UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Deformation and Metamorphism Along Convergent Margins

**2425-1-F7401Q104**

## Aims

The course aims to provide a multidisciplinary and multiscale approach in the study of the structural geology, metamorphic petrology and geodynamics to investigate the deep processes occurring at subduction zones and the pre- and syn-collisional mechanisms controlling the exhumation of the subducted tectonometamorphic units.

## Contents

The course will deepen the study of the main tectonometamorphic processes responsible of the polyciclic evolution of mature collisional orogens (e.g. Italian Alps) and of the analogies with contemporary active convergent margins (subducting and syn-collisional) as proxy of the current subduction zones.

14 two-hours lessons, in person, DELIVERED DIDACTICS (4 CFU)

Role of the mineral assemblages in the subducting oceanic and continental lithosphere to reconstruct Pressure-Temperature-deformation-time paths (*P-T-d-t paths*). Role of fluid phases and stability of hydrous phases in the slab rheology during subduction and generation of deep earthquakes. Multiscale analysis of deformation and metamorphic processes. Microstructural analysis and blastesis/deformation relations to reconstruct the evolution of tectonometamorphic units in collisional belts.

4 six-hours of field activity (Campus Abroad), INTERACTIVE TEACHING (2 CFU)

Study of the deformation and metamorphic processes at the outcrop scale. Reconstruction of the relative chronology of deformation phases. Use and contextualisation of the field analyses in the tectonic evolution reconstruction and geodynamic modelling of an orogen.

## Detailed program

DELIVERED DIDACTICS (4 CFU)

Evolution of the oceanic lithosphere from the oceanic stage to subduction and phase relations in peridotitic, basaltic and sedimentary systems.

Serpentinisation processes of oceanic mantle and alteration of the crust. Evolution of the lithosphere from the oceanic stage to subduction high pressure conditions. Phase diagrams of hydrous ultramafic system, deserpentinisation reactions and introduction to experimental petrology. Breakdown of antigorite and role in the genesis of the double seismic zone. Stability of hydrous phases at high pressures in mafic systems, devolatilisation processes during the oceanic crust subduction and their implication in the rheology of the subducted crust for the genesis of deep earthquakes and pseudotachylytes.

From microstructures to the orogen.

Integrated use of analyses of the structures at the meso- and microscale, of the blastesis/deformation relations and of the phase diagrams coupled with the use of cutting-edge petrologic modelling in the reconstruction of the tectonic evolution and the relative *P-T-d-t paths*. Thermal, viscous models and phase stability during the subduction of oceanic and continental lithosphere. Nature of the slab-mantle interface and exhumation processes of deep rock units. Tectonometamorphic processes and geodynamic modelling of convergent margins.

FIELDWORK, INTERACTIVE TEACHING (2 CFU)

Advanced techniques for the field structural analysis. Recognition of brittle and ductile deformation structures and reconstruction of their relative chronology at the outcrop scale. Study of the main petrographic characteristics of metamorphic rocks in different chemical systems (ultramafic, mafic and sedimentary). Correlation between the variation of equilibrium mineral assemblages and deformation structures (variation of the rheological behaviour of the rock). Integration of the observations at the outcrop scale with those of the single tectonometamorphic units and of wider sectors of the collisional belt.

## Prerequisites

Fundamentals of Structural Geology, Metamorphic Petrology and Geodynamics. Safety in the Field Course

## Teaching form

The course consists of 28 hours of lessons and 20 hours of fieldwork (2-3 days of field excursion). Lessons will be held from March to May, while fieldwork in June. Attendance to lessons is not mandatory but highly recommended. For the best results is also recommended to attend at least 2/3 of the room lessons.

## Textbook and teaching resource

Lecture notes and fieldwork didactic material will be available on *e*-LEARNING webpage (. Recorded video-lessons will be available if, due the Covid-19 emergency, teaching activity at the University campus will be stopped.

Books:

- Bucher and Grapes (2011) - Petrogenesis of metamorphic rocks. 8th ed. Springer-Verlag Berlin Heidelberg.

- Fossen, H. (2010) - Structural Geology. Cambridge University Press.

- Passchier and Trouw (2005) - Microtectonics. Springer.

## Semester

II Semester

## Assessment method

ORAL EXAMINATION ON THE LECTURES TOPICS. The examination will enable the teachers to verify the degree of learning of the topics addressed during room teaching. teachers will evaluate the student ability to integrate the acquired knowledge on metamorphic petrology, structural geology and tectonics to interpret the tectonometamorphic evolution of tectonic units and their role in the geodynamic context of convergent margins.

5 exam dates are programmed and communicated at the beginning of the academic year.

## Office hours

Every day by appointment contacting the teachers (nadia.malaspina@unimib.it – stefano.zanchetta@unimib.it)) using e-mail ……@campus.unimib.it

## Sustainable Development Goals

QUALITY EDUCATION