The Southern African Development Community (SADC)

The Southern African Development Community (SADC - Communauté Économique des États de l'Afrique Centrale (CEEAC) in French) is an economic, social and cultural agreement to increase self-sufficiency and endogenous development, and create a framework for development and mobilisation of human resources and material between fifteen southern African countries. The member states are Angola, Botswana, the Democratic Republic of the Congo, Lesotho, Malawi, Madagascar, Mauritius, Mozambique, Namibia, the Seychelles, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. SADC covers an area of 10 million km^2 (around 32% of Africa) and has an estimated population of 240 million (2010) with a density of around 30 people/km^2 – however, this reflects a range of around 2 people/km^2 in Namibia to over 600 people/km^2 in Mauritius. There has been notable population growth in Malawi and Mozambique. Per capita GDP is estimated at US$ 3 152 – with South Africa being the economic powerhouse of the region [66]. The FAO has reported that agriculture supports about 85% of the rural population and employs 80% of the labour force. Rural poverty, unsustainable development and land tenure issues are the main causes and consequences of environmental degradation throughout the region.

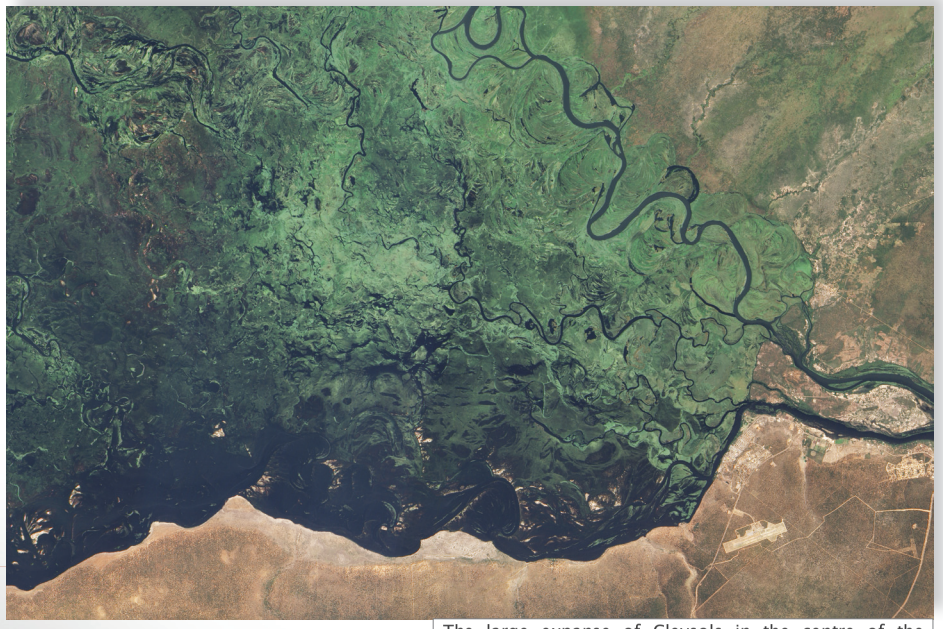
The SADC area is bordered on three sides by the seas of the Atlantic and Indian Oceans, while the north is characterised by tropical rainforest and savannah. Consequently, a broad range of soil types are to be found. The western half of the region is dominated by the Kalahari and Namib Deserts. The arid and hot conditions give rise to characteristic soil types. The Namib consists of sand seas (Arenosols) near the coast with gravel plains and scattered mountain outcrops further inland (Leptosols). Some of the sand dunes are 300 m high. Arenosols are interspersed by Leptosols and Cambisols. Unlike the Namib, the Arenosols of the Kalahari support grasses, acacia trees and salt-tolerant vegetation. As in the Sahara, low soil organic matter levels, low water retention, over-grazing and wind erosion are important considerations in this area.

In the more temperate and more humid southern and eastern parts, a mosaic of leached, red Acrisols, clay-rich Luvisols and stony Leptosols are mixed with Plinthosols, Vertisols and weakly developed Cambisols and Regosols. In general, the soils of southern Africa are not characterised by high fertility with water retention and availability being an issue (the fertile soils of the Western Cape river valleys and on the KwaZulu-Natal coast are exceptions). High concentrations of salts give rise to saline and sodic Solonchaks and Solonetz throughout Botswana, southern Mozambique, South Africa and Zimbabwe. Lightly leached, clay-rich Luvisols,interspersed with Ferralsols and Leptosols, dominate Malawi, northern Mozambique, southern Tanzania and eastern Zambia, with young Cambisols becoming more prevalent in northern Tanzania. Along the Rift Valley, volcanic soils are common and are intensively cultivated. The volcano of Kilimanjaro, the highest mountain in Africa, sits on the northern border of Tanzania.

Western Angola, DR Congo and much of Zambia are dominated by tropical Ferralsols under rainforest (see page 75). While the region is home to the Congo and Limpopo river basins and several large lakes (e.g. Lake Victoria - Africa's largest lake by area and the largest tropical lake in the world), the huge delta of the Limpopo is highlighted as a large expanse of Fluvisols.

The large expanse of Gleysols on the Angola/Zambia border denotes the Barotse wetlands in the Zambezi floodplain. Almost due south in Botswana are the peatlands of the Okavango Delta.

Key issues affecting soils in the SADC region are restricted water-holding capacity, soil erosion and surface crusting, large expanses of inherently saline, acid and/or nutrient poor soils and droughts in combination with organic matter and nutrient depletion through unsustainable cultivation practices.



The large expanse of Gleysols in the centre of the adjacent map denotes the swampy wetlands that are the source of the Zambezi, one of Africa's greatest rivers. The image above was acquired by a sensor onboard NASA's Earth Observing-1 (EO-1) satellite and shows a flood on the eastern tip of the Caprivi Strip in 2010. This striking true-color image shows the stark boundary between the southern and eastern edge of the floodplain (which is higher land and dry) while to the north, the land is flooded. Deep blue channels wind among green, shallowly flooded plains. This area corresponds to the zone of Fluvisols on the borders of the Caprivi Strip with Botswana, Zambia and Zimbabwe. (NASA)

This map shows the soils of Morocco and western Algeria. The major landscape feature in this region is the Atlas Mountain range that separates the slightly wetter and cooler Mediterranean area from the arid and hot Sahara Desert. The mountains manifest themselves as a band of stony Leptosols and weakly developed Cambisols running NE-SW across the map. Along the coasts, a Mediterranean climate, with mild wet winters and hot dry summers, prevails. While the higher regions of the western part of the Atlas Range can receive more than 2 000 mm of precipitation annually (even snow can fall on the peaks of the High Atlas), moisture levels generally decrease away from the coast.

Beyond the Atlas, semi-arid conditions quickly grade into desert, where daily temperatures can rise above 40°C. In more humid mountainous areas, extensive oak and conifer forests occur. At lower elevations, intensive clearance and grazing have produced a distinctive scrubby landscape known as macquis. There is little natural vegetation in the arid desert areas although the date palm is extensively cultivated in the desert oases.

The more humid climate of NW Morocco gives rise to more vegetation and more developed, clay-rich fertile soils such Kastanozems and Luvisols. Pockets of swelling and shrinking Vertisols are evident throughout the landscape. These soils support extensive cereal cultivation in the winter and grazing in the summer. Soils with high levels of calcium carbonate (Calcisols) are very evident, especially in drier conditions.

To the south of the Atlas Mountains, conditions are much more arid and daytime temperatures are significantly higher. Soils are characterised by minimal development and low or negligible organic matter content. Regosols, stony Leptosols and soils with 'fossilised' accumulations of gypsum (Gypsisols) dominate. Arenosols denote the locations of large sand seas and dunes. Saline soils occur in depressions along the coast and as dry lakes in the desert.

The blue linear features are Fluvisols, demarcating river systems in the region. Many are ephemeral in nature (i.e. dry for much of the year).

Where the soils have a well-developed structure and moderate levels of organic matter and water is available, many Mediterranean soils are quite productive. However, excessive lime and the presence of salts can be problematic. Away from the coast, the increasing semi-arid conditions generally lead to poorly developed soils that are vulnerable to degradation by human activities such as overgrazing which can lead to erosion, especially by flash flooding after intense rainfall. Soil organic carbon levels are generally low or very low and droughts are common. Desertification is a key concern throughout the region.

SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

17° 30´ 15° 12° 30´

37° 30´ 35° 32° 30´ 30° 27° 30´

Atlantic Ocean

Madeira

LPli

Funchal

Lanzarote

RGca CLpt LPli Arrecife

Fuerteventura

LPli Puerto del Rosario CMeu

Santa Cruz de la Palma

LVcr LPli La Palma

La Gomera ANsn

LVcr LPli Santa Cruz de Tenerife Tenerife

CMcr CMeu Las Palmas de Gran Canaria Gran Canaria

ANsn El Hierro

Tan-Tan CMhy LPli

Tarfaya CMht CMhy LPli CMeu

SC ARpr RGeu Laāyoune

CMhy FLeu Hauza LP FLeu

WESTERN S

The EU supports the efforts by the Secretary General of the United Nations and his Personal Envoy to find a just, lasting and mutually acceptable political solution which will allow the self-determination of the people of the Western Sahara as provided for in the resolutions of the United Nations.

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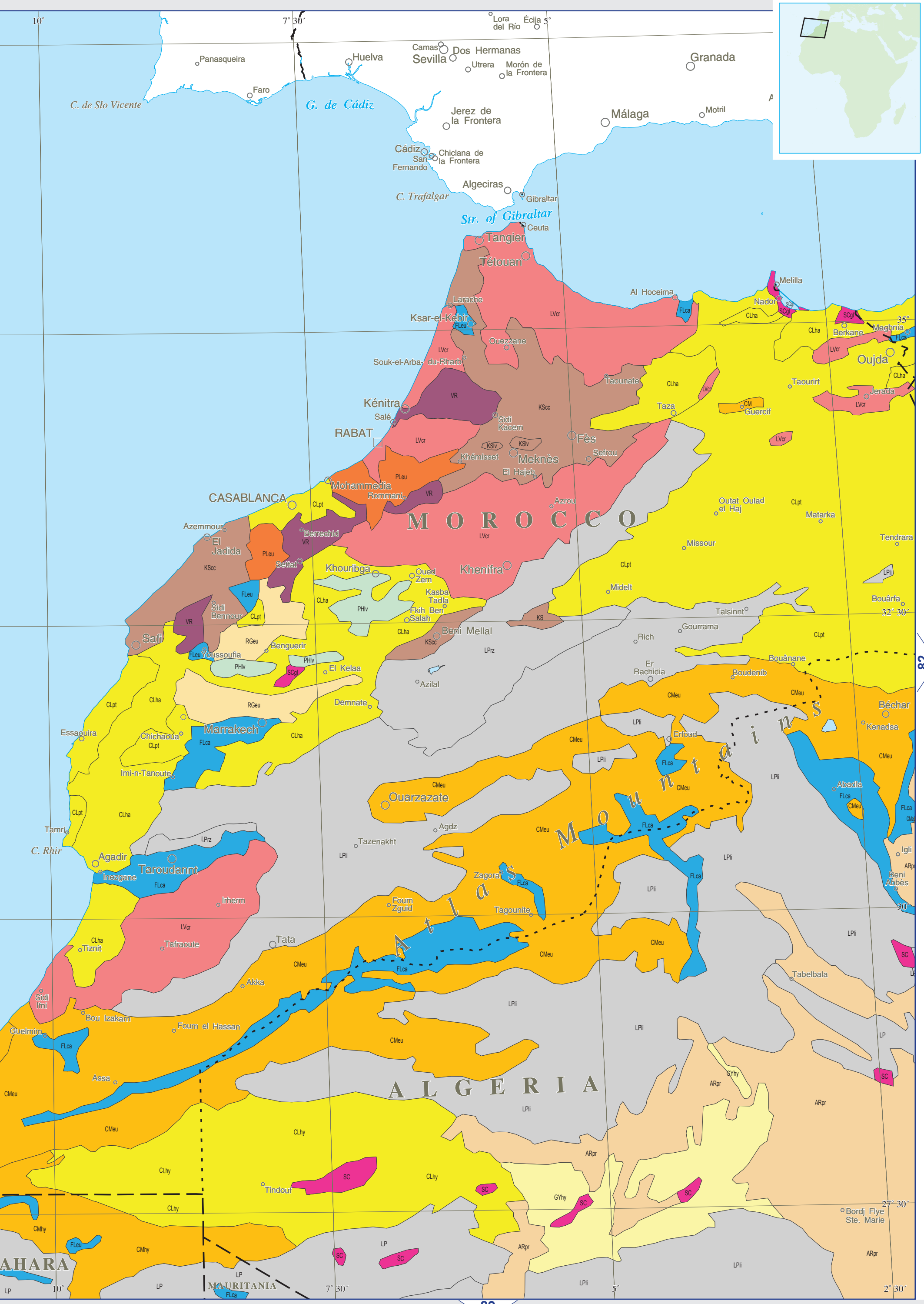
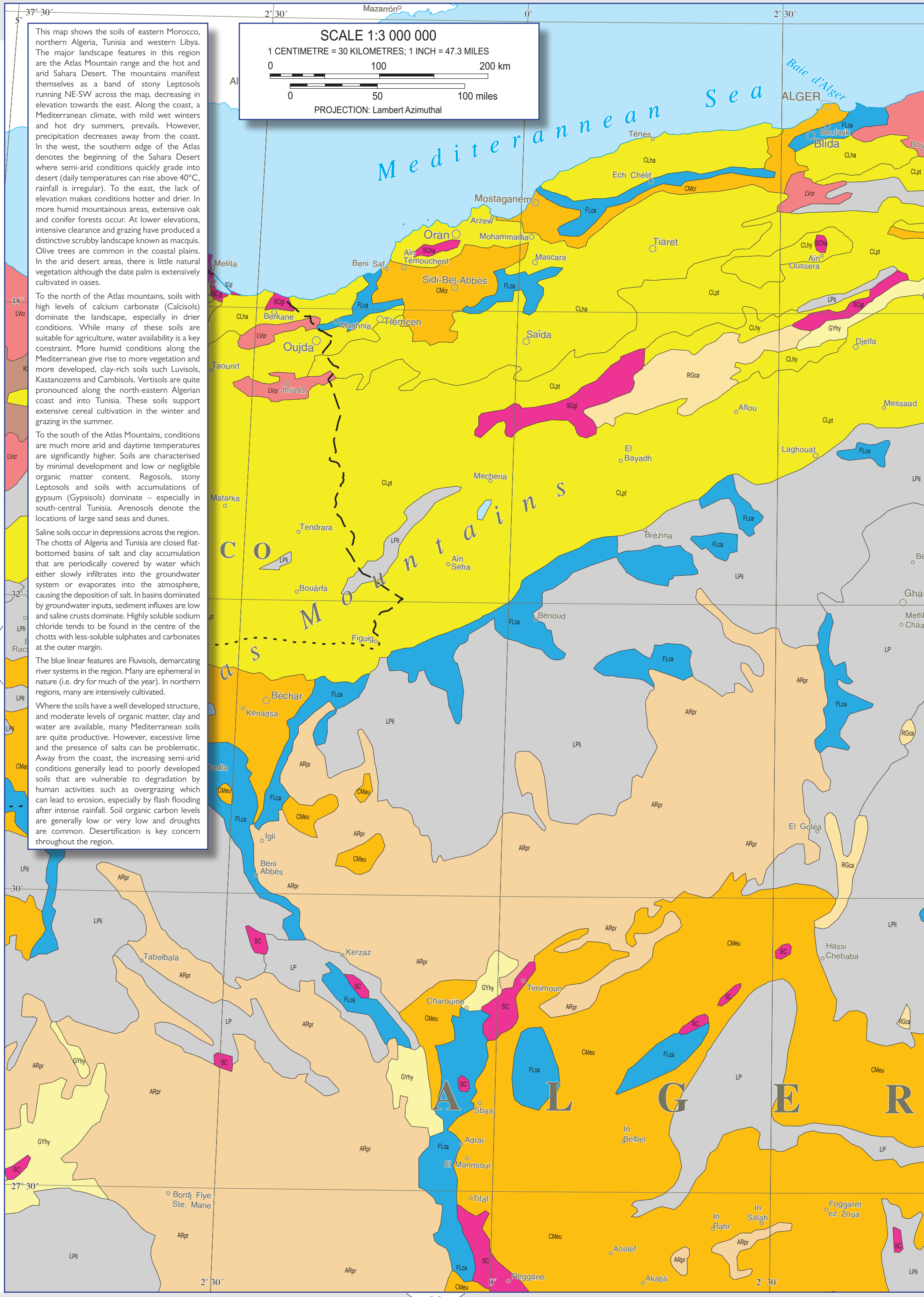

10°
7° 30´
5°
2° 30´
Lora del Río
Écija
Camas
Sevilla
Dos Hermanas
Utrera
Morón de la Frontera
Granada
Panasqueira
Huelva
Faro
C. de Sto Vicente
G. de Cádiz
Jerez de la Frontera
Málaga
Motril
Cádiz
San Fernando
Chiclana de la Frontera
Algeciras
Gibraltar
C. Trafalgar
Str. of Gibraltar
Ceuta
Tangier
Tétouan
Melilla
Al Hoceima
Larache
Ksar-el-Kebir
Nador
Berkane
Maghnia
Oujda
Ouezzane
Souk-el-Arba- du-Rharb
Taounate
Taourirt
Jerada
Taza
Guercif
Kénitra
Salé
RABAT
Sidi Kacem
Fès
Sefrou
Khémisset
Meknès
El Hajeb
Mohammedia
Rommani
CASABLANCA
Azrou
Outat Oulad el Haj
Matarka
Tendrara
Missour
Azemmour
El Jadida
Berrechid
Settat
Khouribga
Oued Zem
Khenifra
Midelt
Bouârfa
Talsinnt
32° 30´
Kasba Tadla
Fkih Ben Salah
Beni Mellal
Gourrama
Rich
Saffi
Sidi Bennour
Youssoufia
Benguerir
El Kelaa
Azilal
Demnate
Er Rachidia
Bouânane
Boudenib
Béchar
Kenadsa
Essaouira
Marrakech
Chichaoua
Erfoud
Imi-n-Tanoute
Ouarzazate
Agdz
Tazenakht
Abadla
Igli
Beni Abbès
Tamri
C. Rhir
Agadir
Taroudannt
Inezgane
Irherm
Zagora
Foum Zguid
Tagounite
Tata
Tiznit
Tafraoute
Akka
Tabelbala
Sidi Ifni
Bou Izakarn
Foum el Hassan
Guelmim
Assa
Tindouf
Bordj Flye Ste. Marie
MOROCCO
ALGERIA
MAURITANIA
AHARA
Atlas Mountains
82
89
30°
27° 30´



This map shows the soils of eastern Morocco, northern Algeria, Tunisia and western Libya. The major landscape features in this region are the Atlas Mountain range and the hot and arid Sahara Desert. The mountains manifest themselves as a band of stony Leptosols running NE-SW across the map, decreasing in elevation towards the east. Along the coast, a Mediterranean climate, with mild wet winters and hot dry summers, prevails. However, precipitation decreases away from the coast. In the west, the southern edge of the Atlas denotes the beginning of the Sahara Desert where semi-arid conditions quickly grade into desert (daily temperatures can rise above 40°C, rainfall is irregular). To the east, the lack of elevation makes conditions hotter and drier. In more humid mountainous areas, extensive oak and conifer forests occur. At lower elevations, intensive clearance and grazing have produced a distinctive scrubby landscape known as macquis. Olive trees are common in the coastal plains. In the arid desert areas, there is little natural vegetation although the date palm is extensively cultivated in oases.

To the north of the Atlas mountains, soils with high levels of calcium carbonate (Calcisols) dominate the landscape, especially in drier conditions. While many of these soils are suitable for agriculture, water availability is a key constraint. More humid conditions along the Mediterranean give rise to more vegetation and more developed, clay-rich soils such Luvisols, Kastanozems and Cambisols. Vertisols are quite pronounced along the north-eastern Algerian coast and into Tunisia. These soils support extensive cereal cultivation in the winter and grazing in the summer.

To the south of the Atlas Mountains, conditions are much more arid and daytime temperatures are significantly higher. Soils are characterised by minimal development and low or negligible organic matter content. Regosols, stony Leptosols and soils with accumulations of gypsum (Gypsisols) dominate – especially in south-central Tunisia. Arenosols denote the locations of large sand seas and dunes.

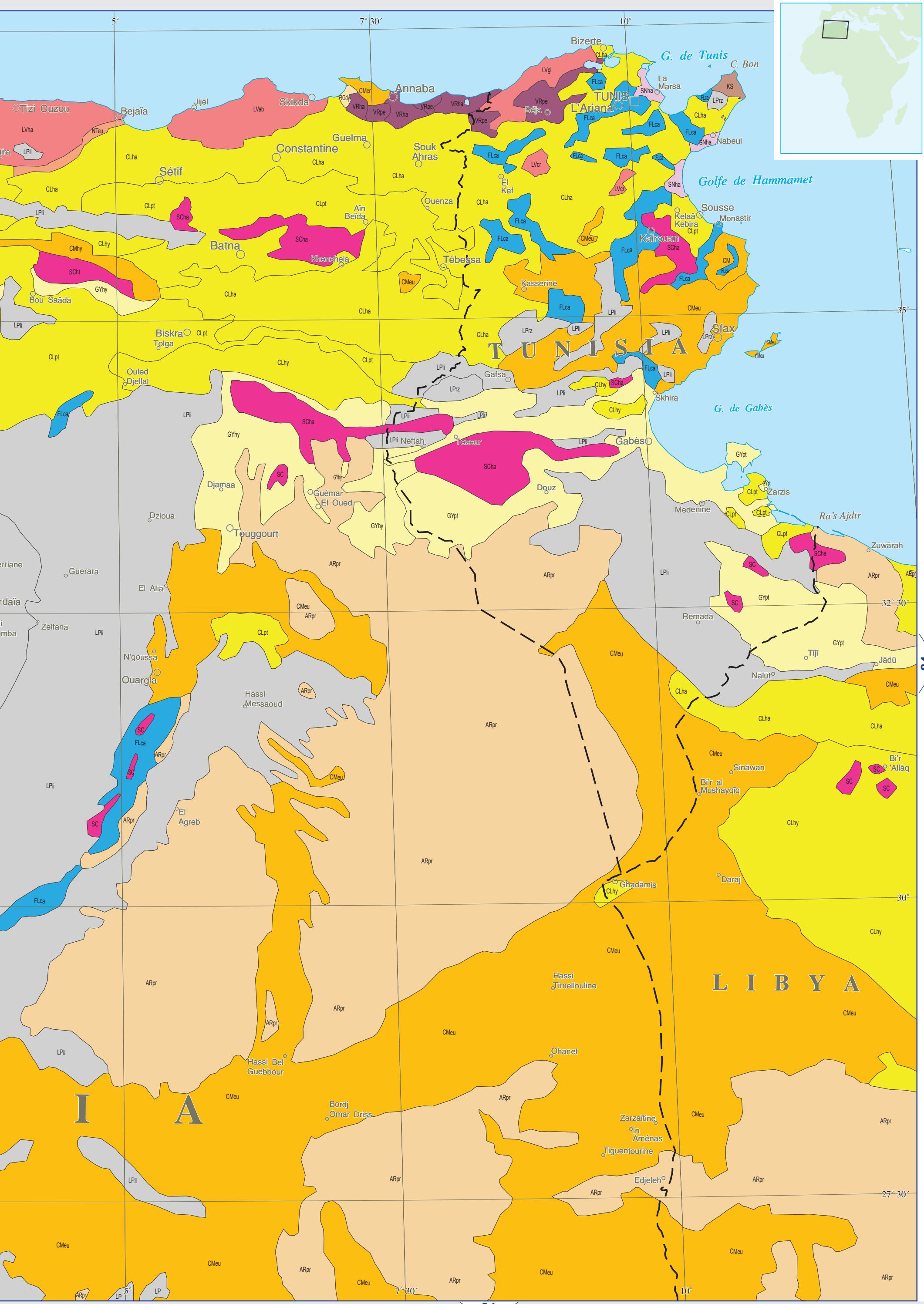
Saline soils occur in depressions across the region. The chotts of Algeria and Tunisia are closed flat-bottomed basins of salt and clay accumulation that are periodically covered by water which either slowly infiltrates into the groundwater system or evaporates into the atmosphere, causing the deposition of salt. In basins dominated by groundwater inputs, sediment influxes are low and saline crusts dominate. Highly soluble sodium chloride tends to be found in the centre of the chotts with less-soluble sulphates and carbonates at the outer margin.

The blue linear features are Fluvisols, demarcating river systems in the region. Many are ephemeral in nature (i.e. dry for much of the year). In northern regions, many are intensively cultivated.

Where the soils have a well developed structure, and moderate levels of organic matter, clay and water are available, many Mediterranean soils are quite productive. However, excessive lime and the presence of salts can be problematic. Away from the coast, the increasing semi-arid conditions generally lead to poorly developed soils that are vulnerable to degradation by human activities such as overgrazing which can lead to erosion, especially by flash flooding after intense rainfall. Soil organic carbon levels are generally low or very low and droughts are common. Desertification is key concern throughout the region.

