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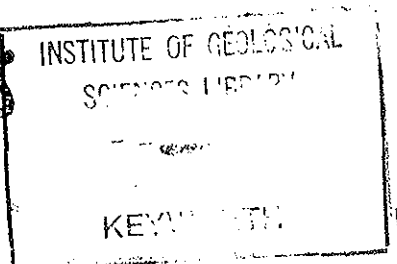
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MALAWI
MINISTRY OF NATURAL RESOURCES

GEOLOGICAL SURVEY DEPARTMENT

**THE GEOLOGY
OF THE
LAKE CHIUTA AREA**

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II. PHYSIOGRAPHY

(a) Relief

Altitude varies from 2,100 to 4,700 feet above sea level and the area can be classified into three more or less distinct physiographic units. The Nsili and Mangoche hills comprise the highest unit, the Lake Chiuta Plain and the Mlomba Uplands are successively lower.

(i) *The Nsili and Mangoche hills*

The Nsili Hills occupy most of the area in the northeast, part of the Mangoche Hills occurs in the extreme northwest corner. To the east and south these hills decrease in size towards the Lake Chiuta Plain. The influences controlling the original development of these hills are two-fold. Firstly, their prominence is due to the resistance to erosion of a perthite-syenite and -granite ring-complex. Secondly, later faults and joints caused dissection of the ring-complex leaving many of the hills as steep sided inselbergs (*see* Plate I); the broad flat valleys between the latter contain colluvial and alluvial material. The centre of the ring-complex is a good example of this type of inselberg formation, *e.g.*, Unango hill, rising from 2,600 to 4,734 feet at an average gradient of 1 : 2½ on steepest sides (*see* Plate II). Other prominent peaks of this type are Chikwelelo (3,662'), Lisale (4,073'), Ulungwe (4,020'), Liselewetu (3,478'), Ilipili (3,508'), Nsili (3,727') and many lower hills. Individual hard bands of perthite-granite and -syenite have weathered as ridges easily seen on aerial photographs. They are especially numerous on hills of the southern edge of the area and pick out the essential ring structure.

The developed physiography of this area can apparently be explained only if the existence of major fractures are postulated as underlying the broad belts of colluvium and alluvium separating hill blocks. For example, the Chitweche Stream, tributary of the Nyenyezi River, follows a northeasterly course in a belt of alluvium about half a mile wide on a colluvial zone two miles wide. Coarse perthite-syenite crops out on both sides, forming the Nasuwi and Chikwelelo hills to the west and the Nlinda Hills to the east. This belt of superficial deposits almost certainly hides a major fracture zone. Some evidence is afforded by a NE.-trending fracture, part of a set of fractures trending in this direction, which cuts into the Lisunga Hills to the south on a direct line with the Chitweche valley. The 'blocky' outcrop pattern of many of the hills can be explained in this way with hidden faults paralleling visible faults trending NE. and NW. Unango Hill is an excellent example, having a well defined NW.-trending fault to the southwest and its blocky outlines suggest further fractures on the other three sides.

Other major fractures are postulated as underlying the Nalupande Stream and along most of the length of the Lifune River. However, minor fractures also contribute to the overall pattern.

The whole Nsili-Mangoche area is part of a larger mature land surface extending south to the Lake Chiuta and Lake Chilwa Plains and ending in the Palombe Plain near Mianje Mountain. The physiographic differences of this part of the surface are due to the weathering characteristics of the predominant perthite-rich rock types present. On the western side of the Nsili complex, softer types of basement gneisses, *e.g.*, biotite-gneisses, form some of the lower hills and crop out in the stream beds. The broad colluvial covered plain between the Mpalangwasi and Likukilo hills is due mainly to the presence of these more easily weathered gneisses.

