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## Physical Geography: Drainage

### **ASIA, THE ERSTWHILE SOVIET UNION/CIS**

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- ❖ Many rivers flow northward because the high mountains are on the southern border and the flat plains on the north.
- ❖ The Ob, the Yenisey, and the Lena (some of the longest rivers in the world) drain vast regions of the eastern part of the country. More than half the territory of the CIS is drained into seas that are frozen during the greater part of the year. One-quarter of the country is drained by rivers that flow into inland basins, such as the Caspian Sea and the Aral Sea.
- ❖ The CIS is a landlocked country as far as outlets to world ports are concerned.
- ❖ Rivers have served as navigation routes for opening the country, and most major cities are built along the banks of rivers.
- ❖ The Danube forms the boundary between the Ukrainian S.S.R. and Romania. It flows into the Black Sea, as do both the Dnieper and the Dniester.
- ❖ The Dnieper and its tributaries drain most of the Ukraine, and the great city of Kiev is located along its banks.
- ❖ The Caspian Sea, the world's largest saltwater lake, receives the waters of the Volga River and the Ural River.
- ❖ The Volga is the most important river in the CIS. It drains the heartland, and it is used as a transportation artery, for generating hydroelectricity for irrigation.
- ❖ Moscow, is located along the banks of the Moskva (or Moscow) River, which is connected by means of canals to the Volga, the Baltic Sea, and the Arctic Ocean.
- ❖ The Volga also is connected to the Black Sea by canal route to the Don River.
- ❖ The Amur River forms much of the boundary between the CIS and China.

### **TIBETAN DRAINAGE**

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Mountains, hills, and highlands cover about 66 percent of the nation's territory, impeding communication and leaving limited level land for agriculture.

In the southwest, the Himalayas and the Kunlun Mountains enclose the Qing Zang Plateau, which encompasses most of Xizang Autonomous Region (also known as Tibet) and part of Qinghai Province. From the Qing Zang Plateau, other less-elevated highlands, rugged east-west trending mountains, and plateaus interrupted by deep depressions fan out to the north and east. A continental scarp is at the eastern margin of this territory extending from the Greater Hinggan Range in northeastern China, through the Taihang Shan (a range of mountains overlooking the North China Plain) to the eastern edge of the Yunnan-Guizhou Plateau in the south. Virtually all of the low-lying areas of China--the regions of dense population and intensive cultivation--are found east of this scarp line. There are also the Gangdise Shan (Kailas) and the Tian Shan ranges.

- ❖ The Tian Shan ranges stand between the Tarim Basin to the south and the Junggar Basin to the north. Tarim Basin-- largest inland basin in China, 1,500 kilometers from east to west and 600 kilometers from north to south at its widest parts.
- ❖ The Kunlun Mountains separates into several branches eastward from the Pamir Mountains.
  - The northernmost branch-- the Altun Shan and the Qilian Shan-- run along the Qing Zang plateau in west central China. Beyond this lies the Qaidam Basin-- sandy and swampy region with many salt lakes.
  - Southern branch divides the watersheds of the Huang He and the Chang Jiang (Yangtze River). The Gansu Corridor, west of the great bend in the Huang He, was traditionally an important communication link with Central Asia.
- ❖ Inland drainage involving a number of upland basins in the north and northeast accounts for about 40 percent of the country's total drainage area. Many rivers and streams flow into lakes or diminish in the desert. Some are useful for irrigation.

#### **Tibetan drainage: Significance for India**

- ❖ All of the biggest rivers of India and China originate in or around Tibetan plateau, example, in the Mt. Kailash & Mansarovar lake. Include the largest rivers across Southeast Asia-- Yangtze, Yellow, Mekong, Brahmaputra, Sutlej, Indus, and (as much as 70% of the summer flow in) the Ganges.
- ❖ China's dams along Yarlung Tsangpo ( the Gyatsa, the Zhongda Dam, and two more planned) will have adverse effect on India's hydropower projects. It would damage water flow, agriculture, ecology, lives and the livelihoods of 1.3 billion people downstream in India and Bangladesh.
- ❖ Dams, canals, irrigation systems can turn water into a political weapon. For instance, creating a natural dam by blasting the river valley of rivers and then demolishing it to flood Indian territories without the danger of being blamed legally or logically.

