



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Sedimentary Petrology

2021-1-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 be 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 petroleum industry.

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 Petroleum Geology

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 HM 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 Petroleum Geology: case histories of interest for oil exploration (with contributions by researchers with specific expertise in the field of oil exploration or directly engaged in oil industry).

Prerequisites

A good knowledge of mineralogy and petrography is necessary. A complementary course in Basin analysis for a better understanding of plate tectonic and regional geology is also important. A real interest in learning techniques for the study of the mineralogy of sediments in the laboratory of sedimentology and sedimentary petrography is strongly recommended. Students interested in petroleum geology are strongly encouraged to follow this course.

Teaching form

Following the indications of our University and the rules related to the Covid-19 emergency period, the lessons will take place remotely and will be videotaped in synchronous and asynchronous mode.

Practical laboratory lessons will also be held in the presence of shifts that will be communicated during the course based on the number of students enrolled.

The recorded lessons will be accessible through the e-learning platform.

The lectures will explain the theory behind a series of real case studies. During the practical exercises, 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.

Semester

The course of Sedimentary 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, t_____

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

Every lesson I will be at disposal of students for further questions and also on demand only by an e-mail request.
