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THE GEOLOGY OF THE KASUNGU AREA

by

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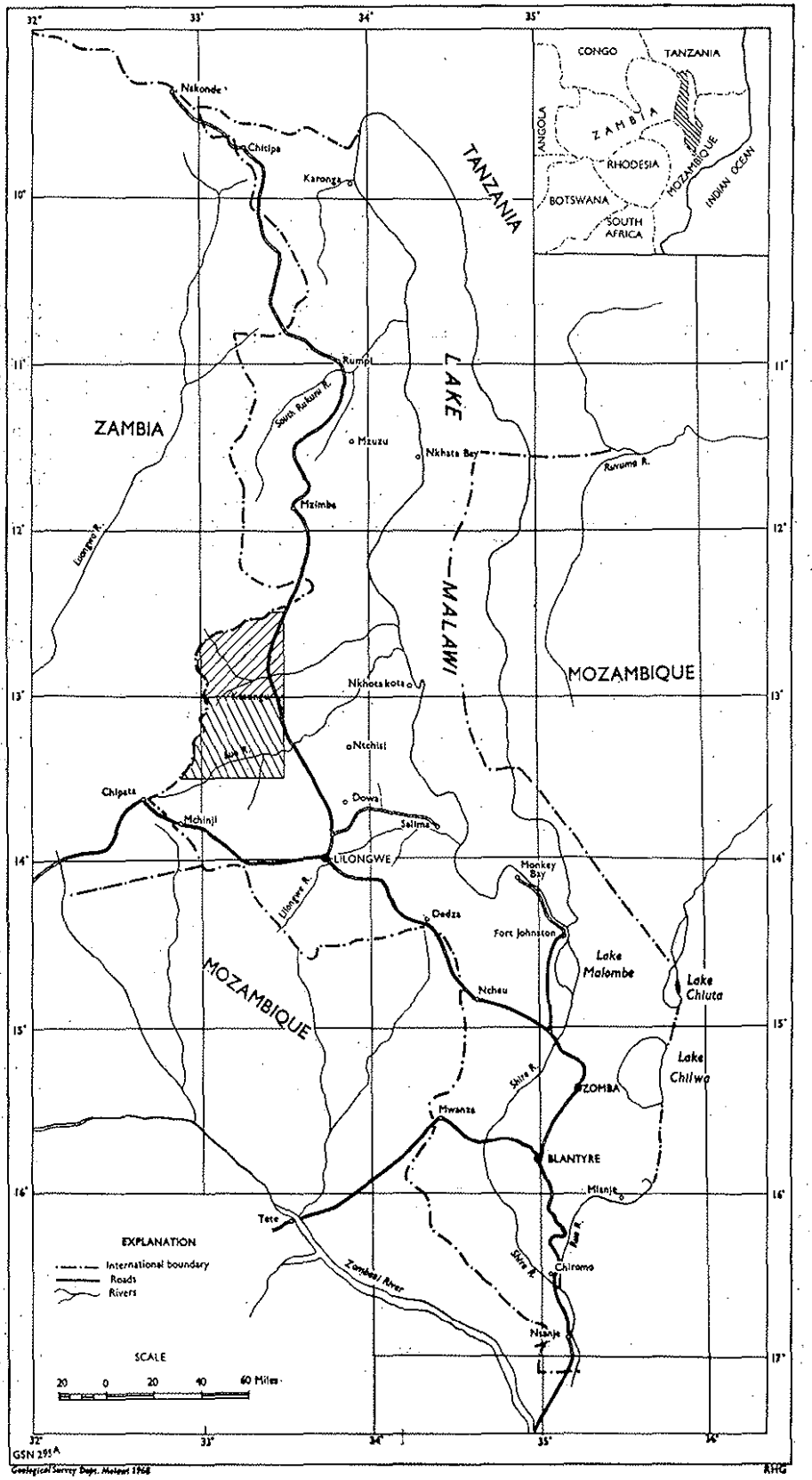

FIG. 1. Location map

A small airfield is situated three miles west of Kasungu on the Game Reserve Road. It is only suitable for light aircraft and there is at present no regular service.

