

# OCEANOGRAPHY



# Assessment

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Quiz: 10%

Assignment: 20%

Written Test: 30%

Final Exam: 40%

Total: 100%



On completion of this course, students would be able to:

1. Explain the evolution of the ocean basin, the features of the marine provinces and the theories of tides.
2. Illustrate the air-sea interaction with its effects on offshore activities,
3. Calculate tides for standard and secondary ports.
4. Examine the elements in ocean circulation and the types of waves.
5. Differentiate between the various type of marine provinces and marine sediments.

# **INTRODUCTION TO OCEANOGRAPHY**

# Ocean?



- ❑ Large, continuous body of salt water.
- ❑ Covers nearly 71% of the Earth's surface
- ❑ Wilderness of beauty & tranquility
- ❑ Vast recreational area
- ❑ Mysterious place
- ❑ Place of employment
- ❑ International highway



# The three principal oceans:

- Pacific:

- the largest ocean
- has an average depth of ~13,000 feet.

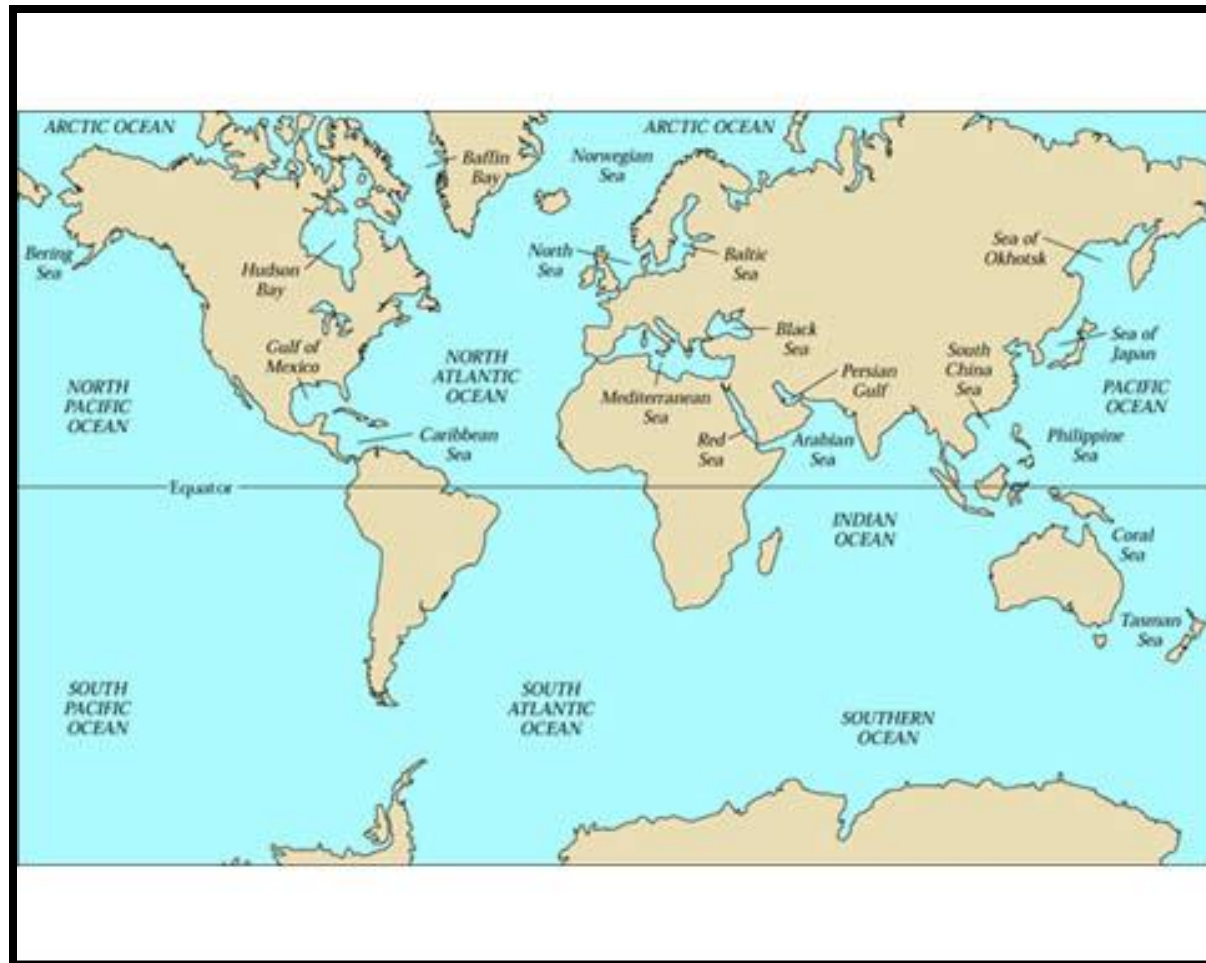
- Atlantic:

- the shallowest with an average depth of nearly 11,000 feet.

