



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare		
ACADEMIC YEAR	2022/2023		
BACHELOR'S DEGREE (BSC)	GEOLOGY		
INTEGRATED COURSE	PETROGRAPHY WITH LABORATORY - INTEGRATED COURSE		
CODE	21975		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	GEO/07		
HEAD PROFESSOR(S)	ROTOLO SILVIO GIUSEPPE	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	ROTOLO SILVIO GIUSEPPE	Professore Ordinario	Univ. di PALERMO
CREDITS	10		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	ROTOLO SILVIO GIUSEPPE Wednesday 12:30 14:30 Studio Prof. Rotolo Thursday 12:30 14:30 Studio Prof Rotolo		

DOCENTE: Prof. SILVIO GIUSEPPE ROTOLO

PREREQUISITES	Chemistry, Mineralogy, Geochemistry
LEARNING OUTCOMES	KNOWLEDGE AND UNDERSTANDING Knowledge of the composition of the Earth's interior and rocks of inaccessible Earth. Classification of igneous and metamorphic rocks on the basis of their structural, textural and mineralogical characters. 2) APPLYING KNOWLEDGE AND UNDERSTANDING Ability to encircle macro and microscopic observation in a common mainframe inclusive of familiarity with rock analyses and their geodynamic context. 3) MAKING JUDGEMENTS. capacity to assign a specific geologic environment the given rock and to interpret the geological inferences 4) COMMUNICATION SKILLS ability to explain geological implications and the connection between observations (micro and macroscopic) even to an audience without geological background. 5) LIFELONG LEARNING SKILLS ability to link in an unique mainframe, theory, technology and practice .
ASSESSMENT METHODS	Constant attendance of lessons and labs is matter of positive evaluation. 1) 'In itinere' assesment (not mandatory) focused on exercise on binary and ternary diagrams (Cooling and/or heating a given composition). 2) Final oral examination, including: a) microscopic identification of 2 thin sections of rocks: optical characteristics of minerals, classification, petrogenesis b) identification of 2-3 macroscopic rock samples and related petrogenetic inferences. c) discussion about arguments developed throughout the course. Will be positively evaluated the comprehension of processes and the capacity to present them in an unique mainframe. The examination consists of a minimum number of 8 main questions (open answers) aimed to ascertain the correct use of technical language, capacity of autonomous thinking and crytical perspective. The requirements for minimum evaluation are as follows: classification and positioning in the geologicalpetrographic context the macro and microscopic rock samples; easiness of the linkages among the arguments of the course. The higher the degree of interconnection among the arguments of the course, the higher the final vote.
TEACHING METHODS	Face to face lessons and microscopy lab

MODULE PETROGRAPHY

Prof. SILVIO GIUSEPPE ROTOLO

SUGGESTED BIBLIOGRAPHY

I file di lezione forniti dal Docente se uniti alla frequenza attiva ed attenta sono sufficienti.

Per eventuali approfondimenti:

- Morbidelli (2003). Le rocce e i loro costituenti. Ed. Bardi. ISBN: 8866870641

-Winter (2015) Principles of igneous and metamorphic petrology. Ed. Pearsons. ISBN 10: 0321592573;

ISBN 13: 9780511813429

AMBIT	50189-Ambito mineralogico-petrografico-geochimico
INDIVIDUAL STUDY (Hrs)	119
COURSE ACTIVITY (Hrs)	56

EDUCATIONAL OBJECTIVES OF THE MODULE

The principal educational aim of the course is the acquisition integrated view of theoretical aspects with those involving rock observation-classification and petrogenetic processes of igneous and metamorphic rocks in their geological context.

