Report N° 1

THE NDOLA - MWERU WANTIPA STRIP

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INTRODUCTION

The present report discusses the first data derived from a synoptic examination of satellite images from the ERTS-1 spacecraft which was launched last year by NASA on July 23rd. Black and white, 70 mm, multispectral MSS bulk images have been received scaled to 1:3,369,000. Photographic prints have been analysed on a 1:1,000,000 scale by direct projection on 1:1,000,000 maps.

The Ndola-Mweru Wantipa strip was exposed to the spacecraft sensors on September 30rd 1972. Four spectral bands permit a complementary interpretation of the landscape scenery : 4 blue, 5 green-yellow, 6 orange-red, 7 infrared. Each 70 mm image covers an area of about 34,000 km^2 observed from a spacecraft height of about 900 km. The whole strip lies between latitudes 8° and 14° south and between longitudes 28° and 30° east but the strips are NE-SW orientated as the ERTS ground trace intersects the meridians at an acute angle. The whole Ndola-Mweru Wantipa strip, which we considerd, covers an area of about 100,000 km^2.

The laboratory's project on Central Africa is concerned primarely with a global regional-geographic and geomorphic analysis of this African subcontinent. An examination of main geographic structures may lead to a subdivision into homogeneous landscape units with a distinct development potential. This short-term objective can be realized before more detailed and thematic research on ERTS-imagery is undertaken. According to C.S. Christian and G.A. Stewart (1952) from the Commonwealth Scientific and Industrial Research Organisation - CSIRO, a land system may be defined as "an area or group of areas throughout which can be recognised a recurring pattern of topography, soils and vegatation". From a global geographic point of view the land system definition may also consider other features such as hydrographic patterns, human occupation and land-use patterns. This extended definition of the land system is at the base of the proposed regional-geographic classification. We hope that this reconnaissance level interpretation of ERTS-images may be a contribution to a better understanding of the geographical structure of the African countries concerned and of their future development planning which falls within the scope of ERTS-launching.

ANALYSIS

1. The Mweru-Wantipa system

On all maps, the Mweru Wantipa depression figures as an almost swampy area including a rather small lake. The ERTS-imagery revealed on 30 September 1972, at the beginning of the rainy season, a vast lake overing an area comparable to the Lake Bangweolo! This sunken area is bordered by a system of fault scarps. The major western fault scarp which continues into Zaire is shown clearly by spectral band 5. Along this scarp clearing and settlement are associated with a SW-NE directed road, west of Kikasa (Zaire).

2. The Ft Rosebery-Chibote system

The northern part of this system is hidden from view by a more or less continuous cloud cover. The central part shows a characteristic Ridge and Valley topography derived from a structural arc. The main direction of lineaments changes from SW-NE to WSW-ENE into the East. Some transverse geofractures are visible east of Chibote. A partly deranged drainage pattern characterizes this central belt with rivers flowing into many swampy depressions and lakes. The southern and southeastern area is marked by a dendritic drainage pattern and marshy valley floors. The rectilinear River Lupoposhi follows a major NW-SE fault step which determines manifestly, the northern margin of Lake bangweolo. This fault crosses another swampy, N-S directed fracture - or fault - line valley which drains into Lake Bangweolo.
A small graben appears west of the Lake (spectrum 5) with a NE-SW direction parallel to the Lake.

Main clearing areas are noted in the neighbourhood of Ft Rosebery, along the major Mufulira-Ft Rosebery-Kasama road, and along the eastern road to Samfya (spectral band 5). Other occupation centres appear near Luwingu and at the eastern border of the above-mentioned small graben, west of Lake Bangweolo.

3. The Bangweolo system

This system corresponds to the Lake and the adjacent, mainly swampy areas of which the most striking feature is the Upper Luapula graben. Spectral bands 5 and 7 reveal most clearly the structural composition of this regional unit.

3.1. Bangweolo 1.

It is suggested by ERTS-imagery that the contourlines of the Lake, especially the northern and western margins, are determined by fault scarps. The question arises whether straight NE-SW directed spits in the lake correspond to tectonic features or to bars of sedimentary origin; the former explanation is the most likely one owing to the rectilinear and angular contour of the spits (see photo).

