

LAND UNITS DESCRIPTION.

Mountain

(Codes L31 and L21)

That class includes the highest ranges in the country (up to 5200m). 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 Kenya (5199 m), Mt. Elgon (4209 m) and an elongated mountainous range extending NW-SE, Aberdare (3999 m). The main origin is mainly Structural-Denudational and Volcanic. In fact, Mt. Kenya, Mt. Elgon and Aberdare Range are volcanic complexes.

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. Mt. Kenya and Mt. Elgon show a more ragged landscape, typically alpine, while in the Aberdare ranges, crags and rocky walls are less frequent, slopes are steep and rarely very steep. The ridges can present a sharp crest but, more often, smooth and rounded features.

The unit is further divided into two subclasses:

High rugged CREST (L31c) poorly vegetated, demarcate the summit where high valleys filled with glaciers occur. Glacial moraines are found on high peaks. Several long valleys descend from the upper slope generally steep and straight, while in the lower part of the mountains; valleys are from steep to moderate. In fact, here the landscape completely changes.

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 footridges, pyroclastic deposits frequently occur.

The second unit (**L21**) comprises steep mountain ranges and some mountain peaks with an average elevation lower than the previous class (**L31**). The principal origin is mainly Structural/Denudational.

Belonging to this class: Cherangani Range with maximum elevation of 3581 m, extending on the west side of the Kerio Valley. The Ol Doinyo Ng'iro and Ol Doinyo Mara ranges that lie on both sides of South Horr Valley (south-east of lake Turkana). These mountains rise at maximum elevation of 2848 m.

The Ndoto and Ol Doinyo ranges (further southwards), with maximum elevation of 2688 and 2637 respectively. The Karisia range, (south-east of Maralal) 2600 m above s. l. Some ridges and peaks of volcanic origin along the Uganda border with an elevation of up to 2600 m above s. l.

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. Elevation ranges between ~ 2600-2800m. These types of mountains are highly dissected with narrow valleys. The biggest and longest valleys are oriented ~ NW-SE.

Hill

(Codes L32, L22, L11h)

It is a very wide class, comprising units with very different morpho-structures. Units were delineated (according to altitude and slope steepness) from steep to gentle undulating. For this reason, in 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. The main origin can be Structural/Denudational or Volcanic & Structural/Denudational. Hills are present in different parts of the country in volcanic, metamorphic and sedimentary formations.

Belonging to this class is the Tugen hills, westward of the Kerio Valley, north-east Mt. Kenya, Loldaika range, Loita hills near the south-west Tanzanian border, south-east of Lake Magadi. There are other two groups in the northern part: The first one near Stephanie along the Ethiopia border. The second one in the north-east side of Lake Turkana where several high peaks present the same characteristics.

The first subclass (**L32**) is defined by a series of ridges with rough profile. The elevation ranges from ~ 2200 - 2800 m. 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 the country. Elevation is moderate, around and below ~ 2000 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 piroclastic. Limestone hills usually show rolling topography. 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. The hills usually show broad rounded crests. Sometimes the crest can be sharper, especially in metamorphic formations. Accumulation on footslopes is well developed.

This is the case of the hills north-east of El Wak (Ethiopia-Somalia border) where the formations produce a very bold topography.

The sedimentary and metamorphic lithologies are dominant. In this unit, the landscape is dominated by low hills and several inselbergs, sometimes very close to rock outcrops that rise in the wide plain.

Inselberg (Code L22i)

Isolated hills generally bare and rocky. They occur in different part of the country and may be large or small occurring either in isolation or in small hill groups. It is a very wide class comprising residual hills with variable slope and shape (the main origin can be Volcanic & Structural/Denudational or Structural/Denudational). The slope gradient is from rolling to moderate. 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.

Plateau (Codes L12, L12d, L12i, L12sf, L12f)

Plateaux are an important geomorphological feature in Kenya especially in the Rift Valley. In Kenya, plateaux are mainly of volcanic origin but an upland with level summit is even found in metamorphic rock.

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. Figure 4.2 shows plateau near Naivasha.

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 the general aspect of the plateau.

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 4.3.

