in the west and south of the area. Details of 27 boreholes drilled for water in the area up to the end of 1973 are given in Table III and their locations are shown on the geological map. Their average depth of 55,5 m (182 ft) and average yield of 910 gallons per hour show that moderately good underground water supplies are

TABLE III

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

Reference No.	Locality	Grid reference	Depth (m)	Depth (ft)	Yield (g.p.h.)	Year drilled
A 187	Chibandauka	WB 714017	81,7	268	240	1962
CM 24	Estate No. 37	WA 680675	76,3	250	720	1973
CM 25	Estate No. 37	WA 676680	76,3	250	600	1973
DD 7	Estate No. 21	WA 711682	70,2	230	1800	1970
DD 14	Estate No. 31	WA 672632	76,3	250	1500	1970
DP 54	Chomwe Ziba	WA 712939	39,7	130	450	1971
E 136	Simblemba Court	WA 741913	61,0	200	300	1958
E 137	Msekawanthu	WA 693941	50,6	166	300	1958
G 12	Jijomo	WA 743635	27,5	90	100	1950
K 59	Kalumba Court	WB 566097	33,6	110	1000	1953
L 107	Offisi	WA 602877	58,0	190	900	1955
L 418	Emfeni	WB 650078	30,8	101	760	1958
M 122	Chisemphere T.C.	WB 561042	30,5	100	500	1954
P 29	Estate No. 15	WA 736671	76,3	250	600	1970
P 33	Estate No. 16	WA 746693	67,1	220	800	1970
P 41	Estate No. 17	WA 763687	61,0	200	1600	1970
P 43	Estate No. 17	WA 761682	64,1	210	360	1970
P 45	Estate No. 21	WA 718684	76,3	250	3000	1970
P 48	Estate No. 32	WA 684637	76,3	250	700	1970
Q 86	Kanjazi Farm	WB 578078	44,2	145	900	1968
Q 312	Emfeni Dispensary	WB 662078	36,6	120	1200	1970
R 144	Chimbaye School	WA 746752	45,8	150	2000	1970
R 172	Emfeni F.T.C.	WB 662071	42,7	140	1200	1970
RB 136	Mthiko	WA 718652	45,8	150	780	1972
W 306	Kapala	WA 569719	33,6	110	900	1961
X 193	Khuza School	WA 594744	61,6	202	540	1971
Z 148	Chamama	WA 869712	?	?	?	?

available. The majority of the boreholes are sited on the Kasungu Plain, a reflection of the mid-Tertiary erosion surface which is characterized by deep weathering of the rock below it to depths frequently exceeding 50 m. Although a few boreholes tap colluvium or fractured rock, most of them derive their yield from confined aquifers in this weathered bedrock.

IX. REFERENCES

ANDREW, A. R. and BAILEY, T. E. G. 1910. The geology of Nyasaland. *Quart. J. geol. Soc. London*, **66**, 189–251.

BELLINGHAM, K. S. and BROMLEY, J. 1973. The geology of the Ntchisi–Middle Bua area. *Bull. geol. Surv. Malaŵi*, **27.**

BLOOMFIELD, K. 1968. The pre-Karroo geology of Malaŵi. *Mem. geol. Surv. Malaŵi*, **5.**

BROWN, P. and YOUNG, A. 1965. The physical environment of central Malaŵi with special reference to its soils and agriculture. *Bull. Dept. Agric. Malaŵi.*

CAHEN, L. and SNELLING, N. J. 1966. *The geochronology of equatorial Africa.* North-Holland, Amsterdam, 195p.

CARTER, G. S., HASLAM, H. W. and SMITH, S. H. 1973. Regional geochemical reconnaissance of Malaŵi. *Bull. geol. Surv. Malaŵi*, **43.**

CHARSLEY, T. J. 1972. The limestone resources of Malaŵi. *Mem. geol. Surv. Malaŵi*, **6**, 75–78.

DIXEY, F. 1924. Sedimentary deposits of the Angoniland Plateau. *Annu. Rep. geol. Surv. Nyasaland for 1923*, 12–13.

HARRISON, D. R. and CHAPUSA, F. W. P. (in preparation). The geology of the Nkhotakota–Benga area. *Bull. geol. Surv. Malaŵi*, **32.**

HATCH, F. H., WELLS, A. K. and WELLS, M. K. 1961. *Petrology of the Igneous Rocks* (12th edition), Murby, London, 385.

HOLMES, A. 1951. The sequence of Pre-Cambrian orogenic belts in south and central Africa. *XVIII Int. geol. Congr.*, **24**, 254–269.

HUNT, E. C., NORTH, A. A. and WELLS, R. A. 1955. Application of paper chromatographic methods of analysis to geochemical prospecting. *The Analyst*, **80**, 172–194.

KING, L. C. 1963. *South African Scenery*, third edition. Oliver and Boyd, Edinburgh, 308 p.

LISTER, L. A. 1967. Erosion surfaces in Malaŵi. *Rec. geol. Surv. Malaŵi*, **7**, 15–28.

PETERS, E. R. 1969. The geology of the Kasungu area. *Bull. geol. Surv. Malaŵi*, **25.**

——(in preparation). The geology of the South Viphya area. *Bull. geol. Surv. Malaŵi*, **36.**

PIKE, J. G. and RIMMINGTON, G. T. 1965. *Malaŵi: a geographical study.* Oxford Univ. Press, London, 218p.

THATCHER, E. C. 1968. The geology of the Dedza area. *Bull. geol. Surv. Malaŵi*, **29**, 24.