3.2. Bangweolo 2.

This subsystem corresponds to the Upper Luapula graben with N-S direction, including Lake Kampolombo. Spectral bands 5, 6 and 7 reveal clearly "subrecent" fault scarps bordering this swampy rift valley. The River Luapula follows the eastern fault scarp and is situated on a graben floor tilted manifestly to the East.

3.3. Bangweolo 3.

A light-toned area east of the Upper Luapula graben indicates higher and better drained ground. A series of villages (Tshingola, Kawando...) are situated on the southwestern "appendix" of this unit. It indicates the relative concentration of population along the R. Luapula.

3.4. Bangweolo 4.

A marshy area with shallow lakes and a hummocky topography.

4. The Luapula system

This unit corresponds mainly to plateau landscapes crossed and entrenched by the R. Luapula and its tributaries. There is a striking structural control of the drainage attern and an expansion of the forested areas to the South.

4.1. The southern Luapula subsystem

South of the R. Luapula. A nice homogeneous area chracterized by a convergent dendritic drainage pattern which is completely controlled by geofractures, may be fault-line valleys, the direction of which varies between WSW-ENE and SE-NW. Secondary transverse geofractures also have influenced the development of the river pattern. Spectral band 5 reveals a relative more dense vegetation with gallery forests, in a subsystem which is poorly populated except for the southern Upper R. Muniengashi (Kipilungu..) which is functionally related to the Zambian Copperbelt.

4.2. The central Luapula subsystem

The area south of the R. Luapula and along this river is largely deforested as the result of riverain settlement (Kabunda). The area north of the R. Luapula is marked by dendritic-subparallel tributaries of the R. Luera, orientated mainly SE-NW by a parallel geofracture system. There is no doubt about the existence of a SW-NE directed, more or less swampy graben which has fixed the position of the upper R. Luera. The lower section of the R. Luera may follow a half-graben downdropped along one southern border fault. We note a correction of the position of the Mufulira-Ft Rosebery road and relative dense settlement near the Luera-Luapula confluence, on Zairese territory.

4.3. The northern Luapula subsystem

A transitional area to the northern Ft Rosebery-Chibote system. Grey-toned ground on spectral band 5 may correspond to heavy ferrallitic soils or some specific pedobotanical association. Marked concentration of clearings and population is observed south of Ft Rosebery, over a distance of more than 30 km along the road. We note a correction on the 1:1.000.000 U.S. Army map

of the position of the R. Luapula, near the village named Kibaya.

5. The Lubembe system

A relative wet area (spectral band 7) compared to the adjacent Luapula and Copperbelt systems, characterized by the dense, dendritic drainage pattern of tributaries of the R. Lubembe Orientale, the position of which is manifestly controlled by a major SSE-NNW geofracture or fault-line. Intensive deforestation due to dense settlement, especially near the Copperbelt area (Sakania, along the Mufulira-Ft Rosebery road). Spectral band 5 shows clearly the contourline of the granitic belt of Mokambo.

6. The Copperbelt

Spectral band 5 offers a spectacular view on road patterns, urban areas and mining centres of the Copperbelt (Luanshya, Ndola, Mutenge, Kitwe and Mufulira). Most striking is the expansion of the centres of Ndola and Mutenge. Some reforestation is visible west and east of Ndola whereas the density of vegetation of non-exploited areas is relatively high, comparable to that of the southern Luapula subsystem.

The straight N-S R. Kafue is certainly structurally controlled. NW-SE orientated lineaments slightly deflected to the South, corresponding to a Ridge and Valley topography, appear in the northern part near Mufulira. This structural trend may belong to the main Katanga-Kundelungu tectonic arc.