(c) Population, settlement and agriculture

The District Commissioner has his headquarters in Kasungu Township and the town is also the centre of trade in the area. The local court is at the *Boma** and there is a Police Station, Post Office and Hospital in the town. The F.M.B.† market is about one and a half miles south of the town and the local secondary school an equal distance north. About a dozen general stores in Kasungu deal in a variety of goods from foodstuffs and clothing to hardware.

Chief Mwase is an important chief in the district and his domain covers the whole of the area described south of the Mpasazi Stream. Mwase's Court is four miles west of Kasungu on the Game Reserve road and there are also native authority courts at Chulu, Kawamba and Santhe. There are dispensaries near all of these courts. The land north of the Mpasazi Stream is part of N. A. Kaluluma.

Kamphuru Estate is 15 miles south of Kasungu, on the Mchinji road. It is one of a group of estates managed by the Kasungu Tobacoo Growers Scheme. Flue-cured tobacco is the main product from this estate. South of the Rusa, on the Mchinji road, there are three large estates growing sun-cured tobacco on a tenant farmer basis.

The northern part of the area around the Mpasazi is densely populated and intensively farmed, with many large herds of cattle. The *dambo*‡ are used as grazing land. The area in the immediate vicinity of Kasungu is also well populated, but over the rest of the area villages are small and scattered. Maize, groundnuts, sweet potatoes and cane sugar are the main crops. Small amounts of tobacoo are also grown on village farms for sale to the F.M.B.

(d) Previous geological work

The first geologist to visit the area was A. R. Andrew who passed through in April, 1907 whilst conducting a mineral survey of Nyasaland under the auspices of the then Imperial Institute. He collected specimens from Kasungu Mountain which he described as a gabbro and referred to the Kasungu Plain as the northern Angoniland Plateau made up of gneisses and quartzites (Andrew, 1907). During 1923, F. Dixey of the Geological Survey accompanied by G. Prentice of the Loudon Mission visited the Karroo rocks in the Kasilete *Dambo*. A record of this visit appears in the annual report of the Geological Survey Department for 1923 (Dixey, 1924).

The area between the Dwangwa and the parallel of latitude 13°S. was mapped by geologists of the B.S.A. Co. Ltd. during 1937-8. This work appears in unpublished reports made available to this department and the limits of the area mapped are shown on figures 4 and 5. F. Habgood (1957) sited some dams and boreholes on the Kamphuru Estate during 1957. At about the same time (1957-58) New Consolidated Goldfields held two concessions in the area and carried out preliminary surveys in two small areas: one southeast of Bua, between the river and 33°33'E., and the other south of the Rusa and Luwelezi streams extending east to Mbwabwa Hill (*see* Figure 5).

K.Bloomfield (1965A) briefly visited Kasungu Mountain and Mtiwa Hill during 1963 and in May 1965, K. E. Wilderspin (1965) assessed two dam sites north of the Dwangwa River.

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* Chichewa: literally fort, now used to denote District Commissioner's compound.
† Farmers' Marketing Board.
‡ Chichewa: broad, grass covered, swampy valley(s).