81

90


5°
7° 30´
10°
35°
32° 30´
30°
27° 30´
Bizerte
CLha
G. de Tunis
C. Bon
La Marsa
SNha
KS
LPrz
TUNIS
L'Ariana
FLca
Béja
LVgl
VRpe
VRha
CMcr
RGdy
Annaba
Skikda
Jijel
LVab
Bejaïa
Tizi Ouzou
LVha
NTeu
LPli
Guelma
Constantine
Souk Ahras
CLha
Sétif
El Kef
LVcr
Golfe de Hammamet
Nabeul
Ouenza
Aïn Beida
SCha
CLpt
Batna
Khenchela
Kelaâ Kebira
Sousse
Monastir
Kairouan
CMeu
Tébessa
CMhy
CLhy
SCht
GYhy
Bou Saâda
Kasserine
CM
Sfax
Biskra
Tolga
T U N I S I A
Ouled Djellal
Gafsa
Skhira
G. de Gabès
Neftah
Tozeur
Gabès
Djamaa
Guémar
El Oued
Douz
Zarzis
Medenine
Ra's Ajdīr
Dzioua
Touggourt
Zuwārah
Guerara
El Alia
Remada
Zelfana
N'goussa
Ouargla
Tījī
Jādū
Nālūt
Hassi Messaoud
Sināwan
Bi'r 'Allāq
Bi'r al Mushayqīq
El Agreb
Ghadāmis
Daraj
Hassi Timellouline
L I B Y A
Hassi Bel Guebbour
Ohanet
Bordj Omar Driss
Zarzaïtine
In Aménas
Tiguentourine
Edjeleh
I A
84
91

This map shows the soils of eastern Tunisia, Libya and western Egypt. This map is dominated by the hot and arid Sahara Desert. The absence of the Atlas Mountains means that desert conditions extend much closer to the coastal regions than in the countries to the west. While a Mediterranean climate with mild wet winters and hot dry summers extends along the coast, precipitation decreases and temperatures rapidly increase inland. A narrow band of semi-arid grasslands extends inland from the Mediterranean coast. However, desert conditions border the sea along the Gulf of Sidra in Libya. In the south of the map daily temperatures can rise above 40°C while annual rainfall is low and irregular. Droughts, often lasting several years, are common. The world's highest shaded temperature was recorded in the Libyan Desert. When precipitation levels are higher, the coastal plains and semi-arid regions are covered with herbaceous vegetation and annual grasses. In the arid desert areas, there is little natural vegetation although the date palm is extensively cultivated in oases.

Soils with high levels of calcium carbonate (Calcisols) dominate the landscape, replaced by soils with accumulations of gypsum (Gypsisols) in drier conditions. Arenosols denote the locations of large sand seas and dunes, especially in south-western Libya and on the border with Egypt. Saline soils occur as salt flats or sabkhas along the Libyan coast. These are formed by the ponding and evaporation of water behind coastal dunes. In western Egypt, they occur in closed depressions in the landscape.

The blue linear features are Fluvisols, demarcating river systems in the region. Many are ephemeral in nature (i.e. dry for much of the year).

Soil organic carbon levels are generally low or very low everywhere. Excessive lime and the presence of salts can be problematic in the cultivation of soils in this region. Salinisation due to over-irrigation is damaging some previously fertile soils. Dust and sandstorms are common and wind erosion is a major driver of desertification.

SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

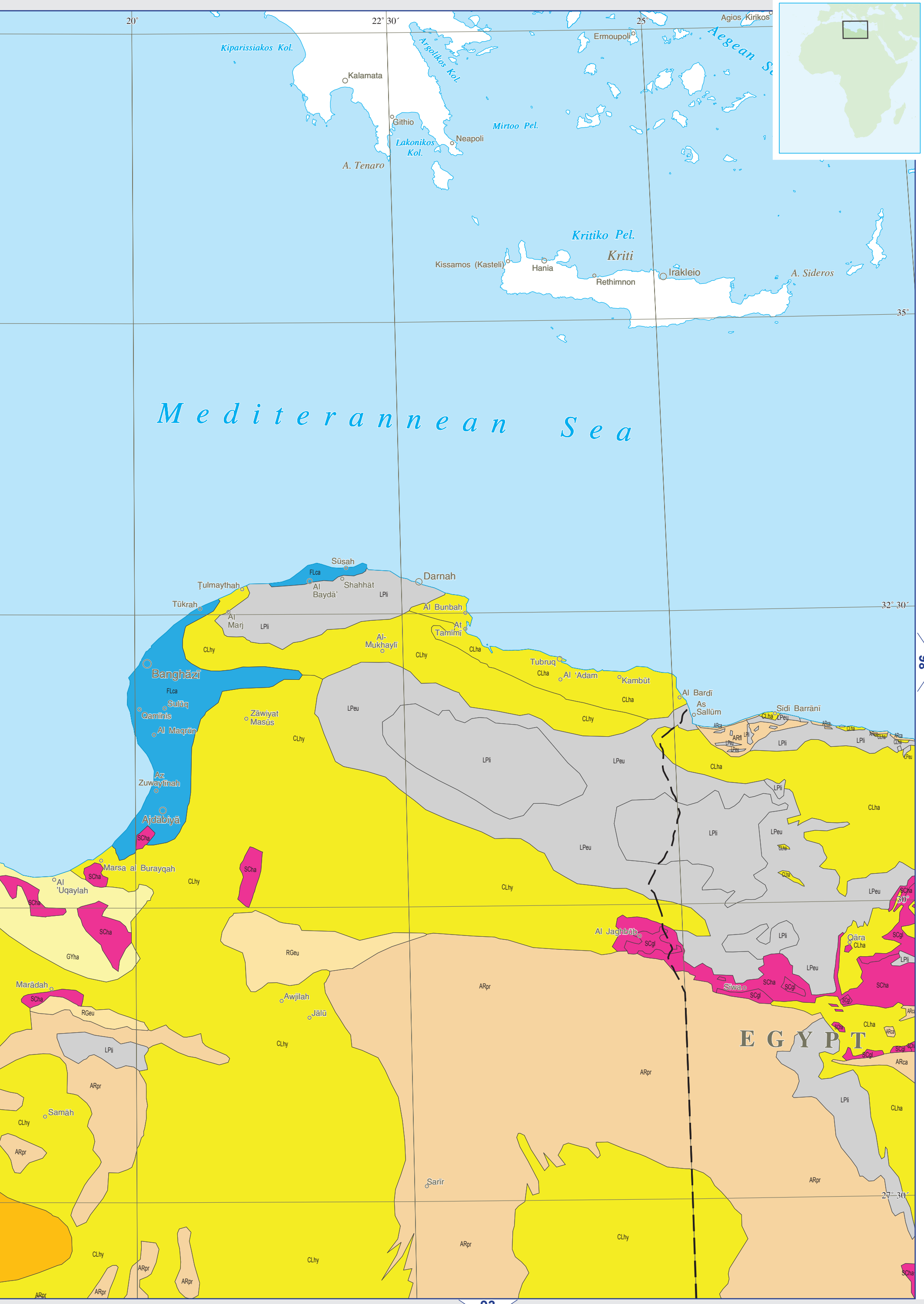
0 100 200 km

0 50 100 miles

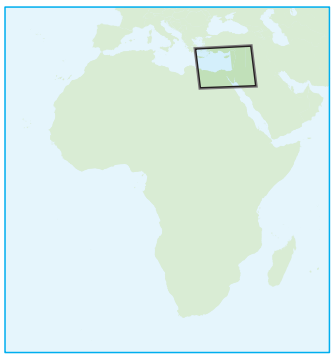
PROJECTION: Lambert Azimuthal

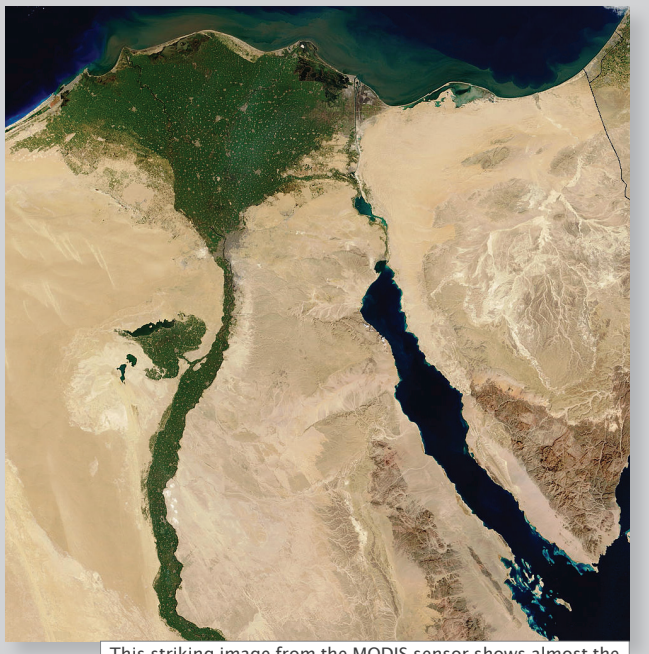
83

92

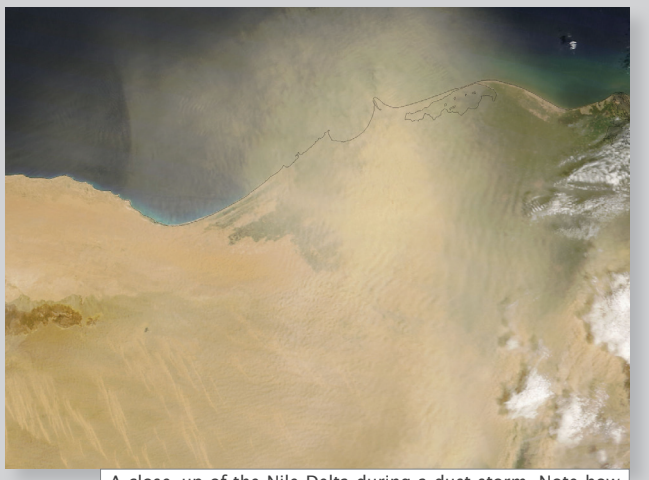

20°
22° 30´
25°
Agios Kirikos
Ermoupoli
Aegean Sea
Kiparissiakos Kol.
Argolikos Kol.
Kalamata
Githio
Mirtoo Pel.
Neapoli
Lakonikos Kol.
A. Tenaro
Kritiko Pel.
Kriti
Kissamos (Kasteli)
Hania
Rethimnon
Irakleio
A. Sideros
35°
Mediterannean Sea
Sūsah
Darnah
Ţulmaythah
Al Baydā'
Shahhāt
Tūkrah
Al Marj
Al Bunbah
At Tamīmī
32° 30´
Al-Mukhaylī
Tubruq
Al 'Adam
Kambūt
Al Bardī
As Sallūm
Sīdī Barrānī
Banghāzī
Sulūq
Qamīnis
Al Maqrūn
Zāwiyat Masūs
Az Zuwaytīnah
Ajdābiyā
Marsa al Burayqah
Al 'Uqaylah
Al Jaghbūb
Qāra
Sīwa
Marādah
Awjilah
Jālū
Samāh
Sarīr
EGYPT
30°
27° 30´
FLca
LPli
CLhy
CLha
LPeu
SCha
SCgl
ARpr
RGeu
GYha
ARca
ARfl


37° 30´
25°
27° 30´
30°
32° 30´
35°
Agios Kirikos
Ermoupoli
Aegean Sea
Mirtoo Pel.
Kritiko Pel.
Kalimnos
Bodrum
Muğla
Gencek
Antalya
Alanya
Rodos
Hania
Rethimnon
Irakleio
Kriti
A. Sideros
CYPRU
Mediterannean Sea
85
Kambūt
Al Bardī
As Sallūm
Sīdī Barrānī
Marsā Matrūḥ
Fūka
El Daba
Al 'Alamein
ALEXANDRIA
Rashīd
Baltīm
Dumyāt
Kafe al Sheik
Kafe al Dauwār
Damanhūr
Al Mansūrah
Tanţā
Al Mahalla al Kubra
Shibīn al Kōm
Az Zaqāzīq
Benhā
CAIRO
AL GĪZA
Helwān
Suez
Sinnūris
Al Faiyūm
Beni Suef
Al Fashn
Maghāgha
Beni Mazār
Samālūt
Al Minya
Mallawī
Dalga
Dairūt
El Qūsiya
Manfalūt
Abnūb
Asyūt
Abū Tig
Tahtā
Al Badārī
Ras Zafarana
Port (Būr
LIBYA
EGYPT
Al Jaghbūb
Qāra
Sīwa
Qaşr al Farāfrah
Al Bawīti
94





This striking image from the MODIS sensor shows almost the same extent as this plate from space. The vegetated areas of the Nile delta and floodplain in green stand out starkly from the bare, unvegetated brown and yellow land. The triangular-shaped area on the west bank of the Nile just south of Cairo is the Al-Fayoum Oasis – a depression in the desert watered by a channel from the Nile. The oasis drains into a large saltwater lake (Birket Qarun). (NASA)



A close-up of the Nile Delta during a dust storm. Note how the delta is almost obscured by blown sand. Wind erosion is an important component of desertification. The white objects on the right of the image are clouds. (NASA)

SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

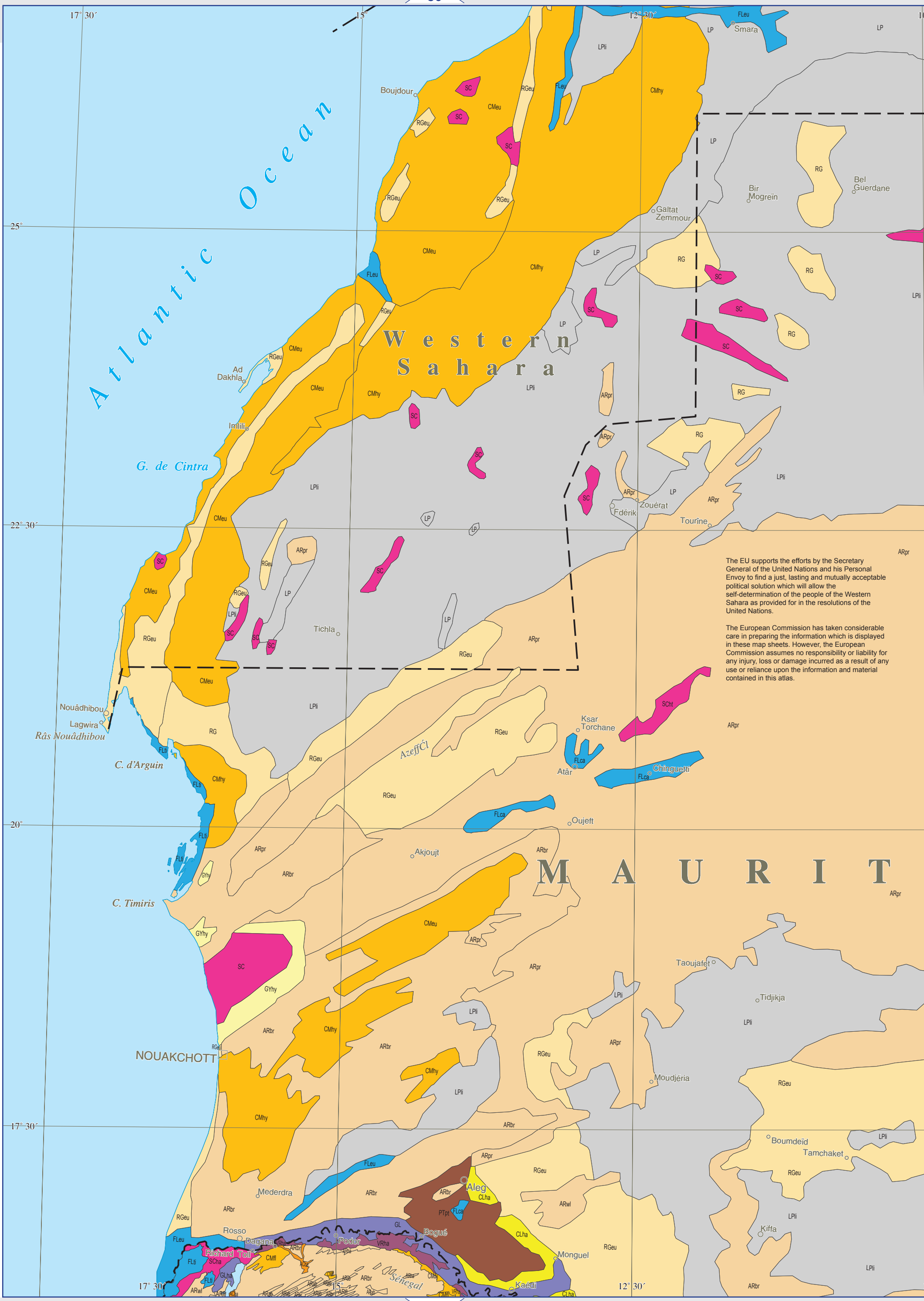
This map shows the soils of northern Egypt. As in the previous plate, this map is dominated by the hot and arid Sahara, with desert conditions extending almost to the Mediterranean coast. The area is generally characterised by low annual precipitation and a considerable seasonal and daily temperature range. Alexandria on the coast has a Mediterranean climate with mild wet winters and hot dry summers. It receives around 175 mm of rainfall annually while Cairo, only a little further inland, only receives 25 mm. Levels decrease even further to the south. While the Sinai Peninsula receives somewhat more precipitation, the Red Sea coastal plain and the Western Desert are almost without precipitation.

The major geographic element on this map is the River Nile and its delta – the longest river in the world. North of Cairo the Nile forms a distinctive delta (denoted on the map as Fluvisols). This is a level triangular-shaped lowland composed of silt brought mainly from the Ethiopian Plateau and comprises some of the most fertile soils in Africa. The Nile splits Egypt in two: towards Libya lies the vast Western Desert while to the west are the narrower, rocky Eastern and Sinai Deserts.

As evidenced by the satellite photograph above, vegetation outside of the Nile's floodplain and delta is sparse or non-existent. Where water exists, shrubs, thorny perennials and grasses can be found. The Nile supports many varieties of water plants and grasses while the date palm is found throughout the delta, in the Nile valley and in the oases. The Western Desert is almost totally devoid of plant life.

The soils of the map reflect the dry and hot conditions. Weakly developed, medium-textured soils with large gypsum concentrations at shallow depths (Gypsisols) dominate the landscape, interspersed by thin, rocky calcareous soils (Leptosols) and sandy soils (Arenosols), the latter are prevalent in the Western Desert and the Sinai. Saline soils occur as salt flats or sabkhas along the Delta coast. These are formed by the flooding and evaporation of seawater. In the Western Desert, fine-textured saline and sodic soils affected by impeded drainage occur in the Qattara Depression – at 133 m below sea level, the second lowest point in Africa.

While the soils along the Nile are highly productive, urbanisation, salinisation, pollution from pesticides and industrial waste and sand encroachment, together with wind and water erosion, are putting increasing pressure on a scare and limited resource in this region.


17° 30´
15°
12° 30´
25°
22° 30´
20°
17° 30´
15°
12° 30´
Atlantic Ocean
G. de Cintra
C. d'Arguin
Râs Nouâdhibou
C. Timiris
Western Sahara
MAURIT
NOUAKCHOTT
Boujdour
Smara
Bir Mogreïn
Bel Guerdane
Galtat Zemmour
Ad Dakhla
Imlili
Tichla
Zouérat
Fdérik
Tourîne
Nouâdhibou
Lagwira
Atâr
Chinguetti
Ksar Torchane
Oujeft
Akjoujt
Mederdra
Rosso
Daganar
Richard Toll
Podor
Bogué
Aleg
Monguel
Kaédi
Taoujafet
Tidjikja
Moudjéria
Boumdeïd
Tamchaket
Kiffa
Sénégal
AzeffCl
The EU supports the efforts by the Secretary General of the United Nations and his Personal Envoy to find a just, lasting and mutually acceptable political solution which will allow the self-determination of the people of the Western Sahara as provided for in the resolutions of the United Nations.
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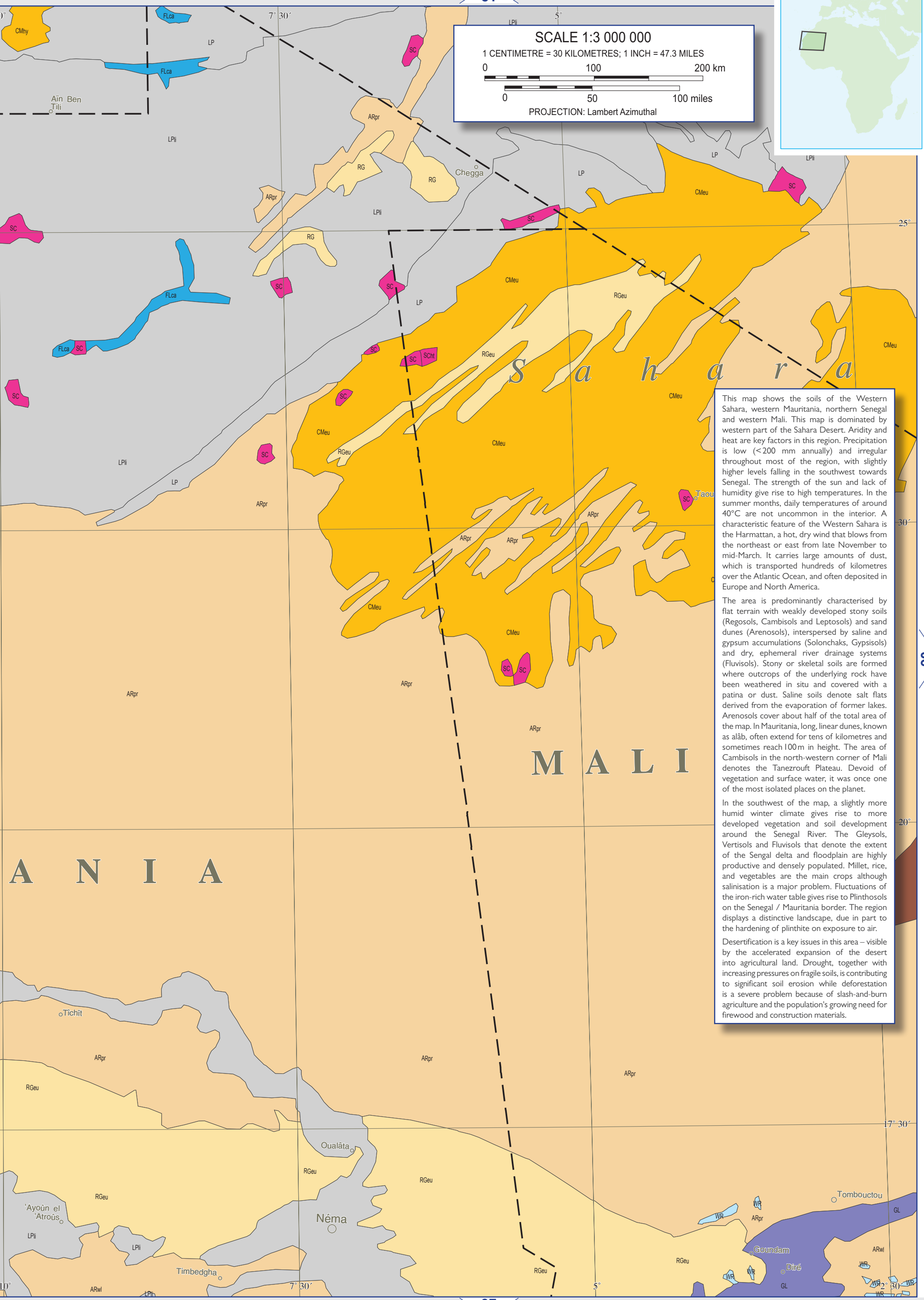

This map shows the soils of the Western Sahara, western Mauritania, northern Senegal and western Mali. This map is dominated by western part of the Sahara Desert. Aridity and heat are key factors in this region. Precipitation is low (<200 mm annually) and irregular throughout most of the region, with slightly higher levels falling in the southwest towards Senegal. The strength of the sun and lack of humidity give rise to high temperatures. In the summer months, daily temperatures of around 40°C are not uncommon in the interior. A characteristic feature of the Western Sahara is the Harmattan, a hot, dry wind that blows from the northeast or east from late November to mid-March. It carries large amounts of dust, which is transported hundreds of kilometres over the Atlantic Ocean, and often deposited in Europe and North America.

The area is predominantly characterised by flat terrain with weakly developed stony soils (Regosols, Cambisols and Leptosols) and sand dunes (Arenosols), interspersed by saline and gypsum accumulations (Solonchaks, Gypsisols) and dry, ephemeral river drainage systems (Fluvisols). Stony or skeletal soils are formed where outcrops of the underlying rock have been weathered in situ and covered with a patina or dust. Saline soils denote salt flats derived from the evaporation of former lakes. Arenosols cover about half of the total area of the map. In Mauritania, long, linear dunes, known as alâb, often extend for tens of kilometres and sometimes reach 100 m in height. The area of Cambisols in the north-western corner of Mali denotes the Tanezrouft Plateau. Devoid of vegetation and surface water, it was once one of the most isolated places on the planet.

In the southwest of the map, a slightly more humid winter climate gives rise to more developed vegetation and soil development around the Senegal River. The Gleysols, Vertisols and Fluvisols that denote the extent of the Sengal delta and floodplain are highly productive and densely populated. Millet, rice, and vegetables are the main crops although salinisation is a major problem. Fluctuations of the iron-rich water table gives rise to Plinthosols on the Senegal / Mauritania border. The region displays a distinctive landscape, due in part to the hardening of plinthite on exposure to air.

Desertification is a key issues in this area – visible by the accelerated expansion of the desert into agricultural land. Drought, together with increasing pressures on fragile soils, is contributing to significant soil erosion while deforestation is a severe problem because of slash-and-burn agriculture and the population's growing need for firewood and construction materials.