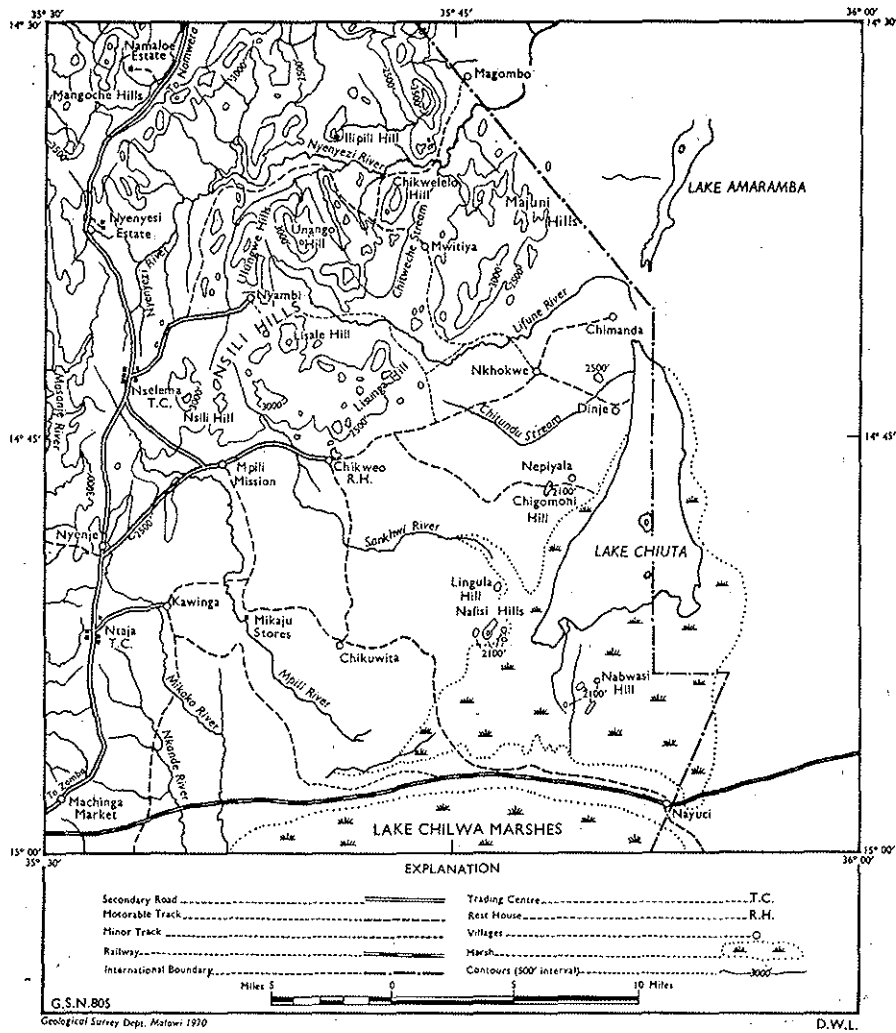


FIG. 2. Communications and physiography in the Lake Chiuta area.

(ii) *The Lake Chiuta Plain*

This plain extends from Mlomba Uplands in the west and Nsili Hills in the north to Lake Chiuta in the east. It is a remarkably flat plain of thick colluvial deposits gently sloping from 2,600 feet in the northwest to lake level at 2,055 feet above sea level (a gradient of 1 : 160). Isolated hills are made up of harder bands of basement gneiss which jut out of the plain. In the west, Kawinga (2,400') and Khole (2,917') give topographic expression to harder parts of north-trending biotite-hornblende-gneisses. Close to the southern edge of Lake Chiuta, five hills comprising the Nafisi group rise abruptly out of the plain as steep sided inselbergs (see Plate II). Their composition (perthite-syenite) is mainly responsible for their resistance to erosion. The highest of the group is Nafisi (2,662') followed by Lakoloko (2,347'), Kandimana (2,320') and Kamphanga (2,255'). Four miles southeast, the Nabwazi group of four hills form islands of the same rock type within the wide belt of marshes fringing Lake Chiuta.

Between lakes Chiuta and Chilwa a broad sand bar forms a striking feature. Its formation is in part due to the shrinking of Lake Chilwa, leaving five distinct raised beaches. The prevailing southwest wind has heaped the sand of these beaches into dunes, especially at the western end thereby consolidating the bar. Three levels can be traced at heights of 10, 40 and 55 feet above Lake Chilwa* (see Garson, 1960). The 55 foot level is somewhat obscured by sand dunes. Two other levels, at 80 and 110 feet, well developed further south along the shores of Lake Chilwa, are just traceable on to the southwest part of the area but then become rapidly obscured to the west by colluvium. Their disappearance was apparently aided by general downwarping of the area between lakes Chiuta and Chilwa, as shown by the northerly dip imposed on the raised beaches in the latter area.