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## AUSTRALIA: DRAINAGE

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### Murray-Darling Basins

Australia's only important river basin (910,000 km<sup>2</sup>), located west of the **Great Divide**.

The rivers merge; flow into the Indian Ocean; are torrential in nature; and subject to prolonged dry and sudden full periods.

### Inland Drainage Basin

The central depression region lacks surface water.

Numerous large closed basins; temporary shallow lakes.

For most part of the year, the region has vast muddy surface, covered with salty incrustations. The largest is **Lake Eyre** (9000 km<sup>2</sup>).

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## NORTH AMERICA

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### Great Lakes

- ❖ A series of interconnected freshwater lakes in northeastern North America, connected to the Atlantic Ocean through the Saint Lawrence River;
- ❖ consists of– Lakes Superior, Michigan, Huron, Erie, and Ontario, together contain 21% of the world's surface fresh water by volume.
- ❖ Total surface is 244,106 km<sup>2</sup>, and the total volume (measured at the low water datum) is 22,671 km<sup>3</sup>.
- ❖ Sea-like characteristics – rolling waves, sustained winds, strong currents, great depths, and distant horizons – called inland seas.
- ❖ Lake Superior second largest lake in the world by area, and Lake Michigan is the largest lake that is entirely within one country.
- ❖ The lakes have been a major highway for transportation, migration and trade, and they are home to a large number of aquatic species. Many invasive species have been introduced due to trade, and some threaten the region's biodiversity.
- ❖ Began to form at the end of the last glacial period around 14,000 years ago, as retreating ice sheets (Laurentide ice sheet) carved basins into the land and became filled with meltwater.
- ❖ Foundational geology was laid from 1.1 to 1.2 billion years ago– two previously fused tectonic plates split apart and created the Midcontinent Rift, which crossed the Great Lakes Tectonic Zone. A valley was formed providing a

basin that became modern day Lake Superior. A second fault line named Saint Lawrence Rift (570 million years ago)– the basis for the lakes Ontario and Erie and the Saint Lawrence River.

- ❖ Some higher hills became Great Lakes islands due to uneven glacial erosion. The Niagara Escarpment follows the contour of the Great Lakes between New York and Wisconsin.

## **LATIN AMERICA**

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### The Hamza River

- ❖ Presumably, a slowly flowing aquifer in Brazil, approximately 6,000 kilometres (3,700 mi) long. Its discovery was announced in 2011; Named in honour of scientist Valiya Mannathal Hamza, of Brazil's National Observatory who has undertaken research on the region for four decades.
- ❖ The Hamza and the Amazon are the two main drainage systems for the Amazon Basin.
- ❖ Reported flow rate of the Hamza— approximately 3,000 cubic metres (110,000 cu ft) per second— 3% of the Amazon's.
- ❖ Some 4,000 metres (13,000 ft) below the Earth's surface, and follows roughly the path of the Amazon river. Its own water has a high salt content.
- ❖ Starts in the Acre region under the Andes; flows through the Solimões, Amazonas and Marajó basins; and opens into the Atlantic Ocean deep under the surface.
- ❖ Around 133,000m<sup>3</sup> of water flows through the Amazon per second at speeds of up to 5 metres per second.
- ❖ A mathematical model to predict the presence of the underground river, based on the measured changes in temperature down the wells.
  - Piementel said that the flow of groundwater was almost vertical through the rocks to depths of around 2,000m. After this, the water flow changes direction and becomes almost horizontal.
  - Presence of the Rio Hamza might account for the relatively low salinity of the waters around the mouth of the Amazon.

## **Volcanism**

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### 1. What is Volcanism?