7. Southern subsystems

7.1. The Kafulafuta Basin

This tributary basin of the R. Kafue is marked by wet soils, high drainage density with a subparallel river pattern. The physiognomy of this basin is comparable to the Lubembe Basin and both units may be developed on a rather impervious or densely fractured subsoil. Settlements and land in cultivation is concentrated along the Ndola-Lusaka road and in the valley-head area of the R. Kafulafuta. The latter belt continues into the Upper R. Muniengashi valley mentioned-above (southern Luapula subsystem, Zaire). It has to be stated however that spectral band 5 does not always permit as to decide clearly in this belt whether light-toned areas are derived from intensive cultivation or from both soil erosion and cultivation. Nevertheless the more or less angular geometry of light-coloured spots in the areas considered suggests clearings and land in cultivation, but correlative soil erosion mey be important.

7.2. Walamba

A locality on the Ndola-Lusaka Railway. The so-called subsystem is characterized by partly forested ridges and valleys with dominant SW-NE lineaments according to a general tectonic trend. This trend continues partly across the southeastern edge of the southern Luapula subsystem and east of this unit. Rectangular drainage pattern. Poorly populated.

7.3. Upper Lunsemfwa Basin

Asymmetrical evolution of a dense, subparallel dendritic drainage pattern. Open vegetation; savanna grassland. The physiognomy of the whole unit resembles to that of the Kafulafuta and Lubembe Basins.

7.4. Mendape and Mwanza-Chawa Hills

A tectonic-geomorphic unit, manifestly a dissected anticline marked by intensive soil erosion on the interfluves.

CONCLUSIONS AND INTERPRETATIONS

From this first analysis it may be concluded that ERTS-imagery is very suitable for a regional-geographic study. Especially spectral bands 5 (green-yellow) and 7 (infrared) permit us to obtain a rather complete impression of all terrain features. Human features (roads, settlements, clearings) and vegetation seem to be represented most clearly on spectral band 5, whereas physical features such as drainage patterns and geomorphic-structural elements, figure well on spectral band 7.

Some striking physical phenomena have been observed : 1) the vast Mweru Wantipa Lake, situated in a sunken area bordered by fault scarps 2) the Upper Luapula and R. Luera grabens which may form part of one rift valley system including the Lake Bangweolo 3) a typical Ridge and Valley topography in the central part of the Ft Rosebery-Chibote system, deranged by many closed swampy basins (karst features?) 4) the structural control of drainage patterns by geofracture systems, e.g. the southern Luapula subsystem. The term "geofracture" has been applied always when no distinct topographic offset proved the existence of a fault-line but one may assume that many of the mapped geofractures correspond in fact to fault zones. It has to be mentioned that the observed Mweru Wantipa, Bangweolo, Luera and Upper Luapula rift structures do not figure on the geological maps of Zambia discussed by W.H. Reeve (1963).

We observed a relative expansion of dense forests from North to South with some concentration in the southern Luapula and in the Walamba subsystems. Swampy valley-floors, narshes and lakes mark the Ft Rosebery-Chibote and the Bangweolo systems. The most open vegetation was found in the central Luapula subsystem and the southern subsystems (except for the Walamba unit).

Spectral band 5 suggests a recent expansion of the Ndola and Mutenge centres in the Copperbelt. Furthermore we observed a striking recent expansion of settlements and land in cultivation along main roads, especially along the axis Lusaka-Ndola-Mufulira-Ft Rosebery-Luwingu-Kasama. A relative concentration of riverain population characterizes the R. Luapula vallay. Except for the Copperbelt System with its urban centres one may speak of a strip showing sparse cultivation with isolated areas of cropping or

fallow land, appearing sporadically in the savanna woodland. Areas of more dense cultivation occur around towns, river banks and major roads.