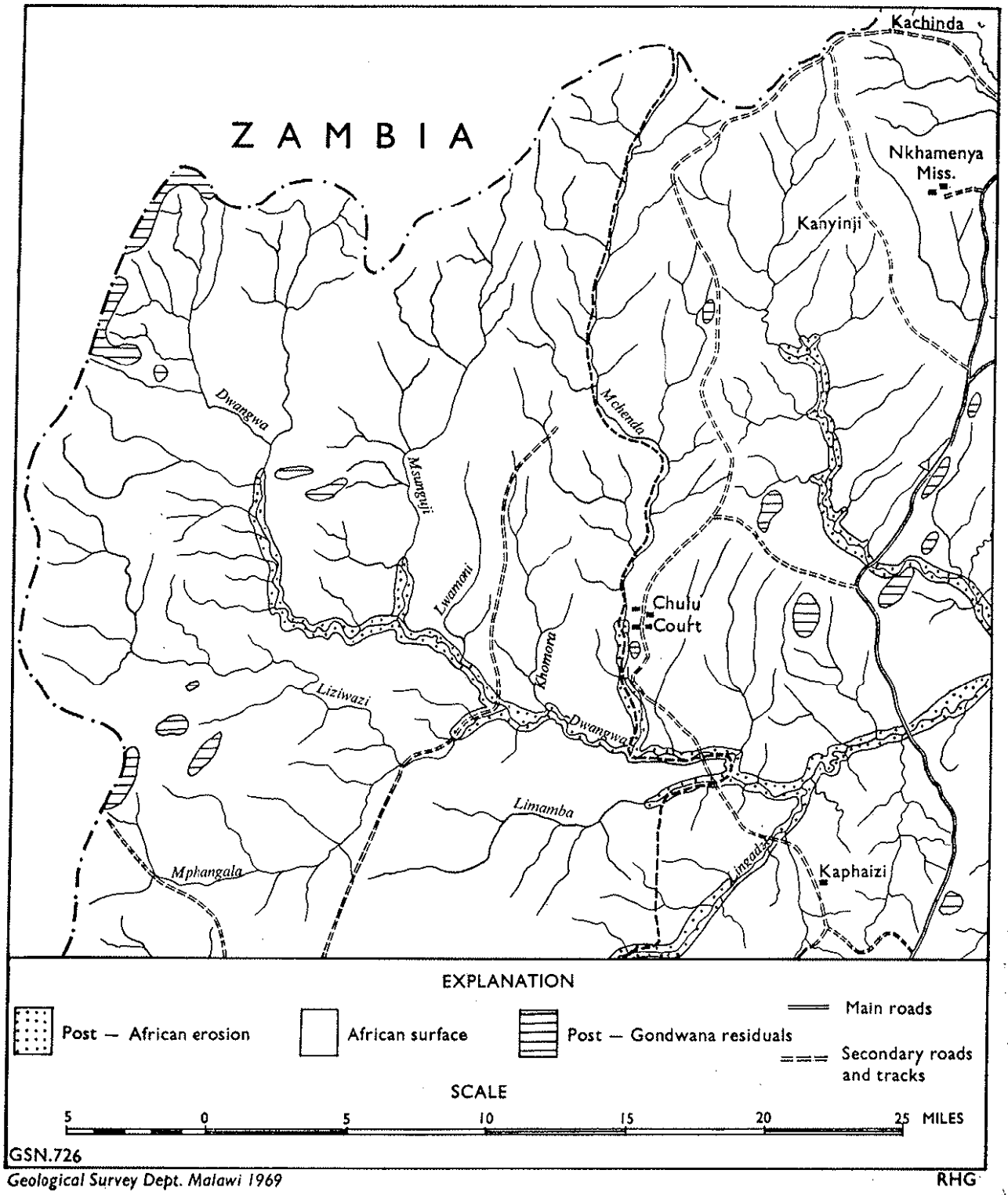

FIG. 2. Erosion surfaces and communications: Kasungu North-West

(e) Present investigations

The present survey forms part of the Geological Survey Department's regional reconnaissance mapping programme. The geological mapping was based on the 1 : 50,000 fifteen minute topographical sheets published by the Directorate of Overseas Surveys. The maps of Kasungu South-West were colour tinted* whereas those for the North-West area were contoured. The area was traversed at approximately two mile intervals with additional traverses along the major streams.

The southeast quarter of sheet 1333A and half of the northeast quarter were surveyed during December and November, 1964. The rest of the Kasungu South-West sheet was surveyed during June and July, 1965, and Kasungu North-West was surveyed from August to November, 1965.

Aerial photographs covering the whole area were used as an aid to geological mapping. E. A. Stephens of the Photogeological Division of the Directorate of Overseas Surveys prepared a photo-interpretation of Kasungu South-West which was also checked and incorporated in the map.

Geochemical drainage samples were collected in conjunction with the geological mapping. Alluvial samples were collected at half mile intervals in all streams and *dambo*. Eluvial samples were collected on watershed areas or in areas away from the active drainage channels.

Field preparation of the samples consisted of drying and then crushing in a wooden pestle and mortar. The samples were sieved and the —80 mesh fraction was retained for analysis. The following elements were determined spectrographically in the Geological Surveys laboratories in Zomba: copper, lead, nickel, chromium, molybdenum, silver, tin. Arsenic, used as an indicator for gold, was determined by the Gutzeit chemical method, and zinc by atomic absorption spectroscopy. The results of the geochemical work are described in Chapter XI.

* Contoured sheets are now available and were used in compiling the accompanying geological maps.