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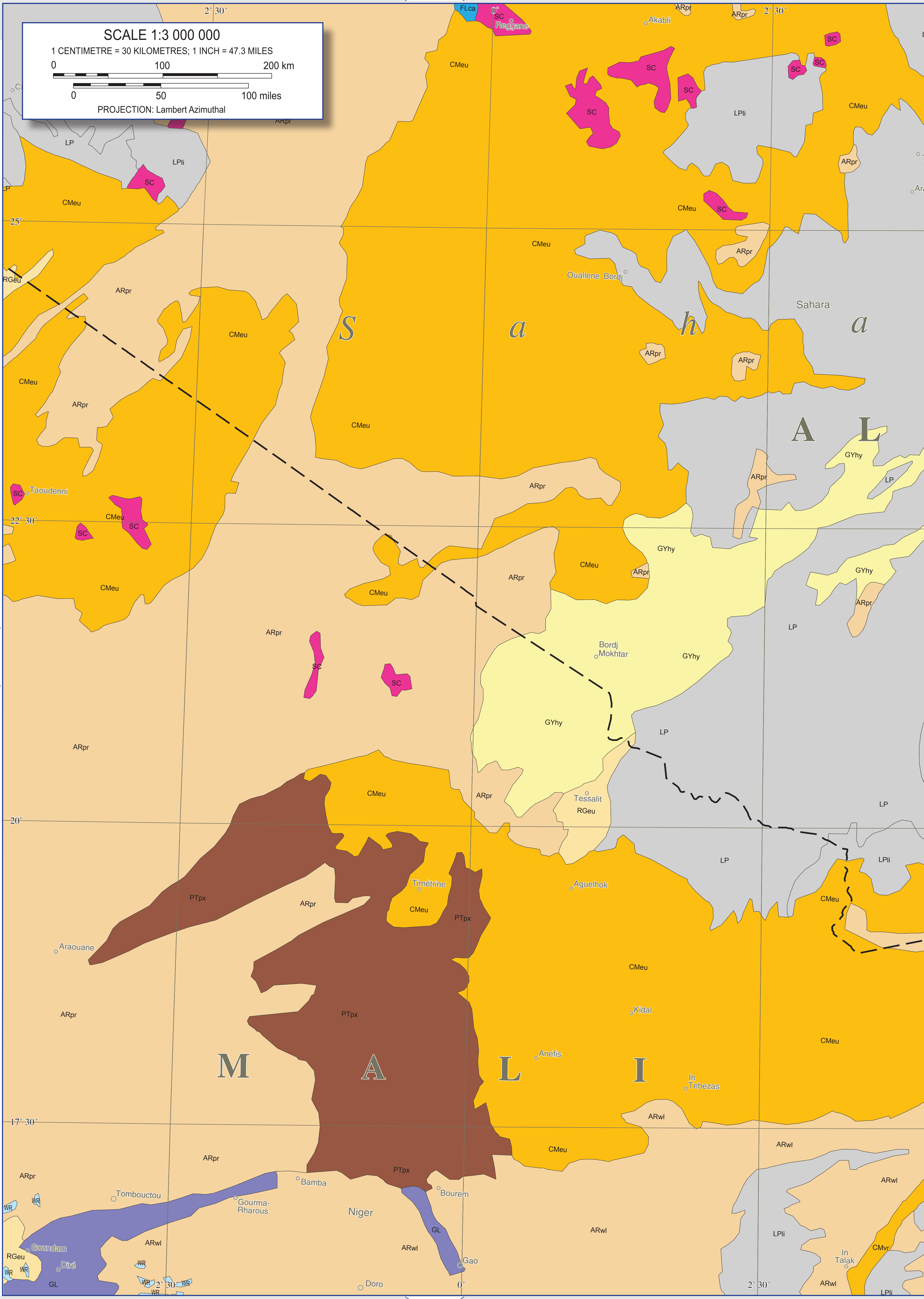
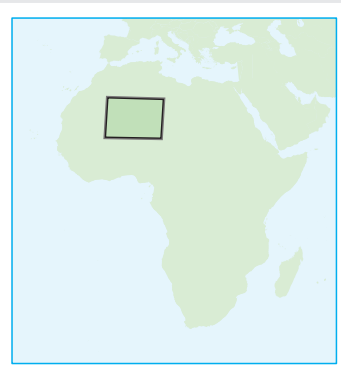

SCALE 1:3 000 000
1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES
0
100
200 km
0
50
100 miles
PROJECTION: Lambert Azimuthal
2° 30´
0°
25°
22° 30´
20°
17° 30´
Reggane
Akabli
Ouallene Bordj
Sahara
Taoudenni
Bordj Mokhtar
Tessalit
Aguelhok
Timétrine
Araouane
Kidal
Anéfis
In Tebezas
Tombouctou
Bamba
Bourem
Gourma-Rharous
Niger
Goundam
Diré
Gao
Doro
In Talak
S a h a r a
A L
M A L I
FLca
SC
CMeu
ARpr
LP
LPli
RGeu
GYhy
PTpx
ARwl
GL
WR
CMvr

98



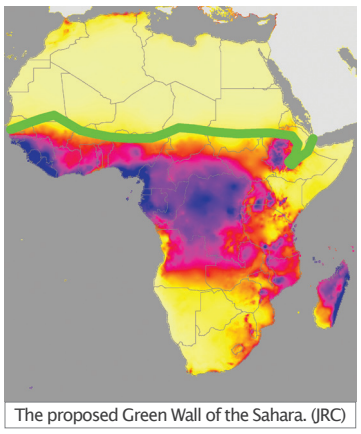
This map shows the soils of eastern Mali, southern Algeria and northern Niger. This map is dominated by the Sahara Desert and much of the area is characterised by flat terrain. Aridity and heat are key factors in the northern and central part of this region. Annual precipitation is very low (< 100 mm) and irregular. The strength of the sun and lack of humidity give rise to high temperatures. In the summer months, daily temperatures of around 40°C are not uncommon in the interior. A characteristic feature of the Western Sahara is the Harmattan, a hot, dry wind that blows from the northeast or east from late November to mid-March. It carries large amounts of dust, which is transported hundreds of kilometres over the Atlantic Ocean, and often to Europe and North America. In the southern part of the map (i.e. south of 20°N), a Sahelian climate is more pronounced with around 300 mm of rain per year and average temperatures of between 23 and 36°C. A distinct dry season lasts from November to June.

The Saharan part of the map is characterised by weakly developed stony or gravelly soils (Regosols, Cambisols and Leptosols) and sand dunes (Arenosols), interspersed by saline and gypsum accumulations (Solonchaks, Gypsisols). Stony or skeletal soils are formed where outcrops of the underlying rock have been weathered in situ and are covered with a patina or dust. Saline soils denote salt flats derived from the evaporation of former lakes. Sandy Arenosols cover much of the northern half of Mali and Niger. The vast expanse of Leptosols in southern Algeria denotes the Ahaggar Mountains, a volcanic highland region with an average altitude of around 1 000 m above sea level (Mount Tahat peaks at 3 003 m). The extension into northern Niger is the Aïr massif, a group of granitic mountains rising sharply from the Sahara with mean elevations approaching 2 000 m. While the surrounding desert is devoid of vegetation, the elevation of these mountain ranges gives rise to slightly higher rainfall and slightly cooler summer temperatures. As a result, dry woodlands and shrublands form a unique and isolated ecosystem.

The Gleysols in the south-western corner denote the floodplain and the 'Great Bend' of the Niger River. Periodic floods and rich alluvial soils make the Niger floodplain an important agricultural region. To the north of the Niger, shallow iron-rich Plinthosols give rise to a hard, red-crusted landscape.

Desertification is a key issue in this area – visible by the accelerated expansion of the desert into the agricultural land in the south, accompanied by drought, famine and intense social upheaval. In the second half of the 20th century, a rapidly increasing population placed tremendous stress on the Sahel. Trees and shrubs were removed to obtain firewood and grow crops while intense overgrazing resulted in bare surfaces. Runoff and the wind then removed the topsoils creating barren wastelands.

To combat the southward expansion of the Sahara, the African Union, supported by the European Union and the World Bank, is developing a 'Great Green Wall of the Sahara' (in French the Grande muraille verte) – a green barrier 7 000 km long and 15 km wide, stretching from Senegal to Djibouti, where alternative soil-water-biomass management practices will aim to combat land degradation. The Green Wall aims to slow down wind erosion and enhance rainwater infiltration in to the soil [63b, 63c].



The proposed Green Wall of the Sahara. (JRC)

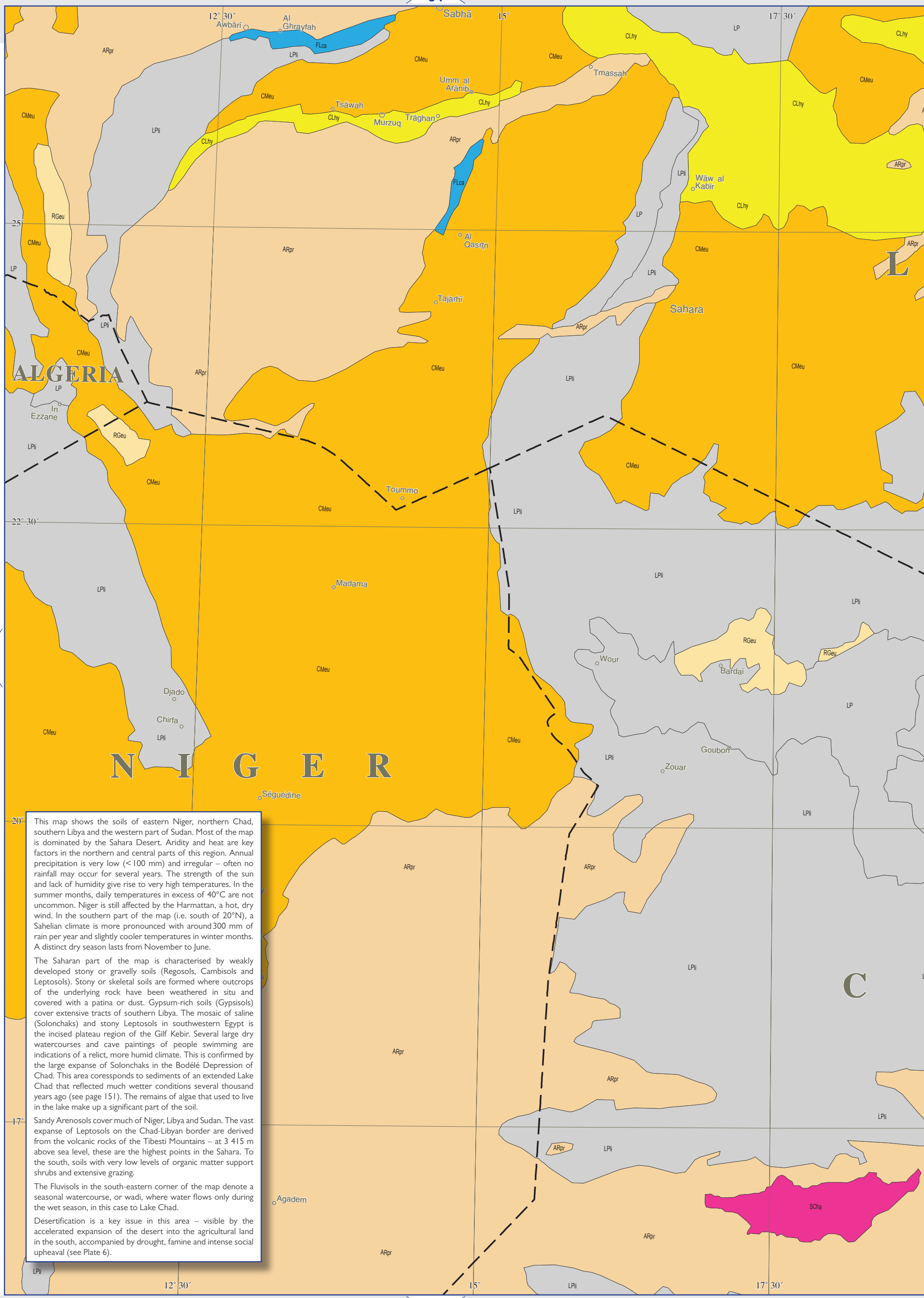
92

99

84

91

100



This map shows the soils of eastern Niger, northern Chad, southern Libya and the western part of Sudan. Most of the map is dominated by the Sahara Desert. Aridity and heat are key factors in the northern and central parts of this region. Annual precipitation is very low (< 100 mm) and irregular – often no rainfall may occur for several years. The strength of the sun and lack of humidity give rise to very high temperatures. In the summer months, daily temperatures in excess of 40°C are not uncommon. Niger is still affected by the Harmattan, a hot, dry wind. In the southern part of the map (i.e. south of 20°N), a Sahelian climate is more pronounced with around 300 mm of rain per year and slightly cooler temperatures in winter months. A distinct dry season lasts from November to June.

The Saharan part of the map is characterised by weakly developed stony or gravelly soils (Regosols, Cambisols and Leptosols). Stony or skeletal soils are formed where outcrops of the underlying rock have been weathered in situ and covered with a patina or dust. Gypsum-rich soils (Gypsisols) cover extensive tracts of southern Libya. The mosaic of saline (Solonchaks) and stony Leptosols in southwestern Egypt is the incised plateau region of the Gilf Kebir. Several large dry watercourses and cave paintings of people swimming are indications of a relict, more humid climate. This is confirmed by the large expanse of Solonchaks in the Bodélé Depression of Chad. This area coressponds to sediments of an extended Lake Chad that reflected much wetter conditions several thousand years ago (see page 151). The remains of algae that used to live in the lake make up a significant part of the soil.

Sandy Arenosols cover much of Niger, Libya and Sudan. The vast expanse of Leptosols on the Chad-Libyan border are derived from the volcanic rocks of the Tibesti Mountains – at 3 415 m above sea level, these are the highest points in the Sahara. To the south, soils with very low levels of organic matter support shrubs and extensive grazing.

The Fluvisols in the south-eastern corner of the map denote a seasonal watercourse, or wadi, where water flows only during the wet season, in this case to Lake Chad.

Desertification is a key issue in this area – visible by the accelerated expansion of the desert into the agricultural land in the south, accompanied by drought, famine and intense social upheaval (see Plate 6).

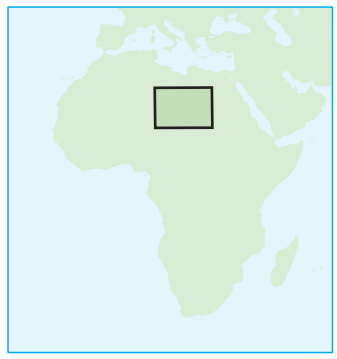
SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal



L I B Y A

E G Y P T

C H A D

S U D A N

Ma'būs Yūsuf

Bi'r al Harash

Bzīmah

At Taj

Al Jawf

Ma'tan as Sārah

Gouro

Ounianga Kebir

Faya-Largeau

Fada

Ourini

Nukheila

Al 'Atrun

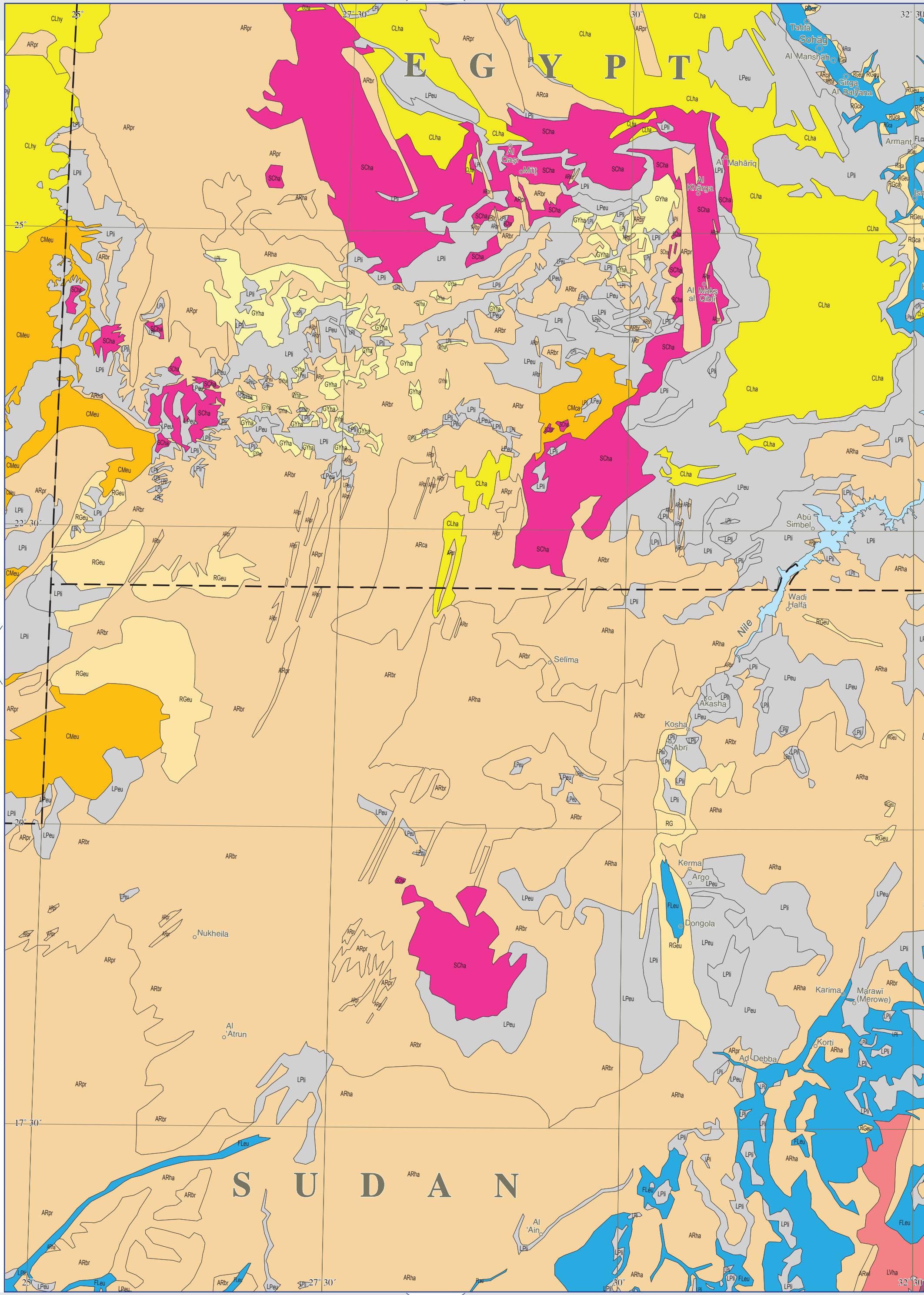
20°

22° 30´

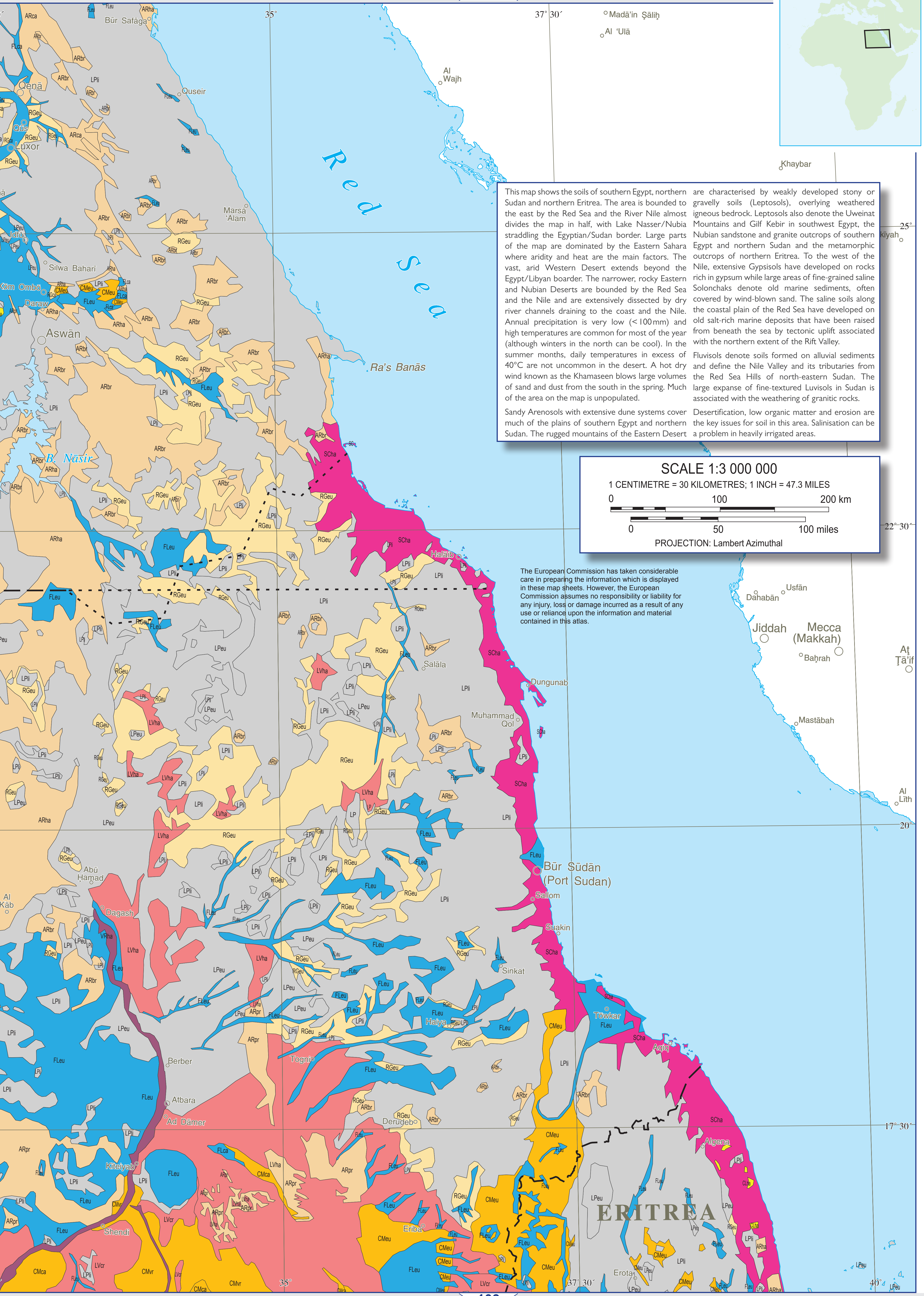
25°

17° 30´

94


E G Y P T
S U D A N
Tahtā
Sohāg
Al Manshah
Girga
Al Balyana
Armant
Al Qaşr
Müţ
Al Mahāriq
Al Khārga
Al Maks al Qibli
Abū Simbel
Wadi Halfā
Nile
Selima
Akasha
Kosha
Abri
Kerma
Argo
Dongola
Karima
Marawī (Merowe)
Korti
Ad Debba
Nukheila
Al 'Atrun
Al 'Ain
25°
27° 30´
30°
32° 30´
22° 30´
20°
17° 30´

93



This map shows the soils of southern Egypt, northern Sudan and northern Eritrea. The area is bounded to the east by the Red Sea and the River Nile almost divides the map in half, with Lake Nasser/Nubia straddling the Egyptian/Sudan border. Large parts of the map are dominated by the Eastern Sahara where aridity and heat are the main factors. The vast, arid Western Desert extends beyond the Egypt/Libyan boarder. The narrower, rocky Eastern and Nubian Deserts are bounded by the Red Sea and the Nile and are extensively dissected by dry river channels draining to the coast and the Nile. Annual precipitation is very low (<100 mm) and high temperatures are common for most of the year (although winters in the north can be cool). In the summer months, daily temperatures in excess of 40°C are not uncommon in the desert. A hot dry wind known as the Khamaseen blows large volumes of sand and dust from the south in the spring. Much of the area on the map is unpopulated.

Sandy Arenosols with extensive dune systems cover much of the plains of southern Egypt and northern Sudan. The rugged mountains of the Eastern Desert are characterised by weakly developed stony or gravelly soils (Leptosols), overlying weathered igneous bedrock. Leptosols also denote the Uweinat Mountains and Gilf Kebir in southwest Egypt, the Nubian sandstone and granite outcrops of southern Egypt and northern Sudan and the metamorphic outcrops of northern Eritrea. To the west of the Nile, extensive Gypsisols have developed on rocks rich in gypsum while large areas of fine-grained saline Solonchaks denote old marine sediments, often covered by wind-blown sand. The saline soils along the coastal plain of the Red Sea have developed on old salt-rich marine deposits that have been raised from beneath the sea by tectonic uplift associated with the northern extent of the Rift Valley.

Fluvisols denote soils formed on alluvial sediments and define the Nile Valley and its tributaries from the Red Sea Hills of north-eastern Sudan. The large expanse of fine-textured Luvisols in Sudan is associated with the weathering of granitic rocks.

Desertification, low organic matter and erosion are the key issues for soil in this area. Salinisation can be a problem in heavily irrigated areas.

SCALE 1:3 000 000

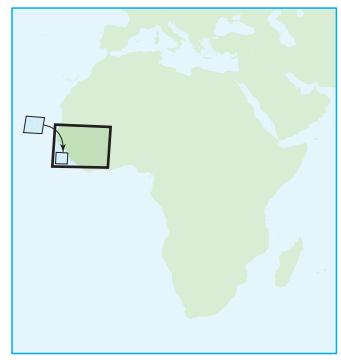
1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

SENEGAL
THE GAMBIA
GUINEA-BISSAU
GUINEA
SIERRA LEONE
LIB
MAUR
S
Atlantic Ocean
Sénegal
Bafing
C. Vert
C. Roxo
DAKAR
BANJUL
BISSAU
CONAKRY
FREETOWN
MONROVIA
St.-Louis
Louga
Kébèmer
Mekhé
Tivaouane
Thiès
Rufisque
Mbour
Joal-Fadiout
Bambey
Diourbel
Mbaké
Fatick
Foundiougne
Guinguinéo
Kaolack
Kaffrine
Koumpentoum
Koungheul
Koussanar
Tambacounda
Bala
Maka
Sokone
Nioro
Kerewan
Georgetown
Brikama
Diouloulou
Bignona
Sédhiou
Ziguinchor
Farim
São Domingos
Canchungo
Mansôa
Bafatá
Nova Lamego
Bolama
Basse Santa Su
Vélingara
Dialakoto
Koundara
Foulamory
Koumbia
Gaoual
Dara
Linguère
Kaédi
Matam
Maghama
Mbout
Diamounguel
Sélibabi
Bakel
Kidira
Goudiri
Ambidédi
Kayes
Yélimané
Sandaré
Dioka
Kirané
Bafoulabé
Kéniéba
Satadougou
Mali
Labé
Pita
Télimélé
Dalaba
Mamou
Dabola
Dinguiraye
Bissikrima
Saraya
Faranah
Tiro
Boké
Victoria
Fria
Boffa
Kindia
Forécariah
Kambia
Batkanu
Falaba
Kabala
Kissidougou
Makeni
Port Loko
Magburaka
Lunsar
Pepel
Marampa
Yonibana
Yele
Sefadu
Guékédou
Kailahun
Koindu
Pendembu
Waterloo
Moyamba
Shenge
Bo
Kenema
Zimmi
Bopolu
Bomi Hills
Kakata
Harbel
Marshall
Buchanan
15°
17° 30´
20°
22°
12° 30´
10°
7° 30´
CAPE VERDE
Atlantic Ocean
Ribeira Grande
Mindelo
São Vicente
Ribeira Brava
São Nicolau
Pedra Lume
Sal-Rei
Tarrafal
PRAIA
São Tiago
22° 30´
25°
15°
LPli
CLha
SCALE 1:3 000 000
1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES
0
100
200 km
0
50
100 miles
PROJECTION: Lambert Azimuthal



This map shows the soils of Senegal, The Gambia, Guinea-Bissau, Sierra Leone, Liberia, Côte D'Ivoire, southern Mali, eastern Burkina Faso and the islands of Cape Verde. The pattern of soil distribution on the map reflects the boundary between the semi-arid Sahel and the more tropical climate of West Africa, coupled with rocks of the West Africa Shield, a stable rock formation 3 billion years old composed of granite, schist and gneiss. The Cape Verde Peninsula in Senegal is the westernmost point of the African continent.

