

LAND UNITS DESCRIPTION

Mountain

(Codes L31 and L21)

That class includes the highest ranges in the country. It is divided into two principal units according to slope gradient, relief intensity and elevation ranges.

The first unit (**L31**) comprises the two highest massive relieves of the study area, Mt Kilimanjaro (5,895 m), Mt. Meru (4,565 m). The main origin is "Structural-Denudational and Volcanic". This unit is characterised by sharp crested ridges, steep and rugged straight slopes radiating from the top and V-shaped valleys; crags, rocky walls and outcrops from very steep to precipitous; irregular rocky slopes from very steep to steep. The relieves can present a sharp crest but, more often, smooth and rounded top features.

The unit is further divided into two subclasses. High rugged CREST (L31c) poorly vegetated, demarcates the summit where high valleys, filled with glaciers, occur. Glacial moraines are found on high peaks. Several long valleys descend from steep and straight upper slope, while in the lower part of the mountains; the valleys display a moderate steepness. A second sub-unit was delineated: the MOUNTAINOUS FOOTRIDGE (L31mf). It comprises a large area of narrow rounded, seldom sharp-crested, ridges sloping away radially from the central mountain edifices. Slope steepness varies from steep to moderately steep. In the mountainous footridges, pyroclastic deposits frequently occur.

The second unit (**L21**) comprises steep mountain ranges and some mountain peaks with an average elevation and slope gradient lower than the previous class (L31). The main origin is mainly "Structural/Denudational & Volcanic" and "Structural/Denudational". The main characteristics of this class are: a series of high ridges - peaks and spurs usually with narrow crests - generally with steep and straight slopes. These types of mountains are highly dissected with narrow valleys.

The two sub-units introduced in the class L31 were also adopted in this unit. The volcanic relieves near Mbeya show a crest and well-defined mountainous footslope, although less prominent than the previous ones.

Belonging to this class the relieves found in Rwanda and Burundi and most of the mountainous ranges found at the edge of the central Tanzanian plateau. The Livingstone Mountain, Usambara, part of Uluguru Range as well as Rubeho and Mbeya-Kipengere Ranges. These mountains display an elevation range from about 2000 to less of about 3000 m.

Hill

(Codes L32, L22, L11h)

It is a very wide class, comprising units with very different morpho-structures. Units were delineated (according to slope steepness, relief intensity and considering also the altitude as a further distinctive parameter) from steep to gentle undulating. For this reason, in the legend three subclasses are considered: the first two are comprised in the SOTER/LCCS classification; while the third was added to delineate low hills with low altitude and slope steepness. In order to respect the combination with the codes of LCCS classification, L11h was used because in this classification low hill must be classified as plain L11.

Hills are present in different parts of the country especially at the margin of the Tanzanian central plateau in volcanic, metamorphic and sedimentary formations. In Rwanda and Burundi, the topography degrades from the high mountainous terrain on the west side of the countries eastward; group of hills of different types have been recognised. The main origin can be “Structural/Denudational” or “Structural/Denudational & Volcanic”.

The first subclass (**L32**) is defined by a series of relieves with rough profile. The elevation ranges can be considered between ~ 1000-1500 m or more. The slopes are straight with a steepness ranging from steep to very steep. Sharp crests and narrow valleys are frequent.

The second subclass (**L22**) embraces hills with a large variety of slope steepness, length and shape. These formations are scattered everywhere over Tanzania. Elevation is moderate, around and below ~ 1000 m. The slope gradient is very variable, ranging from steep, rolling to undulating. Slopes are generally steep with rounded crests but the relief shape changes very often according to the lithology. Hills on metamorphic lithology show sharp crests, while the ones of volcanic structures have relief usually more smooth especially when the lithology is mainly pyroclastic. The accumulation of debris on the footslopes is often very clear on the satellite images.

Last subclass (**L11h**) presents a very smooth and gentle topography. The main characteristics are low slope gradient (between 3-8 %), low elevation and low relief intensity. The shape is variable, but generally can be considered as an undulating topography. Hills usually show broad rounded crests. Sometimes the crest can be sharper, especially in metamorphic formations. The intrusive and metamorphic lithologies are prevalent. Accumulation on footslopes is often well developed.

Ridge and Complex of Ridges

(Code L24, L24c)

The morpho-characteristic of this class as the slope gradient covers a quite large range (8-30 %). Therefore shape is the most distinctive feature of this unit. The ridge shows, in fact, an elongated form with a single crest that usually presents the same elevation. When ridges are arranged in groups a **Complex of Ridges L24c** class was delineated. The main origin encompasses “Structural/Denudational” and “Structural/Denudational & Volcanic” for the class L24 Ridge while the second one was recognised only as “Structural/Denudational”.

These units are widely represented in the Kagera province (Tanzania) and in

Rwanda where the Pre-Cambrian Karagwe-Ankolean formation is found.