II. PHYSIOGRAPHY

(a) Relief, drainage and geomorphology

A mature erosion surface, with residual hills surrounded by wide pediments, extends over the whole of the Kasungu area (*see* figures 2 and 3 and plate IA), and forms part of the Lilongwe Plain. This plain stretches from Dedza to the Chimaliro Escarpment at the Southern end of the Vipya Plateau. Lister (1967) classified the Lilongwe Plain within the African surface (late Cretaceous to early Miocene) with post-Gondwana (early and mid-Cretaceous) residuals. Lister also adds that the surface is gently tilted away from the rift so that towards the west rivers often spread into marshlands. Incipient post-African (late Miocene and Pliocene) erosion is taking place along the floors of shallow streams and rivers which cross the area. Usually only areas near water-courses are composite African and post-African surfaces but the two cycles are indistinguishable as scarps and nick-points do not exist. The Luangwa–Lake Malawi watershed also displays the features of the African surface and the Lilongwe Plain continues west into Zambia.

In the Kasungu area the plain rises gently from about 3,600 feet around the Bua in the south to 3,800 feet in the north. There are many residual inselbergs, *e.g.*, Mbwabwa (3,949 feet), Chipira (4,015 feet), Mtiwa (3,955 feet), Kasungu Mountain (4,764 feet), Ang'ombe (4,363 feet), Phongoli (4,028 feet), Makungwa (4,000 feet), Matu (4,084 feet) and Mwesa (4,200 feet). Mbwabwa and Mtiwa are narrow ridges composed of acid gneiss and granulite respectively. Kasungu Mountain is a rugged conical outcrop of nepheline-syenite. All the other residuals mentioned are steep, smooth-sided outcrops of granitic rocks.

Over large areas of the plain no slope is apparent, and generally slopes in the order of $\frac{1}{2}°$ are usual. Valleys have maximum slopes of 1–2° with wide marshy floors, *e.g.*, the Bua and Rusa flow in wide marshy flood plains less than one mile wide. Further north around the Dwangwa, the post-African cycle is more noticeable and the Dwangwa has cut a valley into the plain with slopes varying from 2–7°.

Two main river systems drain the Kasungu area: the Bua–Rusa drains most of Kasungu South-West and the Dwangwa drains Kasungu North-West and the northern part of Kasungu South-West. The watershed between the two systems is almost imperceptible.

The Bua flows north across the southeastern part of the area turning east soon after the confluence with the Rusa. The Rusa, the major tributary of Bua, flows northeast across the southwestern part and then turns east to meet the Bua. There are only four other streams in this system, the Nanbuma, Kagona and Lisadadzi, all tributaries to the Bua, and the Luwelezi, a tributary of the Rusa. All other tributaries to the two main rivers are large *dambo* such as the Lisandwa and Mavumbwi. The Bua–Rusa forms a very mature system with the latter rivers flowing in wide flood plains. Consequently the tributary *dambo* are eroding to a very shallow base-level and have not developed streams, instead the *dambo* have expanded laterally and in many places they have coalesced. Flow figures at the Bua road bridge show an average highest flow over 10 years of 3,430 cusecs, usually during March, with a short period of nil flow in November–December.

The Dwangwa drains by far the larger portion of the area, rising in the Game Reserve it first flows south and then east-northeast. The major tributaries are the Mpasadzi, Lisitu, Lingadzi and Liziwazi and this system has been rejuvenated, post-African erosion is taking place. The Dwangwa and its tributaries have cut narrow stream courses into the surrounding *dambo*, the previous flood plains,

but incised meanders indicate that this rejuvenation process is taking place slowly. Flow figures at the Dwangwa road bridge show an average highest flow of 2,377 cusecs in February–March, a long period of nil flow in June–October followed by another period of nil flow in November–December after the early rain.

Both the Bua and Dwangwa river systems are seasonal, the erratic flow can be accounted for by the impedance caused by large areas of marshy *dambo*. Water is trapped on or just below the surface and as the gradients are slight it is unable to flow away; it either evaporates or flows slowly by seepage through the marsh. Consequently, during heavy rains surface run-off produces the remarkably high maximum flows over short periods. The water that is retained is unable to maintain the streams and subsequently evaporates and causes long periods of nil flow.