- Indian:

- smallest ocean
- present largely in the Southern Hemisphere







# Oceanography?

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**Ocean:**

Marine Environment

**Graphy:**

Name of a descriptive science

- Also called marine science

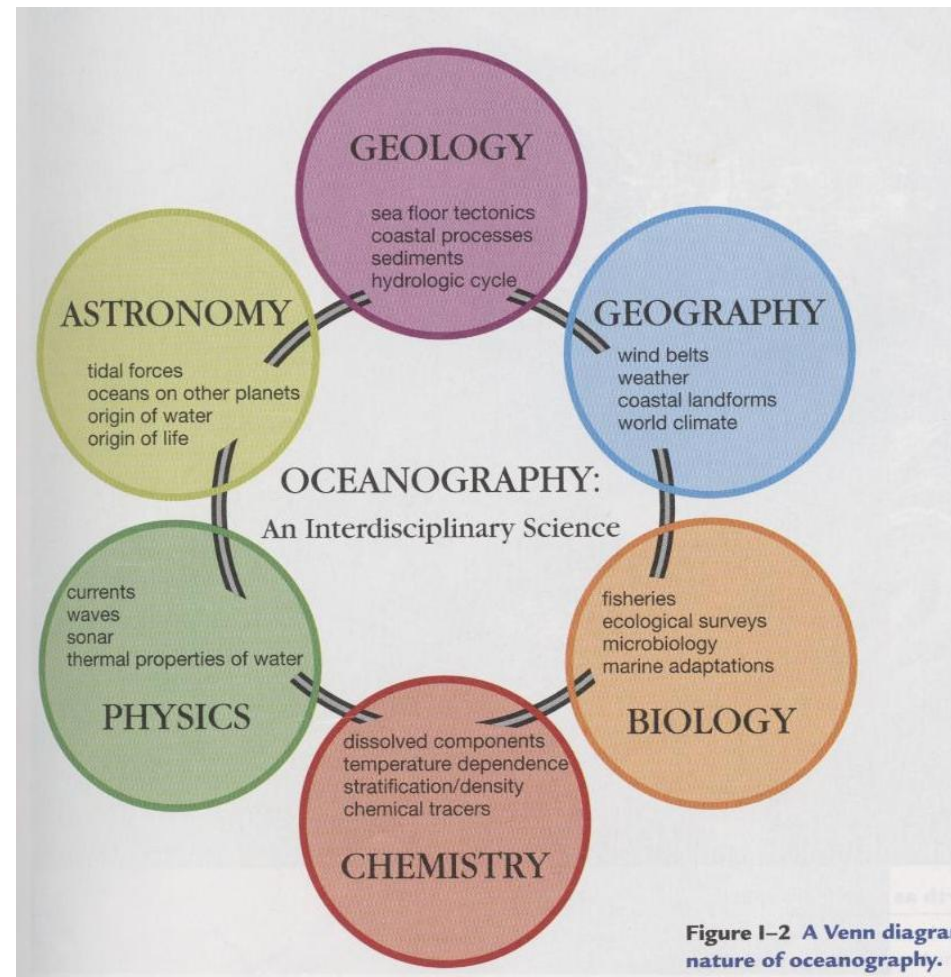
# Scope of Oceanography?

- Water of the ocean
- Life within it
- Solid earth beneath it



# Subfield

- Geological, chemical, physical and biological oceanography
- Ocean engineering
- Marine archeology



# Origin of atmosphere and oceans

## The Earth:

- 197 million square miles of area (approximately).
- 140 million square miles of water.
- broken up into hemisphere: **Northern** and **Southern**.

- **Northern Hemisphere:**

- 61% of water and 39% of land
- called as Land Hemisphere.