Inselberg

(Code L22i)

As the previous class, the distinctive feature is not the morphometry but the relative position. Inselbergs are isolated residual hills. They rise abruptly from an extensive low-level land. They may be large or small occurring either in isolation or in small hill groups. Therefore, it is a very wide class comprising hills with variable slope and shape (the main origin is mainly “Structural/Denudational”). The slope gradient is from rolling to moderate (8-30 %). The shapes of the crests are from sharp to rounded. The surface may be smooth or rugged depending on the rock characteristics and weathering stage. They extensively occur in different part of the country; Kopije, when mapped, are comprises in this class.

Plateau

(Codes L12, L12d, L12i, L12sf)

Plateaux are an important geomorphological feature in Tanzania especially in the central area. The plateaux found in Tanzania are mainly of “Structural/Denudational” origin but an upland with level summit has also been recognised in some volcanic complexes.

Five different sub-classes are considered:

L12 – Structurally controlled plateau (non dissected). Flat or almost flat surface in the highest part of the terrain units. The slope steepness ranges from gentle to moderate; occasionally it can be steep. The length of the slope may be variable: from short to long. Generally the scarp zones are very sharp and precipitous but can have a more gentle shape depending on the rate of the erosion and type of displacement.

L12d – Structurally controlled plateau dissected. Similar to **L12** the distinctive feature of this unit is the high rate of dissection that can be recognised on the summit of the plateau. The drainage pattern is well developed resulting in a high

drainage density that influences its general aspect.

L12i – Isolated remnant of structurally controlled plateau. The general characteristics are the same as of the class L12, but in this case, the plateau's surface is limited. The general aspect of the unit is given by a fragmentation of remnant of small plateaux.

L12sf – Steps fault platform. It is a unit characterised by parallel ridges with gently sloping crest and steep scarps, separated by narrow valleys. The scarps are produced by step faulting on the original plateau surface. See the block-diagram of figure 4.2. This unit has been identified in the northern part of the country where the Gregory Rift enters in Tanzania.

Volcanic shield

(Codes L22sh)

Many volcanic shields recognised in the area show a positive, conical shaped landform. Generally, it is characterised by a moderately steep slope gradient and extensive structure. Often, calderas on top of a volcanic hill mark this feature. The calderas present an irregular topography: a roundish ridges and a central depression, higher at the edges and lower in the centre. When the caldera is well-defined, it was mapped as a single unit and included in the next unit (*L22cr*).

Volcanic footslopes generally shows a gentle to moderate steep slope. Concave form and smooth surface. On these edifices, different dissections can be present. They are characterised by radial valleys that can displays possible planezes features.

Volcanic cones and crater area

(Code L22cr)

It is a unit that includes areas where a series of small volcanic cones arranged along structural alignment and wide craters as the Ngorongoro caldera. The average steepness of the area is medium but the single craters can have very steep wall and, in the internal zone, a flat wide plain. Calderas and craters, when mapped as a single unit, are comprised in this class.

Fault controlled Escarpment

(Codes L33, L23)

The structural scarps are caused by the displacement along the Rift Valley edges. In Tanzania, Rwanda and Burundi, several escarpments have been recognised usually along normal type fault lines. The main direction of these lineaments is extremely variable depending to the structural pattern of the area. The origin can be “Structural/Denudational” and “Structural/Denudational & Volcanic”

This class is subdivided into two sub-units according to the slope gradient.

L33 - It is a linear or almost linear structure with straight and vertical slopes ranging from steep to very steep.

L23- Same characteristics as the previous class, but with less precipitous features. The slope steepness ranges from steep to moderate.

Plain

(Code L11)

It is a rather flat, sometime gently sloping, surface lower than the surrounding features. According to the main origin, several flat or almost flat rock tables are classified as “Structural/Denudational” and “Structural Denudational & Volcanic”. A further division of the plains follows a lithological criterion. In fact, main peculiarities come from different lithologies that include volcanic, sedimentary cover and metamorphic rocks of the Basement. Some are overlain by gravel or sand, others by layers of soil, while others are bare and reveal the eroded bedrock. The alluvial plains are considered in a separate class.

Dissected plain

(Code L26)

The peculiarities are the same of the previous class but the unit present a more accentuated sloping land displaying a more or less constant crest level. Drainage density is generally very high due to intense erosive cutting. On the central area of Tanzania, this unit is widely present.

Low gradient Footslope

(Code L14)

It is generally a gently inclined surface. Sometimes the slope can be steeper, ranging from steep to moderately steep. The slope length is very variable. The slope form goes from straight to concave.

The footslopes occur in different zones of the country even at the base of the major structural escarpments. The area extent can be variable (only some of them were mapped due to the adopted scale). Due to the size and the level of generalisation of the survey, it was impossible to separate the erosion and the accumulation surface. The class comprises both.

Alluvial Plain

(L11ap)

Extensive plains formed of alluvial deposits occur round the bases of many mountain ranges all over the country. This class comprises the flat plains of alluvium developed mainly by fluvial activities. The nature of the sediments depends upon the type of river, which has built up the deposits, the history of changing flow and sediments discharges. The alluvial plain encloses the characteristic features strictly linked with the fluvial system as flood plain, terraces, river channel, valleys bottom etc. Because of the mapping scale constrains, the delineation of these sub-units were not possible.

