UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Sedimentary Petrology

2627-1-F7402Q033

Aims

*In terms of knowledge and understanding, the Sedimentary Petrology course provides a broad spectrum of basic knowledge and an adequate terminology to conduct provenance studies on loose sediments and sedimentary rocks, applying the most modern methodologies and in particular the quantitative analysis of heavy minerals. A ten-year experience of the Provenance Group in many research fields (e.g. Geoarchaeology; Past Climate Studies) will be shared to explain how to address the problems related to field sampling, laboratory sample preparation, the effects of hydraulic selection, weathering and diagenesis, as factors modifying the original detrital mineral assemblages (**DdD1**).*

*Through teaching and practical activities, using the planet as a natural laboratory, students will be able to develop quantitative indicators by applying classical optical techniques to the polarizing microscope and the most modern and advanced methods of mineral recognition in Raman spectroscopy. Students will be educated and made autonomous on how to address and solve problems related to the identification of minerals in different depositional environments and geodynamic contexts. Course participants will be trained in the needs of industry for the good management of georesources, in collaboration and connection with the world of work (**DdD2**).*

*After a detailed analysis and description of most of the heavy mineral groups and rock fragments, we will illustrate a wide range of examples from real cases. The course aims to train the course participants to be able to extract information from sediments and collect mineralogical data that can be used in research and industry, contributing to increasing the students' critical and judgmental skills on the use of natural resources and on sustainability issues (**DdD3**).*

*The final exam part conducted in practical form with the recognition of a selection of minerals under the microscope and in oral form, with a question asking them to present a case study described in a scientific article, will help build their communication skills, using appropriate scientific language (**DdD4**).*

The interactive lessons using the microscope and the Raman spectroscope, with ample moments of collective discussion and scientific commentary on scientific articles and media content (videos, photographs, podcasts), on the topics of the course, will strengthen their ability to study and analyze data in an autonomous and critical way

*(**DdD5**).*

Contents

Introduction to Sedimentary Petrography

Sampling in the field

Laboratory for heavy mineral separation

Petrography of siliciclastic detritus

Heavy-mineral studies

Physical processes

Chemical processes

How to count in provenance studies and data processing

Geochronology of detritus

Applications to georesources

Detailed program

Introduction:
Sedimentary Petrography. Tectonic and sedimentation. Connection between the geological settings and the geology of source rocks and mineralogy of sediments. First cycle and polycyclic sediments.

Sampling in the field:
Strategies for collecting sediments in the field for provenance studies.

Laboratory:
Sampling criteria, preparation and separation of sediments and sedimentary rocks in the laboratory of provenance studies and geochronology.

HM in the laboratory:
HM separation in sand and silt fraction. How to identify transparent and opaque heavy minerals in grain mounts. Polarizing microscope. Raman Spectroscopy. The choice of the counting method. Case histories.

Petrography of siliciclastic detritus:
Principal components. Textures. Classification of sandstones. Classification of rock fragments. Accessories minerals. Models of provenance.

Heavy-mineral studies:
Historical overview. HM in provenance studies. Source rocks of different HM. HM and Plate tectonic.

Physical processes:

Mechanical abrasion. Selection of the minerals to size and density. Selective entrainment. Hydraulic sorting and placer formation. Mineralogical and textural changes during the long-distance transport. Economic implications for strategical elements exploration.

Chemical processes:
Alteration and dissolution in soils. Diagenesis and intrastratal dissolution. Implications for the analysis of origin of clastic rocks. Geochemical and isotopic tracers in provenance studies. Analysis of different grain size: clay, silt and sand. Geochemical and isotopic analyses of sediment in bulk rock versus single mineral approach. Indices of weathering. How to solve the problem of recycling. Case histories and applications.

How to count in provenance studies and data processing:
Single grain versus bulk methods. The choice of the counting method. Big data in provenance studies. Bi-plot. Ternary Plot. MIRAGEM. Raman counting.

Geochronology of detritus:
Fission track of apatite and zircon. U-Pb dating of zircon. Case histories and applications.

Applications to Georesources:
Case histories of interest for oil exploration and to the study of placers containing minerals enriched in REE and essential elements for industry and technology.

Prerequisites

A basic knowledge of mineralogy and petrography is required. It is suggested to combine this course with the contents of the Sedimentary Basins course in order to better understand the links of sedimentary mineralogy and petrography with plate tectonics and regional geology. A strong curiosity and interest in laboratory work and the use of classical and innovative tools in the Earth sciences are helpful in tackling this highly multidisciplinary course. Students interested in georesources and sustainable exploitation of the planet are strongly encouraged to attend this course.

Teaching form

Frontal lessons: lessons will take place face to face as lectures in the classroom and in the laboratory. The pdf of the lessons of the course with the contents and topics covered will be uploaded to the e-learning site, accompanied by an appropriate selection of in-depth bibliography and supplementary material to be searched online via the links indicated. Students' participation in the discussion of the topics covered will be stimulated to facilitate understanding of the topics covered through an active and continuous discussion during the course. The lessons of the course will be made available regularly, together with photographic material; simulated trips with Google Earth; movies and video excerpts. Lessons will not be recorded during this academic year.

Exercises: in the lectures the theory underlying a series of real case studies of sediments will be explained. During the practical lessons, the laboratory for the separation of heavy minerals will be shown and used and lessons will be given on the use of the polarizing microscope and the Raman spectrometer for the identification of minerals.

Breakdown in hours/CFU of Delivered Didactics (DD) and Interactive Teaching (IT): the course teaching hours/CFU subdivision will be distributed as follows
a) 14 two-hour lectures, in person, Delivered Didactics (DD), which includes some moments of Interactive Teaching (IT) to engage students.
b) 12 two-hour lab activities, in person, Interactive Teaching (IT)

All activities a,b, are carried out in person.

Textbook and teaching resource

Pdf of the frontal lessons and references dealing on different topics will be uploaded in e-learning every week.

Free downloadable textbook for the heavy minerals part:

https://www.mdpi.com/journal/minerals/special_issues/heavy_minerals

Standard grain mount of single minerals will be available for each student to learn how to identify heavy minerals by polarizing microscope and Raman spectroscopy.

Semester

The course of Sedimetary Petrography is in the first semester of the 1st year of the Master Thesis program.

The course will start on October, 2026 and will end on January, 2027 and will be conducted in English.

Assessment method

There are no ongoing tests planned.
The skills assessed for the final test are those provided during the frontal lessons,
whose knowledge of the different topics covered and the use of appropriate language will be assessed,
together with the ability to connect the topics covered in class.

The final exam assessment criteria include a general assessment of the knowledge acquired in the course.
The final exam includes a **written test** worth 10 points, in which two slides of heavy minerals from the 12 presented in the course will be presented. Students will be asked to identify them under a polarizing microscope, by completing a form provided by the instructor with information on the mineral's optical properties and its occurrence in the rocks from which they originate;
an **oral exam** worth 20 points (4 questions of 5 points each), which will include an interview on the topics covered in class and the practical exam.

Office hours

The lecturers of the course will be available to students throughout the academic year,
upon appointment and request via e-mail:

The names and emails of the course teachers are listed below:

Sergio Andò: sergio.ando@unimib.it

Eduardo Garzanti: eduardo.garzanti@unimib.it

Alberto Resentini: alberto.resentini@unimib.it

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | AFFORDABLE AND CLEAN ENERGY | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION