Study Plan

School: School of Sciences and Technology
Degree: Master
Course: Paleontology (cód. 440)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO10326M	Paleontology and Evolution	Geology and Biology	6	Semester	162
GEO10327M	Methods in Paleontology	Geosciences	6	Semester	162
BIO10328M	Systematics and Taxonomy	Biology	6	Semester	162
GEO10329M	Paleobotany and Palynology	Geosciences	6	Semester	162
GEO10330M	Invertebrates Paleontology	Geology	6	Semester	162

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO10331M	Vertebrates Paleontology	Geology	6	Semester	162
GEO10332M	Micropaleontogy	Geology	6	Semester	162
GEO10333M	Taphonomy and Paleoecology	Geology	6	Semester	162

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO10334M	Geochemistry applied to Paleontology	Geology	6	Semester	162
GEO10335M	Geochronoloy applied to Paleontology	Geology	6	Semester	162
GEO10336M	Archeozoology and Archeobotany	Geology	6	Semester	162
GEO10337M	Stratigraphy and Sedimentary Processes	Geology	6	Semester	162
HIS10338M	Geological heritage and Museology	History	6	Semester	162
GEO10339M	Dynamics of Sedimentary Basins	Geology	6	Semester	162

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para conclusão do curso é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades curriculares:

1º Ano

1º Semestre:

5 UC obrigatórias num total de 30 ECTS

2º Semestre:

3 UC obrigatórias num total de 18 ECTS

2 UC Optativas, num total de 12 ECTS

Para obtenção do grau, é necessário também a aprovação na Dissertação ou Trabalho de Projecto, com um total de 60 ECTS, no 3.º e 4.º Semestre. ***

Program Contents

Back

Paleontology and Evolution (GEO10326M)

1. Evolution
1.1. Fundamentals concepts of evolution
1.2. Species and speciation
1.3. Types of evolution
1.4. Fundamentals concepts of molecular evolution,
1.5. Natural Selection and adaptation
2. The Evolution of Evolution
2.1. Before Darwin; the evolution of Darwin; Neo-Darwinian evolutionary Synthesis.
2.2. Microevolution, Macroevolution and Evo-Devo
2.3. The evidence of evolution
3. Methods of studying evolution and taxonomy
3.1. Phylogeny and Cladistics
3.2. Morphometry
3.3 Taxonomy
3.4. Tools for the study of evolution. Software of Cladistics
4. Evolution and diversity.
4.1. The diversity as a by-product of evolution.
4.2. Origins, extinctions and diversifications
5. The problematic of evolution in Palaeontology

Back

Methods in Paleontology (GEO10327M)

Fossils: sampling and methods of study.
Techniques for preparation of Microfossils (Calcareous and Siliceous).
Techniques for preparation chemical and mechanics of fossils vertebrate.
The importance of consolidating in preparation. Stages of preparation.
Techniques for electron microscopy in the study of fossils.
Digital methodologies applied to the study of vertebrates.
Illustration of fossils.
Treatment of laboratory samples for mesofossil plants, spores and pollens.
Importance of Palaeontology for paleoenvironmental and paleoecological reconstructions.

Back

Systematics and Taxonomy (BIO10328M)

1. Intrapopulation variability
2. Phenetic
3. Cladistics
4. Phylogenetic
5. Numerical Methods for Inference of Phylogeny
6. Biological Nomenclature

Back

Paleobotany and Palynology (GEO10329M)

Theoretical

1 - General aspects of Paleobotany and Palynology. History. Systematics, taxonomy and nomenclature. Methods and techniques of study.

2 - Overview of leaves, stems, spores and pollen morphology. Dinoflagellates.

3 - Fossilization.

4 - Methods of collection, preparation and study. Pollen diagrams. Palynofacies.

5 - Overview of paleoecology. Dinoflagellates and plant fossils as environmental and climate indicators.

6 - Classification of dinoflagellate cysts and plants.

7 - Evolution of dinoflagellates and plants in time. Origin of terrestrial vegetation. Plants of the Paleozoic and the Mesozoic. Origin of angiosperms. The Cenozoic vegetation. Progressive Quaternary degradation of vegetation in Europe.

Practices

Treatment of samples for obtaining palynological analysis. Slides for pollen analysis. Observation under an optical microscope; palynofacies.

Note macroremains plant collections representing the evolution of vegetation over time.