The northern half of the map reflects soils of the Sahel. Daily temperatures are still generally high and the winter months are dry. Precipitation increases from north to south and extensive grasslands give way to open savanna. Weakly developed Regosols and stony Leptosols on flat terrain are covered in many places by extensive sand deposits (Arenosols). As rainfall increases, more alkaline Lixisols with leached, clay-rich subsoils occur in strongly-weathered fine textured materials of old erosion or deposition surfaces under natural savannah or open woodland vegetation. The Gleysols in the west denote the floodplains of the Senegal and Gambia rivers while the large expanse in Mali is the result of periodic flooding in the inland delta of the River Niger. These soils are highly important for agriculture. In addition, productive Nitisols have developed on scattered igneous deposits in southern Mali and Burkina Faso.

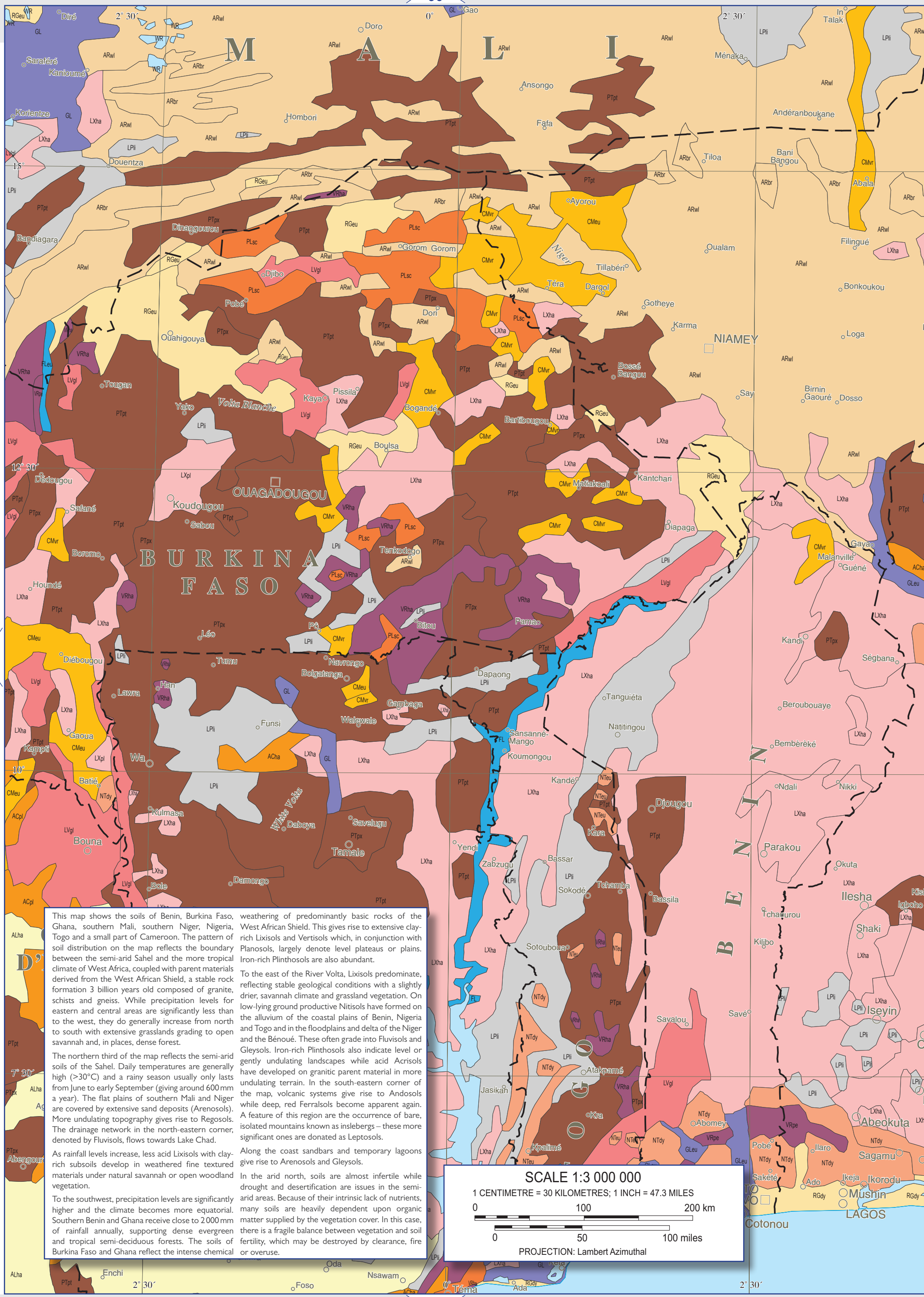
To the south and east, precipitation increases significantly and the climate becomes more tropical. The interior of Liberia receives around 2000 mm of rainfall annually. Cultivation without irrigation becomes increasingly possible and the tree density begins to increase, eventually reaching mature tropical rainforests in Côte D'Ivoire and Liberia.

At first appearance, the distribution of soil types on the southern part of this map appears complex. In reality, it reflects the interactions between the underlying parent material, the evolution of the landscape, the climate and vegetation. Along the Atlantic coast, swampy mangroves and sandbars give rise to Fluvisols and Arenosols respectively. Inland, the flat, sandy coastal plain of West Africa is characterised by Ferralsols, the classic deeply weathered, red or yellow soils of the humid tropics. Crystalline-rock outcrops bordering the plain give rise to a band of thin, stony Leptosols running from Guinea-Bissau to Liberia.

Further inland, high humidity and temperatures drive intense chemical weathering of the old rocks of the West Africa Shield giving rise to soils with increasing clay, iron and aluminium content. On granitic material, acid Acrisols develop on undulating topography while Ferralsols are found where the relief is gentler. Lixisols denote slighty less acid soils on old weathered deposits. On more basic rocks, Alisols tend to occur on hilly or undulating terrain while Plinthosols and Vertisols are found on level ground. A common view is that plinthite is associated with rain forest areas whereas petroplinthic and pisolithic soils are more common in the savannah zone.

Drought and desertification are issues of concern in the semi-arid areas. Soil conservation is extremely important on the more tropical soils. While low fertility, high levels of aluminium and phosphate fixation affect the use of the soil, heavy rainfall can cause serious erosion, especially following forest clearance.

98



This map shows the soils of Benin, Burkina Faso, Ghana, southern Mali, southern Niger, Nigeria, Togo and a small part of Cameroon. The pattern of soil distribution on the map reflects the boundary between the semi-arid Sahel and the more tropical climate of West Africa, coupled with parent materials derived from the West African Shield, a stable rock formation 3 billion years old composed of granite, schists and gneiss. While precipitation levels for eastern and central areas are significantly less than to the west, they do generally increase from north to south with extensive grasslands grading to open savannah and, in places, dense forest.

The northern third of the map reflects the semi-arid soils of the Sahel. Daily temperatures are generally high (>30°C) and a rainy season usually only lasts from June to early September (giving around 600 mm a year). The flat plains of southern Mali and Niger are covered by extensive sand deposits (Arenosols). More undulating topography gives rise to Regosols. The drainage network in the north-eastern corner, denoted by Fluvisols, flows towards Lake Chad.

As rainfall levels increase, less acid Lixisols with clay-rich subsoils develop in weathered fine textured materials under natural savannah or open woodland vegetation.

To the southwest, precipitation levels are significantly higher and the climate becomes more equatorial. Southern Benin and Ghana receive close to 2 000 mm of rainfall annually, supporting dense evergreen and tropical semi-deciduous forests. The soils of Burkina Faso and Ghana reflect the intense chemical weathering of predominantly basic rocks of the West African Shield. This gives rise to extensive clay-rich Lixisols and Vertisols which, in conjunction with Planosols, largely denote level plateaus or plains. Iron-rich Plinthosols are also abundant.

To the east of the River Volta, Lixisols predominate, reflecting stable geological conditions with a slightly drier, savannah climate and grassland vegetation. On low-lying ground productive Nitisols have formed on the alluvium of the coastal plains of Benin, Nigeria and Togo and in the floodplains and delta of the Niger and the Bénoué. These often grade into Fluvisols and Gleysols. Iron-rich Plinthosols also indicate level or gently undulating landscapes while acid Acrisols have developed on granitic parent material in more undulating terrain. In the south-eastern corner of the map, volcanic systems give rise to Andosols while deep, red Ferralsols become apparent again. A feature of this region are the occurrence of bare, isolated mountains known as inslebergs – these more significant ones are donated as Leptosols.

Along the coast sandbars and temporary lagoons give rise to Arenosols and Gleysols.

In the arid north, soils are almost infertile while drought and desertification are issues in the semi-arid areas. Because of their intrinsic lack of nutrients, many soils are heavily dependent upon organic matter supplied by the vegetation cover. In this case, there is a fragile balance between vegetation and soil fertility, which may be destroyed by clearance, fire or overuse.

SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

97

107

91


N I G E R
N I G E R I A
C A M E R O O N
Sahel
5°
7° 30´
10°
15°
12° 30´
10°
7° 30´
Tillia
Abalak
Tahoua
Tanout
Illéla
Bouza
Dakoro
Dabnou
Madaoua
Birnin-Konni
Malbaza
Dogondoutchi
Tessaoua
Zinder
Miria
Maradi
Gazaoua
Boultoum
Gazamni
Gouré
Guidimouni
Goudoumaria
Chéri
Ouatcha
Dungas
Magaria
Daura
Katsina
Jibiya
Sokoto
Wurno
Isa
Lema
Argungu
Moriki
Zurmi
Kaura Namoda
Talata Mafara
Birnin Kebbi
Jega
Gummi
Anka
Gusau
Fokku
Dan Gulbi
Zuru
Wasagu
Funtua
Malumfashi
Ingawa
Gumel
Hadejia
Nguru
Gashua
Katagum
Danbatta
Kunya
Kano
Ringim
Gaya
Kura
Azare
Potiskum
Birnin Kudu
Ningi
Nafada
Zaria
Soba
Kaduna
Kusheriki
Yelwa
Bin Yauri
Auna
Tegina
Zungeru
Minna
Kachia
Jos
Bukuru
Bauchi
Duku
Bara
Gombe
Kumo
Pankshin
Shendam
Akwanga
Keffi
Lafia
Jen
Lau
Bénue
Jalingo
Wawa
Kaiama
Mokwa
Jebba
Bida
Lapai
ABUJA
Lafiagi
Pategi
Baro
Nasarawa
Igbetti
Ilorin
Offa
Ogbomosho
Ilobu
Ila
Oshogbo
Ede
Oyo
Iwo
Ile Ife
Ikire
Ilesa
IBADAN
Effon-Alaiye
Ado Ekiti
Ikerre
Ilawe-Ekiti
Akure
Ikare
Oka
Owo
Ondo
Kabba
Lokoja
Okene
Auchi
Niger
Idah
Tunga
Ibi
Wukari
Beli
Makurdi
Ankpa
Enugu Ezike
Nsukka
Gboko
Takum
Eha Amufu
Ogoja
Obudu
Nkambe
Mayo Daga
Enugu
Abakaliki
Kumbo
Awka
Onitsha
Asaba
Uromi
Ijebu Ode
Okitipupa
Benin City
Sapele
Afikpo
Ikom
Mamfé
Bamenda
Foumban

100

108

92

99


12° 30´
15°
17° 30´
7° 30´
10°
LPli
Termit
Bélabirim
ARpr
ARbr
ARwl
N I G E R
Koro
Toro
Nédéley
Salal
Nokou
Rig
Rig
Mao
Mondo
Ngouri
Moussoro
SCha
SC
Nguigmi
Goudoumaria
Kélekam
Chéri
Maïné Soroa
Diffa
VRha
GLeu
FLeu
L. Chad
Baga
Kukawa
Mongonu
Dapchi
Niger
Makari
PLsc
Massakori
Djédaa
VRpe
C
H
Ati
Am
Djéména
SNha
Yao
PL
PLeu
Bokoro
Massaguet
N'DJAMENA
Mongo
Dourbali
ARfl
RGeu
N I G E R I A
Magumeri
Maiduguri
Damaturu
Murguba
CMgl
Bama
Dikwa
GLum
Waza
LVgl
PTpt
LPli
Nafada
NTdy
Buni
Dumboa
CMvr
LXha
PHha
Biu
PTpx
Mora
Mokolo
PLsc
Maroua
Massénya
Temki
Melfi
Guélengdeng
Bousso
Chari
Miltou
Yagoua
Bongor
Kaélé
Garkida
Gombe
Kumo
Shani
Gombi
Mubi
LVcr
Guider
Song
Korbol
Dik
Laï
Goundi
Numan
FL
Jen
Benue
Lau
Jimeta
Yola
Garoua
Bibémi
Pala
Kélo
Sarh
Bénou
Jalingo
Jada
NTum
Koumra
Doba
Beïnamar
Moundou
Poli
Tchollíré
Moïssala
RGdy
Toungo
Kontcha
LV
Mbé
ALha
Goré
FRha
Baïbokoum
C A M E R O O N
FRro
FRum
FLdy
Ngaoundéré
Batangafo
Kouki
Mayo
Daga
Banyo
CMeu
ACha
Bocaranga
Tibati
Meiganga
Bossangoa
Bouca
Bozoum
Kimi
Sangbé
Bouar
Lom
Garoua Boulaï
Baboua
Bossenptélé

109

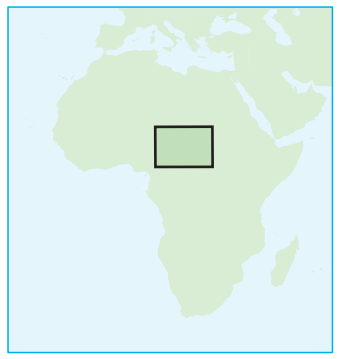
SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal



This map shows the soils of eastern Nigeria, southern Chad, western Sudan, northern Cameroon, the northern part of the Central African Republic and north-western South Sudan. The pattern of soil distribution on the map reflects a transition from desert conditions in the north to a more humid climate in the south. In addition, the soils in the southern half of the map have formed on the rocks of the Congo Craton, a stable rock formation more than 3 billion years old. Precipitation increases from north (annual average of 25 mm, falling infrequently) to south (central Cameroon receives 1 500 mm annually) with desert and semi-arid vegetation grading into grasslands, savannah and eventually deciduous forests. A major feature of this map is Lake Chad which straddles the borders of Cameroon, Chad, Niger and Nigeria. Due to high demand for water, the area of Lake Chad has shrunk dramatically since the 1960s.

The northern half of the map reflects arid and semi-arid conditions. Daily temperatures are generally high (30-40°C) with winter rainfall increasing to around 700 mm a year in southern Chad. Much of the terrain is flat and covered by extensive sand deposits (Arenosols). Saline and sodic soils occur in depressions in the landscape and between dunes. The large expanse of Leptosols with interspersed Luvisols on the Chad/Sudan border marks out the Marrah Mountains, a rugged volcanic mountain range that defines the Nile–Lake Chad watershed (the rivers denoted by the Fluvisols in the northwest flow to the Nile).

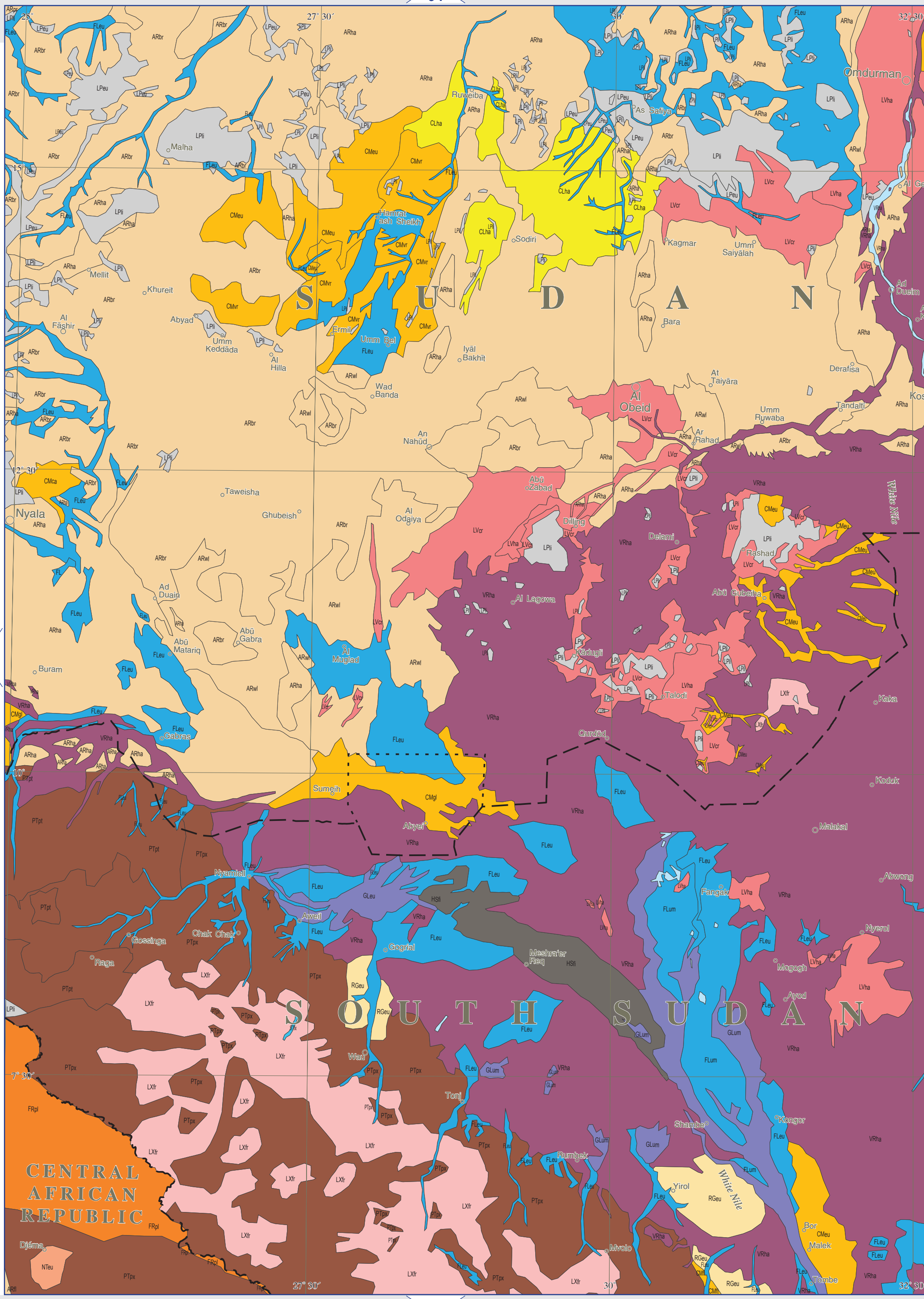
The Fluvisols, Gleysols, Vertisols and Planosols in the centre and west of the map define the alluvial and clayey deposits that accumulated on the floor of an extended Lake Chad and the seasonally flooded areas of the Chari and Logone. These rivers, and their seasonal tributaries, flow from the highlands of Cameroon and the Central African Republic to feed Lake Chad. As the climate becomes more Sahelian, increased rainfall and grassland vegetation give rise to clay-rich, alkaline Lixisols.

To the south of the 11°N line of latitude, the influence of the basement rocks of the Congo Craton become very evident. Intense chemical weathering over long periods of time has lead to the predominance of deep, red and yellow-coloured, kaolinite-rich Ferralsols and iron-rich Plinthosols. Acrisols have developed on acidic, granitic-like material where the terrain is more undulating, while deep Nitisols, with their distinctive nut-shaped structure, develop in similar landscape settings but in more basic parent material. The northern part of the Central African Republic is quite arid the land flattens into a treeless, desert-like savanna grassland dominated by fine sandy deposits (Arenosols).

In the arid north, soils are almost infertile while drought and desertification are issues in the semi-arid Sahelian areas. While fertile soils are widespread, nutrient management is a major concern in southern parts of the map.

102

110


25°
27° 30´
30°
32° 30
15°
12° 30´
10°
7° 30´
27° 30´
30°
32° 30
Malha
Ruweiba
As Safiya
Omdurman
Hamrat ash Sheikh
Sodiri
Kagmar
Umm Saiyālah
Mellit
Khureit
Al Fāshir
Abyad
Umm Keddāda
Al Hilla
Ermil
Umm Bel
Iyāl Bakhīt
Bara
Ad Dueim
Derafisa
Wad Banda
An Nahūd
Al Obeid
At Taiyāra
Umm Ruwaba
Tandalti
Ar Rahad
Taweisha
Ghubeish
Al Odaiya
Nyala
Abū Zabad
Dilling
Delami
Rashad
Abū Gubeiha
White Nile
Ad Duain
Abū Matariq
Abū Gabra
Al Muglad
Al Lagowa
Kadugli
Talodi
Kaka
Buram
Gabras
Qurdūd
Kodok
Sumeih
Abyei
Malakal
Nyamlell
Aweil
Gossinga
Chak Chak
Raga
Gogrial
Meshra'er Req
Mogogh
Nyerol
Ayod
Wau
Tonj
Rumbek
Shambe
Kongor
Yirol
Bor
Malek
Tombe
Mivolo
Djéma
CENTRAL AFRICAN REPUBLIC
S O U T H S U D A N
S U D A N

101

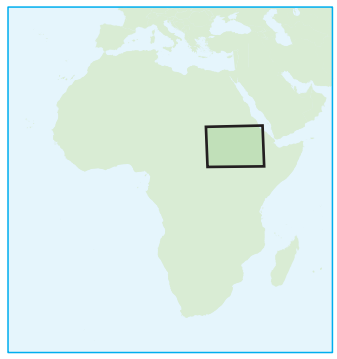
SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal



This map shows the soils of southern Sudan, north South Sudan, western Ethiopia and southern Eritrea. While the pattern of soil distribution on the western part of the map reflects the transition from desert conditions in the north to a more humid climate in the south, the influence of parent material is much more significant. The major feature of the map is the enormous expanse of Vertisols that characterise the western branch of the Great Rift Valley. The Blue and White Niles meet at Khartoum.

The soils of the north-western quadrant (Sudan) reflect arid and semi-arid conditions and generally flat terrain. Daily temperatures are high (30-40°C) with rainfall ranging from 50-700 mm a year Extensive sand deposits (Arenosols) dominate with Leptosols and Cambisols denote higher ground and the exposure of hard rock. Fluvisols demarcate alluvial soils of desert deltas and terraces of the Nile Valley. Many soils display significant calcium carbonate levels (Calcisols).

The soils of the south-western corner of the map reflect the weathering processes on the rocks of the Congo Craton, a stable rock formation more than 3 billion years old. Deeply weathered sediments give rise to clay-rich Lixisols, Ferralsols and Plinthosols under grasslands and savannah vegetation.

The dominant feature on this map is the expanse of dark, cracking Vertisols of the Central and Southern Clay Plains of Sudan and South Sudan. These heavy, alkaline soils, containing a high proportion of swelling clays, reflect the long-term flooding of the area by the Nile over thousands of years. When dry, deep cracks appear in the soil which close on subsequent rewetting. The high clay content makes Vertisols sticky when wet and difficult to work. However, Vertisols account for almost all of the cultivated land in South Sudan and about one third in Sudan. Organic-rich Histosols and Gleysols indicate marshy conditions in the floodplains of the Blue and White Nile, grading into stratified Fluvisols.

To the east, the land rises to the Ethiopian Plateau and highlands of Eritrea which are characterised by Leptosols and Cambisols. Lake Tana in Ethiopia, the source of the Blue Nile, sits in a pocket of clay-rich Luvisols and Nitisols that have developed on basaltic rocks and tuffs. Vertisols occupy valley floors while extensive Nitisols define outcrops of metamorphic rocks to the south. The rich coffee-growing regions of Ethiopia are found on the Nitisols of the Western Highlands.

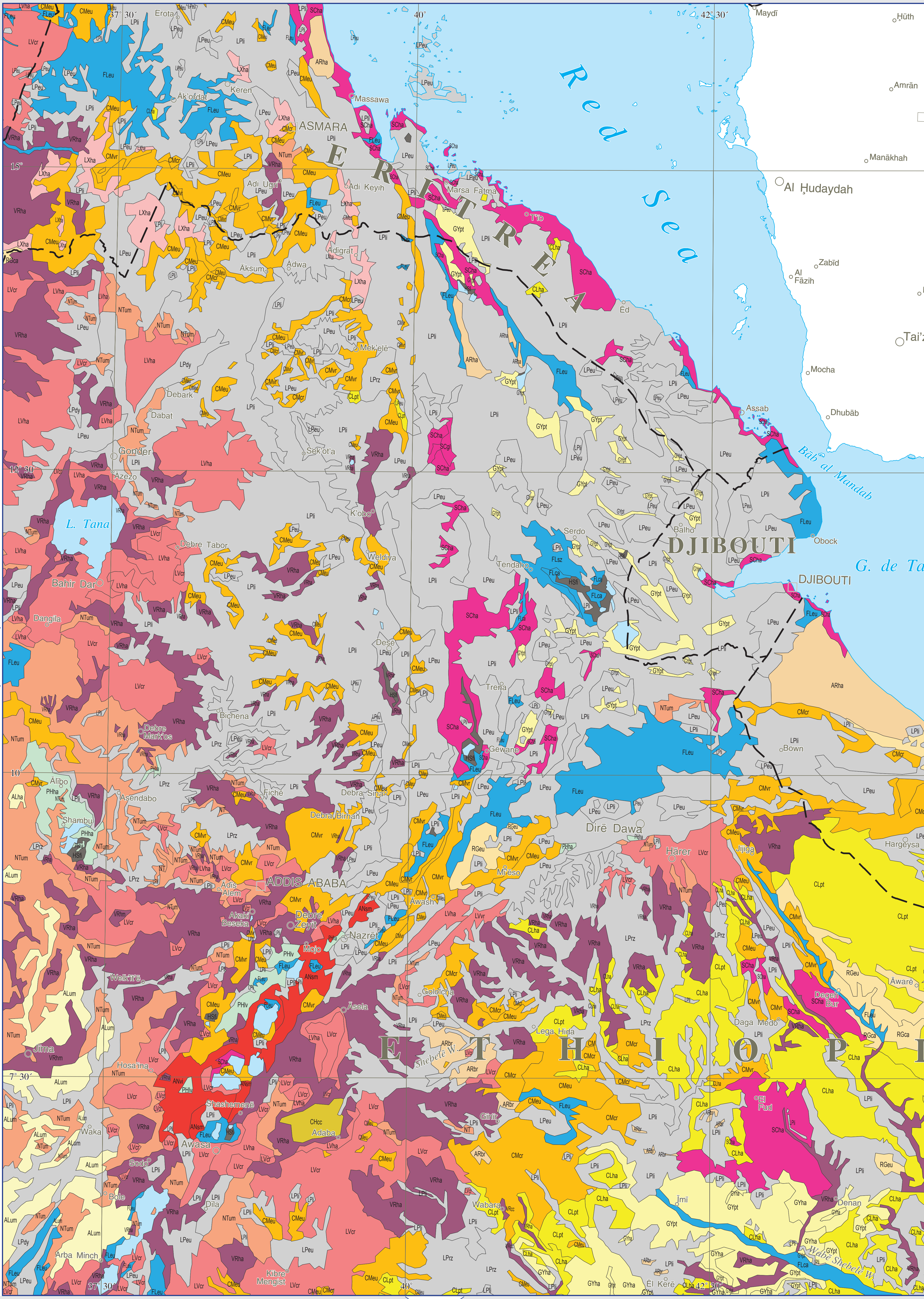
The line of Andosols just south of Addis Ababa marks volcanic activity associated with the Great Rift Valley. Most of the lakes in this area occupy collapsed volcanic cones (calderas). The Dendi Caldera is 8 km wide.

