UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Petrogenesis and Geodynamic Setting

2223-2-F7401Q105

Aims

The course aims to provide advanced knowledge on the igneous and metamorphic petrological processes characterizing the chemical and tectonic evolution of the lithosphere in the main geodynamic settings. The lessons will cover:

The study of phase diagrams and phase equilibria in chemical systems representative of oceanic crust rocks and the lithospheric mantle.

The geochemical and phase equilibria modeling for the construction of quantitative models on magmatic petrogenesis in different geodynamic contexts.

The chemical and physical role of the fluid phases in the subduction processes and the metasomatism and refertilization of the supra-subduction mantle.

The analysis of Plio-Quaternary magmatism in Italy in the context of recent geodynamic models.

Laboratory classes aimed at learning the main analytical techniques for the study of fluid phases: fluid inclusions and Raman microspectroscopy.

The goal of the course is to provide students a multidisciplinary approach, aimed at integrating igneous and metamorphic petrology with terrestrial geodynamics.

Contents

Analysis of the crystallization / melting processes of igneous rocks, with emphasis on phase relationships and on the geochemical evolution of magmas as geodynamic tracers. Genesis and evolution of orogenic and anorogenic magmatism. Role of the fluid phases in the processes of refertilization and partial fusion of the supra-subduction

mantle. Main analytical techniques aimed at studying volatile phases in rocks. The example of study is represented by the recent Italian magmatism, analyzed in the framework of recent geodynamic models.

Detailed program

Introduction to the study of igneous rocks: Composition of magmas, differentiation processes, assimilation, Magma Mixing / Hybridization, partial melting.

Petrogenetic modeling: Ternary phase diagrams with congruent and incongruent melting, and projections of the Ne-Fo-Di-Si system (Yoder and Tilley).

Metasomatism and partial melting processes of the mantle: Modal and cryptic metasomatism. Geochemical characterization of fluids and melts in the lithospheric mantle, and enrichment and fertilization processes. Petrological meaning of diamonds in different geodynamic contexts.

Evolution of the lithosphere during active subduction. High-pressure hydrate and carbonate phase stability in mafic and pelitic systems and devolatilization processes during sub-subduction at sub-arc depth. Physical and chemical characterization of COH fluids released during deep subduction.

Geochemistry and Geodynamics: Behavior of trace elements in melting and crystallization processes. Spider diagrams. Systematics of radiogenic and stable isotopes; HIMU, EMI, EMII, FOZO mantle reservoirs, and relations with PM. Trace elements and isotopes as geodynamic tracers.

Study of volatile phases in rocks: fluid inclusions. Thermodynamic study of the main H2O, H2O-NaCl, CO2, H2O-SiO2 systems. Phase transition analysis: microthermometry. Introduction to the study of fluid phases by Raman microspectroscopy.

Petrological analysis of the recent Italian magmatism. The geodynamic framework of the western Mediterranean area from the Miocene to the present. The orogenic and anorogonenic magmatism of central-southern Italy. Mantle evolution, the genesis of magmatism, and geodynamics. Terrestrial carbon ingassing and outgassing in Italy.

Prerequisites

Fundamentals of petrography, geodynamics, and structural geology. Basic knowledge of geochemistry and fundamental principles of thermodynamics.

Teaching form

- Lessons (4 credits)

- Laboratory (2 credits)

In the period of recurrence of COVID-19 or coronavirus precautionary measures, I will adjust the course organization partially face-to-face, and/or online or blended teaching.

Textbook and teaching resource

Lecture notes available on the e-learning page

Scientific and Review Articles available on the e-learning page

The following books are suggested for supporting material:

- Philpotts and Ague (2009) Principles of igneous and metamorphic petrology. Cambridge University Press, Cambridge, UK.

- Peccerillo A. (2005) - *Pliocene and Quarternary Volcanism in Italy*. Springer, Berlin. ISBN-13: 9783540258858.

Semester

Second semester

Assessment method

Oral exam: Interview on the topics covered in class and report on in-depth issues not covered in class.

Office hours

Monday 2pm 6pm

Sustainable Development Goals

CLIMATE ACTION