ACKNOWLEDGEMENTS

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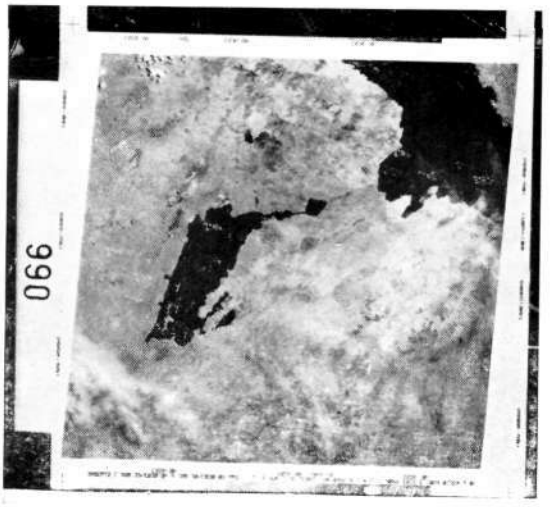
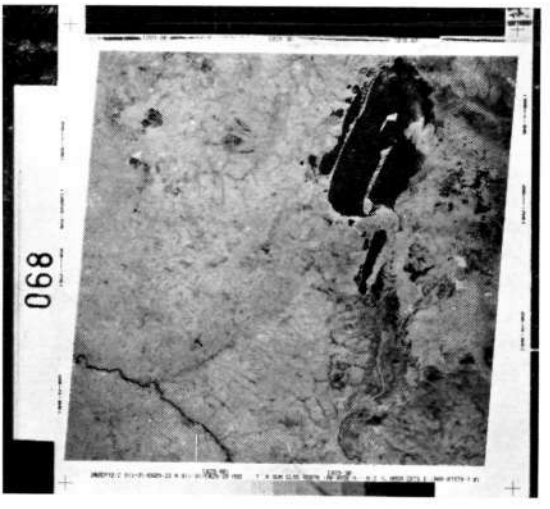


Lake Mweru Wantipa
and Lake Tanganyika



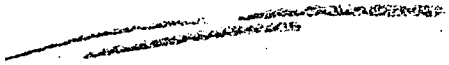
Lake Bangweolo and
Upper Luapula graben

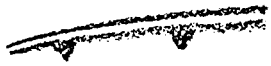
L E G E N D

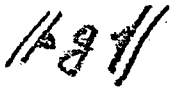
Scale 1/1 000 000

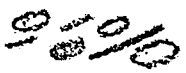
Physical features:

geofractures 

lineament 

fault scarp 

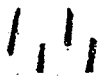
graben 

blowouts  and fossil dunes 

marsh 

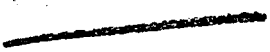
lake 

river pattern 

grassland (wet) 

Human features:

scattered or dense settlement, cropping and fallow land 

road 

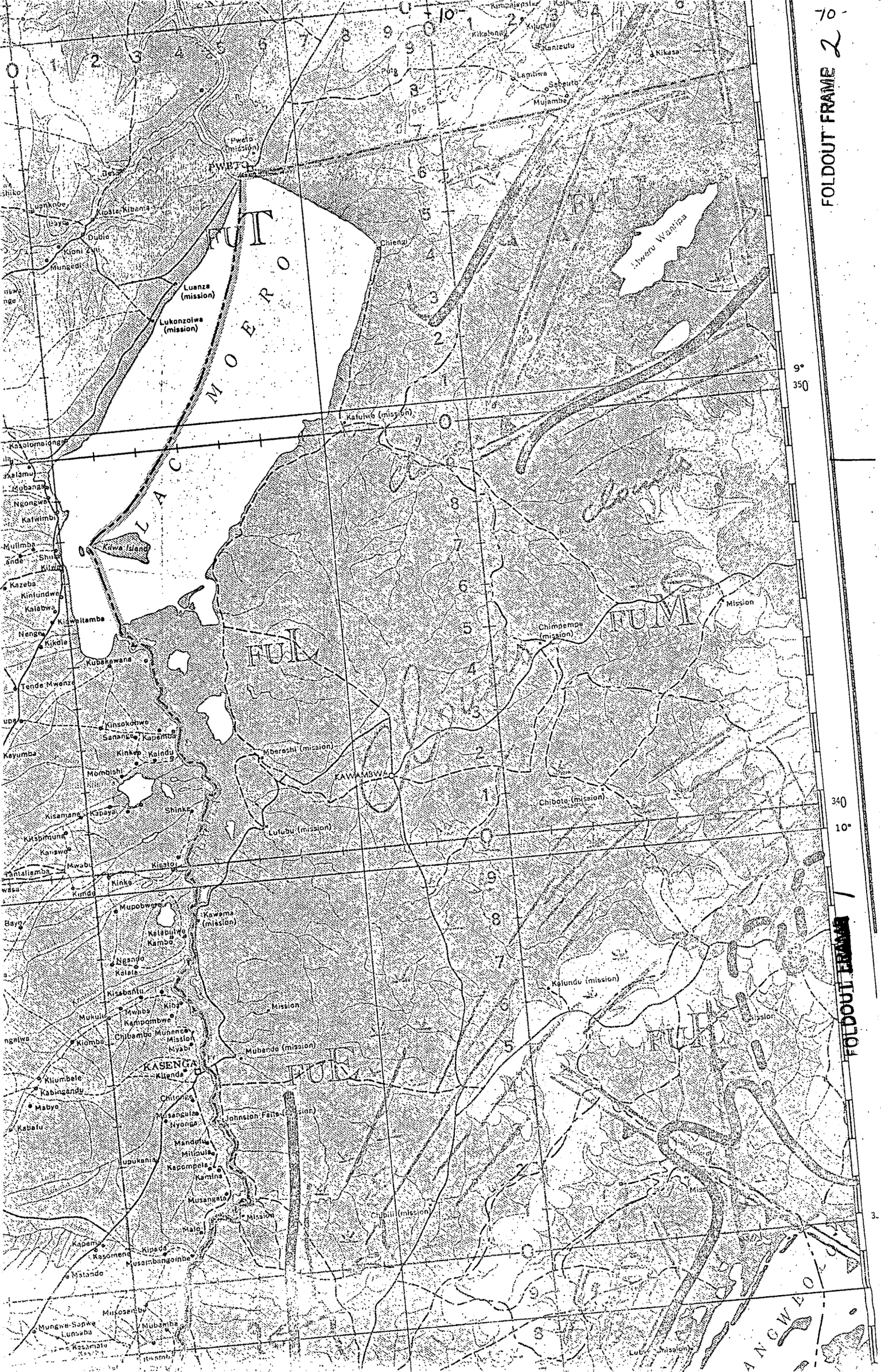
Regional-geographic classification

limit of systems 

limit of subsystems 

FOLDOUT FRAME 2

FOLDOUT FRAME 1


FOLDOUT FRAME 2
FOLDOUT FRAME
PWETO
Pweto (mission)
Luanza (mission)
Lukonzolwa (mission)
Chienga
Lwera Wanfipa
Kafulwa (mission)
Kilwa Island
LAC MOERO
Kasolompongo
Ngongwa
Kafwimbi
Kazeba
Kinlundwe
Kalabwa
Kiwalitamba
Nenge
Kikole
Kubakawana
Tende Mwenza
Kinsokolwe
Sanansa
Kapemba
Kayumba
Kinkwa
Kaindu
Mombishi
Kisamane
Kapaya
Shinka
Kitshimuna
Kanswa
Mwabu
Kinsoro
Kinka
Kimba
Mupobwera
Kawama (mission)
Kalabulwa
Kambo
Ngando
Kalala
Kisabantu
Kiba
Mukuli
Mwaba
Kampombwe
Chibambo
Munanca
Mission
Nyabi
Kiombe
Mubande (mission)
KASENGA
Kilenda
Kiumbele