(iii) *The Mlomba Uplands*

Half of this surface lies along the western edge of the Lake Chiuta area, from the Mangoche Hills in the north to the Zomba - Namwera road in the south. The Makongwa scarp (at 1,850 feet above sea level) defines the westward limit of these uplands in the adjoining Lake Malombe area. Southwards, the surface extends into the Zomba area (Bloomfield, 1965). The Masanje scarp falls just inside the Lake Chiuta area forming a prominent N. - S. step feature some 250 feet above the level of the base of the Makongwa scarp.

The uplands constitute two fairly mature and eroded scarps, inclined gently westwards, with gradients averaging 1 : 38. Rivers tend to follow major fractures and, to a lesser extent, the regional N. - S. strike of the basement rocks.

Dykes of microgranite, dolerite and lamprophyre trend NNW. across the area forming well developed ridges easily seen on aerial photographs.

(b) Drainage

The major watershed along the Mlomba Uplands separates water draining west to the Lake Malombe, Shire River and Zambezi River water system, from water draining east to lakes Chilwa, Chiuta, Amaramba and the Indian Ocean. Erosion is pushing this divide slowly eastwards. The Masanje is the only perennial river in this locality draining to the west. It flows south along the Masanje Fault for part of its course before turning northeast to empty into Lake Malombe. Two mature perennial rivers, the Nkhande and Mikoko, flow southeast into the enclosed system of Lake Chilwa. Late in the dry season the sluggish flow in these rivers is sometimes halted, leaving only stagnant pools.

Further east, the Mpili River is prevented from flowing direct into Lake Chilwa only by the sand bar which deflects its flow into Lake Chiuta. The poor definition of its channel at this point arises, in part, from a loss of water by seepage below the bar.

* 1961 level (in dry season).

Two other perennial rivers flowing into Lake Chiuta are the Sankhwi and Lifune. Both debouch into areas of marsh before filtering into the lake. As with the other rivers mentioned, flow becomes sluggish in the dry season and may cease altogether for short periods. In periods of heavy rainfall the water level rises rapidly giving 'flash' floods in the latter two rivers and the lesser streams of the district. Short, steep, boulder-strewn courses of minor streams draining the Nsili Hills take only 'flash' flood water for very short periods in times of heavy rainfall. The Sankhwi and Lifune rivers, in common with the Nyenyezi River in the north, rise in the Nsili Hills; their upper reaches have semi-mature profiles due to the erosion-resistant nature of the terrain. The Nyenyezi flows north into Mozambique parallel to Lake Amaramba, joining the lake at its northern end.

Rivers of the Lake Chiuta Plain show no conformity to structural lines; they meander, often in more than one channel, in a thick colluvial cover. Only in the Nsili Hills and Mlomba Uplands can some water courses be seen to be structurally controlled, mainly by major faults and joints. Strike-controlled rivers are sparse. As mentioned above, many of the large rivers in the Nsili Hills follow fractures which are probably of major importance in fashioning the topography.

River capture of the Chitweche Stream by the Lifune River near the Lisunga Hills, robs the Nyenyezi of some water. More water will eventually be lost from the latter river system when the headwaters of the Lifune cut back far enough to capture the Mpila Stream, a major tributary of the Nyenyezi.

(c) Climate

There is little variation in temperature throughout the area. The Lake Chiuta Plain, Mlomba Uplands and the broad valleys in the Nsili Hills have a mean annual temperature of 70 - 75 degrees. The greatest variation of temperature is with height, being approximately 3 degrees per 1,000 feet. Hence, the tops of individual hills in the Nsili Hills have mean annual temperatures in the range of 65 - 70 degrees.

At Nselema, on the top edge of the Mlomba fault scarp, and at Nyambi in the Nsili Hills, the average annual rainfall is 36 inches. Just north of the area at Namwera, this average rises to 43 inches. The rainfall decreases steadily south-westwards to 20 - 25 inches in some areas. Over the Lake Chilwa catchment area, the mean annual rainfall is 20 inches, although in an exceptional year (e.g., 1967/68 wet season) as much as 35 inches can fall. Like the rest of Malawi, the rain is seasonal and 95 per cent falls between late November and early May.