- **Southern Hemisphere,**

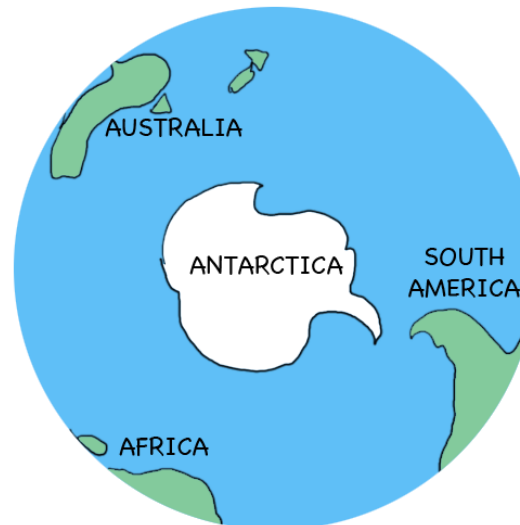
- 81% of water and 19% of land
- called as Water hemisphere.

# The Hemispheres of the Earth

- Northern Hemisphere: 39% land.




- Southern Hemisphere: 19% land.



# The Earth's ocean

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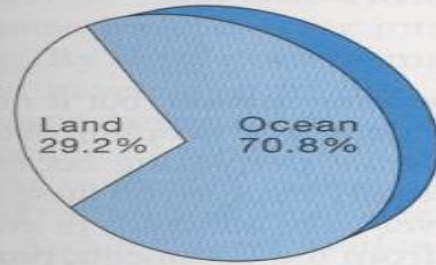
- Largest & most prominent feature
- Influence weather
- 80% of volcanic activities take place under water
- Supply 70% oxygen

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- Taking carbon monoxide out of the atmosphere
  - Contain the greatest number of living things
  - Source of food, minerals and energy
  - Biggest dumping ground of wastes

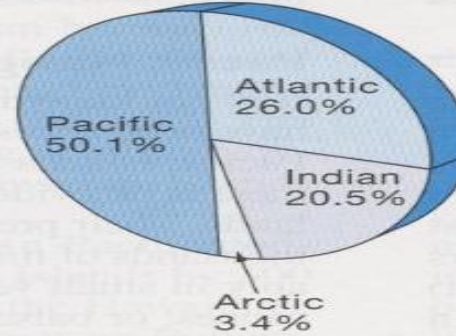


# Ocean size & depth

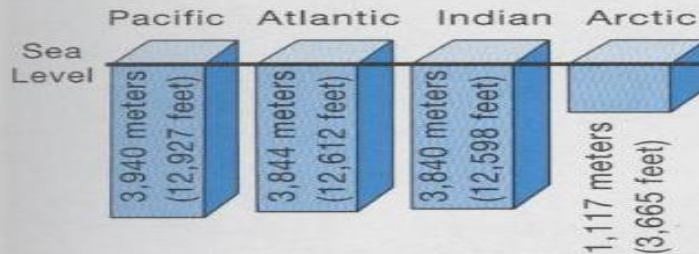
(a) Earth's Surface



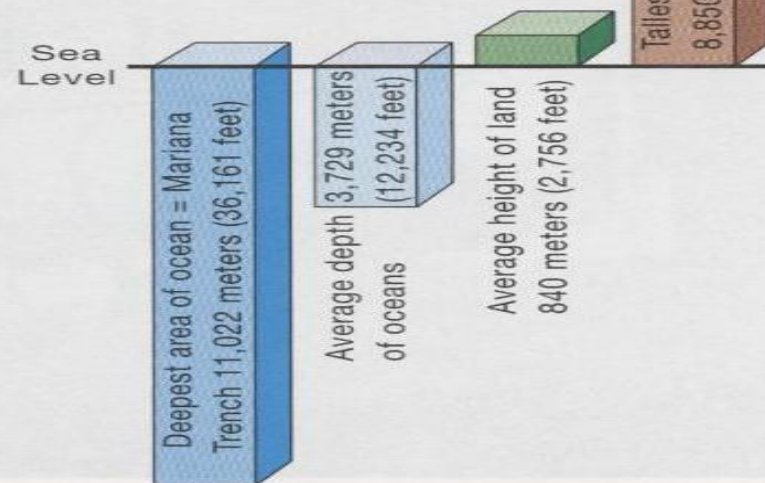
(b) Relative Ocean Size



(c) Average Ocean Depth



(d) Comparing Oceans to land



# Ocean Topography

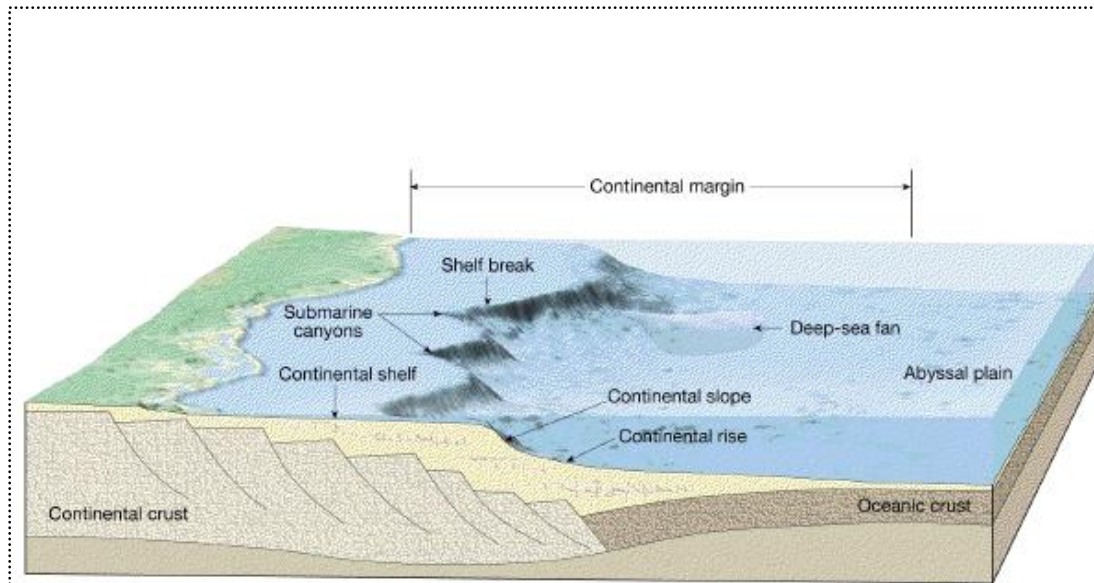
The oceans can be divided as three major units:

