UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Chemistry of Marine Environment

2526-1-F7504Q001

Aims

The course aims at providing fundamental knowledges concerning the processes and mechanisms that regulate the chemical composition of the sea and oceans.
A special attention is given to the climate change impact on the chemistry of the Oceans. In particular the Ocean chemistry is detailed with respect to the exchange of material with other environmental compartment and with the biogeochemical cycles.

Contents

The course CHEMISTRY OF MARINE ENVIRONMENT provides an understanding of the chemical composition of seawater and related chemical reactions. Equlibrium and steady state conditions in aqueous solution are discussed and applied. A particular attention is also given to priority and emerging pollutants.

Detailed program

1. Properties of Water that are fundamental for chemistry of the ocean: cooperative nature of hydrogen bond, cluster model of water, hydration shell, electrostriction, gas hydrates and clathrates (and their stability zone) isotopes in seawater and their usage for paleoclimate reconstruction.
2. Equilibrium and steady state models: their usage in chemistry of the oceans in dirrent context. The concept of activity, apparent equilibrium constants in seawater; box model and residence time in seawater.
3. Salinity and major constituents of seawater: salinity definitions through history till now, Marcet principle, conservative elements and major constituents of sewater definition and their use for paleoclimate in ice cores.
4. Acustic wave transmission in the sea in function of the seawater chemical composition, the role of

magnesium sulfate and tetraborate; osmotic pressure and Vant'Hoff equation and log equation of osmotic pressure. Osmotic green energy
5. Air-sea exchange of gases: Henry's law, Fluxes, exchange coefficient, bubble entrainment
6. Acid-base reactions. pH, chemical composition, buffer intensity in the oceans.
7. CO?,HCO??, CO?²? equilibria in oceans and seawater. Log C – pH diagrams in the deep ocean and at the surface.
8. Acidity and alkalinity. Concept of ocean acidification and its calculation in function of the atmospheric rising of CO?. Geoengineering climate applied to the oceans. Solubility-pH of trace metals; metal ions speciation.
9. Organic matter in the sea. Nutrients. Microplastics. Organic pollutants (i.e. hydrocarbons, pesticides, dioxins and PCBs, flame retardants, and endocrine substances). Reaction in anoxix environment.
10. Atmospheric-ocean interaction: marine aerosols and their photochemistry and atmospheric aerosol as a source of nutrients.

Prerequisites

Basics of inorganic and organic chemistry.

Teaching form

The teaching form is constituted by:
6 CFU (42 h, 21 two-hours lessons) of in person, Delivered Didactics, with frontal lessons even by videoconference and recorded. During these lessons questions and discussion with the students are encouraged with Interactive Teaching and discussions.

Textbook and teaching resource

Slides and two textbooks:

1- An Introduction to the Chemistry of the Sea, 2?? ed., Michael EQ Pilson, Cambridge University Press, 2013.

2- Chemical Oceanography, 4th Ed., Frank J. Millero, CRC press, Taylor & Francis Group, 2013

Semester

Second semester

Assessment method

Oral exam with written parts. The written parts are part of the oral exam during which the students have to demonstrate the capability to mange the most important chemical equilibrium equations concerning the chemistry

of the sea or they have to write the most important equations concernig the Alkalinity or draw the vertical profile behaviour of the most important chemical components od seawater in different oceans.

In the oral examination, the student will be assessed on the basis of the following criteria: 1) knowledge and understanding; 2) connection of the different concepts; 3) reasoning autonomy; 4) ability to use scientific language

Mark range: 18-30/30 with laude

Office hours

Office at 3rd floor of U1 building (Piazza della Scienza 1, Milano).
By appointment via e-learning or contacting me at my mail address (luca.ferrero@unimib.it)

Sustainable Development Goals

CLEAN WATER AND SANITATION | CLIMATE ACTION | LIFE BELOW WATER