In the arid north, drought and desertification are persistent concerns. Gully and sheet erosion are serious problems in northern Ethiopia while nutrient management, sticky and heavy conditions and a limited cultivation window can cause difficulties on Vertisols.

E T H I O P I A

104

112


Red Sea
ERITREA
DJIBOUTI
ETHIOPIA
Bāb al Mandab
G. de Ta
L. Tana
ASMARA
ADDIS ABABA
DJIBOUTI
Erota
Keren
Āk'ordat
Massawa
Adi Ugri
Adi Keyih
Marsa Fatma
T'io
Ēd
Adīgrat
Ādwa
Āksum
Mek'elē
Debark
Dabat
Gonder
Āzezo
Sek'ot'a
K'obo
Debre Tabor
Weldiya
Bahir Dar
Dangila
Desē
Bichena
Debre Mark'os
Ālībo
Asendabo
Shambu
Fichē
Debra Sina
Debra Birhan
Ādīs 'Alem
Akaki Beseka
Debre Zeyit
Nazrēt
Mojo
Āwash
Welk'īt'ē
Jīma
Hosa'ina
Shashemenē
Waka
Awasa
Sodo
Bole
Dīla
Arba Minch
Kibre Mengist
Adaba
Āsela
Gololcha
Gīnīr
Wabara
Lega Hida
Mī'ēso
Dirē Dawa
Hārer
Jijiga
Hargeysa
Āwarē
Degeh Bur
Daga Medo
El Fud
Īmī
Denan
Ēl Kerē
Shebelē W.
Wabē Shebelē W.
Serdo
Tendaho
Balho
Obock
Trena
Gewane
Assab
Bown
Maydī
Hūth
Amrān
Manākhah
Al Ḩudaydah
Zabīd
Al Fāzih
Tai'z
Mocha
Dhubāb
15°
12° 30´
10°
7° 30´
37° 30´
40°
42° 30´

103
112

This map shows the soils of Djibouti, southern Eritrea, eastern Ethiopia and northern Somalia – an area commonly known as the 'Horn of Africa'. The overall pattern of soil distribution reflects two distinct lithological and climatological regions. To the north and the west, slightly cooler temperatures and significantly more rainfall (up to 2 000 mm annually) characterise the volcanic highlands of western Ethiopia while to the south and east, increasing aridity and high temperature give rise to soils dominated by salts, gypsum and calcium carbonate. Parts of Djibouti only receive 130 mm of rain per year, falling on less than 30 days while the summer temperatures on the northern coast of Somalia averages more than 38 °C. At 51°27'52" E, Ras Hafun in Somalia is the most easterly point of the African continent.

The highly weathered material on the mountains of the highlands of Eritrea and the Ethiopian Plateau to the east of Lake Tana are characterised by poorly developed Leptosols and Cambisols. Clayey Luvisols have developed on volcanic rocks but are prone to erosion and display low nutrient retention and crusting.

The line of Andosols just south of Addis Ababa marks the Great Rift Valley which separates the rocky soils of the Djibouti, Eritrea and the Western Highlands in Ethiopia from the Eastern Highlands of Ethiopia and the sediments of Somalia. Many of the lakes in this area occupy collapsed volcanic cones (calderas).

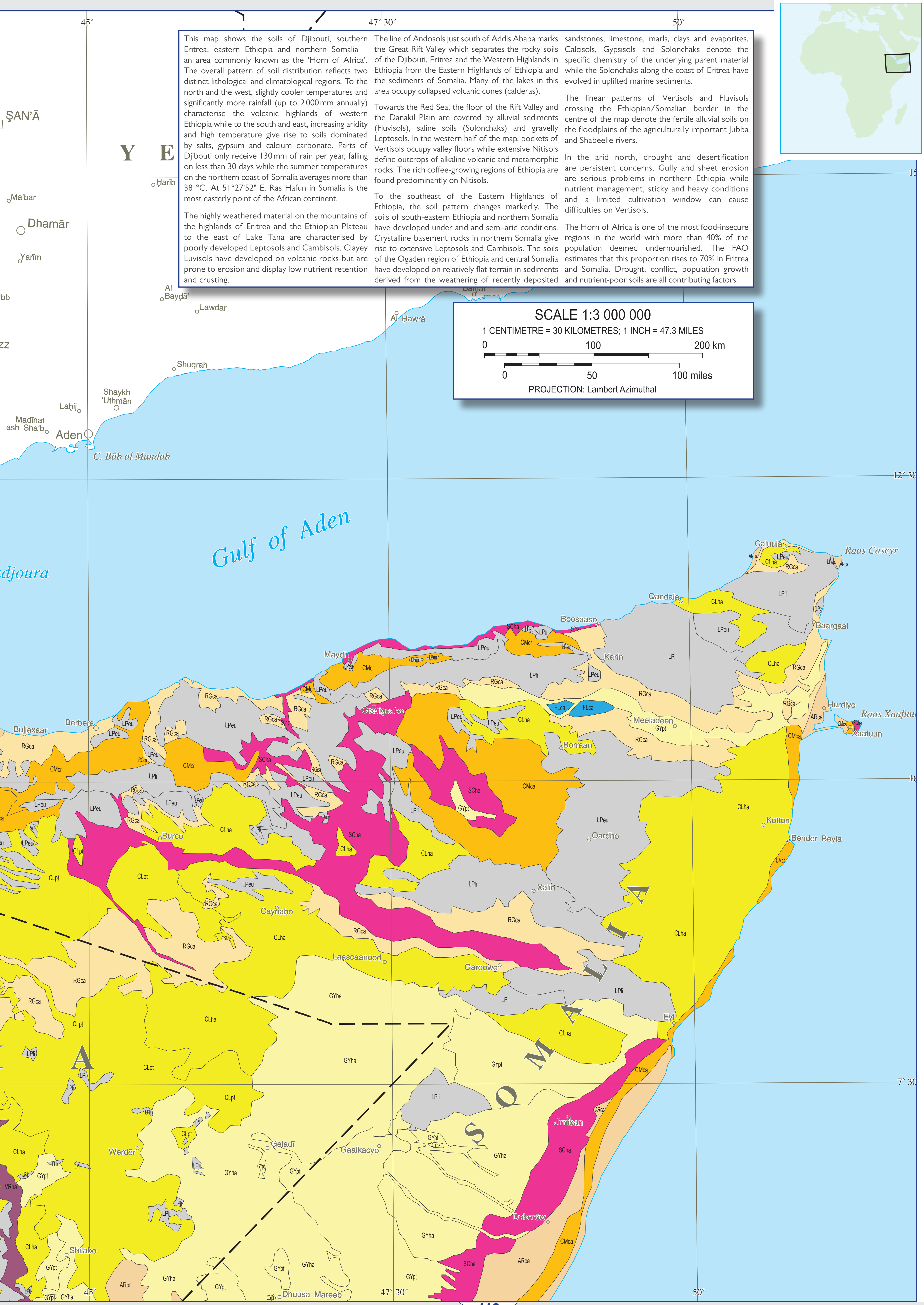
Towards the Red Sea, the floor of the Rift Valley and the Danakil Plain are covered by alluvial sediments (Fluvisols), saline soils (Solonchaks) and gravelly Leptosols. In the western half of the map, pockets of Vertisols occupy valley floors while extensive Nitisols define outcrops of alkaline volcanic and metamorphic rocks. The rich coffee-growing regions of Ethiopia are found predominantly on Nitisols.

To the southeast of the Eastern Highlands of Ethiopia, the soil pattern changes markedly. The soils of south-eastern Ethiopia and northern Somalia have developed under arid and semi-arid conditions. Crystalline basement rocks in northern Somalia give rise to extensive Leptosols and Cambisols. The soils of the Ogaden region of Ethiopia and central Somalia have developed on relatively flat terrain in sediments derived from the weathering of recently deposited sandstones, limestone, marls, clays and evaporites. Calcisols, Gypsisols and Solonchaks denote the specific chemistry of the underlying parent material while the Solonchaks along the coast of Eritrea have evolved in uplifted marine sediments.

The linear patterns of Vertisols and Fluvisols crossing the Ethiopian/Somalian border in the centre of the map denote the fertile alluvial soils on the floodplains of the agriculturally important Jubba and Shabeelle rivers.

In the arid north, drought and desertification are persistent concerns. Gully and sheet erosion are serious problems in northern Ethiopia while nutrient management, sticky and heavy conditions and a limited cultivation window can cause difficulties on Vertisols.

The Horn of Africa is one of the most food-insecure regions in the world with more than 40% of the population deemed undernourished. The FAO estimates that this proportion rises to 70% in Eritrea and Somalia. Drought, conflict, population growth and nutrient-poor soils are all contributing factors.



113

This map shows the soils of eastern Liberia, eastern Guinea, the Côte D'Ivoire, Ghana, Togo, Benin and southwest Nigeria. The pattern of soil distribution on the map reflects the intense weathering of the rocks of the West African Shield, a stable 3 billion year old rock formation, under hot and humid equatorial conditions. The large expanse of water lying along the Greenwich Meridian in Ghana is Lake Volta, the largest reservoir by surface area in the world (about 8 500 km²).

While the south-western part of the map has a typical hot and humid equatorial climate with extensive evergreen rainforest, the majority of the region has a humid savannah environment. Precipitation levels increase significantly to the south and west with the southern parts of Liberia receiving some of the highest rainfall in Africa (approaching 3 000 mm annually). Average monthly temperature varies between 25-35°C).

To the north and east, the humid savannah climate is characterised by the dry Harmattan wind (which blows from the northeast during, winter), a dry season lasting from about November to March and annual precipitation of around 1 500 mm. The shrubby grasslands of the north become more wooded towards the south, eventually grading into forest. The boundary between the savannah and forest is increasingly being cleared for rain-fed cultivation.

The distribution of soil types reflects the interplay between the underlying parent material, topography and climate. In the west, the intense chemical weathering of the West African Craton gives rise to a gently undulating landscape where extensive acidic Acrisols have developed on granites and schists while Alisols occur on more basic materials. Clay- and iron-rich Plinthosols denote more level terrain. On the alluvial sediments of the coastal plain of the Côte D'Ivoire, Liberia and Togo, deep, red or yellow Ferralsols have formed under rainforest.

The valley of the River Volta, denoted by alluvial Fluvisols, marks the eastern boundary of the West African Craton. To the east, less acid Lixisols with leached, clay-rich subsoils occur in strongly-weathered, fine textured materials under natural savannah or open woodland vegetation. Nitisols are found on gentle slopes between the coastal plains and interior plateau of Benin, Nigeria and Togo while iron-rich Plinthosols also indicate level or gently undulating landscapes. In Nigeria, bare, isolated mountains known as inslebergs give rise to individual patches of Leptosols.

Along the coast sandbars and lagoons or deltas give rise to Arenosols and Gleysols respectively. The Gleyosols and Fluvisols on the coast at the extreme right of the map denote the beginning of the delta of the River Niger.

Soil conservation is extremely important in this region. While low fertility, high levels of aluminium and phosphate fixation affect the use of the soil, heavy rainfall can cause serious erosion, especially following forest clearance.


98
99
108
GHANA
TOGO
BENIN
NIGERIA
L. Volta
White Volta
Volta
Bight of Benin
Gulf of Guinea
C. Three Points
a n
Léo
Pô
Tumu
Navrongo
Bolgatanga
Funsi
Walewale
Gambaga
Dapaong
Tanguiéta
Natitingou
Sansanné-Mango
Koumongou
Kandé
Kara
Djougou
Savelugu
Daboya
Tamale
Yendi
Zabzugu
Bassar
Sokodé
Tchamba
Bassila
Damongo
Salaga
Sotouboua
Kintampo
Wenchi
Atakpamé
Sunyani
Ejura
Jasikan
Kra
Kumasi
Kpalimé
Nkawkaw
Obuasi
Kade
Tafo
Koforidua
Dunkwa
Oda
Nsawam
Foso
Ho
Tsévié
Vogan
Aného
LOMÉ
Keta
Ada
ACCRA
Téma
Winneba
Cape Coast
Tarkwa
Nsuta
Sekondi-Takoradi
Axim
Kandi
Ségbana
Beroubouaye
Bembèrèkè
Ndali
Nikki
Wawa
Kaiama
Mokwa
Jebba
Parakou
Okuta
Ilesha
Kishi
Igboho
Igbetti
Tchaourou
Kilibo
Shaki
Ilorin
Offa
Ogbomosho
Savé
Savalou
Iseyin
Ilobu
Ila
Oyo
Oshogbo
Ede
Effon-Alaiye
Iwo
Ile Ife
Ilesa
Ado Ekiti
Ikire
IBADAN
Ilawe-Ekiti
Akure
Ondo
Abomey
Abeokuta
Pobé
Ilaro
Sagamu
Ijebu Ode
Allada
Sakété
Ado
Ikeja
Ikorodu
PORTO NOVO
Mushin
LAGOS
Okitipupa
Ouidah
Cotonou
0°
2° 30´
5°
7° 30´
LXha
LPli
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VRha
VRpe
NTdy
NTeu
ACha
ALha
CMeu
CMvr
GL
GLeu
FL
FLti
LVgl
PLsc
RGdy
FRxa
SCALE 1:3 000 000
1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES
0
100
200 km
0
50
100 miles
PROJECTION: Lambert Azimuthal

SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

This map shows the soils of São Tomé and Príncipe, southern Cameroon, southern Central African Republic, Congo, the western part of the Democratic Republic of the Congo, Equatorial Guinea and Gabon. The equator runs horizontally through the middle of the map. The major geographical features of the region are the Niger Delta and the vast Congo Basin.

The climate is classic equatorial, typified by constantly heavy precipitation, high temperatures and high humidity. Precipitation averages more than 2 000 mm and in places can be much higher (> 3 000 mm). Debundscha at the foot of Mount Cameroon is regarded as the wettest place in Africa with a staggering 10 000 mm of rainfall annually. Seasonal temperatures are relatively stable (22-30°C) with significantly greater variation between day and night, while along the coast the sea has a considerable cooling effect. The average daily humidity is about 80 percent.

The vegetation is almost exclusively broadleaved, evergreen rainforest, grading into deciduous African Oak forests where precipitation levels are lower. Dense growths of broadleaved trees form a closed upper canopy over an undergrowth of leafy plants and vines. Coconut palms and mangrove forests grow in the coastal regions.

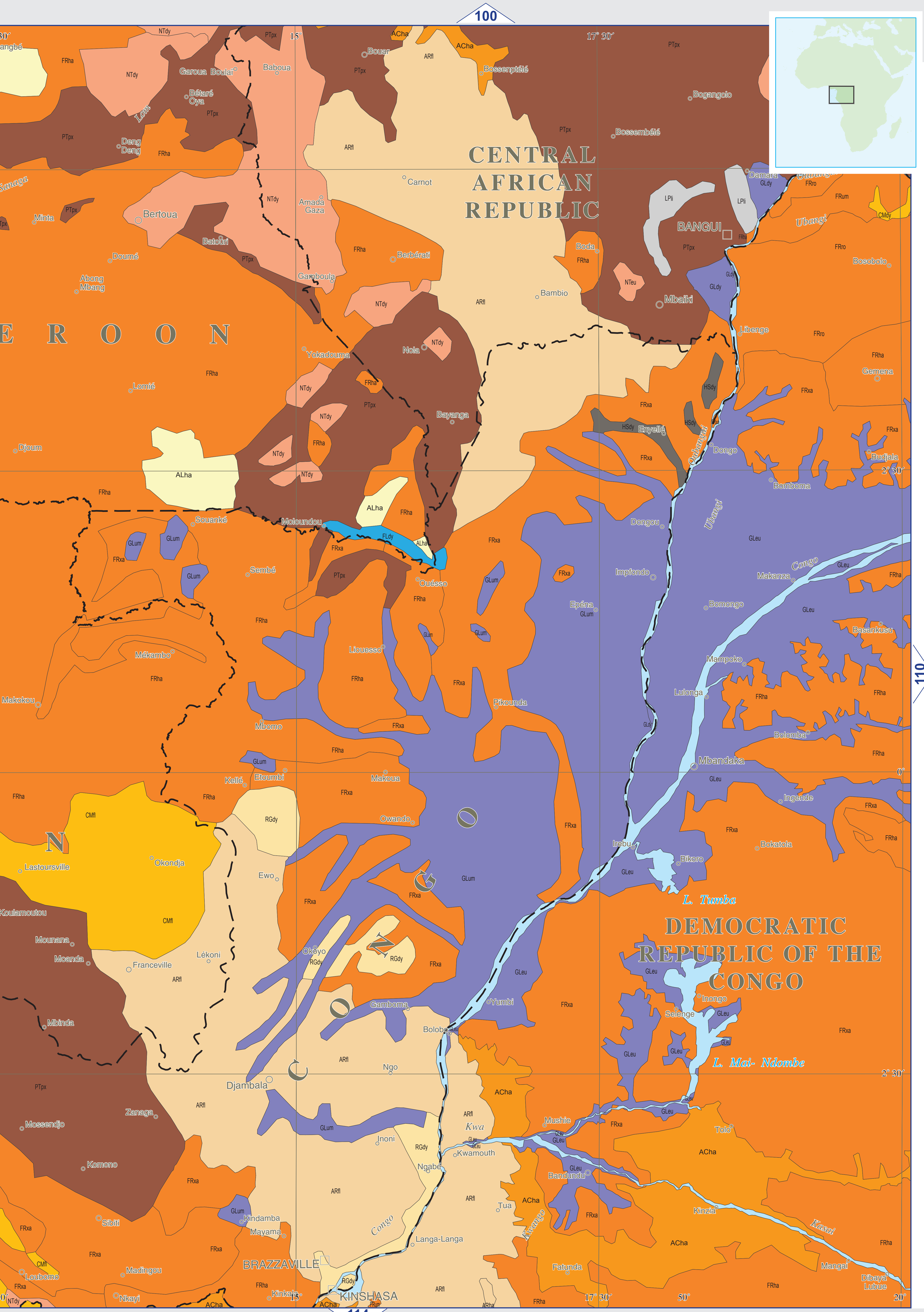
The pattern of soil types on the map reflects the long and intense weathering of the Congo Shield, an ancient, stable rock formation. The dominant soil are Ferralsols, the classic red or yellow deeply weathered soils of the tropics. Ferralsols are coarse-grained soils containing sand and gravel with high levels of iron and aluminium sesquioxides. Organic matter and nutrient levels are low because plant remains are rapidly decomposed by bacterial action in the hot and humid climate before it can accumulate as humus in the soil. Topsoil erosion due to heavy rainfall, and especially after deforestation, is a major problem. Iron- and clay-rich Plinthosols indicate soil formation in level or gently undulating landscapes affected by groundwater movements while Nitisols are found on gentle slopes between the coastal plains and interior plateau of Nigeria. Much of Gabon is characterised by a series of granite plateaus on which weakly developed Cambisols have formed.

Sandbars, lagoons and deltas along the coast give rise to Arenosols and Gleysols. Along the coast of Cameroon and Gabon, mangrove forests give rise to Tidalic Fluvisols. A distinctive area is the delta of the River Niger in the Gulf of Guinea. Gleysols highlight low-lying marshy areas which give rise to waterlogged soils with Fluvisols occurring on the depositional front of the delta. Deeply weathered Ferralsols are found in sandy alluvium sediments. The Gulf of Guinea is actually a major tectonic rift, similar to the Great Rift Valley of Eastern Africa. Consequently, the volcanic activity which created the islands of São Tomé and Príncipe and Mount Cameroon (one of Africa's largest volcanoes), gives rise to Andosols.

The other significant feature on the map is the extensive organic-rich Gleysols that characterise the vast area of low-lying, swampy lands adjacent to the River Congo and its tributaries (with a length of 4 700 km, the Congo is the continent's second longest river after the Nile).

Because of their intrinsic lack of nutrients, many soils are heavily dependent upon organic matter supplied by the vegetation cover. In this case, there is a fragile balance between vegetation and soil fertility, which may be destroyed by clearance, erosion, fire or overuse.

100



CENTRAL AFRICAN REPUBLIC
CAMEROON
CONGO
DEMOCRATIC REPUBLIC OF THE CONGO
BANGUI
BRAZZAVILLE
KINSHASA
Bouar
Baboua
Garoua Boulaï
Bétaré Oya
Deng Deng
Bossenptélé
Bogangolo
Bossembélé
Carnot
Amada Gaza
Bertoua
Batouri
Minta
Doumé
Abong Mbang
Gamboula
Berbérati
Boda
Bambio
Mbaiki
Damara
Libenge
Bosobolo
Gemena
Nola
Yokadouma
Lomié
Bayanga
Enyellé
Dongo
Budjala
Bomboma
Djoum
Souanké
Moloundou
Ouésso
Sembé
Dongou
Impfondo
Epéna
Makanza
Bomongo
Basankusu
Mampoko
Lulonga
Bolomba
Mbandaka
Ingende
Bokatola
Irebu
Bikoro
Mékambo
Makokou
Liouesso
Pikounda
Mbomo
Kellé
Etoumbi
Makoua
Owando
Okondja
Lastoursville
Ewo
Koulamoutou
Mounana
Moanda
Franceville
Lékoni
Okoyo
Gamboma
Yumbi
Inongo
Selenge
Mbinda
Bolobo
Ngo
Djambala
Zanaga
Mossendjo
Inoni
Kwamouth
Ngabé
Mushie
Tolo
Bandundu
Komono
Sibiti
Kindamba
Mayama
Tua
Kinzia
Langa-Langa
Loubomo
Madingou
Nkayi
Kinkala
Fatunda
Mangai
Dibaya Lubue
Sanaga
Lom
Oubangui
Ubangi
Congo
Kwa
Kwango
Kasai
L. Tumba
L. Mai- Ndombe
15°
17° 30´
2° 30´
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PTpx
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ARfl
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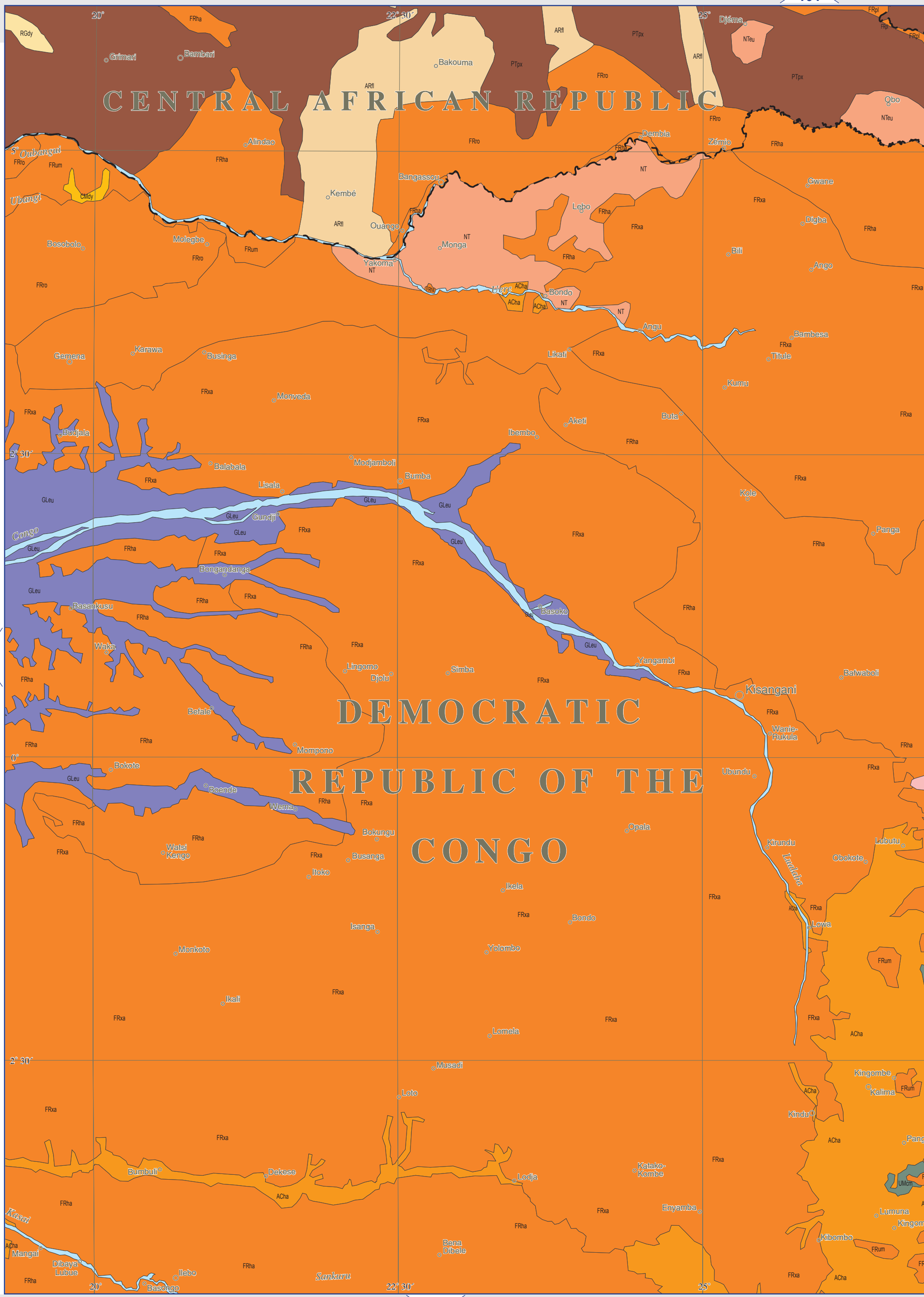
GLeu
CMfl
RGdy
ARha

110

114


CENTRAL AFRICAN REPUBLIC
DEMOCRATIC REPUBLIC OF THE CONGO
20°
22° 30´
25°
5° 30´
2° 30´
0°
Oubangui
Ubangi
Congo
Kasai
Uele
Lualaba
Sankuru
Grimari
Bambari
Bakouma
Djéma
Obo
Alindao
Dembia
Zémio
Bangassou
Kembé
Ouango
Lebo
Gwane
Digba
Bosobolo
Molegbe
Monga
Yakoma
Bili
Ango
Bondo
Angu
Bambesa
Titule
Likati
Gemena
Karawa
Businga
Monveda
Kumu
Budjala
Balabala
Modjamboli
Bumba
Lisala
Gundji
Aketi
Ibembo
Buta
Kole
Panga
Bongandanga
Basankusu
Basoko
Waka
Lingomo
Djolu
Simba
Yangambi
Bafwaboli
Kisangani
Befale
Wanie-Rukula
Mompono
Bokote
Boende
Wema
Ubundu
Opala
Watsi Kengo
Bokungu
Busanga
Itoko
Kirundu
Lubutu
Obokote
Ikela
Bondo
Isanga
Lowa
Monkoto
Yolombo
Ikali
Lomela
Musadi
Loto
Kingombe
Kalima
Kindu
Bumbuli
Dekese
Lodja
Katako-Kombe
Enyamba
Lumuna
Kibombo
Mangai
Dibaya Lubue
Ilebo
Basongo
Bena Dibele
RGdy
CMdy
FRha
FRro
FRum
FRxa
FRpl
ARfl
PTpx
NTeu
NT
ACha
GLeu
UMcm

109

114

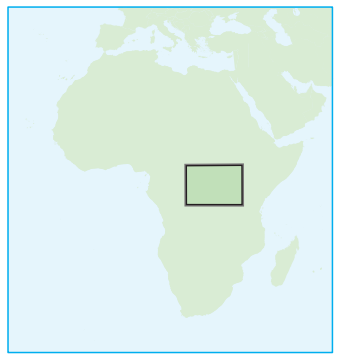
SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal



This map shows the soils of Burundi, south Central African Republic, northern Democratic Republic of the Congo, Rwanda, southern South Sudan and western Uganda. The equator runs horizontally through the middle of the map. The major geographical features of the region are the low-lying Congo Basin, the Western Rift Valley and the tectonically uplifted block of eastern Africa. The large water body on the east of the map is Lake Victoria, the largest lake in Africa and the second largest in the world.