- Continental margin
- Ocean basin floor
- Mid-oceanic ridges

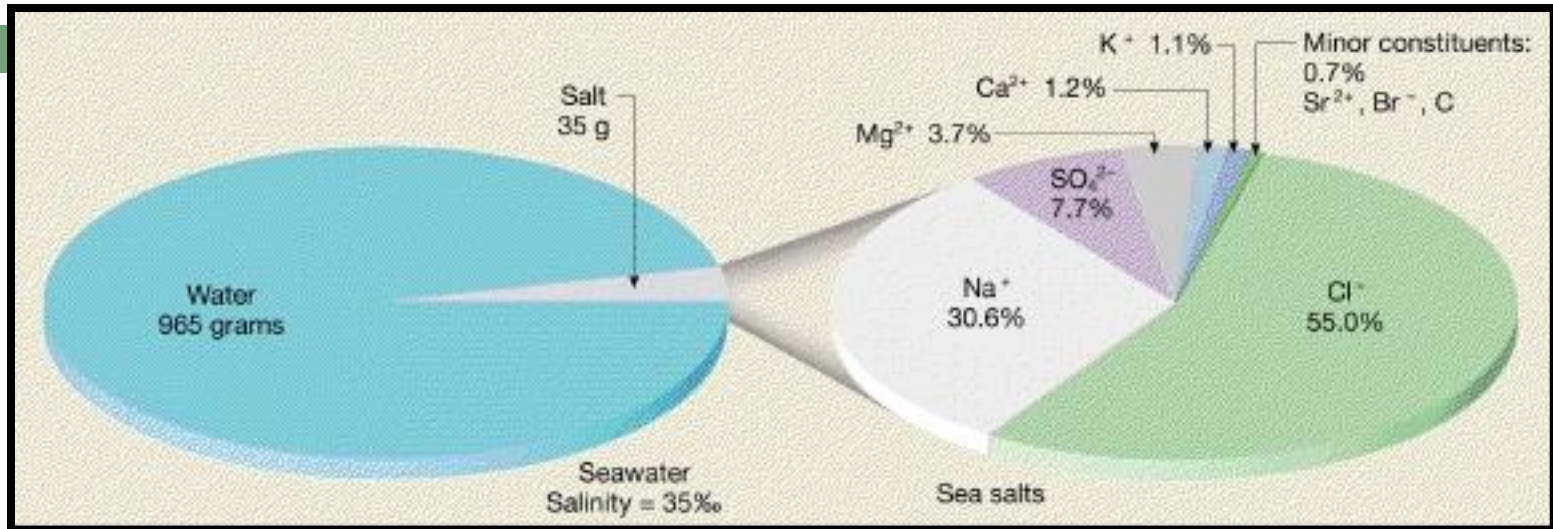


## Continental margin includes:

- **Continental shelf**
  - very gentle slope (submerged land)
- **Continental slope**
  - steep slope on edge of continental shelf.
- **Continental rise**
  - gentle slope
  - No trenches



# What is Ocean Water Composed of?



## Main elements in oceans:

55% Chloride  
31% Sodium  
7.7% Sulfur  
3.7% Magnesium  
1.2% Calcium  
1.4% Other

# Resources from Oceans and Seawater:

- **sea salt (halite),**
- **magnesium** (a light metal used in the making of light bulbs),
- **bromine** (gasoline additives/fireproofing materials).
- **fresh water** (through desalinate process).
- **Gold** (in very low concentrations)





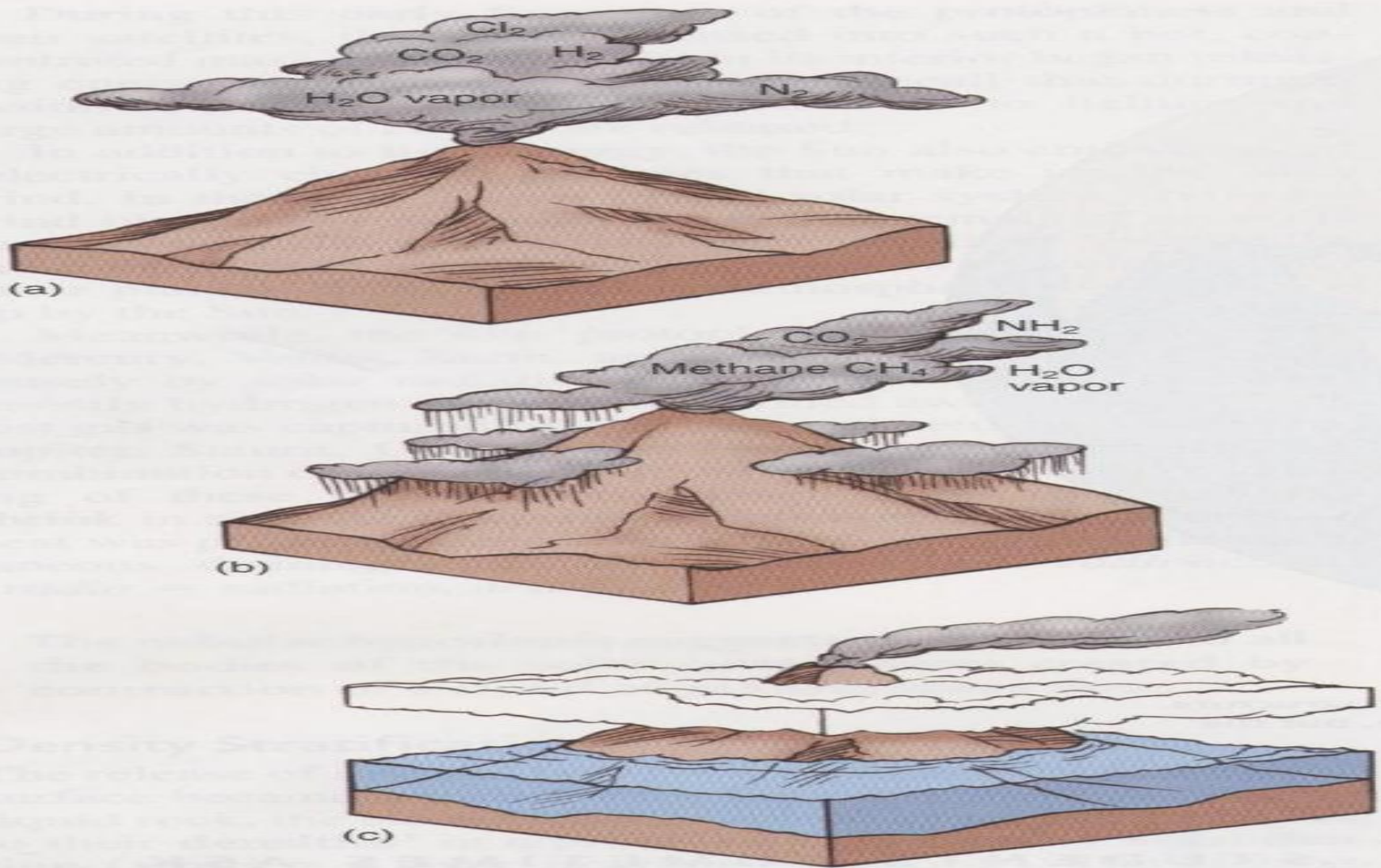
# Ocean Salinity

- Relentless rainfall on rocky surface eroding particles & dissolving elements and compounds, carrying them into the oceans.
- Comprise of salt: chlorine, sodium, magnesium & potassium.
- Most important component of salinity, chloride ion remains constant over time.

# Sources of salts in the ocean

- ❑ Chemical weathering releases elements contained in rocks by dissolving them
- ❑ Physical weathering breaks down rocks by various natural processes
- ❑ Water carrier both dissolved materials and solid particles toward oceans
- ❑ Volcanic gases emitted into atmosphere and up in the oceans





**Figure 2–7 Formation of Earth's early atmosphere and oceans.**

Early in Earth's history, widespread volcanic activity released large amounts of water vapor ( $\text{H}_2\text{O}$  vapor) and smaller quantities of various gases such as carbon dioxide ( $\text{CO}_2$ ), chlorine ( $\text{Cl}_2$ ), hydrogen ( $\text{H}_2$ ), and nitrogen ( $\text{N}_2$ ). This produced an atmosphere containing water vapor, carbon dioxide, methane ( $\text{CH}_4$ ), and ammonia ( $\text{NH}_3$ ). As Earth cooled, the water vapor (a) condensed into clouds and (b) fell to Earth's surface, where it accumulated to form the oceans (c).

# Our Layered Oceans:

## Shallow surface mixed zone (2%):

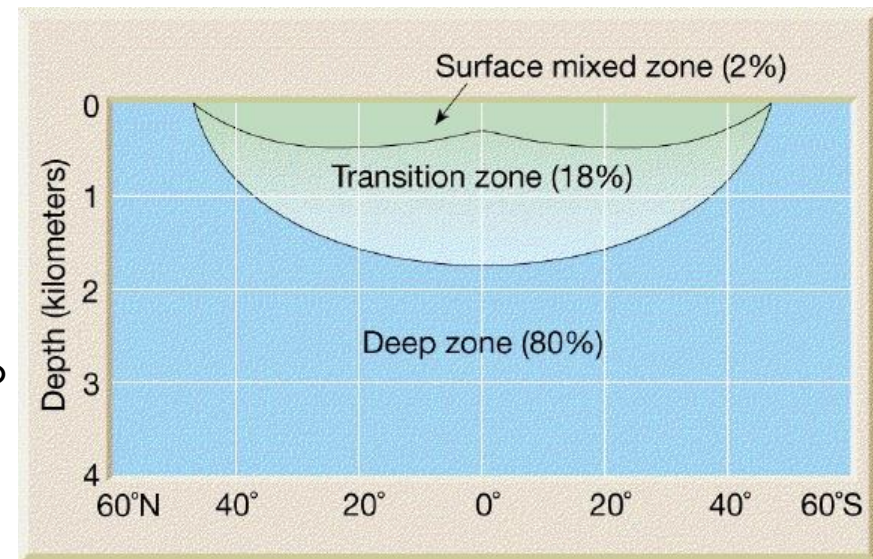
- warmest from solar energy,
- 1500 feet thick
- 70-80 degrees,
- most saline.

## Transition zone (18%):

- includes **thermocline**:
  - point of great drop-off in temperature to ~39 degrees
- Includes **Halocline**:
  - which is point of salinity drop-off

## Deep zone (80%):

- just slightly above or below freezing.
- Not very saline.