Volcanism Includes all the phenomena connected with movement to molten material from beneath to the 'surface. Thus it includes

- (i) generation of Magma;
- (ii) intrusion of Magma; and
- (iii) extrusion of Magma and associated materials

## 2. Distribution

- (i) Ridge volcanism
- (ii) Arc volcanism-Kamchatka, Kurile, Japan, Phillipines, Celeba new Guinea, etc.
- (iii) Volcanic Chains-straight line volcanoes associated with fold mountains.
- (iv) Volcanic clusters-
  - On Ocean-Madeira, Galpagos, Canary, Azores, Reunioh.
  - On Continents – Ethiopia, East African rift valley
- (v) Volcanic lines- Dominantly extinct lines of volcanoes, Emperor seamount, Line Tuamotu

## Generation of magma

**What is magma?** –Magma is Kneaded mixture, but any hot mobile material is called magma.

**Nature of magma**-It is molten silicate, not entirely liquid but a mixture of solid, liquid and gas.

- Important components:  $\text{SiO}_2$ ,  $\text{H}_2\text{O}$ , Al, Ca, Fe, Mg, Na k, of which Si is the most important
- Magma is of many types:
  - Granitic having 70%,  $\text{SiO}_2$ -It is viscous, having a temperature  $<800^\circ\text{C}$ .
  - Basaltic magma having 55-60% silica content is more fluid and mobile  $1200^\circ\text{C}$ .
  - Alkaline-high ratio of Na/K to silicon.

### **Generation of Magma**

1. Increase in heat
  - local concentration of radioactive elements
  - energy from earthquakes
  - frictional heating
2. P/T disequilibrium
3. Role of water

## Plate tectonics and Magma Generation

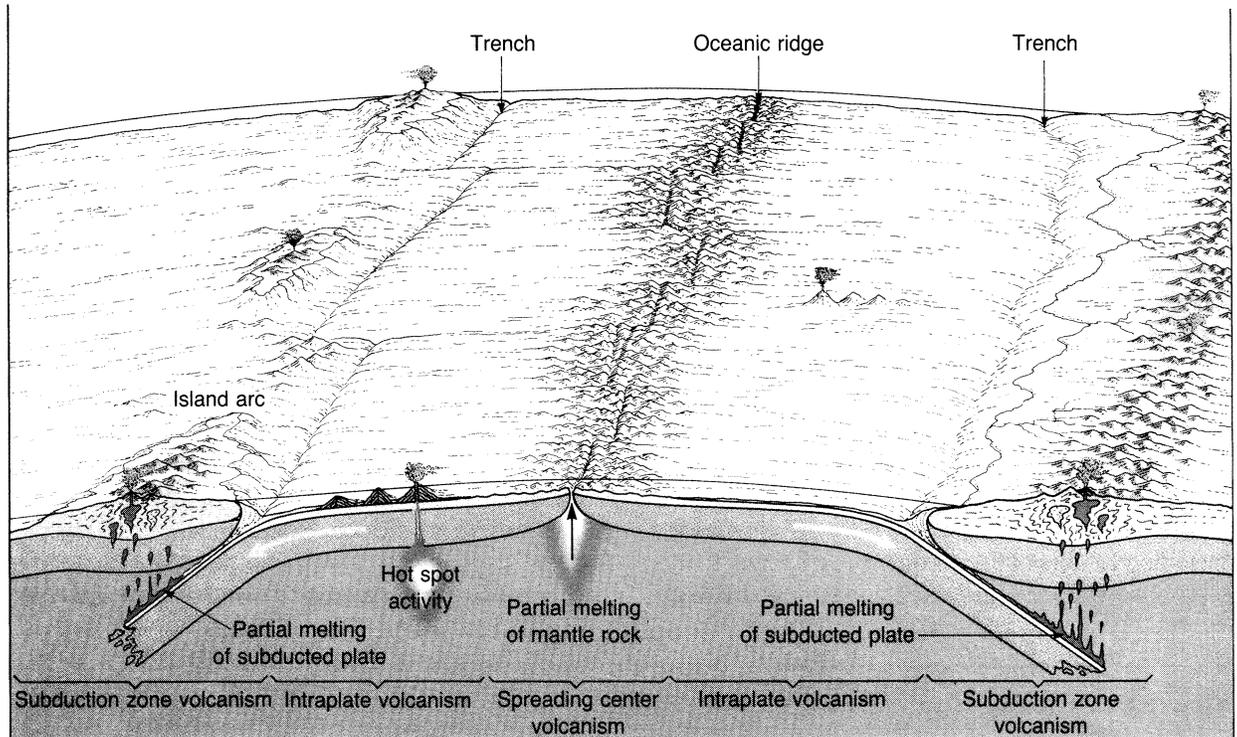


Figure 8.2 Plate Tectonics and Volcanism.