The Rift Valley is a vast depression occupied by vast lakes, where large segments of the Earth's crust have subsided between fault lines. A number of volcanic peaks are associated with the rifting process. Immediately to the west of the Rift Valley, the land rises to a height of several thousand metres (the ice-capped peaks of the Ruwenzori are over 5 000 m above sea level). Further west, the Congo Basin is a shallow, bowl-shaped structure, gently sloping towards the Atlantic coast. To the east of the Rift Valley, the basin of Lake Victoria sits on a high plateau with an average elevation between 1 000 and 1 500 m.

The western part of the map has an equatorial climate, typified by constantly heavy precipitation (2 000 mm annually), high temperatures (22-30°C) and high humidity (80%). However, to the east of the Rift Valley, annual precipitation is nearly 1 000 mm lower while mean annual temperature drops by 5 °C – both continue to fall towards the Indian Ocean coast. While seasonal temperatures are relatively stable in the Congo, Uganda has two distinct dry and rainy seasons.

To the west, the vegetation is almost exclusively dense, broadleaved, evergreen rainforest. The higher elevation and drier climate of the eastern part of the map give rise to deciduous forests and savanna grasslands.

The pattern of soil types on the map reflects the long and intense weathering of the Congo Shield, an ancient, stable rock formation. Extensive Ferralsols, the classic red or yellow deeply weathered soils of the tropics, characterise the Congo Basin. These soils have developed in coarse-grained weathered sediments of the Congo Craton and contain high levels of iron and aluminium. Organic matter and nutrient levels are low because organic matter is decomposed by rapid bacterial action in the hot and humid climate, before it can accumulate as humus in the soil. To the north, iron and clay-rich Plinthosols indicate soil formation in slightly drier conditions on level or gently undulating landscapes affected by groundwater movements. Nitisols occur on gentle slopes while clay-rich, acidic Acrisols and Umbrisols indicate weathering where relief is more pronounced. Lixisols reflect the leaching of certain clays from the soil giving it a higher pH than the surrounding Ferralsols. The other significant feature on the western half of the map is the extensive organic-rich Gleysols that characterise the vast area of low-lying, swampy lands adjacent to the River Congo and its tributaries. South Sudan contains extensive plains of Vertisols. These heavy, alkaline soils, containing a high proportion of swelling clays, reflect the long-term flooding of the area by the Nile over thousands of years.

On the plateau of East Africa, Fluvisols denote river systems draining to the lower elevations of the Rift Valley floors. Cambisols and Ferralsols predominate with weathered volcanic sediments giving rise to highly fertile Nitiosols on gently sloping ground and dark, clay-rich Vertisols on valley floors.

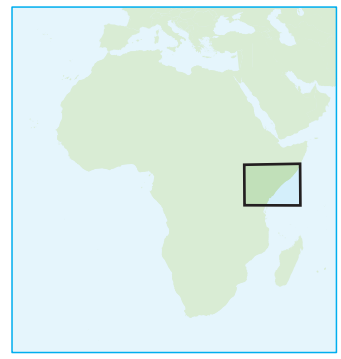
Volcanic activity along the rifts has given rise to numerous lava and ash deposits. These are denoted by Andosols. Fluvisols and saline soils characterise the floor of the Rift Valley.

112

104

111

117



This map shows the incredible variety of soils covering southern Ethiopia, Kenya, southern Somalia and northern Tanzania. The major geographical feature of the region is the Eastern Rift Valley that runs north-south through the left-hand side of the map. The diversity of soil types is due to the range of geological and climatic conditions of the area and the tectonically uplifted block of eastern Africa.

The Eastern Rift Valley is a vast depression where large segments of the Earth's crust have subsided between fault lines caused by the separation of Africa and the Arabian Peninsula. The valley floor is occupied by several large, shallow lakes and a number of volcanic peaks are associated with the rifting process. Kilimanjaro, at 5 895 m Africa's highest mountain and volcano, lies just south of the equator on the border of Kenya and Tanzania. Either side of the valley, the land rises by around 600 m to a high plateau with an elevation of 1 000 - 1 500 m above sea level. The Kenyan Highlands are one of the most successful agricultural production regions in Africa. To the northeast, the plateau falls away to a low, flat, semi-arid plain that extends across the Ethiopian/Kenyan border to the Indian Ocean. Olduvai Gorge, regarded as the birthplace of human beings, is located in volcanic sediments of northern Tanzania.

The climate of the region ranges from humid savannah in the west and dry savannah in the centre to semi-arid in southern Somalia. This is matched by a gradual decrease in vegetation cover. Annual temperatures are generally high in the Rift Valley and coastal plain but are moderated by elevation on the plateau. While the Rift Valley floor is dry, the highlands receive around 700 mm of rainfall annually. While the more tropical Kenyan coast receives slightly higher rainfall, the area between the sea and the plateau is notably drier. To the northwest, the coastal and inland plains of Ethiopia and northern Kenya are quite arid with irregular annual rainfall (around 250 mm) and annual temperatures in the order of 30°C.

The distribution of soil types on the map can be divided into two regions east and west of the 38°E meridian. To the west, the soils reflect the weathering of volcanic and uplifted sediments. Extensive lava deposits have produced fertile and sandy-loam Andosols while Planosols interspersed with Luvisols and productive clay-rich Vertisols (the latter tending to develop on the level ground of valley floors). On the slopes of volcanoes (e.g. Mount Elgon), fertile Nitisols are well known for coffee and tea production while the extensive grasslands of the Serengeti and Mara Plains give rise to organic and lime-rich Phaeozems. To the north, the semi-arid basin of Lake Turkana is characterised by Calcisols, Cambisols and Regosols while increasing temperatures are also denoted by large expanses of sodic Solonetz.

To the east of the 38°E meridian, the land drops in elevation and a large, predominantly sandy, plain extends towards the Indian Ocean coastlines of Somalia and northern Kenya. This coarse grained material gives rise to Arenosols and red coloured Ferralsols while the evaporation of saline groundwater gives rise to widespread occurrences of Solonetz. Lixisols reflect less acid soils in areas with a pronounced dry season. Fluvisols denote the alluvial sediments of river systems draining from the plateau and dark, clayey Vertisols tend to develop on valley floors in sediments derived from the weathering of basic volcanic material on the plateau.

The linear patterns of Vertisols and Fluvisols crossing the southern Somalian coastal plain define the fertile alluvial soils on the floodplains of the agriculturally important Jubba and Shabeelle rivers, the latter gives rise to the fertile marsh lands and plains around Mogadishu. The Arenosols flanking much of the Somalian coastline is a vast belt of ancient dunes that stretches for more than 1 000 km.

Many of the soils on this map are subject to widespread erosion largely due to the lack of tree cover, overgrazing and cultivation. The issue is particularly pronounced in the more arid and semi-arid regions. The Horn of Africa is one of the most food-insecure regions in the world with more than 40% of the population deemed undernourished. The FAO estimates that this proportion rises to 70% in Eritrea and Somalia. Drought, conflict, population growth and nutrient-poor soils are all contributing factors.

The very dense soil patterns for Kenya reflects a more detailed soil mapping base. Such a level of information should be the minimum goal for the other African countries (see also Plates 21, 23 and 24).

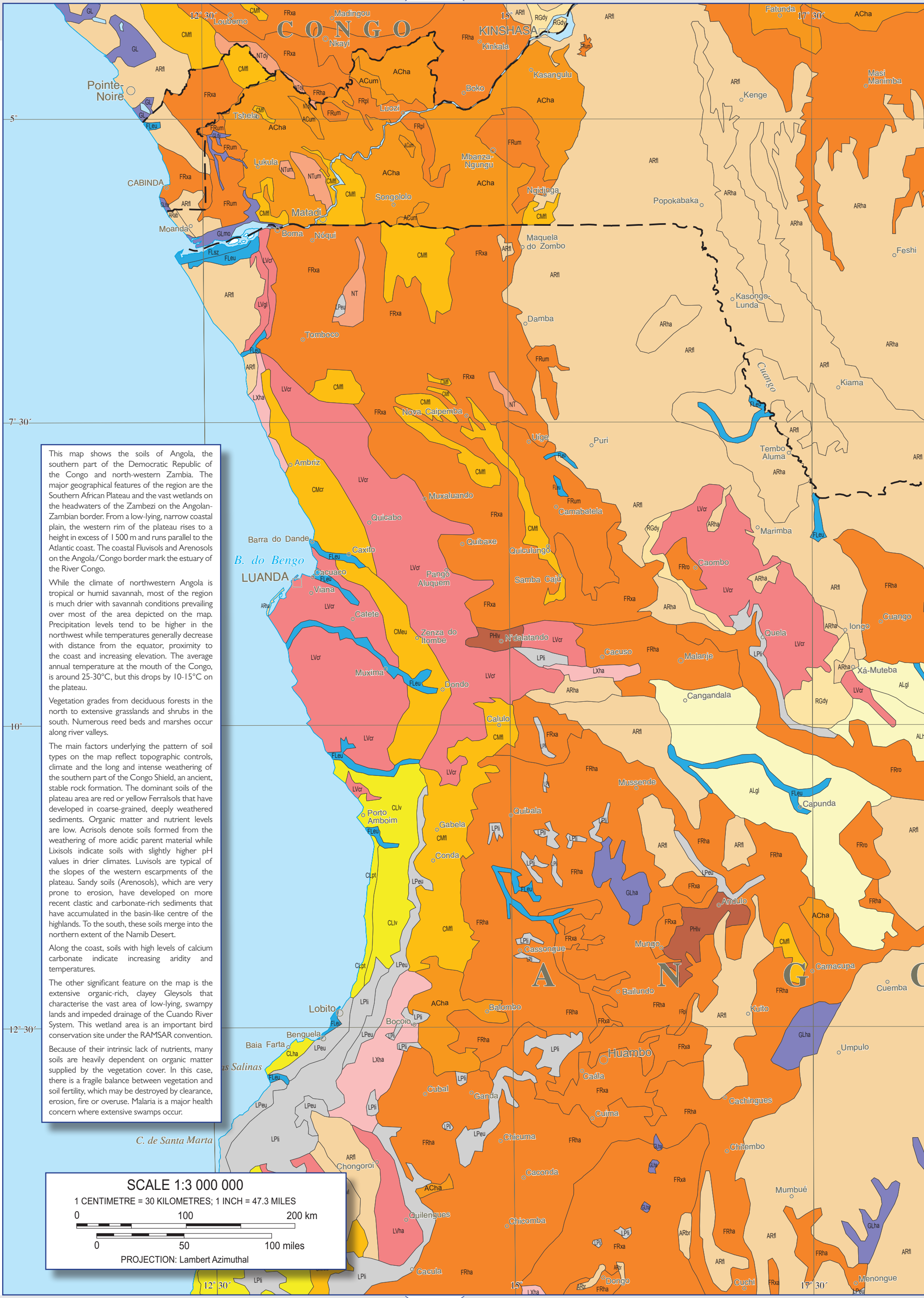
SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal



This map shows the soils of Angola, the southern part of the Democratic Republic of the Congo and north-western Zambia. The major geographical features of the region are the Southern African Plateau and the vast wetlands on the headwaters of the Zambezi on the Angolan-Zambian border. From a low-lying, narrow coastal plain, the western rim of the plateau rises to a height in excess of 1 500 m and runs parallel to the Atlantic coast. The coastal Fluvisols and Arenosols on the Angola/Congo border mark the estuary of the River Congo.

While the climate of northwestern Angola is tropical or humid savannah, most of the region is much drier with savannah conditions prevailing over most of the area depicted on the map. Precipitation levels tend to be higher in the northwest while temperatures generally decrease with distance from the equator, proximity to the coast and increasing elevation. The average annual temperature at the mouth of the Congo, is around 25-30°C, but this drops by 10-15°C on the plateau.

Vegetation grades from deciduous forests in the north to extensive grasslands and shrubs in the south. Numerous reed beds and marshes occur along river valleys.

The main factors underlying the pattern of soil types on the map reflect topographic controls, climate and the long and intense weathering of the southern part of the Congo Shield, an ancient, stable rock formation. The dominant soils of the plateau area are red or yellow Ferralsols that have developed in coarse-grained, deeply weathered sediments. Organic matter and nutrient levels are low. Acrisols denote soils formed from the weathering of more acidic parent material while Lixisols indicate soils with slightly higher pH values in drier climates. Luvisols are typical of the slopes of the western escarpments of the plateau. Sandy soils (Arenosols), which are very prone to erosion, have developed on more recent clastic and carbonate-rich sediments that have accumulated in the basin-like centre of the highlands. To the south, these soils merge into the northern extent of the Namib Desert.

Along the coast, soils with high levels of calcium carbonate indicate increasing aridity and temperatures.

The other significant feature on the map is the extensive organic-rich, clayey Gleysols that characterise the vast area of low-lying, swampy lands and impeded drainage of the Cuando River System. This wetland area is an important bird conservation site under the RAMSAR convention.

Because of their intrinsic lack of nutrients, many soils are heavily dependent on organic matter supplied by the vegetation cover. In this case, there is a fragile balance between vegetation and soil fertility, which may be destroyed by clearance, erosion, fire or overuse. Malaria is a major health concern where extensive swamps occur.

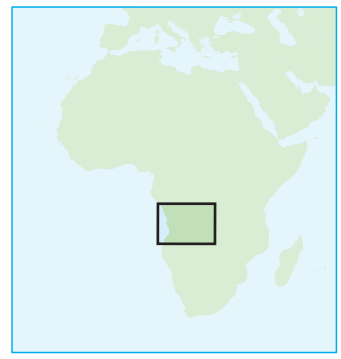
SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal



DEMOCRATIC REPUBLIC OF THE CONGO

ANGOLA

ZAMBIA

Dibaya Lubue
Ilebo
Basongo
Sankuru
Bena Dibele
Mweka
Kikwit
Idiofa
Lusambo
Mashala
Pania Mutombo
Luebo
Lukolela
Banga
Demba
Dimbelenge
Gungu
Kilembe
Kananga
Kandale
Mbuji-Mayi
Kabinda
Tshikapa
Gandajika
Dibaya
Kasai
M'Boi
Mwene Ditu
Luiza
Luputa
Kahemba
Lóvua
Chitato
Kabongo
Kaniama
Cambulo
Cuilo
Camaxilo
Capaia
Lucapa
Caungula
Sombo
Kamina
Lubalo
Chiluage
Saurimo
Sandoa
Kinda
Bukama
Luena
Mona Quimbundo
Muriege
Sokele
Cacolo
Cucumbi
Busanga
Kasaji
Dilolo
Mutshatsha
Kolwezi
Alto Chicapa
Luau
Muconda
Sautar
Caianda
Kalene Hill
Luando
Leua
Luena
Cangumbe
Cazombo
Mwinilunga
Munhango
Lucusse
Lutuai
Lumbala Kaquengue
Macondo
Luvuei
Chavuma
Tempué
Lutembo
Zambezi
Kabompo
Chitokoloki
Lumbala N'guimbo
Muié
Lupire
Longa

Sankuru
Lubilash
Luachimo
Kasai
Cassai
Zambezi

20°
22° 30´
25°
7° 30´
10°
12° 30´

116
119

This map shows the soils of the eastern Democratic Republic of the Congo, southern Tanzania, northern Malawi, northern Mozambique and Zambia.

The major geographical feature of this map is the Rift Valley with the great African lakes of Tanganyika and Malawi. Lake Tanganyika is the world's second deepest, second largest (by volume) and longest freshwater lake.

The Rift Valley is a vast tectonic depression where large segments of the Earth's crust have subsided between fault lines. Extensive volcanic activity is associated with this process and gives rise to Andosols. Either side of the Rift Valley, the land rises steeply. To the west, high mountains drop down to the Congo Basin while to the east, the terrain is very dissected with deep valleys and plateau surfaces running down to the Indian Ocean coast.

While the Congo Basin and the narrow Indian Ocean coastal plain have a hot and tropical climate, most of the eastern part of the area shown on the map possesses a dry savannah climate, typified by seasonal variations in temperature and precipitation. Summer temperatures range from 25-30°C but drop in winter and significantly with altitude. Rain falls in a single wet season (summer) and is highest over the rift highlands and coastal islands (2 000 mm). However, most of the region receives between 600 – 1 500 mm, decreasing from north to south in the east.

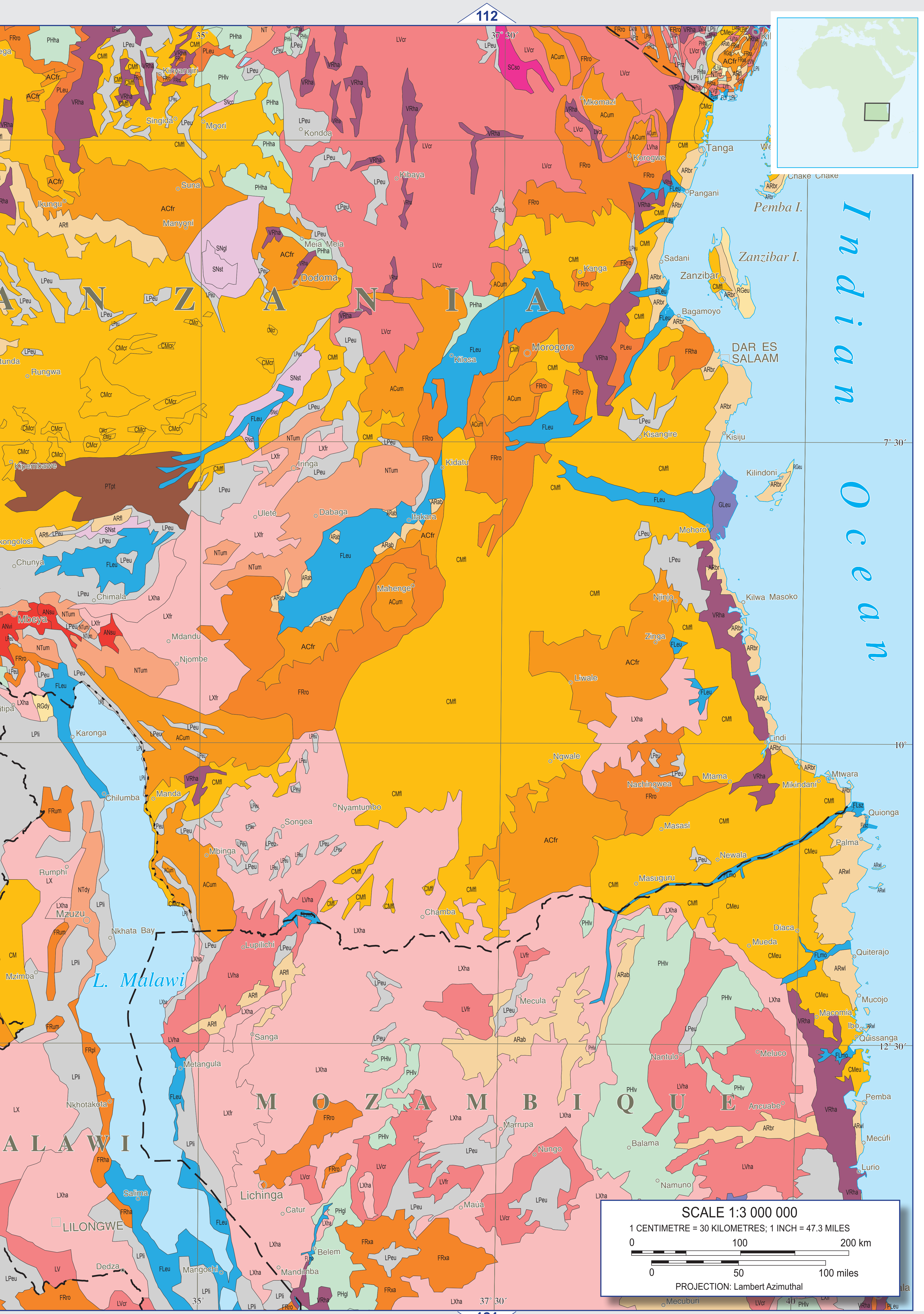
Where precipitation levels are high, forests grow. However, the plateau areas are primarily miombo woodland, consisting of an open cover of trees and grasses. In areas of less precipitation, bushland and thicket are found, giving way to grassland in more arid conditions.

To the west of the Rift Valley, the soil pattern reflects the long and intense weathering of the eastern part of the Congo Shield, an ancient, stable rock formation. Extensive Cambisols and Ferralsols, the classic red or yellow deeply weathered soils of the tropics, characterise much of the Congo Basin. Acidic Acrisols denote soil formation on granitic rocks in undulating terrain. Leptosols and Luvisols define the soils on the slopes of the high mountains flanking the Rift Valley. Dark, clay-rich Vertisols have formed on flat terrain or valley floors from the weathered sediments of relatively recent volcanic deposits. Gleysols and Histosols denote low-lying areas where water logging is a prominent factor. The Bangweulu Swamps and the Kafue Flats are wetlands of international ecological importance.

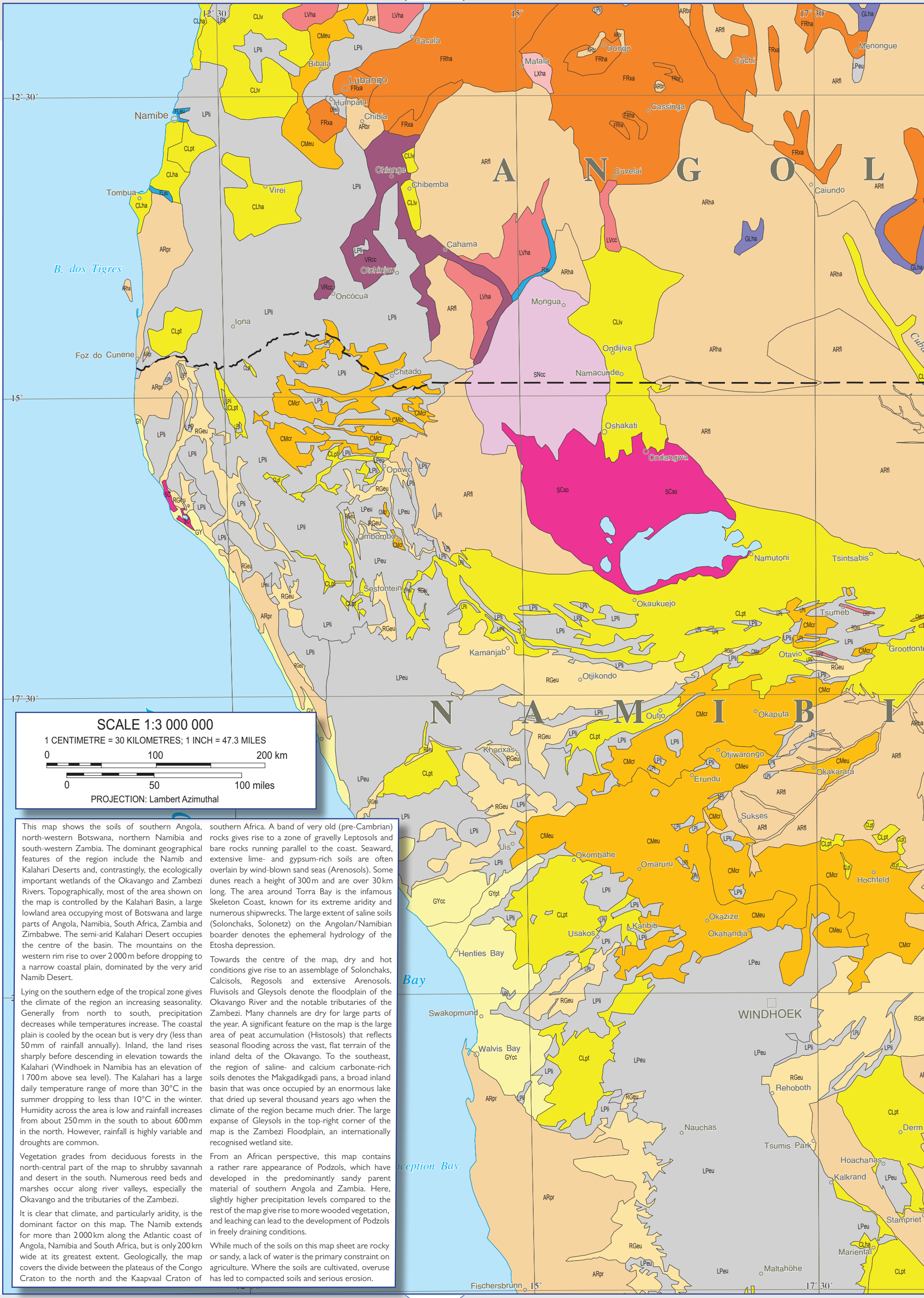
To the east of the Rift Valley, the pattern is a little more complex. The undulating terrain and variation in the chemical make-up of parent material gives a mosaic of soil types. The continuous uplift of the area is reflected in the extensive areas of weakly developed Cambisols. Nitisols occur on gentle slopes, while acidic Acrisols and clay-rich Luvisols indicate soil formation where relief is more pronounced. Sporadic formations of Vertisols reflect soil formation from weathered basic volcanic deposits. The extensive Fluvisols in central Tanzania denote the floodplains of the Rufiji River and its tributaries, in particular, the ecologically important wetlands of the Great Ruaha River.