# Early history of ocean exploration

- Think About...
- What are 3 main reasons for **early** civilizations to “interact” with the **ocean**?



# Early Evidence of Ocean Travel

- The Atlantic and Mediterranean

- Phoenicians

- The Phoenicians contributed to ocean exploration by establishing the first trade routes throughout the Mediterranean, even as far north as Great Britain.

- Greeks

- Romans

- Chinese

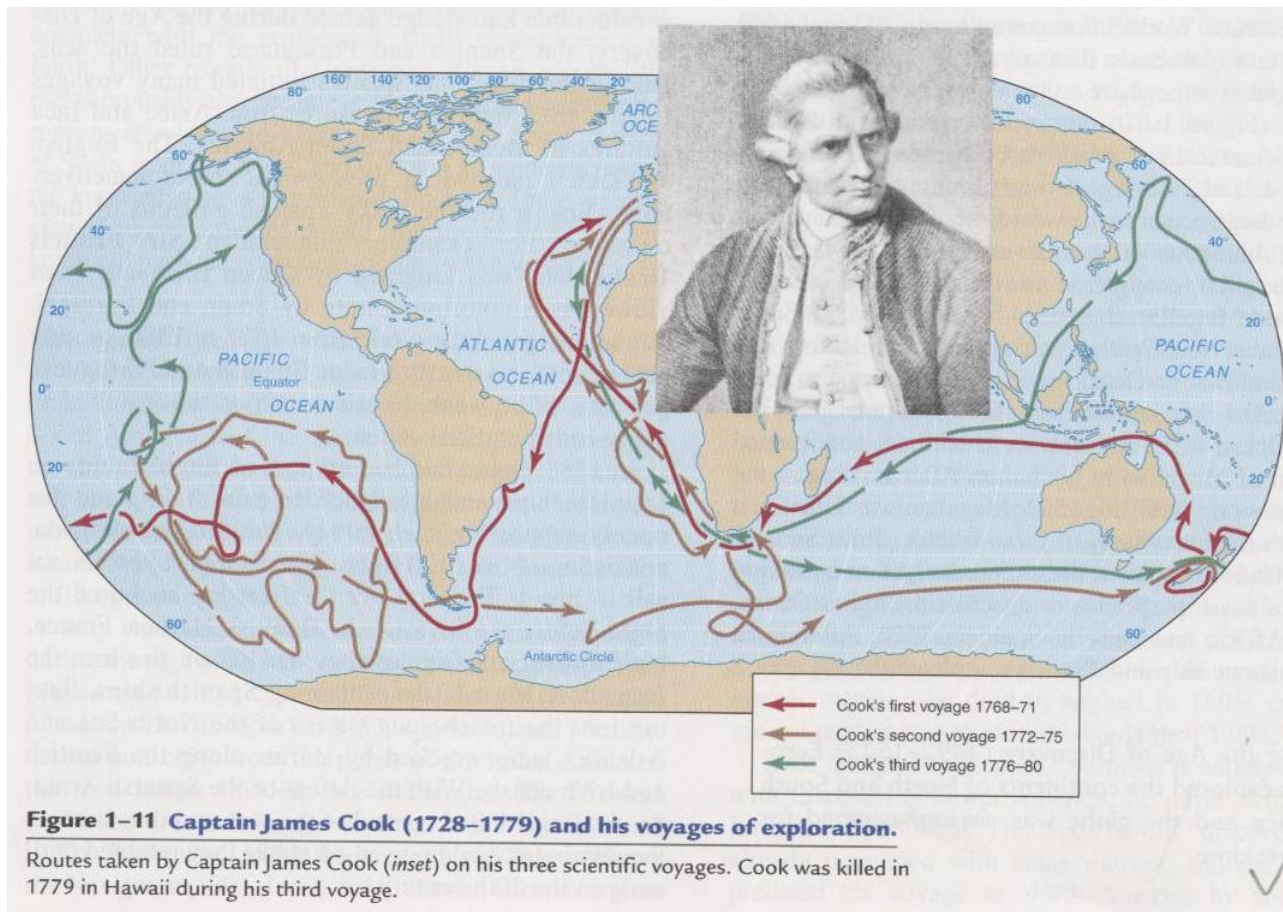
- The Pacific Islands

# Cook's Expeditions

- The first sea expeditions devoted to methodical, scientific oceanography.
- Discovered Australia, New Zealand, many islands in the South Pacific, the Hawaiian Islands, the West Coast of the US and Canada, the Bering Strait and the Antarctic Circle.
- A major contribution to Cook's voyages was the invention of the chronometer.
- Chronometer: to measure accurately the time of a known fixed location.