L12f – It is a flat topped area characterised by a very dark tone (on the satellite image). It is formed by a recent lava flow that shows different petrologic characteristics in respect to the other surrounding volcanic rocks. This formation shows an abrupt change in vegetation cover and stage of weathering compared to the surrounding features.

Complex Landform (L4)

It is a complex unit difficult to describe with a sole geomorphologic definition. These types of features extend mainly in the northern part of the country. It presents a sequence of low (100/150m) elongated hills with very steep slopes, very little plateau zones, lava plains of variable extent, sometimes small volcanic cones and large amount of low gradient footslopes. Due to the scale of mapping it was almost impossible to consider these forms separately therefore they were grouped together. This landform can be a residual feature of an erosion action on basaltic plateau in arid climate. See figure 4.4 a and b.

Volcanic shield (Codes L22sh)

Many volcanic shields recognised in the area show a positive, conical shaped landform. Generally characterised by a moderately steep slope gradient and extensive structure. See figure 4.5 a and b. Often, calderas on top of a volcanic hill mark this feature. The calderas present an irregular topography with a round ridge and depression pattern: higher at the edges and lower in the centre. Volcanic footslopes generally present gentle to moderate steep slope. Concave form and smooth surface. See figure 4.6

An example of circular caldera is the Longonot volcanic shield, SE of Naivasha see figure 4.7.

On these edifices, different dissections are present. They are characterised by radial valleys (Kulal Shield) that can present possible planezes features (figure 4.8).

Volcanic cones and craters area

(Code L22cr)

It is an area with several small volcanic cones, developed along structural alignments. The average steepness of the area is medium but the single craters can have very steep slopes.

Fault controlled Escarpment

(Codes L33, L23)

The scarps are caused by the vertical displacement along the Rift Valley edges. The main direction of these lineaments is N-S or NNW-SSE. Figure 4.9 is an example of vertical escarpment (Eastern Rift, west of Ngong hills).

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.

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 (compare the most impressive depression of the Rift Valley with the smaller structural Kisumu depression).

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 and 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 rock of the Basement. Some are overlain by gravel, others by layers of sand, while others are bare and reveal the eroded bedrock. This unit can be punctuated by shallow depressions. The alluvial plains are considered in a separate class.

Low gradient Foothlope

(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 foothslopes occur in different zones of the country. 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 always possible.

This class is widely present in the eastern part of the country.

Flood plain

(Code 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 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 where cultivation can occur and in stream courses.

Other zones, along the perennial rivers adjacent to the previous one, 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.

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.

Bad land
(Code L32bl)

It is an irregular surface due to intense/severe fluvial erosion. Different tone, mottling pattern and irregular texture reveals very high erosion activity. Bad lands are barren sharp low hills that are highly dissected. It was mapped in both flanks of Tana River where the weathering process on weak rocks has developed this landform.

In this work, badlands are taken as one landform and not included in others' classes (hills) as in SOTER.

Swampy area
(Code L11sw)

It is a flat surface extending along small valleys or in small depression. It is generally densely vegetated and most of the time covered by water. These characteristics make it very easy to detect on satellite images.

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.

Coastal plain
(Code L11cp)

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.

In Kenya, the coast is mainly of organic origin. The coral reef that lies off much of the Kenya coast is the fringing type - a coral platform, up to 1 km wide, jointed to the coast, or separated from it by a shallow lagoon.

Depression (Code L13)

In arid and semiarid areas, 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, etc.). It must be also considered the important contribute and influence of the lacustrine processes on it. For this reason, the main origin of depressions is indicated as Lacustrine/Polygenetic origin. Using as distinction criteria, main lithology, genesis, shape and photo-keys, three sub-classes were distinguished.

Playa (Code L13y)

Playas occur in the lowest portion of two interior basins: Chalby and El Wak. It has a flat, slightly concave topography. The surface is smooth. The water rapidly evaporates leaving sediments (sand and clay) and evaporites (salt). For this reason, these surfaces on the image appear extremely light-toned.

Shore (Code L13ho)

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

Lacustrine (Code L13l)

It is a flat, slightly concave, terrain generally filled of shallow water during the rainy season. On the opposite, it becomes completely dry one or two months after the end of the rain. The depression is filled with unconsolidated sediments especially clay and silt.