Back

Invertebrates Paleontology (GEO10330M)

1.General concepts
Invertebrates and metazoans
Importance on modern biosphere and during the Phanerozoic
Biostratigraphic relevance
Palaeoecology
2.Biodiversity and Fossil Record
Diversity of modern invertebrates
Skeletal synthesis, fossilization and preservation
Implications of fossil record bias
3.Origin and early diversification
First Metazoans
The Upper Proterozoic marine faunas
Origin and evolution of main Phyla
The meaning of Cambrian radiation
Mass extinctions
4.Main phyla (morphology, classification, evolution and phylogeny, biostratigraphic, palaeoecologic and biogeographic importance)
Phylum: Porifera/Cnidaria/Briozoa/Brachipoda/Mollusca/Echinodermata/Annelida/Arthropoda/Hemichordata
5.The Invertebrates on the Portuguese Palaeontology
Historical synthesis
Main stratigraphic intervals with fossil record
Mains fossil sites
Museological collections
Scientific importance and heritage
6.Exceptional sites (lagerstätten)
7.Conclusions

Back

Vertebrates Paleontology (GEO10331M)

Vertebrate Palaeontology: Vertebrate origins, evolution, systematics and characterization of the major vertebrate groups.
Agnathans and fishes (Class Placodermi, Class Acanthodii, Class Chondrichthyes); Tetrapods and Amphibians; Reptiles (i) Archosaurs (dinosaurs, birds, crocodiles and pterosaurs) (ii) Mosasaurs (iii) Plesiosaurs; Mammals; Primates and hominids
Comparative Anatomy: skeleton, teeth, non-skeletal organs.
Transition environments, examples and key adaptations: Conquest of the land environment, secondary aquatic adaptations, origin of active flight.

Back

Micropaleontogy (GEO10332M)

Systematic study of the major groups of microfossils (foraminifera, ostracods, calcareous nanoplancton, radiolaria).
Stratigraphic distribution and ecology. Biostratigraphical (biozonation scales) and paleoecological importance. The microfossils as proxies (indicators of physical and chemical conditions of the environment and its evolution in space and time).
Laboratorial techniques for treatment of samples, preparation and study of microfossils.
Topics of scientific research in micropalaeontology (case studies, involving sequential stratigraphy and in particular the definition of cronostratigraphic boundaries, paleoceanography, paleogeographic reconstructions, and biological evolution).

Back

Taphonomy and Paleoecology (GEO10333M)

Taphonomy.Definition and parts.Skeletal composition of fossils
Biostratinomy.Field questionaries.Fossil assemblages. Fossildiagenesis
Taphonomic feedback.Time averaging. aphofacies
Palaeoecology:general concepts.Diversity, equitability, dominance.Massive extinctions
Trophic structure of ecosystems.Trophic webs. Models in ancient communitties
Sediment-organism relations.Bioturbation and bioerosion Neoichnology and Palaeoichnology
Well preserved old ecosystems
Ecobiostratigraphy
Stable isotope technicals applied to palaeoecology
Practices
Labeled samples of several types of preservation, transportation effects and endogenous biological destruction.
Taphonomical studies in the laboratory
Diversity index, equitability and dominance histograms of samples
Description of several trace fossils, determination of their behavioral category and palaeoenvironment
Interpretation of sets of isotopic data from Mollusks
Taphonomy in shell concentrations of Lisboa marine Upper Miocene

Back

Geochemistry applied to Paleontology (GEO10334M)

1) Introduction: the chemical elements
a)Element abundance in the Universe
b)The chemical composition of the Earth's crust
c)The geochemical classification of the elements
2)Isotopes
a)Stable isotopes and radiogenic isotopes
b)Characteristics of the stable isotope systems with geological interest
c)Mechanisms of fractionation of the stable isotopes
3)Isotopic systems with interest to the Paleontology
a)Oxygen and Carbon
i)Characteristics and properties
ii)Fractionation equations
iii)Paleoenvironmental information: paleotemperature, paleohydrology and paleovegetation
4)The rare-earth elements
a)Chemical properties
b)Mechanisms of fractionation in surficial environments
c)Application in paleoenvironmental studies.
5)Neodymium isotopes: paleoceanographic applications
6)The geochemistry and the Stratigraphy: general concepts and applications
7)Geochemical changes during diagenesis and metamorphism.