The drainage pattern generally is a composite one. The main streams have been inherited from a previous cycle of erosion and bear little relation to the underlying structure. The tributaries to both major systems form a rectangular pattern following either the foliations or the joints of the underlying basement rocks.

Chemical weathering is dominant through the area, the streams are now so sluggish that they possess little erosive transporting power and the main means of removing materials is in solution. The resistant materials such as quartz and muscovite remain in the soil and an iron rich layer has formed a few feet below the surface. Mechanical weathering takes place in the quartzites and the harder quartzo-feldspathic rocks but schists disintegrate readily and are rarely exposed.

(b) Vegetation and wildlife

The vegetation sheet of the old Federal Atlas of Rhodesia and Nyasaland shows the Kasungu area as covered by *Brachystegia woodlands* with *Julbernadia globiflora* except in the vicinity of Bua, Rusa and Dwangwa rivers where there are *Combretum–Acacia–Piliostigma–Terminalia woodlands*. Brown and Young (1965) describe two types of vegetation in the area: one found on the hydromorphic *dambo* soils and the other supported by the ferallitic soils that are common throughout the area.

Marsh and *dambo* grasslands occupy all the poorly drained areas that are subject to annual waterlogging. These areas are covered by tufted grass, normally long but kept short by burning and grazing, without trees or shrubs. These grasslands are found particularly along the Bua and Rusa and in all other *dambo*.

The rest of the area is covered by *Brachystegia–Julbernadia plateau* and *savanna woodland*. In its natural state, *e.g.*, over most of Kasungu Game Reserve, it is an open woodland with trees of medium height and a moderate grass cover. Over the rest of the area formations resulting from regrowth after cultivation are common. They consist of savanna woodland of varied composition dominated by *Brachystegia* and *Julbernadia* with a dominance of *Julbernadia paniculata* during the early years of growth.

Outside the Game Reserve wildlife is restricted to baboon, hyena, bush pig and bush buck. A large variety of game is to be found in the Reserve, although it is not abundant. The following animals can usually be seen: elephant, buffalo, rhinoceros, lion, leopard, eland, kudu, sable, roan, hartebeest, zebra, warthog, bush pig, bush buck, baboon and hyena.

(c) Climate

The overall climate of Malawi can be described as tropical continental with a single rainy season. Three seasons usually occur. The cool season lasts from May until August and is dry with relatively low temperatures. The hot season, September to November, is dry and hot with progressively increasing temperatures. The wet season, December to March or April, is wet and fairly hot.

