



# Groundwater Quality

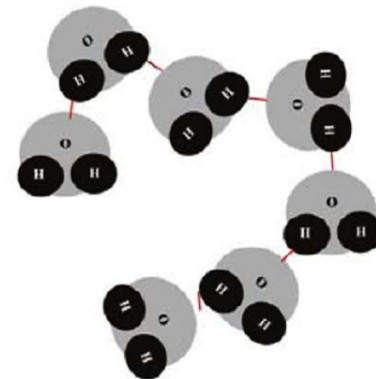
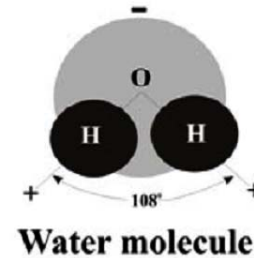
# Chemistry of Groundwater

## **Water Characteristics**

- Colorless, odorless, tasteless
- Found in all three states of matter-  
solid, liquid and gaseous
- Universal Solvent
- Highest heat capacity
- Highest heat of vaporization

# Water Molecule

- Two hydrogen atoms combining with one oxygen atom
- Electrical dipole – due to arrangement of the Hydrogen and Oxygen Atoms



Bonding of Hydrogen and Oxygen atoms in water

# Properties of ground water

Dissolution of rock forming minerals in the flowing water change its properties like-

- pH

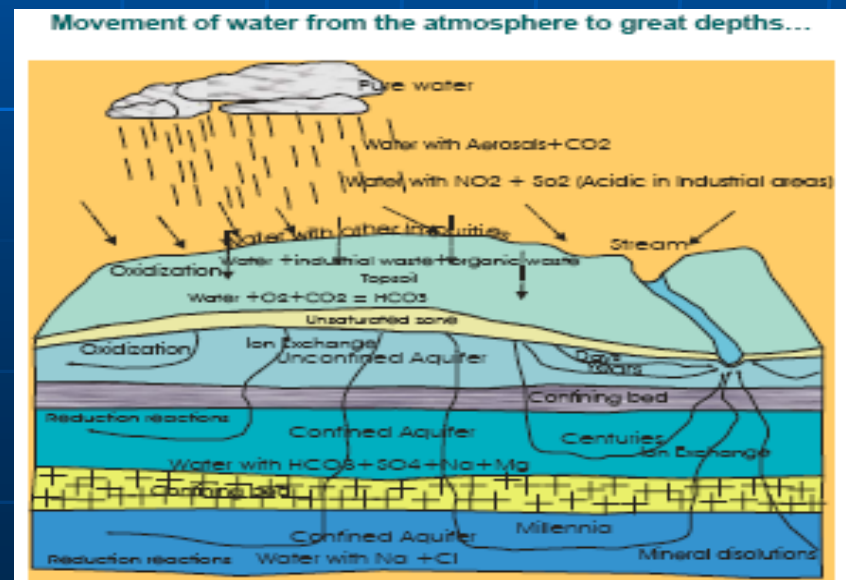
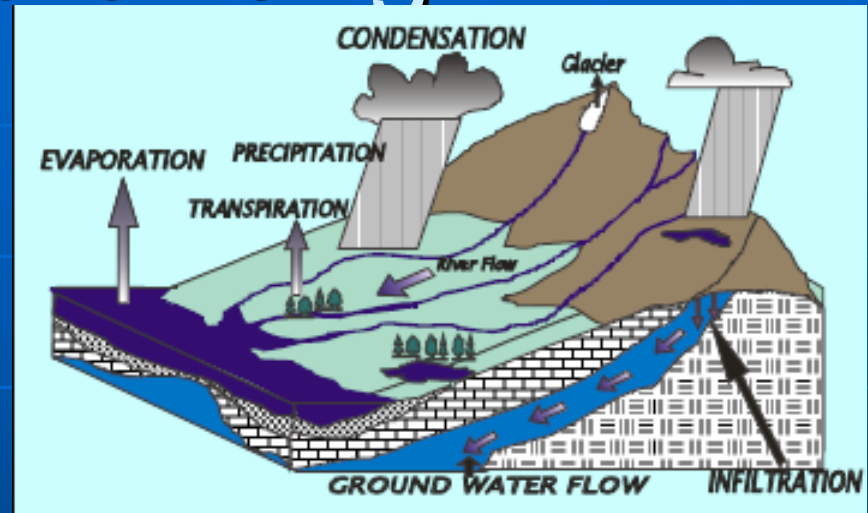


- Hardness (mg/l)- due to Ca, Mg, Fe, Mn.
- TDS (mg/l)- concentration of dissolved solids (inorganic salts), described as Salinity
- Electrical Conductivity- ability of water to conduct electricity



