UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

# Petrografia del Sedimentario

**2223-1-F7401Q028**

## Aims

This course in Sedimentary Petrography is dedicated to MSc and PhD Students, worldwide interested in heavy mineral identification and provenance studies of sediments and sedimentary rocks carried out with classical optical methods and supported by innovative methods as Raman spectroscopy. Students will be showed how longstanding problems concerning the appropriate identification of detrital minerals can e solved. After detailed analysis of most groups of heavy minerals, and rock fragments we will illustrate a wide range of examples from real case histories from different geological settings in different areas of the world. The course aims at improving student's capability to extract information from detrital sediments and to collect accurate quantitative mineralogical data. We will also explain how to tackle problems related to hydraulic sorting, chemical weathering and diagenesis. Finally, we will illustrate how Raman spectroscopy allows us to correctly identify any mineral in grain mounts or in thin sections. By using this innovative technique we can also assess chemical variability within each heavy-mineral group and compare their diagnostic chemical signatures with different source rocks. We will show you how to apply sedimentary petrography for future Source to Sink studies and to investigate sediment routing system with a multidisciplinary integrated approach for reservoir prediction in georesources.

## 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

The lessons will take place following the instructions of our University in compliance with the rules related to the Covid-19 emergency period.

Lessons will take place face to face as lectures in the classroom and in the laboratory. The contents of the lessons, in the form of slides for each lesson, together with further bibliographic material to support the course, will be made available to students through the e-learning platform of the course. Lessons will not be recorded during this academic year.

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 lessons will be given on the use of the polarizing microscope and the Raman spectrometer for the identification of minerals.

## 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.

In compliance with the University rules for the Covid-19 emergency management, the course will start on 17th of

October, 2022 and will end on 26th of January, 2023 and will be conducted in English.

## Assessment method

The final exam will be divided in a practical exercise to check the knowledge of Attendees with the polarizing microscope on standard slide of heavy minerals, together with an oral exam dealing on the arguments of the entire course.

## 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

AFFORDABLE AND CLEAN ENERGY | CLIMATE ACTION