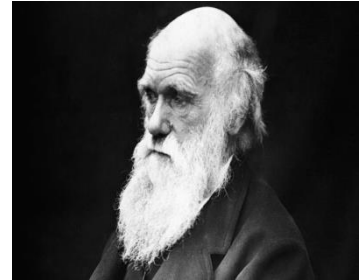




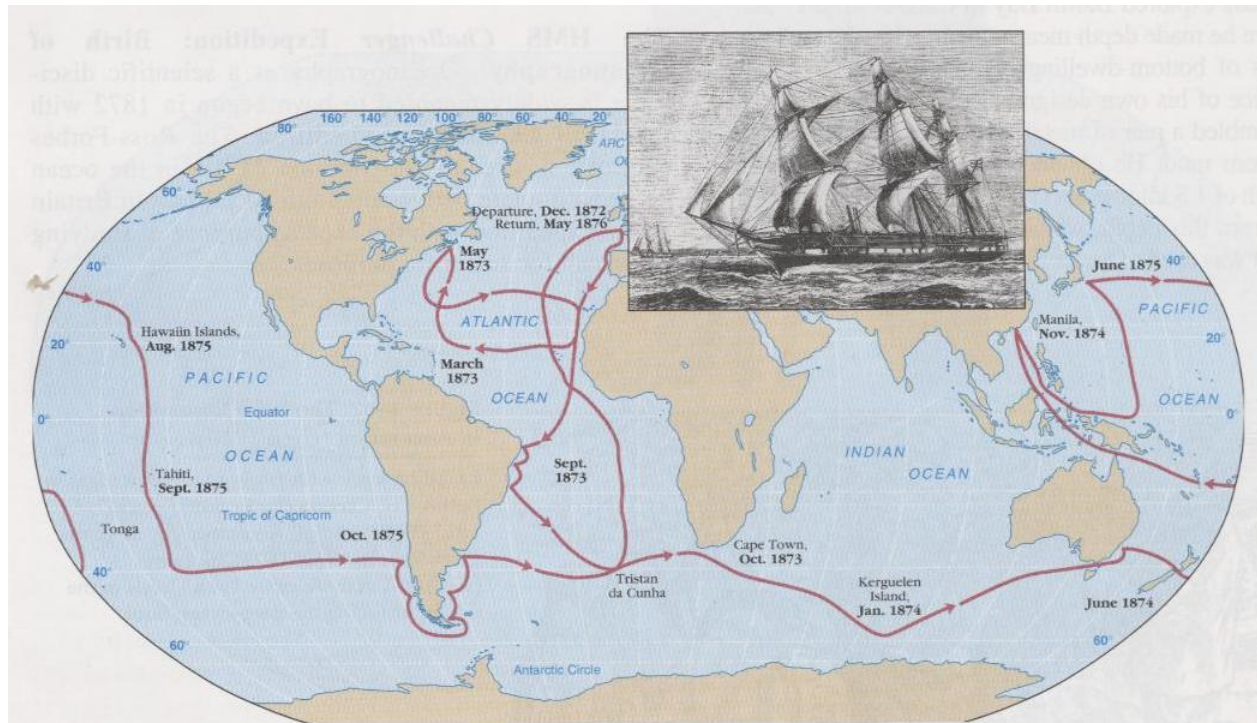


# Darwin and the H.M.S. *Beagle*

- The ship's naturalist in 1831.
- The H.M.S. *Beagle* ultimately circled the Earth.
- Darwin noted that coral grows in relatively shallow, warm, upper depths.
- Darwin is renowned for his **theories on natural selection and the evolution of species.**
- In 1859, he published ***The Origin of Species*.**







**Figure 1–13 Route of the HMS Challenger (1872–1876).**

Map showing the route traveled by HMS *Challenger* (inset) during its voyage of December 1872 to May 1876, which was the first large-scale voyage with the express purpose of studying the ocean for scientific purposes.