# Groundwater Origin

- Most groundwater abstracted is derived from rainfall and infiltration within normal hydrogeological cycle.
- rainwater is pure water containing between 10mg/l and 20mg/l of dissolved material.
- interaction with the rock or soil-changes chemical composition of water
- Quality can vary with rocks and within aquifers along groundwater flow paths
- Due to slow water movement there is chemical interaction between rocks and groundwater



# Groundwater Quality

- **Temperature and depth** affect groundwater quality  
As depth increases, temperature increases and salinity of groundwater increases



## **Dissolved salts increase with**

- Depth
- Time

Older water at depth and may resemble sea water

# Microbiological quality of ground water

- Contamination by pathogenic microorganisms
- Due to-
  - Sanitation methods in the community
  - Characteristics of groundwater
  - Type and construction of water point
  - Incidence and seasonality of disease in the community



# Pollution of Groundwater

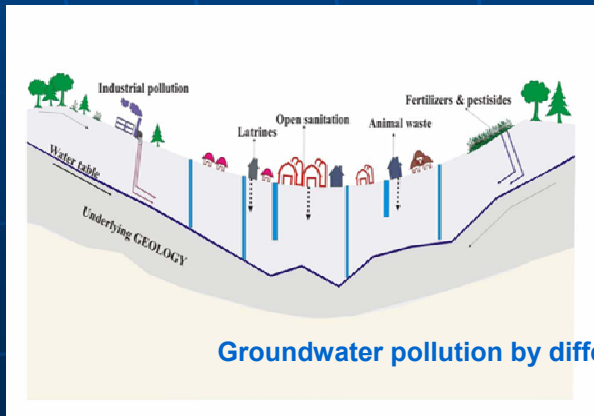
## Sources of Pollution

### Geogenic / Geochemical Processes

- **Mineral dissolution.**
- **Redox reaction**

### Anthropogenic Activities

- **Improper Sanitation**
- **Urban Pollution**



# Sampling and Analysis

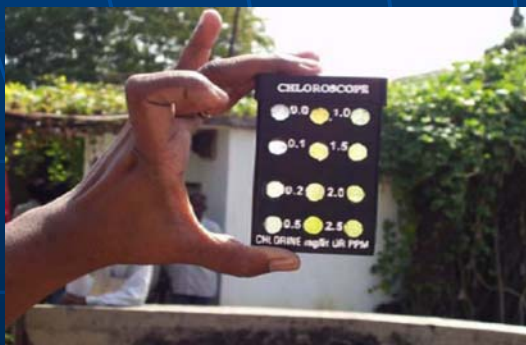


## Objectives

- General Quality
- Chemical Quality
- Determining Toxicity
- Detect Pollutants
- Microbiological Quality of Groundwater

# Protocol of Sampling Groundwater

- In-situ or sent to laboratory
- Samples to reach within 24hr of collection
- Chemical Analysis- 1 L sample to be collected
- Microbiological Analysis- 1 L sample to be collected





# Sampling Requirements

- Calibration of Instruments
- Clean, dry and sterilized equipments and containers
- Distilled Water
- Maintain Field Notebook



# Post Sampling

- **Remove air bubbles** after collecting sample
- Fill the container till brim and close tightly
- **Label** containers correctly
- Get sample tested in **ISO certified lab**
- Chemical analysis of basic **cations, anions and trace elements**
- Field parameters like **pH, Eh, TDS, electric conductivity** should be tested on field as well as in the laboratory