To the south, increasing aridity and predominance of grassland savannah give rise to extensive Lixisols.

112


T A N Z A N I A
M O Z A M B I Q U E
M A L A W I
Indian Ocean
L. Malawi
Pemba I.
Zanzibar I.
DAR ES SALAAM
LILONGWE
Kinyangiri
Singida
Mgori
Kondoa
Kibaya
Mkomazi
Tanga
Korogwe
Pangani
Chake Chake
Suna
Ikungu
Manyoni
Meia Meia
Dodoma
Kanga
Sadani
Zanzibar
Bagamoyo
Morogoro
Kilosa
Rungwa
Kipembawe
Iringa
Kidatu
Kisangire
Kisiju
Kilindoni
Ulete
Dabaga
Ifakara
Mohoro
Chunya
Chimala
Mahenge
Kilwa Masoko
Njinjo
Mbeya
Mdandu
Njombe
Zinga
Liwale
Karonga
Lindi
Ngwale
Mtama
Mtwara
Mikindani
Nachingwea
Chilumba
Manda
Nyamtumbo
Songea
Masasi
Quionga
Rumphi
Mbinga
Newala
Palma
Masuguru
Mzuzu
Nkhata Bay
Chamba
Lupilichi
Diaca
Mueda
Quiterajo
Mzimba
Mecula
Macomia
Mucojo
Ibo
Sanga
Quissanga
Metangula
Nantulo
Meluco
Nkhotakota
Ancuabe
Pemba
Marrupa
Balama
Mecúfi
Nungo
Lurio
Salima
Lichinga
Namuno
Catur
Maúa
Belem
Dedza
Mangochi
Mandimba
Mecuburi
7° 30′
10°
12° 30′
35°
37° 30′
SCALE 1:3 000 000
1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES
0
100
200 km
0
50
100 miles
PROJECTION: Lambert Azimuthal

121



This map shows the soils of southern Angola, north-western Botswana, northern Namibia and south-western Zambia. The dominant geographical features of the region include the Namib and Kalahari Deserts and, contrastingly, the ecologically important wetlands of the Okavango and Zambezi Rivers. Topographically, most of the area shown on the map is controlled by the Kalahari Basin, a large lowland area occupying most of Botswana and large parts of Angola, Namibia, South Africa, Zambia and Zimbabwe. The semi-arid Kalahari Desert occupies the centre of the basin. The mountains on the western rim rise to over 2 000 m before dropping to a narrow coastal plain, dominated by the very arid Namib Desert.

Lying on the southern edge of the tropical zone gives the climate of the region an increasing seasonality. Generally from north to south, precipitation decreases while temperatures increase. The coastal plain is cooled by the ocean but is very dry (less than 50 mm of rainfall annually). Inland, the land rises sharply before descending in elevation towards the Kalahari (Windhoek in Namibia has an elevation of 1 700 m above sea level). The Kalahari has a large daily temperature range of more than 30°C in the summer dropping to less than 10°C in the winter. Humidity across the area is low and rainfall increases from about 250 mm in the south to about 600 mm in the north. However, rainfall is highly variable and droughts are common.

Vegetation grades from deciduous forests in the north-central part of the map to shrubby savannah and desert in the south. Numerous reed beds and marshes occur along river valleys, especially the Okavango and the tributaries of the Zambezi.

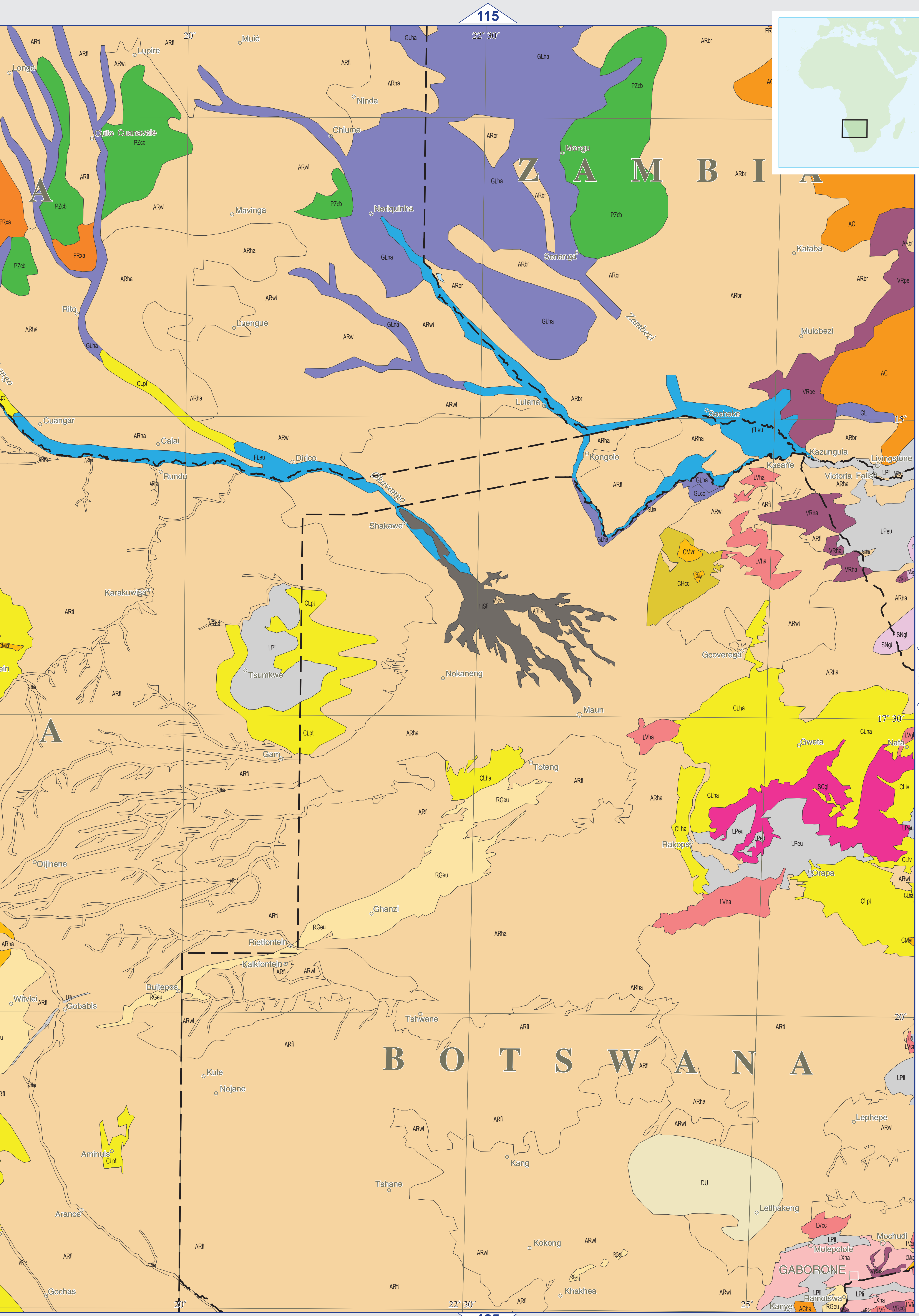
It is clear that climate, and particularly aridity, is the dominant factor on this map. The Namib extends for more than 2 000 km along the Atlantic coast of Angola, Namibia and South Africa, but is only 200 km wide at its greatest extent. Geologically, the map covers the divide between the plateaus of the Congo Craton to the north and the Kaapvaal Craton of southern Africa. A band of very old (pre-Cambrian) rocks gives rise to a zone of gravelly Leptosols and bare rocks running parallel to the coast. Seaward, extensive lime- and gypsum-rich soils are often overlain by wind-blown sand seas (Arenosols). Some dunes reach a height of 300 m and are over 30 km long. The area around Torra Bay is the infamous Skeleton Coast, known for its extreme aridity and numerous shipwrecks. The large extent of saline soils (Solonchaks, Solonetz) on the Angolan/Namibian boarder denotes the ephemeral hydrology of the Etosha depression.

Towards the centre of the map, dry and hot conditions give rise to an assemblage of Solonchaks, Calcisols, Regosols and extensive Arenosols. Fluvisols and Gleysols denote the floodplain of the Okavango River and the notable tributaries of the Zambezi. Many channels are dry for large parts of the year. A significant feature on the map is the large area of peat accumulation (Histosols) that reflects seasonal flooding across the vast, flat terrain of the inland delta of the Okavango. To the southeast, the region of saline- and calcium carbonate-rich soils denotes the Makgadikgadi pans, a broad inland basin that was once occupied by an enormous lake that dried up several thousand years ago when the climate of the region became much drier. The large expanse of Gleysols in the top-right corner of the map is the Zambezi Floodplain, an internationally recognised wetland site.

From an African perspective, this map contains a rather rare appearance of Podzols, which have developed in the predominantly sandy parent material of southern Angola and Zambia. Here, slightly higher precipitation levels compared to the rest of the map give rise to more wooded vegetation, and leaching can lead to the development of Podzols in freely draining conditions.

While much of the soils on this map sheet are rocky or sandy, a lack of water is the primary constraint on agriculture. Where the soils are cultivated, overuse has led to compacted soils and serious erosion.

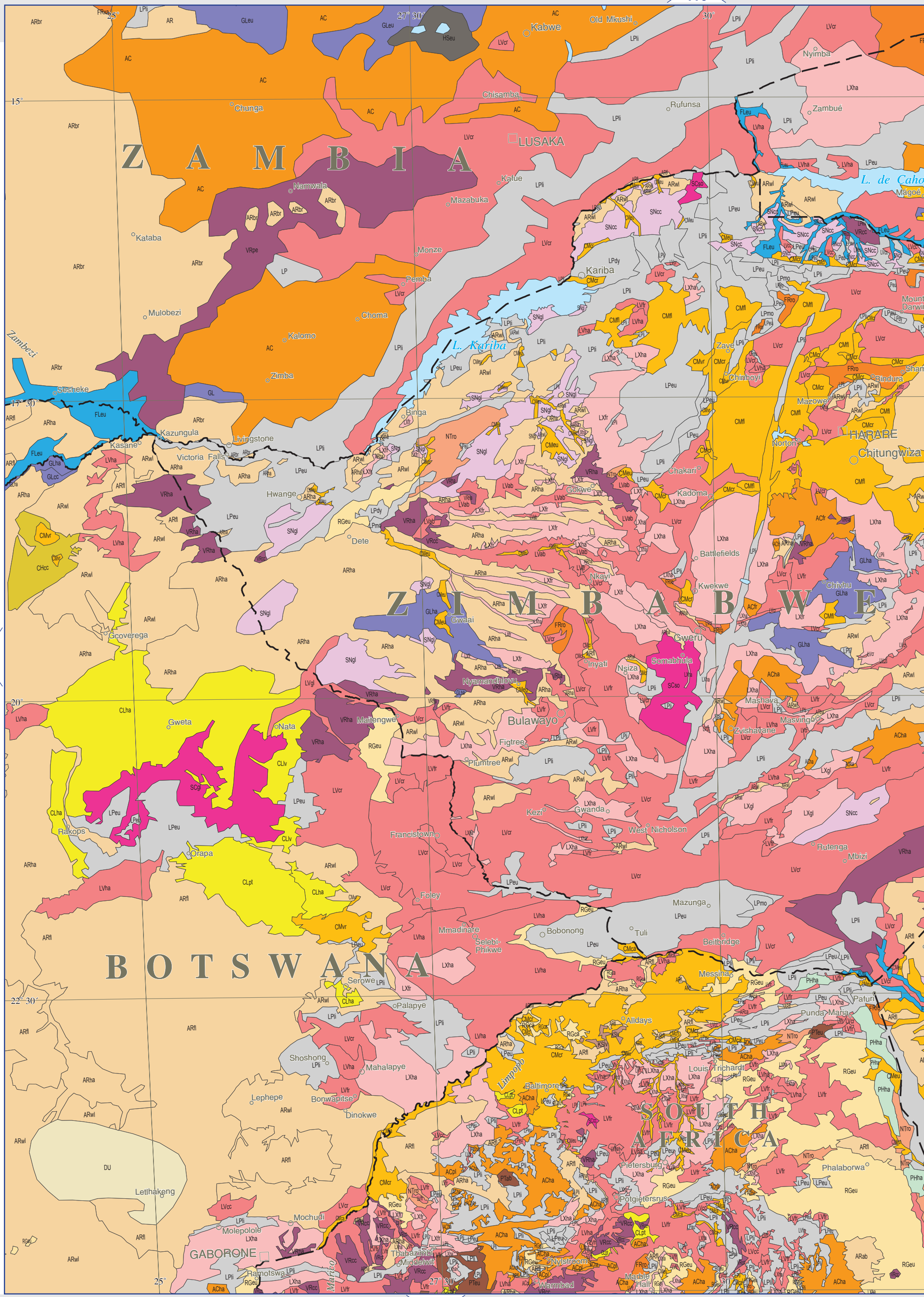
115



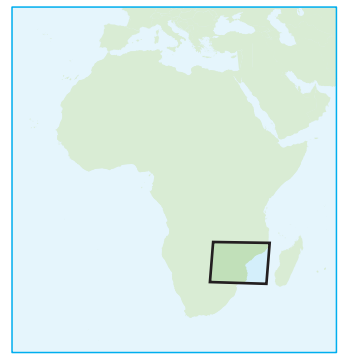
ZAMBIA
A
A
BOTSWANA
Okavango
Zambezi
20°
22° 30´
15°
17° 30´
20°
25°
Muié
Lupire
Longa
Ninda
Chiume
Cuito Cuanavale
Mongu
Mavinga
Neriquinha
Senanga
Kataba
Rito
Luengue
Mulobezi
Cuangar
Calai
Dirico
Rundu
Luiana
Sesheke
Kongolo
Kasane
Kazungula
Livingstone
Victoria Falls
Shakawe
Karakuwisa
Tsumkwe
Nokaneng
Gcoverega
Maun
Gam
Toteng
Gweta
Nata
Rakops
Orapa
Otjinene
Ghanzi
Rietfontein
Kalkfontein
Buitepos
Witvlei
Gobabis
Tshwane
Kule
Nojane
Lephepe
Aminuis
Kang
Tshane
Letlhakeng
Aranos
Kokong
Mochudi
Molepolole
GABORONE
Khakhea
Ramotswa
Gochas
Kanye

120

125


Z A M B I A
Z I M B A B W E
B O T S W A N A
SOUTH AFRICA
LUSAKA
HARARE
GABORONE
Kabwe
Old Mkushi
Nyimba
Chisamba
Chunga
Rufunsa
Zambué
Kafue
Namwala
Mazabuka
Kataba
Monze
Kariba
Pemba
Mulobezi
Choma
Kalomo
Zimba
Sesheke
Zambezi
L. Kariba
L. de Caho
Mágoé
Mount Darwin
Zaye
Chinhoyi
Bindura
Mazowe
Shamva
Kazungula
Livingstone
Victoria Falls
Kasane
Binga
Hwange
Dete
Gokwe
Chakari
Kadoma
Norton
Chitungwiza
Battlefields
Kwekwe
Chivhu
Gweru
Gwaai
Inyati
Somabhula
Nsiza
Nyamandhlovu
Bulawayo
Figtree
Plumtree
Mashava
Masvingo
Zvishavane
Gcoverega
Gweta
Nata
Maitengwe
Rakops
Orapa
Francistown
Kezi
Gwanda
West Nicholson
Rutenga
Mbizi
Foley
Mmadinare
Selebi-Phikwe
Bobonong
Tuli
Beitbridge
Messina
Mazunga
Serowe
Palapye
Shoshong
Mahalapye
Lephepe
Bonwapitse
Dinokwe
Letlhakeng
Mochudi
Molepolole
Ramotswa
Thabazimbi
Middelwit
Nylstroom
Warmbad
Alldays
Louis Trichardt
Baltimore
Limpopo
Pietersburg
Potgietersrus
Phalaborwa
Punda Maria
Pafuri
Marble Hall
Marico
25°
27° 30°
30°
15°
17° 30°
20°
22° 30°

119



SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

This map shows the soils of eastern Botswana, southern Mozambique, the northern parts of South Africa, south-eastern Zambia and Zimbabwe. The major geographical features of this map are the eastern expression of the Kalahari, the Zambezi River and southern section of the Rift Valley containing Lake Kariba and the Victoria Falls. The Rift Valley is a vast tectonic depression where large segments of the Earth's crust have subsided between fault lines. Most of the land on the eastern side of the map is at a significantly lower elevation than that to the west.

This map is characterised by a range of climatic conditions. While technically in the tropics, the high average elevation of most of the region (around 300 m above sea level) means that climate is actually more sub-tropical in nature. Hot and humid conditions are mostly found in the lowlands of Mozambique where an annual temperature of around 25°C compares to 14°C–21°C in Harare (in the centre of the map). Monsoon winds bring significant summer rain to eastern Zimbabwe and Mozambique while, to the far west, a hot and dry climate defines the semi-arid Kalahari Desert and surrounding regions (annual rainfall is irregular and less than 300 mm while summer temperatures can reach the mid-30°C). Much of southern Mozambique has quite low rainfall (500–1 000 mm), parts of which are considered semi-arid and subjected to periodic droughts.

Most of the area is characterised by savannah grasslands tending to wooded savannah and even forest where precipitation levels are sufficiently high. In areas of less precipitation, bushland and desert plant communities become more prevalent.

The soils of the Kalahari (western part of the map) reflect the dry and hot conditions. Extensive sandy Arenosols dominate with Solonchaks and Calcisols denoting the Makgadikgadi pans, a broad inland basin that was once occupied by an enormous lake that dried up several thousand years ago when the climate of the region became much drier.

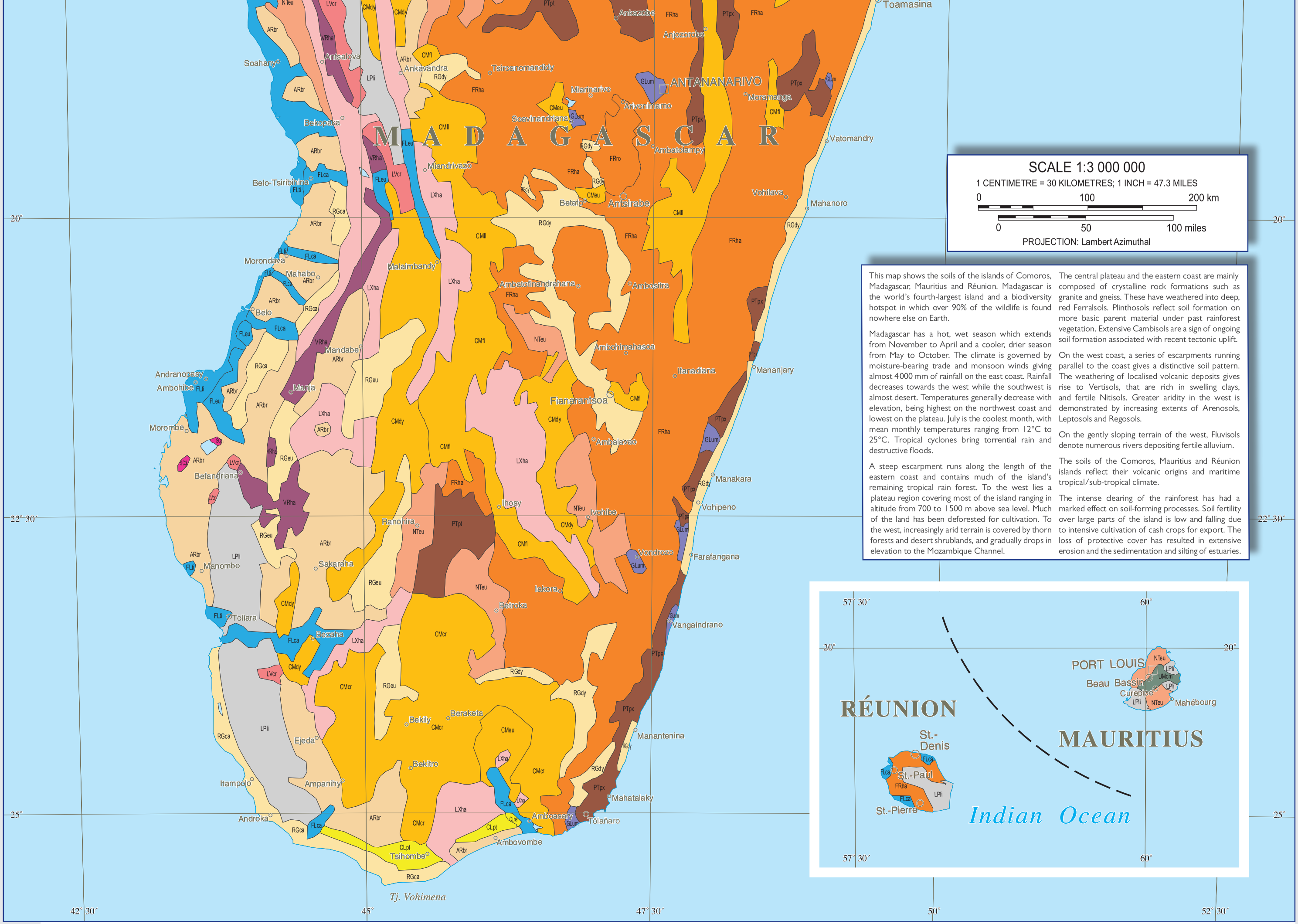
The northern, southern and centre portions of the map reflect the weathering of old, stable land surfaces. Coarse-textured soils have developed on deeply weathered granites (Ferralsols, Acrisols) while soils with higher clay content (Luvisols, Lixisols) reflect basement schists and more basic rocks. The distribution of Vertisols tends to mirror the distribution of basaltic rocks and the subsequent redeposition of these sediments along river valleys. Many of these soils are fertile and heavily cultivated. Limestones and sandstone deposits often develop into weakly developed Regosols.

The long linear Leptosol feature running through the centre of Zimbabwe is the Great Dyke – a vast intrusion of hard igneous rocks which has given rise to a line of north-south trending hills. Many of the other Leptosol exposures reflect the weathering of basalt and granite outcrops. The large expanse of Vertisols to the northwest of Lake Karibo denotes the floodplain of the Kafue River, one of the world's great wildlife environments and a major tributary of the Zambezi.

The soils of lowland southern Mozambique have developed in more recent sedimentary deposits and reflect the drier conditions. Sandy Arenosols with low water retention capacities characterise the coastal zone while strongly alkaline, clay-rich Solonetz are extensive inland. Fluvisols and Vertisols denote the broad expanse of rich alluvial soils along the Zambezi delta and floodplain. In this region, fertility is largely limited to alluvial soils in major river valleys such as the Limpopo and Maputo.

Sporadic heavy rain storms associated with monsoons give rise to rapid runoff and high rates of erosion. Many soils have inherently low fertility and, under cultivation, productivity drops rapidly after a few years. High population pressure and a lack of access to manure and mineral fertilisers are major issues in many parts.

The very dense soil patterns for South Africa reflects a more detailed soil mapping base.



SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

This map shows the soils of the islands of Comoros, Madagascar, Mauritius and Réunion. Madagascar is the world's fourth-largest island and a biodiversity hotspot in which over 90% of the wildlife is found nowhere else on Earth.

Madagascar has a hot, wet season which extends from November to April and a cooler, drier season from May to October. The climate is governed by moisture-bearing trade and monsoon winds giving almost 4 000 mm of rainfall on the east coast. Rainfall decreases towards the west while the southwest is almost desert. Temperatures generally decrease with elevation, being highest on the northwest coast and lowest on the plateau. July is the coolest month, with mean monthly temperatures ranging from 12°C to 25°C. Tropical cyclones bring torrential rain and destructive floods.

A steep escarpment runs along the length of the eastern coast and contains much of the island's remaining tropical rain forest. To the west lies a plateau region covering most of the island ranging in altitude from 700 to 1 500 m above sea level. Much of the land has been deforested for cultivation. To the west, increasingly arid terrain is covered by thorn forests and desert shrublands, and gradually drops in elevation to the Mozambique Channel.

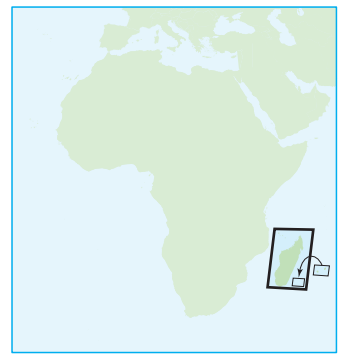
The central plateau and the eastern coast are mainly composed of crystalline rock formations such as granite and gneiss. These have weathered into deep, red Ferralsols. Plinthosols reflect soil formation on more basic parent material under past rainforest vegetation. Extensive Cambisols are a sign of ongoing soil formation associated with recent tectonic uplift.