## Intrusive features

- (a) Major
  - (i) Concordant: Lopolith
  - (ii) Discordant: Batholiths with associated bosses and stock, stoping, xenoliths cupolas
- (b) Minor
  - (i) Concordant:
    - Sills,
    - Laccolith,
    - Bysmalith,
    - Phaccolith
  - (ii) Discordant:
    - dykes,
    - ring, complexes to include cone sheets,

- ring dyke,
- dyke swarms,
- dilation dykes, and couldron subsidence,
- volcanic neck, diapers,

## Products

1. Gases- H<sub>2</sub>O lahars H<sub>2</sub>S, acids
2. Lava- Basaltic and granitic basaltic flow can be aa, pahohoe and under water eruption called pillow lava.
3. Pyroclastic materials-called tephra, ejection includes-bombs, blocks, lapilli, ash, nuees ardentee

## Extrusive Features

1. Formed of Fissure Eruption
  - Flood basalts
  - pressure ridges,
  - lava tunnels
  - spatter cones
2. Central Eruption includes effusive form, explosive form, collapse form and exhalative form
  - Effusive forms
    - shield volcano
    - Cumulo dome
    - Plug Dome
    - Tholoid
  - Explosive form
    - ash or cinder cone.
    - Composite cone,
    - Parasitic cone
    - Ash Flow, Ignimbrite Plateau
  - Collapse form
    - crater
    - nested crater
    - caldera
    - nested caldera
  - Exhalative form
    - hot springs
    - geysers, intermittent eruption
    - fumaroles, continuous jet-like solfataras
    - Mud volcanoes
  - Pseudo volcanic features
  - Environment and volcanoes- jokulhaup, tsunami

# URBAN CLIMATE

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## Introduction

- Urban climate is the study of atmospheric phenomena attributable to human settlements.
- Clearest example of man's role in climatic modification.
- Urban structures create microclimates of their own, collection of which is urban climate.
- UCL – Urban Canopy Layer – air layer below roof level.
- UBL – Urban Boundary Layer – extent of urban local effect.

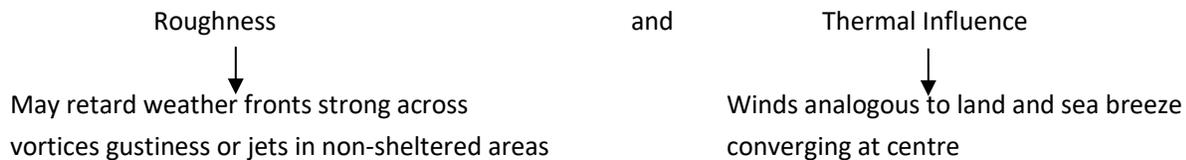
## Influence of Urban Climate

### 1. Urban Heat island Circulation

#### Due to

- (i) Absorption of long-wave radiation by polluted atmosphere.
- (ii) Sky view factor
- (iii) Concrete stores greater heat
- (iv) Anthropogenic heat from building sides
- (v) Decreased evaporation
- (vi) Decreased loss of sensible heat.

### 2. On winds –



### 3 On Urban Energy System

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- Lack of vegetation → channelling more energy into sensible rather than latent heat.
- Urban heat island due to –
  - (i) Increased counter-radiation due to pollutants.
  - (ii) Reduced sky-view factor → low outgoing radiation.
  - (iii) Building material storing more heat.
  - (iv) Anthropogenic heat from building sides.
  - (v) Decreased evaporation due to non-vegetated surface.
- Magnitude of heat island varies diurnally; in response to weather; and city size.