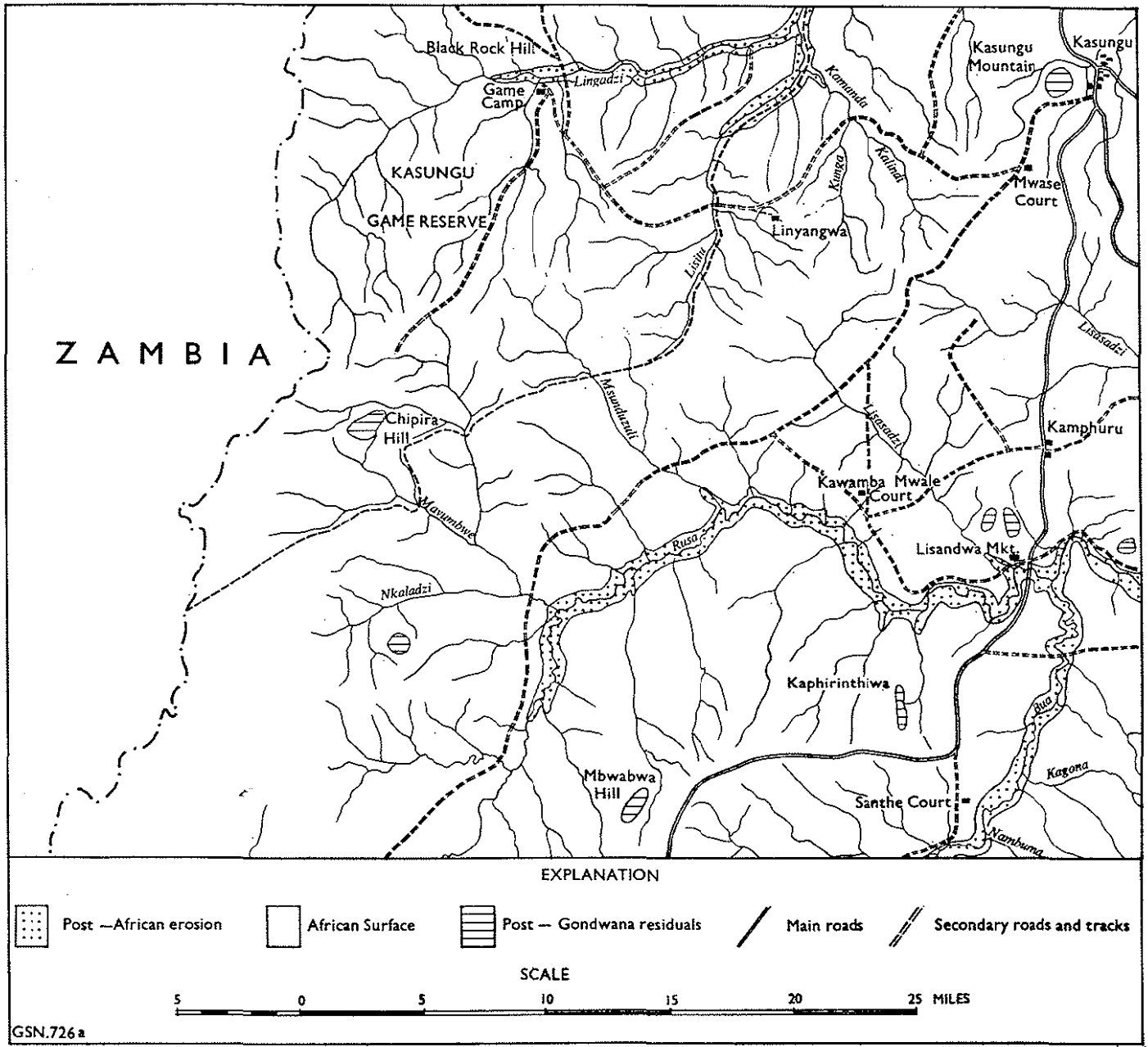

Fig. 3. Erosion surfaces and communications: Kasungu South-West

Brown and Young (1965) place the Kasungu area in a warm-dryish zone—average temperature 65–70° F., rainfall 30–40 inches. For example, the average annual rainfall at Kasungu (1955–65) was 33 inches. 85 per cent of the rainfall occurs during the four months December to March and there is almost complete drought from May to October. Mean monthly temperatures range from 60° F. in June and July to 70° F. in November with a diurnal range of 20–25°. Brown and Young (*op. cit.*) suspect that a drier zone exists west of Kasungu, 25–20 inches rainfall, but this cannot yet be corroborated due to the lack of weather stations.

TABLE IV

GEOCHEMICAL RESULTS, LISANDWA META-GABBRO

Type of sample	Cu		Ni		Zn		Cr	
	Average (ppm.)	Range (ppm.)	Average (ppm.)	Range (ppm.)	Average (ppm.)	Range (ppm.)	Average (ppm.)	Range (ppm.)
Rock chips	48	30-95	325	150-550	20	15-26	375	100-700
Soil over gabbro	56	25-180	287	45-1000	30	20-60	448	150-5000
Soil over gneisses	46	5-55	148	50-60	36	10-48	389	50-500

(b) Nepheline-syenite

There are two large outcrops of nepheline-syenite in this area, both within four miles of Kasungu Boma, *i.e.*, Kasungu Mountain and Kasungu–Chipala Hill.

Nepheline-syenite is used in the ceramics and glass-making industry. Over recent years it has been replacing feldspar as a source of alumina and alkali for manufacturing glass, pottery, floor and wall tiles, refractory cements, *etc.* Nepheline-syenite has a lower fusibility and greater fluxing reaction compared with the normal vitrifying agents, this enables manufacturers either to use less or to fire at a lower temperature.

For glass-making, the low iron and high alumina+alkali content of nepheline-syenite constitutes a useful way of introducing alumina. Finely ground material is used as an extrusive pigment in paint and as a filler in plastics and rubber and also as an inert carrier for insecticides. It has also been reported that at Volkhou Aluminium Works near Leningrad, nepheline-syenite is used for producing alumina.