On the west coast, a series of escarpments running parallel to the coast gives a distinctive soil pattern. The weathering of localised volcanic deposits gives rise to Vertisols, that are rich in swelling clays, and fertile Nitisols. Greater aridity in the west is demonstrated by increasing extents of Arenosols, Leptosols and Regosols.

On the gently sloping terrain of the west, Fluvisols denote numerous rivers depositing fertile alluvium.

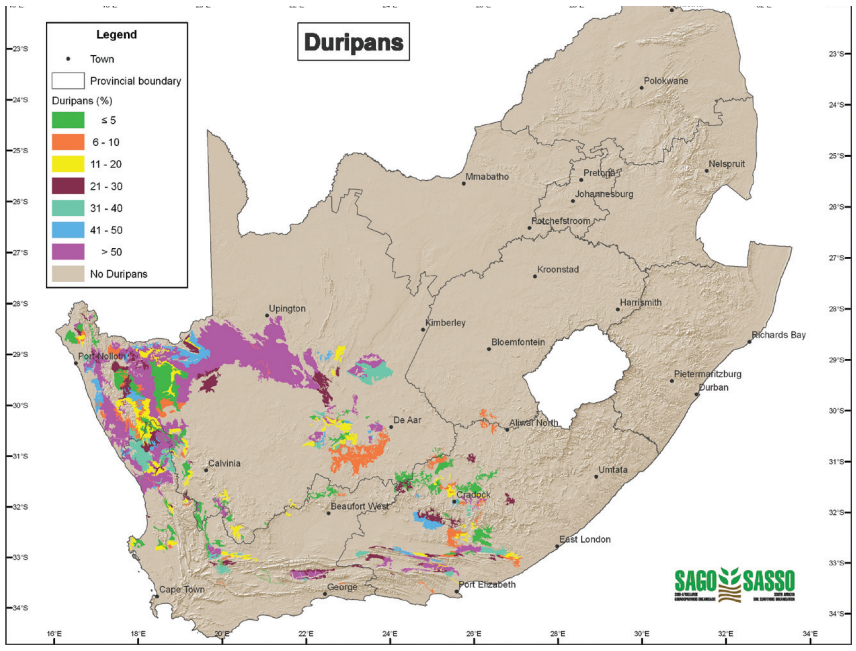
The soils of the Comoros, Mauritius and Réunion islands reflect their volcanic origins and maritime tropical/sub-tropical climate.

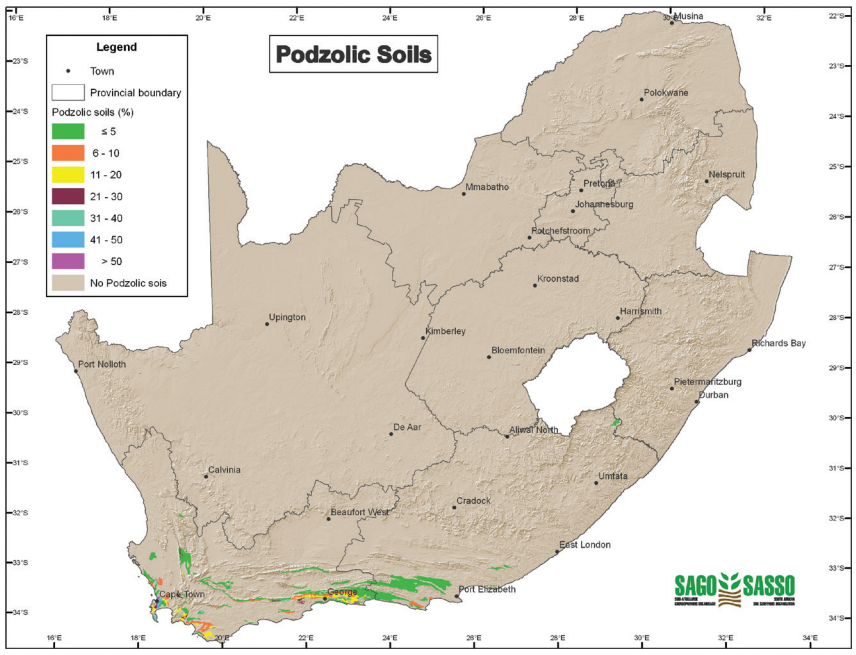
The intense clearing of the rainforest has had a marked effect on soil-forming processes. Soil fertility over large parts of the island is low and falling due to intensive cultivation of cash crops for export. The loss of protective cover has resulted in extensive erosion and the sedimentation and silting of estuaries.



Podzolic and silicic soils of South Africa

Compared with the rest of the continent, South Africa contains significant amounts of podzolic soils (highly leached, low in lime with subsurface accumulations of iron and organic matter) and soils that are characterised by an accretion of silica (see pages 58-59). In most cases, they do not appear on small scale maps as they are often not the dominant soil type. For this reason, the distribution maps of these two soils are provided in addition to the usual maps. [66a]





SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

This map shows the soils of southern Botswana, southern Namibia and the western half of South Africa. The dominant geographical features of the region include the Namib and Kalahari Deserts and, contrastingly, the high plateau lands of South Africa. Topographically, the land in the northern part of the map is dominated by the Kalahari Basin, a large, semi-arid lowland area occupying most of Botswana, while to the south, the rocks of the geologically stable Karoo Basin and Kaapvaal Craton cover most of South Africa.

While the climate of the region is greatly influenced by the surrounding oceans, a subtropical high-pressure belt of descending air produces stable atmospheric conditions over most of the area giving a generally dry climate while temperatures are moderated by the fairly high elevation of much of the terrain. The west coast is cooled by the cold northward-flowing Benguela Current which also contributes to the dryness and stability of the atmosphere over western regions. Most of the area shown on the map is regarded as arid with highly variable precipitation ranging from less than 50 mm to 600 mm annually. Alexander Bay (where the Namibia-South Africa border meets the west coast) receives less than 50 mm of rain annually. Temperatures are strongly determined by elevation and distance from the sea. Summers are generally warm to hot while winters are mostly cool to cold, with higher elevations having lower temperatures.

Vegetation cover increases from north to south and west to east. Grassland savannah adjacent to the Kalahari becomes more woody to the south as rainfall increases. Winter rainfall and coastal fogs in the semi-arid southern and south-western parts of South Africa support the unique floristic diversity of the Karoo and Fynbos biomes.

It is clear that climate, and particularly aridity, is a dominant soil-forming factor on this map. Low soil organic matter is characteristic of most of the region. Both the Namib on the Atlantic Coast and the inland Kalahari Deserts are characterised by extensive sandy Arenosols and separated by a zone of gravelly Leptosols and bare rocks running parallel to the coast. Lime-rich Calcisols and Solonchaks reflect old evaporative surfaces, salt pans and depressions in a generally flat landscape.

Soils on the higher plateau of South Africa reflect the weathering of ancient crystalline rocks. Soils are generally weakly developed sandy Cambisols or shallow Leptosols. Calcisols and Solonchaks denote the accumulation of calcium carbonates and other salts under dry conditions. Soils with a horizon cemented by silica are known as Durisols. Towards the east, changes in the underlying lithology to sedimentary rocks (associated with intrusive igneous rocks) and increased precipitation give rise to clay-rich Luvisols under extensive grasslands. Lixisols denote soil formation on strongly weathered but less acidic materials.

Between the sea and the Great Escarpment a more humid climate has led to the formation of a mosaic of sandy (Arenosols, Podzols) and sandy loam (Planosols) soils intermixed with heavier Luvisols, Gleysols and Solonetz.

The very dense soil pattern for South Africa reflects a more detailed soil mapping base. Such a level of information should be a goal for other African countries (see also Plates 17, 21 and 24).

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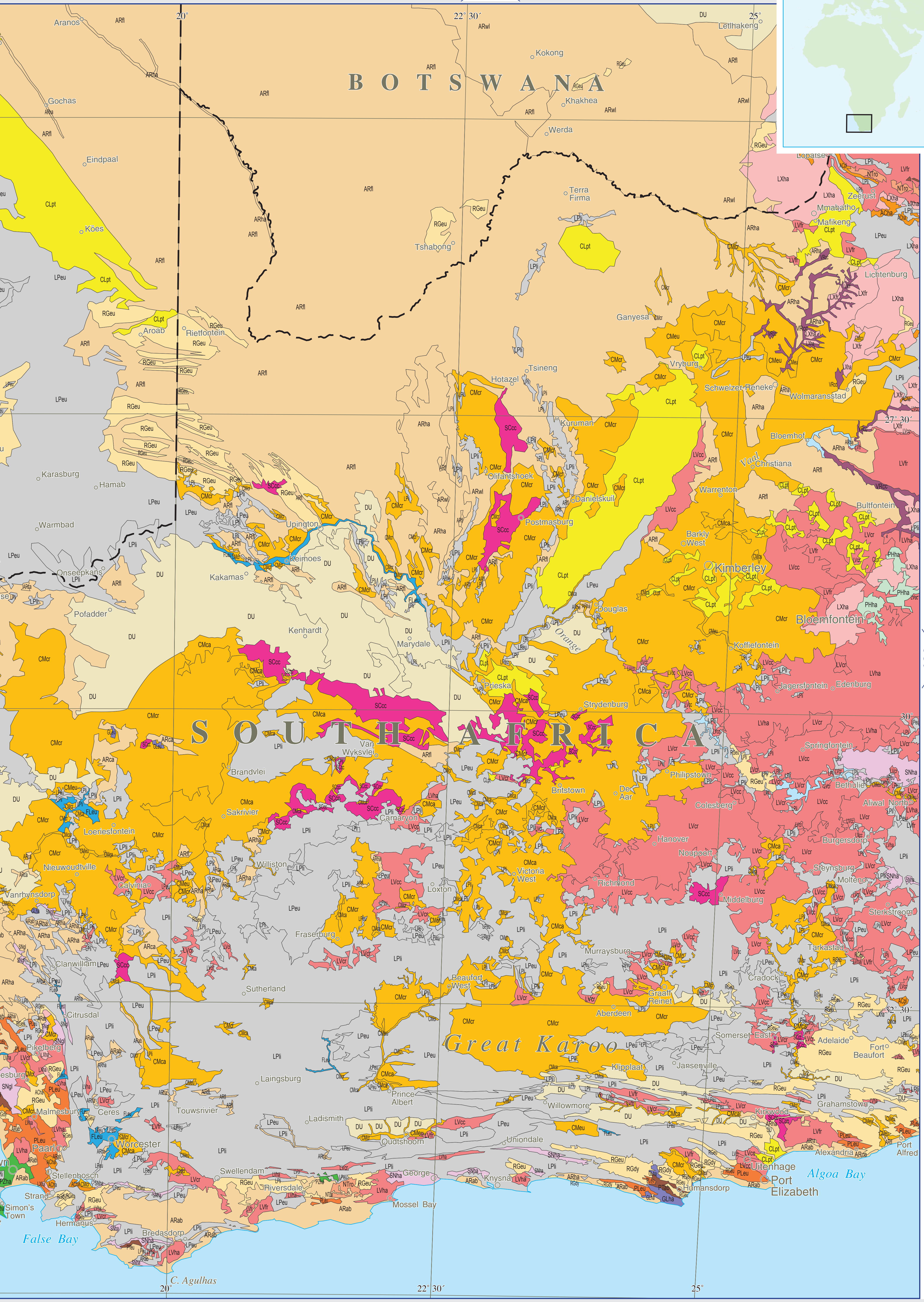
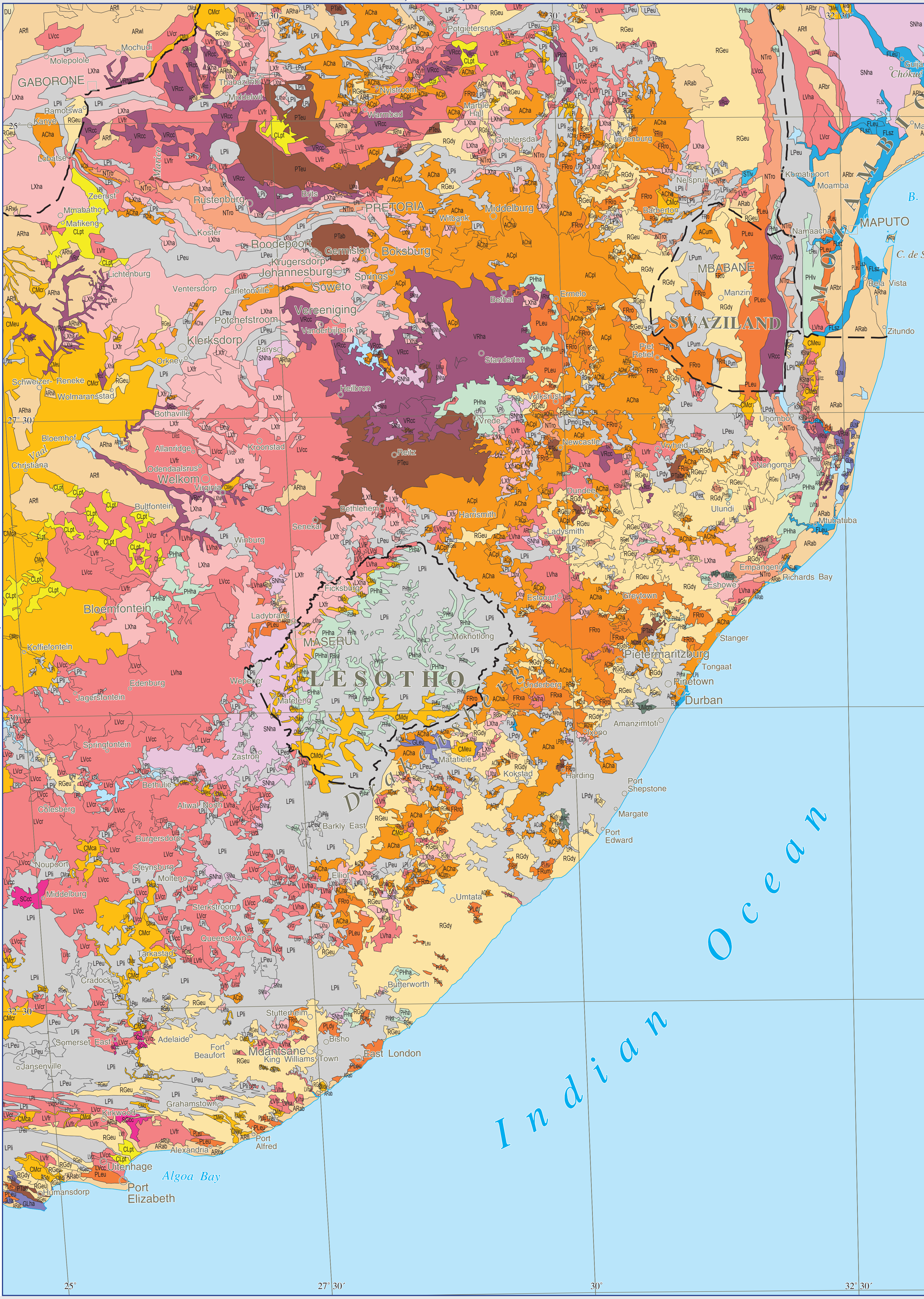
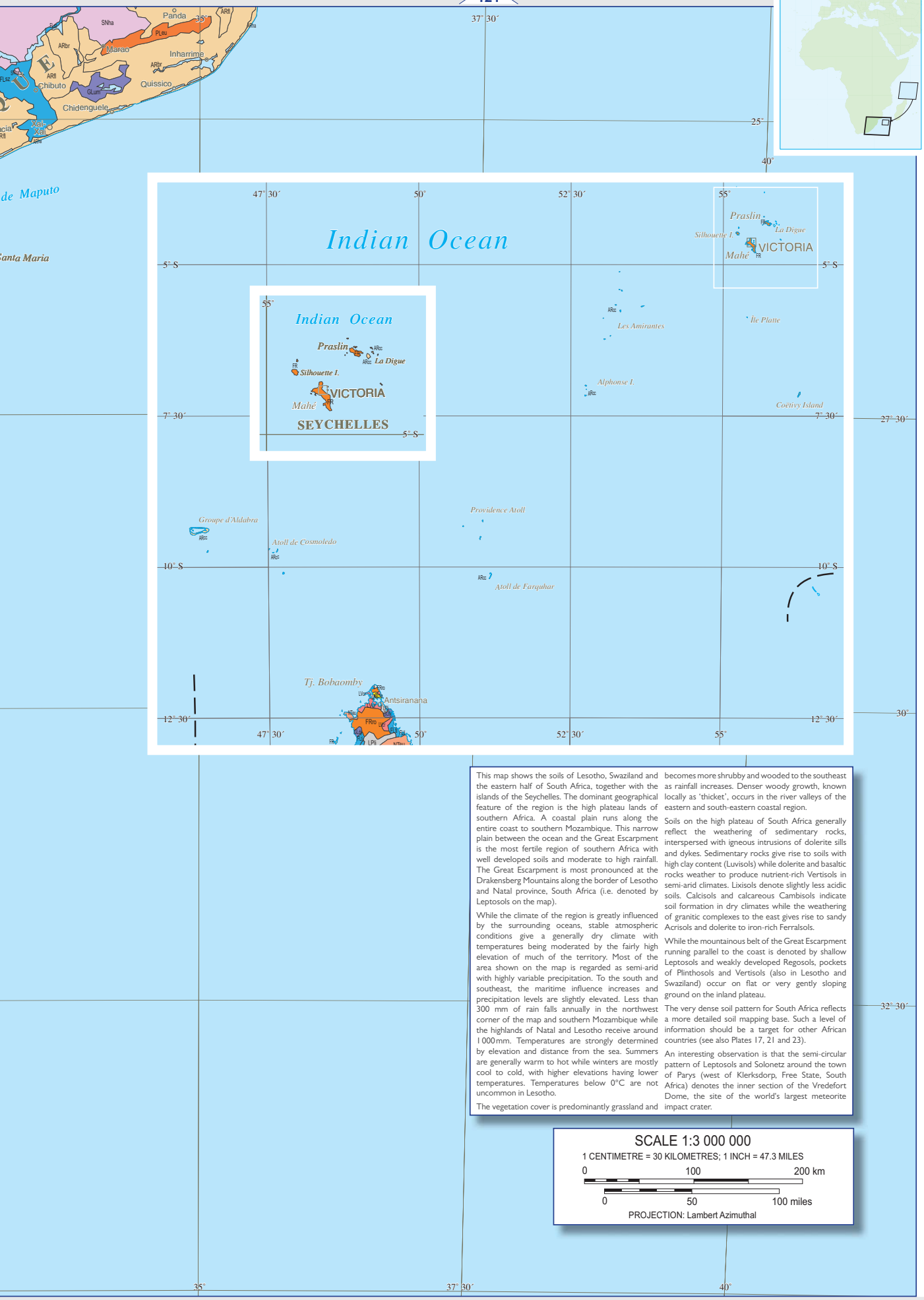

BOTSWANA
SOUTH AFRICA
Great Karoo
20°
22° 30´
25°
27° 30´
30°
32° 30´
Aranos
Gochas
Eindpaal
Köes
Aroab
Rietfontein
Karasburg
Hamab
Warmbad
Onseepkans
Pofadder
Kokong
Khakhea
Werda
Letlhakeng
Lobatse
Terra Firma
Tshabong
Zeerust
Mmabatho
Mafikeng
Lichtenburg
Ganyesa
Vryburg
Tsineng
Hotazel
Schweizer-Reneke
Wolmaransstad
Kuruman
Bloemhof
Olifantshoek
Vaal
Christiana
Danielskuil
Warrenton
Postmasburg
Upington
Keimoes
Kakamas
Barkly West
Bultfontein
Kimberley
Douglas
Orange
Bloemfontein
Kenhardt
Marydale
Koffiefontein
Prieska
Jagersfontein
Edenburg
Strydenburg
Van Wyksvlei
Brandvlei
Springfontein
Philipstown
Britstown
De Aar
Bethulie
Sakrivier
Carnarvon
Colesberg
Aliwal North
Loeriesfontein
Hanover
Burgersdorp
Noupoort
Nieuwoudtville
Williston
Steynsburg
Calvinia
Victoria West
Richmond
Molteno
Vanrhynsdorp
Loxton
Middelburg
Sterkstroom
Fraserburg
Tarkastad
Clanwilliam
Murraysburg
Cradock
Beaufort West
Sutherland
Graaff Reinet
Aberdeen
Citrusdal
Somerset East
Adelaide
Piketberg
Fort Beaufort
Klipplaat
Jansenville
Laingsburg
Prince Albert
Willowmore
Grahamstown
Malmesbury
Ceres
Touwsrivier
Kirkwood
Ladismith
Worcester
Paarl
Oudtshoorn
Uniondale
Port Alfred
Alexandria
Uitenhage
Stellenbosch
Swellendam
George
Knysna
Algoa Bay
Port Elizabeth
Humansdorp
Strand
Riversdale
Mossel Bay
Simon's Town
Hermanus
Bredasdorp
False Bay
C. Agulhas

126

120

125


GABORONE
Molepolole
Mochudi
Ramotswa
Kanye
Lobatse
Zeerust
Mmabatho
Mafikeng
Lichtenburg
Thabazimbi
Middelwit
Nylstroom
Warmbad
Potgietersrus
Marble Hall
Groblersdal
Lydenburg
Nelspruit
Barberton
Komatipoort
Moamba
Namaacha
MAPUTO
Bela Vista
Zitundo
MBABANE
Manzini
SWAZILAND
MOZAMBIQUE
Marico
Rustenburg
Brits
PRETORIA
Witbank
Middelburg
Koster
Roodepoort
Germiston
Boksburg
Krugersdorp
Johannesburg
Springs
Soweto
Ventersdorp
Carletonville
Vereeniging
Vanderbijlpark
Potchefstroom
Klerksdorp
Parys
Orkney
Schweizer- Reneke
Wolmaransstad
Bothaville
Bloemhof
Vaal
Christiana
Allanridge
Odendaalsrus
Welkom
Virginia
Kroonstad
Bultfontein
Heilbron
Bethal
Ermelo
Standerton
Piet Retief
Volksrust
Vrede
Reitz
Newcastle
Vryheid
Nongoma
Ubombo
Mtubatuba
Dundee
Ulundi
Harrismith
Bethlehem
Senekal
Winburg
Ladysmith
Empangeni
Richards Bay
Eshowe
Estcourt
Greytown
Stanger
Pietermaritzburg
Tongaat
Pinetown
Durban
Amanzimtoti
Ixopo
Underberg
Mokhotlong
Ficksburg
Ladybrand
MASERU
LESOTHO
Wepener
Mafeteng
Bloemfontein
Koffiefontein
Edenburg
Jagersfontein
Springfontein
Zastron
Bethulie
Aliwal North
Colesberg
Burgersdorp
Noupoort
Steynsburg
Molteno
Middelburg
Sterkstroom
Queenstown
Tarkastad
Cradock
Barkly East
Drakensberg
Matatiele
Kokstad
Harding
Port Shepstone
Margate
Port Edward
Elliot
Umtata
Butterworth
Stutterheim
Bisho
Adelaide
Fort Beaufort
Mdantsane
King Williams Town
East London
Somerset East
Jansenville
Grahamstown
Kirkwood
Alexandria
Port Alfred
Uitenhage
Algoa Bay
Port Elizabeth
Humansdorp
Indian Ocean
25°
27° 30´
30°
32° 30´



This map shows the soils of Lesotho, Swaziland and the eastern half of South Africa, together with the islands of the Seychelles. The dominant geographical feature of the region is the high plateau lands of southern Africa. A coastal plain runs along the entire coast to southern Mozambique. This narrow plain between the ocean and the Great Escarpment is the most fertile region of southern Africa with well developed soils and moderate to high rainfall. The Great Escarpment is most pronounced at the Drakensberg Mountains along the border of Lesotho and Natal province, South Africa (i.e. denoted by Leptosols on the map).

While the climate of the region is greatly influenced by the surrounding oceans, stable atmospheric conditions give a generally dry climate with temperatures being moderated by the fairly high elevation of much of the territory. Most of the area shown on the map is regarded as semi-arid with highly variable precipitation. To the south and southeast, the maritime influence increases and precipitation levels are slightly elevated. Less than 300 mm of rain falls annually in the northwest corner of the map and southern Mozambique while the highlands of Natal and Lesotho receive around 1 000 mm. Temperatures are strongly determined by elevation and distance from the sea. Summers are generally warm to hot while winters are mostly cool to cold, with higher elevations having lower temperatures. Temperatures below 0°C are not uncommon in Lesotho.

The vegetation cover is predominantly grassland and becomes more shrubby and wooded to the southeast as rainfall increases. Denser woody growth, known locally as 'thicket', occurs in the river valleys of the eastern and south-eastern coastal region.

Soils on the high plateau of South Africa generally reflect the weathering of sedimentary rocks, interspersed with igneous intrusions of dolerite sills and dykes. Sedimentary rocks give rise to soils with high clay content (Luvisols) while dolerite and basaltic rocks weather to produce nutrient-rich Vertisols in semi-arid climates. Lixisols denote slightly less acidic soils. Calcisols and calcareous Cambisols indicate soil formation in dry climates while the weathering of granitic complexes to the east gives rise to sandy Acrisols and dolerite to iron-rich Ferralsols.

While the mountainous belt of the Great Escarpment running parallel to the coast is denoted by shallow Leptosols and weakly developed Regosols, pockets of Plinthosols and Vertisols (also in Lesotho and Swaziland) occur on flat or very gently sloping ground on the inland plateau.

The very dense soil pattern for South Africa reflects a more detailed soil mapping base. Such a level of information should be a target for other African countries (see also Plates 17, 21 and 23).

An interesting observation is that the semi-circular pattern of Leptosols and Solonetz around the town of Parys (west of Klerksdorp, Free State, South Africa) denotes the inner section of the Vredefort Dome, the site of the world's largest meteorite impact crater.

SCALE 1:3 000 000

1 CENTIMETRE = 30 KILOMETRES; 1 INCH = 47.3 MILES

0 100 200 km

0 50 100 miles

PROJECTION: Lambert Azimuthal

Examples of medium-scale soil maps