Back

Geochronoloy applied to Paleontology (GEO10335M)

Characterization of the method of radiocarbon (C14), of the radiometric method using zircon U-Pb isotopic system, and of the K-Ar isotopic system with amphibole and mica.
Methods of concentration, separation and selection of samples and minerals (sampling, grinding, separation by magnetic susceptibility and density by optical observation).
Data processing and error estimate, preparation of Tera-Wasserburg diagrams and concordias using software that is suitable for organizing and presenting results.
Practical examples of studied zircon, amphiboles and micas geochronology applied to the calibration of the ages of fossiliferous or non-fossiliferous sedimentary sequences, with crucial importance: in the interpretation of stratigraphic columns and analysis of sedimentary provenance and characterization of sources, in establishing maximum age of deposition and developing models of palaeogeographic reconstruction of regional and global scale.

Back

Archeozoology and Archeobotany (GEO10336M)

What is Archaeozoology. Wild and domestic fauna in archaeological sites. Methods of excavation, recovery and conservation.Cultural, economic and social meanings of the faunal associations in archaeological context from Early Palaeolithic to present times. Paleoecological incidences. Osteometry and domestication. Case-studies.
Morphology of Angiosperms, leaves, stems shoots, spores and pollen. Methods of study and preparation of samples.
Antracology. Dendrochronology. Plants and climate. Phytoecology and phytossociology. Main plant bioma.Vegetation evolution during the Cenozoic. The vegetation of European Quaternary. Present vegetation in Portugal.

Back

Stratigraphy and Sedimentary Processes (GEO10337M)

Theoretical
Fundamentals of Stratigraphy. Definition and objectives. Historical aspects. Stratigraphic Classification. Dimension "time". Rock systems and time periods. Principles of Stratigraphy.
Discontinuities. Facies. Sequential analysis. Paleogeography. Stratigraphy of events. Lithostratigraphic, chronostratigraphic, biostratigraphic units. Stratotype. Chronostratigraphical and geochronological scales. Paleobiogeographic, Palaeoecology.
Methods of physical and geochemical stratigraphy. Correlations. Global syntheses.
Geohistory. Pre-Cambrian. Paleozoic. Caledonic and Hercinian or Variscan Orogenic cycles. Mesozoic. Alpine orogenic cycle.
Paleoclimatology. Cenozoic. Continuation of the Alpine orogenic cycle, paroxysmal phases. Paleogeography. Paleoclimatology.
Practices
Exercises involving concepts of stratigraphy and lithostratigraphic column design, interpretation.
Field trip, visits to exemplary illustration of outcrops of stratigraphic concepts.

Back

Geological heritage and Museology (HIS10338M)

1. Around a permanent changing concept: cultural and natural heritage
1.1. The concept evolution during the XXth and XXI centuries
1.2. Portuguese legislation and the international framework
1.3. Heritage as a resource. Development and endogenous resources in a global perspective. From development policies to UNESCO Heritage Lists and new development paradigmas
1.5. The geological heritage case
2. Heritage valorisation and museology
2.1. Concept and monument memorial value
2.2. The evolution of museogical mouvement and the diferent kind of museums
2.3. Territorial museums and ecomuseums
3. Landscape and Geological heritage valorisation and museology
3.1. Cultural and heritage landscapes
3.2. Geological heritage and geotourism
3.3. The UNESCO Global GeoParks Network
4. Heritage valorisation and Museums case studies

Back

Dynamics of Sedimentary Basins (GEO10339M)

Theoretical
1. Basic concepts for the analysis of sedimentary basins.
2. Interplay between basin analysis and different thematic areas of Earth Sciences.
3. The Wilson Cycle. The formation and evolution of sedimentary basins related to different models of build-up and evolution of the continental margins.
4. Classification and analysis of sedimentary basins in the framework of plate tectonics. Evolution of sedimentary environments and the sedimentary record in different tectonic contexts.
5. Syn-sedimentary and post-depositional deformation structures as markers of inner or outer basin dinamics.
6. Paleogeographic, paleotectonic and paleoclimatic reconstructions; criteria and methods
7. Basin characteristics for traps and reservoirs and for exploitation of economic resources or the selection of wasting sites.
Practical
Drawing of simplified paleogeographic maps based on geological mapping in sedimentary contexts. Field trips in areas of different tectonic contexts.