Kabingandu
Mabyo
Kabalu
Chitonga
Musangula
Nyonga
Johnston Falls (mission)
Mandulu
Milipulo
Lupukania
Kapompela
Kamina
Musangato
Mission
Kapemba
Kasomena
Kipeta
Musambangombe
Matando
Mukosemba
Mungwa-Sapwe
Lunsaba
Mubamba
Kasamalu
Mwambi
Chibili (mission)
Kalundu (mission)
Mberashi (mission)
KAWAMBWA
Chibote (mission)
Lufubu (mission)
Chimpempu (mission)
Mission
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35°
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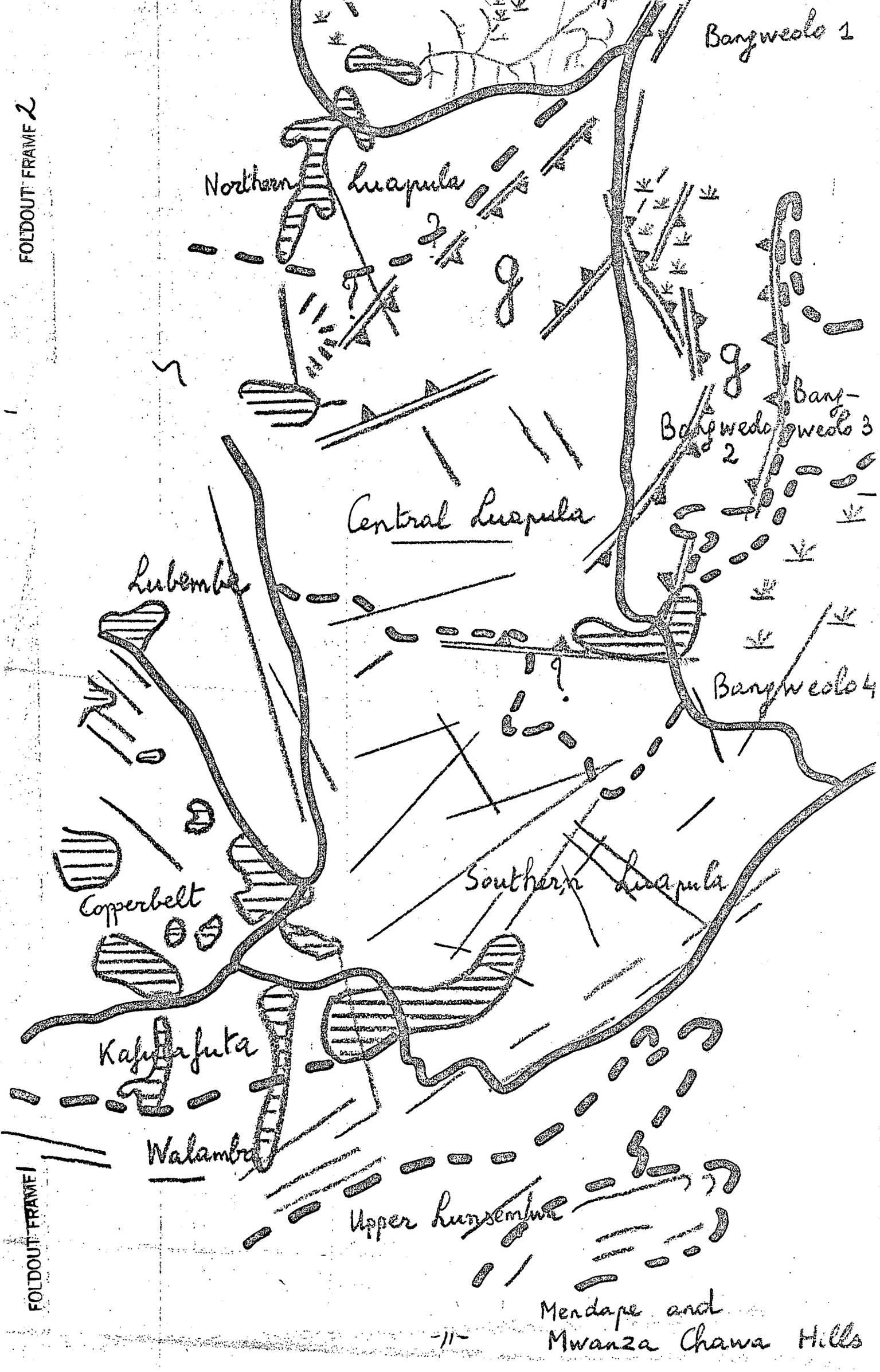
10°


FOLDOUT FRAME 2
Bangweolo 1
Northern Luapula
Bang-
Bangweolo 2
weolo 3
Central Luapula
Lubemba
Bangweolo 4
Copperbelt
Southern Luapula
Kafubafuta
Walamba
Upper Luvsemfwe
Mendape and
Mwanza Chawa Hills
FOLDOUT FRAME 1

1/1 000 000

FOLDOUT FRAME

FOLDOUT FRAME