# Analysis of water samples

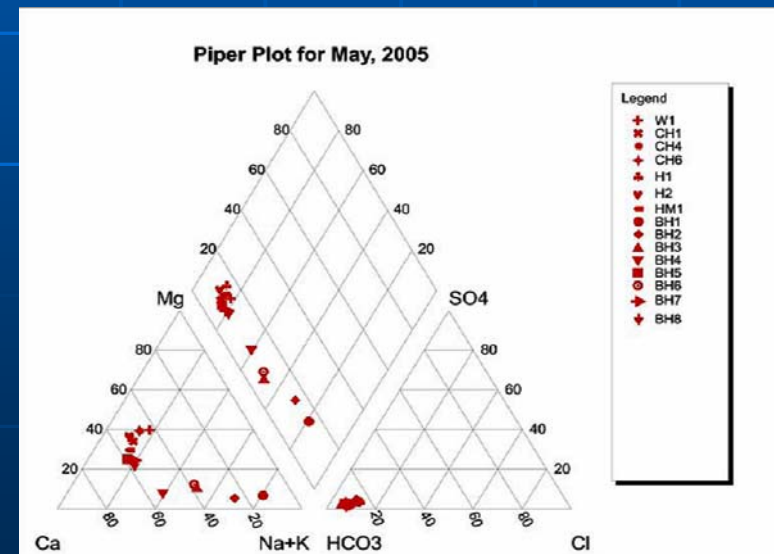
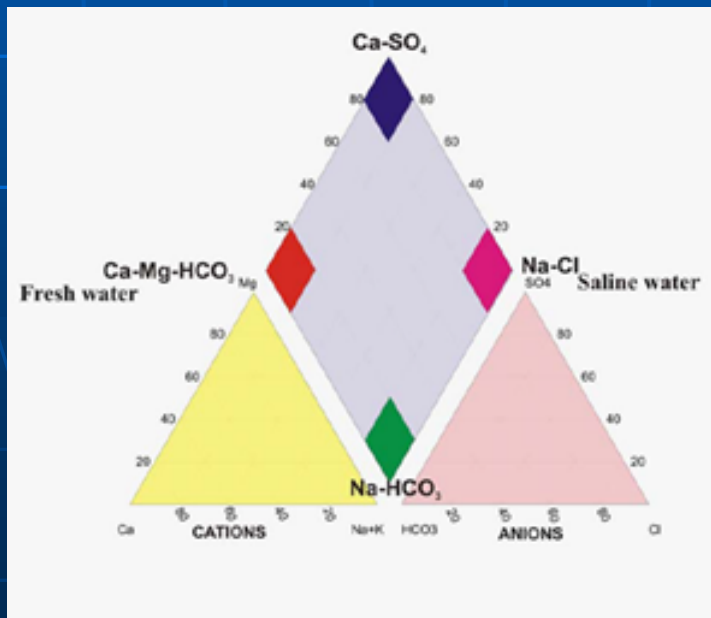
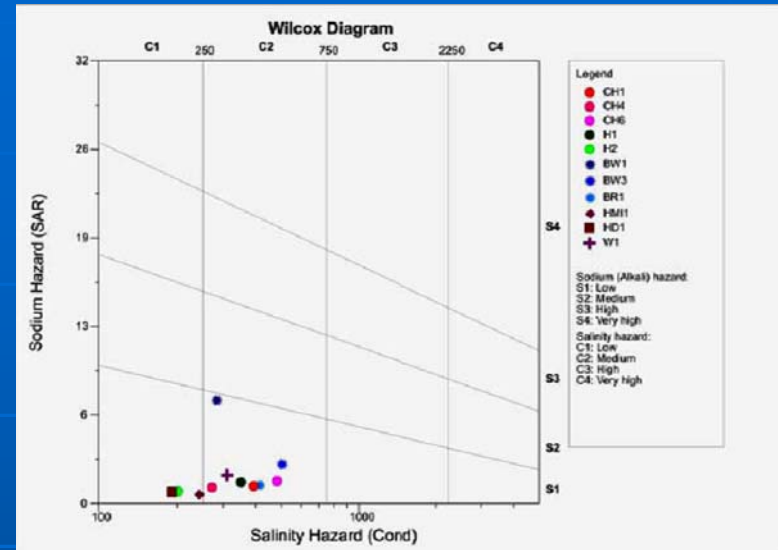
- The analysis of water samples may give indications about:
  - Impact of artificial recharge in the watershed
  - areas;
  - Agricultural pollution;
  - Industrial pollution;
  - Domestic water quality;
  - Aquifer heterogeneity
  - Ground water pollution
  - Saline intrusion
- This may help in better planning and implementation of watershed projects.

# Analysis

Can be done by using-

1. Wilcox diagram

2. Piper Diagram

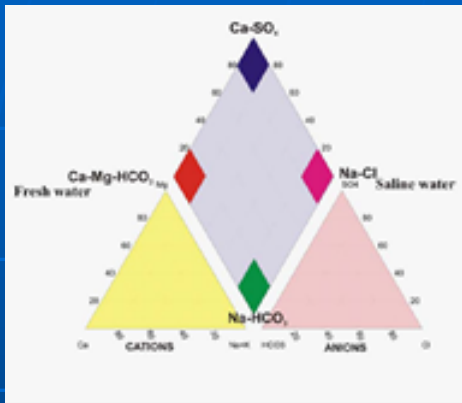


# Groundwater Quality Problems and Issues

Chemical Component	Effects
Fluoride	Mottled teeth enamel, Skeletal deformities,
Arsenic	Internal cancers, skin disorders, cardiovascular disorders, neurological and respiratory problems
Iron and Manganese	Unpleasant taste. Leaves stains on laundry, sanitary articles & plumbing fixtures
Nitrate	Harmful to infants, " Blue baby syndrome"
Heavy metals like Cadmium, lead, nickel, Copper etc	Cadmium: high renal toxicity, Lead: neurotoxic for unborn, Nickel; High allergenic
Total dissolved solids (TDS)	Cause problem to certain crops, difficult for soap to get lather, may cause serious corrosion of any metal



# Lessons



Constituent	Water Quality ( w.r.t. Salinity)
$\text{CaCO}_3$	Fresh Water
$\text{CaSO}_4$ and $\text{Na-HCO}_3$	Intermediate Quality
$\text{NaCl}$	Saline Water

Higher the TDS higher will be the Electric conductivity hence water will show higher salinity.