The following figures can be considered as generally applicable to nepheline-syenite ores, low iron content is important in all cases.

1. Ceramic grade—64–73.99 per cent SiO_2 with a K_2O : N_2O ratio of 6:1 and not less than 3:1
2. Glassmaking: SiO_2 between 64–71.99 per cent
   Al_2O_3 between 15–19.99 per cent
   Fe_2O_3 between 0.15–0.2 per cent.

The only analysis available (*see* Table I) for the Kasungu nepheline-syenite (KB 1929) was collected from the peak of Kasungu Mountain (SiO_2 : 51.43 per cent, Al_2O_3: 15.9 per cent, Fe_2O_3: 3.62 per cent and K_2O: Na_2O=3: 2). This single analysis indicates that the Kasungu nepheline-syenite is a low grade ore but more sampling is obviously required.

(c) Water supply

Kasungu is a dry area for several reasons. The soil is particularly sandy so there is very little surface water and although the headwaters of the Bua and Dwangwa rivers are located in this area they do not flow throughout the year. The area is also so flat and undissected that the tributary *dambo* do not extend below the water table during the dry season. Local village water supplies are from shallow wells in *dambo* supplemented by boreholes. Kasungu Township is supplied almost exclusively by boreholes. There are also several small agricultural Department and Veterinary Department dams in the area, *e.g.*, Chulu and Mwase. The accompanying table of boreholes shows that over most of the area there are adequate supplies of groundwater.

TABLE V

BOREHOLES DRILLED FOR WATER IN THE KASUNGU AREA

Ref. No.	Locality	Year drilled	Depth in feet	Standing water (feet)	Yield (gallons per hour)
G.68	Chulu	1950	140	5	250
G.6	Kasungu	1950	85	35	420
G.5	Kasungu	1950	100	31	400
G.19	Kasungu	1950	71	34	200
G.20	Vizuma	1950	80	25	100
G.71	Zita	1950	126	78	50
K.55	Bwanali	1954	100	20	600
L.160	Cimangeni	1955	95	60	600
L.160	Kasungu	1955	95	60	600
L.110	Kasungu	1955	125	65	500
L.112	Mankhanga	1955	112	23	900
L.109	Mkanda	1955	150	20	1000
E.113	Kalolo	1957	100	16	500
E.135	Kaminga	1957	120	10	900
E.115	Kapaiza	1957	90	17	180
E.114	Njombwa	1957	101	20	400
E.202	Chizoa	1958	128	80	264
L.419	Kasungu	1958	120	19	900
E.200	Kathansela	1958	159	57	264
E.206	Kawanba Court	1958	103	34	132
E.204	Linyanhga	1958	131	29	440
E.201	Padukana	1958	120	54	220
E.259	Santhe Court	1958	100	10	528
E.205	Tena	1958	120	34	264
W.131	Chalimbana	1960	171	50	60
W.127	Chimbiranjara	1960	81	51	60
W.129	Chipwala	1960	152	80	288
W.132	Chisazima	1960	130	50	288
W.135	Chiziya	1960	142	40	200
W.134	Diwala	1960	90	25	900
W.164	Kasungu	1960	101	37	288
W.130	Malewa	1960	132	50	120
W.128	Mbumbu	1960	94	41	180
W.133	Simon Kaswarcanje	1960	121	55	411
W.305	Chaimu	1961	103	35	900
W.306	Kapala	1961	110	35	900
A.117	Kasungu	1961	137	36	3,330
W.308	Kasungu	1961	106	32	225
A.115	Mbambo	1961	95	26	246
W.307	Mgwende	1961	90	21	900
A.114	Mpazi	1961	140	26	900
A.76	Gumba	1962	132	20	450
A.281	Kasungu	1963	144	2	288
A.282	Kasungu	1963	214	17	480
J.106	Kasungu	1963	165	8	330
H.39	F. M. B. Santhe	1965	120	—	1,200
Q.6	Kanjala	1966	68	8	250
Q.8	Kawaye X	1966	75	8	250
Q.9	Mtanila XII	1966	50	6	250
Q.5	Tembwe XI	1966	65	4	250
Q.13	Yolamu	1966	50	8	250
Q.10	Zilikani	1966	42	?	250