(d) Agriculture and vegetation

Staple food crops of the area are maize, cassava, groundnuts, and bananas. Tobacco is the main cash crop. Fishing in Lake Chiuta supplies the region with *Chambo*, *Mlamba* and many other species. Beef comes from a cattle rearing area on damp ground along the Chiuta - Chilwa sand bar.

Natural vegetation is left only in small patches on the flat colluvial land and is often a savannah type with sparsely spaced shrubs and trees. Main rivers provide the conditions for growth of larger trees such as *Mlombwa* (*Pterocarpus*). In the Mangoche Hills *Brachystegia* woodlands occur, bamboo brakes (*Oxytenanthera abyssinica*) are common on the lower hill slopes, giving way higher up to small trees and woody underbush.

Pterocarpus woodland of woody scrub firmly interlaced with liana is found west of the Zomba - Namwera road below the lip of the Rift escarpment on the Mlomba Uplands.

IX. ECONOMIC GEOLOGY

(a) Gold

A few worn colours of gold were recovered in pan samples from the Nyenyezi Stream by Alexander (1937). He considered that the gold is derived from thin quartz-pegmatites of which there are great numbers in the basement gneisses but only a few appear to be mineralised. The latter conclusions seem generally valid and the gold occurrences are probably not of economic interest.

(b) Sand

The sand of the Lake Chiuta/Chilwa bar, contained in the 40-foot and 55-foot raised beaches of Lake Chilwa, is suitable for building purposes. A detailed pitting programme, with mechanical and chemical analysis of the sand collected, has shown that three large areas of sand from the middle section of the bar could be worked to make 9th quality amber glass (Johnston and Johnston, 1961), provided the heavy mineral content is removed. A minimum of 25 million tons of suitable sand is present. This deposit may be economically workable when the Nacala - Balaka rail link is built across this bar. The relevant tables of analysis of the sand are given in appendix A.

The cumulative curves (Figures 5 and 6), obtained from the mechanical sieving data, show that the sand is a partially wind resorted, lacustrine deposit. It is more feldspathic towards the western end of the bar and the eastern end is much coarser and gravelly. The middle section is a well sorted sand of mainly sub-angular quartz grains with some feldspar. Seventy per cent of the heavy mineral fraction present consists of magnetite and ilmenite. Smaller amounts of weathered pyroxene, amphibole, spinel and rutile are also present and zircon and garnet are fairly abundant constituents.

(c) Water supply

Village water supplies are mainly obtained from shallow wells, often dug in the beds of seasonal streams. Some boreholes have been drilled and these are listed in Table I, they are also marked on the geological map of the area (back pocket).

The Lake Chiuta plain is ideal for holding ground water, hence borehole construction is probably the best way of increasing local supplies. In the Nsili Hills and Mlomba Uplands, soil cover is thin and ground water is poorly held. Small dams would be the best way of obtaining water in these areas unless a water filled fissure or joint could be located.

TABLE I

WATER BOREHOLES IN THE LAKE CHIUTA AREA

Borehole No.	Locality	Depth (feet)	Yield (g.p.h.)	Rest level (feet)	Year drilled
A.95	Muwawa	96	300	24	1961
A.250	Mwitya	109	100	17	1964
A.251	Ialitu	167	720	23	1964
E.76	Kawinga	91	700	23	1957
E.237	Kawelama	121	850	25	1959
E.238	Kankhomba	105	500	23	1959
E.239	Mikachu	103	960	28	1958
E.240	Mtimbwilimwe	100	720	25	1958
E.241	Bamba	131	400	25	1958
E.242	Chipalenga	80	360	30	1958
E.243	Chisawa	77	300	6	1958
E.244	Chikwee	80	180	20	1958
J.7	Namilepe	76	675	16	1959
J.8	Katolome	108	1,080	31	1959
J.9	Nkomera	125	1,080	19	1959
J.10 } J.11 }	No information - private estate boreholes				
K.28	Nyanje	100	530	10	1954
K.29	Ntaja	70	500	25	1954
L.264	Nselema	88	450	24	1956
L.265	Nyenje	102	350	18	1956
W.61	Mwenja	90	96	30	1959
W.62	Natuli	117	40	35	1959
W.64	Waidi Mataka	148	680	20	1959
W.114	Ngokwe	100	1,080	21	1959
W.144	Ntaja	128	680	30	1959
W.145	Chiwalö Court	118	680	31	1959