### 4. On Moisture -

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- As compared to the countryside, daytime moisture is lower due to less evaporation and more mixing.
- Reverse is true for night due to lesser dewfall and vapour from combustion.
- But in high latitude cities in winter due to frozen surface humidity is largely governed by vapour from combustion & hence more humid in both day & night.

#### 4. Precipitation –

- Cities enhance precipitation downwind areas especially in case of convective rainfall may be due to –
  - (i) Altered microphysics of urban clouds &/or
  - (ii) Cloud dynamics changed by UBL
- Exact role is difficult to determine.

#### PRESENT STATUS OF URBAN CLIMATE.

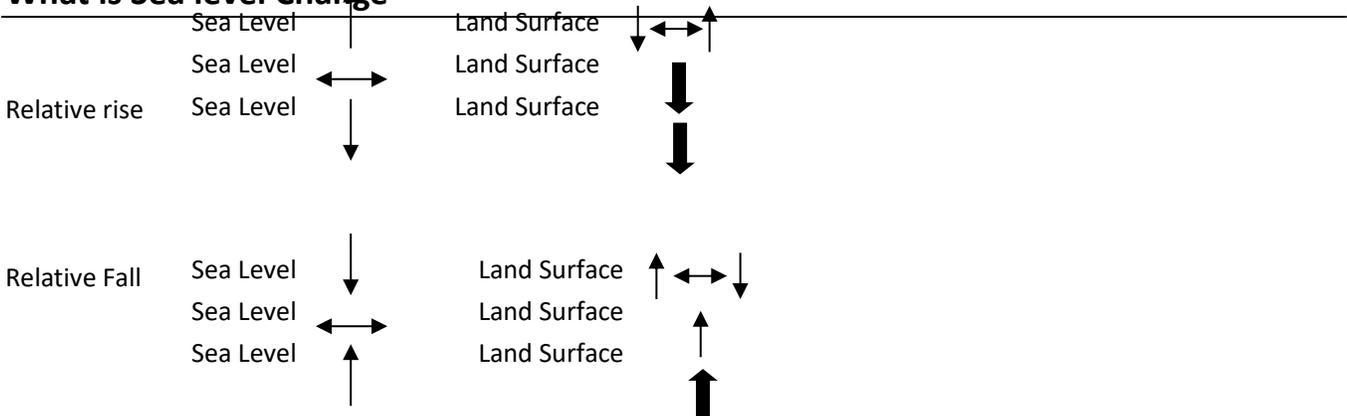
- Little knowledge of tropical urban climates.
- Its failure to develop applied science aspects.

## SEA LEVEL CHANGE

### Importance of Sea Level

1. Navigation to harbors, canals, waterway
2. Inundation or exposure of beach
3. Rate and pattern of coastal erosion
4. Stability of estuary for residential and industrial development
5. Suitable areas for reclamation
6. Tidal power generation
7. Storm surges in Coast

### What is Sea level Change



Transgression and Regression **GRAPHICS 31**

## **Mechanism of sea level change**

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### Long term changes

1. Changes in ocean water volume
  - Melting of Ice bergs
  - Temperature changes
2. Changes in Ocean Basin volume
  - (a) Sedimentation on the ocean floor
  - (b) Trench formation
  - (c) Subsidence of oceanic crust
    - Can be ignored as offset by subduction
  - (d) Uplift of mid oceanic crust
  - (e) Increase or decrease in the length of the ridge system
  - (f) Orogeny - reduction in crustal Area- fall in sea level
  - (g)** Desiccation of small ocean basins **VIDEO 10**
  - (h) Geoidal changes. The equipotential surface of the Earth's geoid is controlled by the interrelationship of the Earth's gravity and shape. The pressure exerted varies around the globe and is considered to result in sea-level differences of several metres between different parts of the globe.

### Short term changes

1. Sea density - eastern Pacific high than low temp, higher density, lower Sea level effected lesser by salinity
  2. Atmospheric Pressure
  3. Speed of Ocean currents
  4. Seasonal piling along windward coast Monsoon
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