



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare
ACADEMIC YEAR	2021/2022
MASTER'S DEGREE (MSC)	GEORISK AND GEORESOURCES
SUBJECT	GEOCHEMISTRY OF NATURAL WATERS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	21015-Attività formative affini o integrative
CODE	16482
SCIENTIFIC SECTOR(S)	GEO/08
HEAD PROFESSOR(S)	PARELLO FRANCESCO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	PARELLO FRANCESCO Monday 09:00 10:00 via archirafi 36 terzo piano

DOCENTE: Prof. FRANCESCO PARELLO

PREREQUISITES	Review basic fundamentals of chemistry. Understand commonly used concentration units and unit conversions. Learn to calculate and understand the significance of charge-balance error. Be introduced to some common ways of graphically displaying natural water compositions.
LEARNING OUTCOMES	Knowledge and understanding skills Acquiring the knowledge necessary to understand the laws that govern the abundance and distribution of elements in the natural waters . Ability to apply knowledge and understanding Ability to apply the acquired knowledge in the modeling of natural phenomena, with the help of the thermodynamic equilibrium approach, regarding the process of rock water interaction in relation to the mobility of the elements. Judgment autonomy Capacity and autonomy in the evaluation of phenomena leading to a given abnormal situation in aquifers, water basins and wild waters Communicative Skills Ability to expose the results of geochemical studies to an unknowable audience. To be able to clearly highlight the possible scientific implications of geochemical applications. Learning Skills Ability to study and understand specialized sector publications as well as books published in a language other than Italian. Ability to follow, using the knowledge acquired during the course, both in-depth courses and specialized seminars in the hydrogeochemistry field.
ASSESSMENT METHODS	The oral test consists in an interview, directs to verify the possession of the competences and the anticipated disciplinary knowledges of the course; the evaluation is expressed in thirtieths. The questions are designed to test the expected learning outcomes and will tend to verify the knowledge the student acquired. The threshold of the sufficiency will be reached when the student shows knowledge and understanding of the matters at least in the general lines. The student will owe equally to possess ability espositiva and such argomentativa to allow the transmission of his/her knowledges the examiner. Under of such threshold, the examination will be considered insufficient. The rating will tend to grow if verification ensures a good judgment that can represent the unique aspects of the discipline . As regards the verification of expositiva capacity, it has a minimum rating in the case where the student demonstrates yes a property of adequate language but not sufficiently articulated, while the maximum rating can be achieved by students that demonstrate full command of the language of the scientific field in object.
EDUCATIONAL OBJECTIVES	The preminent goal of the course is to study the laws that govern the abundance of elements in the hydrosphere. The composition and evolution of the hydrosphere will be discussed in relation to the history of the planet Earth. In particular, human-induced perturbations will be highlighted where necessary, trying to capture short and long-term effects. Specific applications of geochemistry and isotope geochemistry will be presented to environmental issues and to the study of the water resources of the planet. Particular attention will be given to the study and to the understanding of possible causes of degradation of natural waters and to perform the appropriate remediations. At the completion of the course will be done some exercises where will be presented the main analytical techniques for the analysis of natural waters of both the major and minor constituents . There will also be exercises for the use of specific software capable of modeling situations that can be found in the reality.
TEACHING METHODS	The course includes frontal theoretical lessons through power-point presentations and Use of pc to learn how to use computing programs
SUGGESTED BIBLIOGRAPHY	Appelo C.A.J., Postma D. (2007) Geochemistry, Groundwater and Pollution. Balkema Ulteriori testi di consultazione - Appunti del corso forniti dal docente

SYLLABUS

Hrs	Frontal teaching
6	Basic concepts of chemistry - atomic structure, chemical bonds, concentration units and conversion of chemical data, estimation of error in calculation of charge balance. Introduction to some graphic representations to explain the chemical composition of natural waters. Water classification based on Piper and Langelier-Ludwig diagrams.
6	. B) Using some simple thermodynamic tools. Principles of equilibrium and balance constants. Definition of the concept of activity and activity coefficients; Calculation and use of IAP and SI. Calculation of the equilibrium constant variation with the temperature. Calculation of the effects of activity coefficients on mineral solubility. Calculate the effect of complexation on mineral solubility.
6	Introduction to some basic concepts of chemical kinetics; Order of a reaction and fundamental laws of kinetics. Use of Arrhenius equation. Study of factors controlling precipitation of minerals and study of dissolution kinetics.

SYLLABUS

Hrs	Frontal teaching
6	Study of the main sources of CO ₂ in natural waters. Definition of alkalinity. Calculation of the solubility of some carbonate minerals. Study of the incongruent dissolution concept. Applying these concepts to some case studies.
6	Study of factors affecting the resistance of primary minerals to weathering. Study of the nature of weathering products (clay, oxides and hydroxides). Studying the principles governing the solubility of quartz. Study of the principles governing the solubility of Al and Fe oxides. Study of incongruent dissolution of silicates. Calculating and using activity diagrams. G) Study of absorption, adsorption and ion exchange concepts.
6	Study of absorption, adsorption and ion exchange concepts. Definition of the concept of oxidation and reduction. Examples of redox reactions in the field of water geochemistry. Balancing redox reactions. Defining the variables Eh and pe. Calculation of EH from redox pairs. Measure the value of Eh in the field and fall back on such measures. Construction and use of pe-pH (Eh-pH) diagrams.
4	Description of the main organic compounds present in natural waters and the main contamination processes.
Hrs	Workshops
16	Study of some hydrogeochemical models (study of the water-rock interaction process). Specification of Specimenation and Reaction Paths and its Use of Specimen Calculation Software (PHREEQC). M) Isotopic geochemistry: stable isotopes (¹⁸ O / ¹⁶ O, ² H / ¹ H,) and radioactive isotopes (³ H).