This class is widely present in the Tanzania.

Flood plain

(Code L11w, L11wa, L11we)

It is a flat terrain adjacent to and formed by alluviating rivers. Irregular texture and pattern are recognisable. Point bars, natural levees, basins (back swamps) and abandoned channels are generally present. During the flood, the river can spread over the entire width of the plain. Most flood plains are marshy, with swamps and small lakes.

The main criteria adopted to subdivide this unit are based on photo-keys

(pattern, reflectance, colours) and deduct from indirect indicators such as topographical data, agricultural activities, period (season) of images acquisition, etc.

Two sub-classes are introduced: **L11wa** frequently flooded and **L11we** episodically flooded. The first one is clearly visible along the main rivers courses where cultivation can occur.

Other zones adjacent to the previous one present along the perennial rivers or in flooding depression areas were considered not frequently flooded zones and indicated as **L11we**. In this unit, flooding should occur, depending on rainy supply, annual or seasonal river discharge.

Due to the total absence of fieldwork, the separation between the two sub-classes was entirely based on specific photo-characteristics. The type and phenology of natural vegetation as well as the holistic overview of the all system were the most effective and reliable ones.

When no differentiation was possible due to the scale constrain or to uncertain differentiation between the two sub-classes, the interpretation remains at the general level L11w.

Valley

(Code L41)

Fluvial erosion produces several types of valleys, most of which exhibit different forms and features that are extremely variable. The valley sides range from rolling to steep. The forms of the slopes are generally irregular and often asymmetric.

At the scale of the mapping exercise, valleys made up of side slopes, valley bottom and river bed is often taken as a single mapping unit. Those mapped were recognised in sedimentary and metamorphic formations.

Valley bottom/river bed

(Code L15)

It is the deepest portion of the valley streams, generally on elongated level lands. Valley bottoms change in width and shape. It can be as wide as the riverbed or wider. This is the reason why two definitions are used in combination. Usually, the valley bottom is densely vegetated.

Due to the scale constraint, this class can be mapped as a single unit only when the valley shows a large bottom. Otherwise, it was been included in the previous one L41 or in the class floodplain if the large flooding area, present at the bottom valley, is the most preponderant physiographic aspect.

Alluvial fan

(Code L11af)

Some alluvial fans are identifiable in areas where streams, from a narrow mountain valley, flow into a plain or into broad valleys. A fan-shaped deposit is the characteristic peculiarity easy to detect. Some extensive alluvial fans have been recognised in the Kilombero Valley and at the bottom of the Usambara-Pare Mountains.

Swampy area

(Code L11sw)

It is a flat surface extending along river valleys or in closed depressions. It is generally densely vegetated and most of the time covered by water. These characteristics make it very easy to detect on satellite images. The unit has been recognised in the deepest zone of several structural depressions of the countries, along the main river courses and along the coast.

Delta plain

(Code L11d)

A delta is a large low-lying surface of river deposits laid down where a river flows into the sea (generally, it presents a peculiar triangular shape). The delta surface is swampy with several small lakes and lagoons formed by river and marine deposition. Delta formation depends on the amount of sediment deposited relative to the amount removed by waves and total currents. Deltas are present on the coast and along the shore of some lakes.

Coastal plain

(Code L11cp)

In Tanzania the coastal landform displays cliffed coast as well as beaches. The first, align often along fault lines, presents a steep slope face along the Ocean. It varied in height, profile and plan and marine erosion process are dominant. It wasn't possible mapped because of the scale constraint. On the other hand, where the coast is low-lying the landform is well identifiable. The unit includes the beaches that are formed for coastal accumulation of sand or shingle.

It is a flat terrain, gently sloping towards the ocean. Elongated ridges, parallel to one another, varying in height can be present. Unconsolidated materials such as mud, sand, pebbles and fragments shells cover the coastal area.

Depression

The depressions can be formed by a number of different mechanisms, often acting in combination (block faulting, broad shallow warping, chemical weathering and solution, wind erosion). In the study area, the origin of depressions appears to be mainly determined by faulting. In this case, depressions have been considered in the class "Structural/Denudational". In case of the contribution and the influence of the lacustrine deposition processes becomes a preponderant peculiarity, the unit was considered in the class Lacustrine/Polygenetic. Using as distinction criteria genesis, main lithology, shape and photo-keys, three classes were distinguished.

Structural depression

(Code L13)

It is a flat or almost flat terrain, confined by steep scarps usually due to normal fault displacements. The shape depends on the local characteristics of the fault pattern.

Shore

(Code L13ho)

It is a flat or almost flat terrain, extending around the lakes that in the study area are mainly of structural origin. Lacustrine deposits are easy to be recognised because of their light tone and even textured band parallel to the shore.

Lacustrine

(Code L13I)

It is a flat, slightly concave, terrain generally filled of shallow water, especially, during the rainy season. On the opposite, it can become completely dry one or two months after the end of the rain. The depression is filled with unconsolidated sediments especially clay and silt and evaporites (salt). This unit has been recognised in the wide Bahi and Wembere swampy areas and in the Kigoma province (Malagarasi catchment).