Propriedades Físico-Químicas da Água – O Líquido da Química e da Vida

QG 101
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Planeta Água
LAND AREA 29.1%

WATER AREA 70.9%
GEM DISCOVERY
POINTS TO SUBTERRANEAN OCEANS

MINERAL: RINGWOODITE
hidden within DIAMOND
FIRST TIME found in Earth

1.5% WEIGHT = WATER

From "Rare mineral points to vast ‘oceans’ beneath the Earth" ow.ly/u6BuC
1. Volcanoes cause geological activity on the Earth's surface which may affect areas deep underground.

2. Three times the amount of water found in Earth's oceans may be locked up in a mineral called ringwoodite, found 660km (400 miles) beneath the Earth.

3. Earth's water may have come from within, driven to the surface by geological activity, rather than being deposited by icy comets hitting the forming planet.

The transition zone is located between the upper and lower mantle sections from approximately 410-660km depth. Researchers from the University of Alberta believe there could be oceans of water there.
Gravitational forces from both the sun and the moon continuously pull on the Earth. Although the moon is much smaller than the sun, the moon's gravity is the dominant force behind Earth's tides.

**High Tide and Low Tide** How high tides get and how often they occur depend on the position of the moon as it revolves around the Earth. The moon's pull is strongest on the part of the Earth directly facing the moon. When that part happens to be a part of the ocean, the water there bulges toward the moon.
Water

Tetrahedral Electron Pair Geometry

Bent Molecular Geometry

104.4°

Slightly negative end (pole)

Slightly positive end (pole)
Hydrogen bond

(length appears different for perspective (3D))
The large drawing is not to scale. A scale drawing looks more like the one above.
Maximum density at 3.98 °C = 39.2 °F
estimated bp of H₂O in absence of hydrogen bonding
liquid surface
Hydration shells

Salt crystal

Water as a Solvent

Cl⁻

Na⁺
O ciclo hidrológico

Calor do Sol causa evaporação e transpiração de água.

Vapor se resfria para formar nuvens.

Chuva, neve, granizo.

Evaporação dos oceanos.

Evaporação de lagos e rios.

Evaporação a partir da precipitação.

Transpiração.

Água subterrânea.

Infiltração e percolação.
Groundwater flow

- Recharging precipitation
- Unsaturated zone (soil moisture)
- Saturated zone (groundwater)
- Aquifer
- Groundwater flow
- Recharge ditch
- Stream fed by groundwater discharge
- Groundwater discharge to the sea
- Saltwater intrusion
Dissociação de Moléculas de água

- Um próton – um íon de hidrogênio ($H^+$).
- A molecule de água que perde um $H^+$ forma uma anión hidróxido ($OH^-$).
- Cátion hidronio ($H_3O^+$).
- \( \text{H}_2\text{O} \leftrightarrow \text{H}^+ + \text{OH}^- \)

- A reação é reversível.

- No equilíbrio a concentração de moléculas de água é bem superior a \([\text{H}_3\text{O}]^+\) e \(\text{OH}^-\).

- Em água pura somente uma molécula em cada 554 milhões está dissociada.
  - No equilíbrio, a \([\text{H}_3\text{O}]^+\) ou \(\text{OH}^-\) é de \(10^{-7}\text{M}\) (25°C).
Chuva Ácida

• chuva, neve ou neblina pH < 5.6
• pH 1.5
• SOx e NOx reagem com água na atmosfera
  – Diminui pH do solo afetando a solubilidade de minerais – prejuízos para as florestas
  – Diminui pH of lagos – Lagos com pH < 5 sem peixes.
Chemical reaction

Exhaust gas

Combination with steam in the air

SO\textsubscript{x}

H\textsubscript{2}O

H\textsubscript{2}SO\textsubscript{4}

NO\textsubscript{x}

NHO\textsubscript{3}

Acid cloud generation

Acid rain
CO₂ – Combustão de combustíveis fósseis
25% of CO₂ absorvido pelos oceanos
CO₂ dissolvido na água do mar forma ácido carbônico = oceanos ácidos
Osmosis

- **Low Solute Concentration**
- **High Solute Concentration**

**Diagram Explanation:**
- Left side: 
  - Low solute concentration
  - More water
  - Less solute
  - Semi-Permeable Membrane

- Right side: 
  - High solute concentration
  - Less water
  - More solute

The process shows water moving from the side with lower solute concentration (left) to the side with higher solute concentration (right) through the semi-permeable membrane.
Transpiration—Cohesion Hypothesis

Evaporation (the driving force)
The lower water potential of air causes evaporation from cell walls.
This lowers the water potential in cell walls and in cytoplasm.

Cohesion (in xylem)
Cohesion holds water columns together in capillary-sized xylem elements.
Air bubbles block movement of water to next element.

Water uptake (from soil)
Lower water potential in root cells draws water from soil.
The absorptive surface increases with the production of more root hairs.
Water moves through endodermis by osmosis.
Terrenos áridos $d > 3$ a $5$ vezes a sua altura
Alto calor específico e de evaporação.

Calor Específico da água : 1 cal/g/°C
Água é Transparente

- A luz é transmitida através da água.
  - Plantas aquáticas recebem a luz do sol.
  - A visão humana é possível. Luz passa pelos nossos olhos e chega aos receptores celulares.
The mathematic-thermodynamic analysis of the anomalies of water and the temperature range of life

Karl Trincher


Water between 0 and 15°C consists of a vacuum component and of 3 substantial components: a quasi-crystalline component (K), a fluid component (F) and ice-relicts (R). Together they form a colloid system. (K) forms the dispersing milieu in which (R) and (F) are included as two dispersed phases. As the temperature rises from 0 to 15°C, the (R)-component diminishes in amount while the (K)-component increases proportionally. Between 19 and 30°C (F) remains the only dispersed phase. Between 30 and 45°C water consists of two phases (F) and (K), dispersed in the vacuum component. Between 45 and 60°C (F) is the dispersing medium with (K) the dispersed phase. After 60°C, water becomes a structurally homogeneous fluid, (F). All anomalies of water, both the "continuous" ones, occurring over large temperature and pressure ranges, and the "discrete" ones appearing at 15, 30, 45 and 60°C, are the results of these changes between the (R), (K), and (F) components. The biological evolution of warm-blooded animals has resulted in forms whose life is restricted to a narrow range of temperature with an optimum at approx. 37.5°C. At this temperature water possesses its minimum of heat capacity, a low coefficient of compressibility and the maximum of structural possibilities based on combinations of its (K) and (F) components.