SYLLABUS

Hrs	Frontal teaching
2	Classification of igneous rocks on the basis of: mineral abundance, chemistry and CIPW norm. The importance of the composition of solid solutions as a proxy for magma composition. Classification of gabbroic rocks.
3	Structure of the Earth from the experimental petrology viewpoint Experiments on mantle peridotites in a historical perspective. Ringwood's experiments on germanates. The discovery of high pressure upper and lower mantle minerals. The outer and inner core: experiments with shock waves. Determination of the solidus of the Earth's core
3	Classification of ultramafic rocks. The mantle adiabat. Partial melting of lherzolite. Refractory rocks and partial melts and the control on degree of melting. Primary magmas: chemical characterization. Picrites and komatiites. The primordial magma ocean
3	Structure of silicate melts. H ₂ O dissolution in silicate melts, effects on magma viscosity/polymerization. Volatile saturation and their influence on crystallization paths. Physical characteristics of magmas and their relationships with melt composition, temperature and H ₂ O content. Magma crystallization, dry and wet solidus. Clapeyron relation. Crystallization due to cooling and due to decompression. Undercooling and related mineral textures.
3	T-X 2 component systems characterized by solid solutions. Equilibrium and fractional crystallization. The significance of mineral zoning: inferences on magma feeding system. 1 T-X Two components systems with eutectic. From phase diagram to the thin section.
3	Two components systems with peritectic point. Enstatite incongruent melting and its broad-scale petrogenetic significance (basalts over- and undersaturated in silica). Two components systems with azeotropic point. Sub-solidus immiscibility.
2	Three components T-X systems: generalities. Diopside-albite-anorthite; diopside-anorthite-forsterite. forsterite-diopside-enstatite. Heating and cooling.
2	Crystallization and melting exercises on binary and ternary diagrams.
3	Magma differentiation processes: fractional crystallization, immiscibility, assimilation. The role of oxygen fugacity on iron-bearing minerals. Magma crystallization stages. The importance of pegmatites and hydrothermal crystallization.
3	Trace elements: compatible and incompatible. Distribution coefficients. Modeling of fractional crystallization and partial melting. Rare earth elements and chondrite normalization. Brief recall of the Sr isotopic ratio in igneous petrology: depleted and enriched mantle sources.
2	Geometries of magmatic bodies. Pyroclastic rocks. Magmatic series and their relationships with plate tectonics, Discriminating diagrams.
2	Magma production at mid ocean ridges. MORB and alkaline basalts. Ophiolites. OIB magmatism: petrography, trace elements and isotopic characterization.
3	Arc magmatism and andesites petrogenesis. The modified mantle. Calcalkaline and shoshonitic series. Super-volcanoes tied to subduction. Amphibole stability in CA magmas and its breakdown during magma ascent. The H ₂ O transport in the deep mantle. The fate of the subducted slab.

2	Within plate magmatism, continental flood basalts. Peralkaline magmas and the petrogenesis of pantellerites. Plio quaternary magmatism in Sicily.
2	Carbonatites and carbonated mantle. Stability of carbonates in Iherzolite subsolidus. Carbon speciation in the Earth's mantle as a function of P and fO ₂ . Kimberlites and their significance. Diamond formation. Moissanite
2	Petrography of granitoid magmas and their classification schemes. I and S granites. Anatexis. Alteration processes of granitic rocks. The residual system and the phonolite minimum. The importance and occurrence of leucite in Italian magmatism.
2	The Moon: mare basalts and anorthosites. The moon magma ocean. Meteorites: classification and importance as proxies for inaccessible Earth (chondrites, pallasites, siderites). Tektites and fulgurites.
2	Classification of arenitic rocks. Clays and clay minerals. Structural classification of clay minerals. X-ray diffractometry.
2	Metamorphic processes. Foliation and lineation. Relationships between crystallization and deformation. Mylonites. Nomenclature of metamorphic rocks.
4	Index minerals. facies and isograds concepts. Regional metamorphism. Metamorphism and geodynamic setting. Metamorphic reactions : dehydration, decarbonation, partial melting. The role of fluid composition (XCO ₂ , XH ₂ O) on reaction rate and progress . The Clapeyron relation applied to metamorphic reactions: Clapeyron slope and its significance in devolatilization reactions. The phase rule applied to metamorphic reactions. Examples and exercises
2	Metamorphism of pelitic rocks. Anchimetamorphism and Illite crystallinity index. The amphibolite facies minerals in metapelites. Kaolinite-out and muscovite-out reactions. Anatexis and migmatites. Granulites
2	Metamorphism of mafic rocks. Zeolite facies. Amphibole compositional variations with metamorphic grade. Mafic granulites. High and very high pressure metamorphism, blueschists and eclogite
1	Metamorphism of calcareous rocks. Decarbonation reactions and the importance of fluid composition (XCO ₂).
1	P-T-t paths, theory and applications to microstructures. Metamorphic basements in Italy: Alps, Sardinia, Calabria-Peloritani orogen.

**MODULE
PETROGRAPHY LABORATORY**

Prof. SILVIO GIUSEPPE ROTOLO

SUGGESTED BIBLIOGRAPHY

Morbidelli L . Le rocce ed i loro costituenti.
- Atlante microscopico: [http:// alexstrekeisen.it](http://alexstrekeisen.it)

AMBIT	10707-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	27
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

deciphering the hidden history of a rock both in a thin section and in a macroscopic sample;

SYLLABUS

Hrs	Workshops
3	Generalities on Scanning Electron Microscopy and EDS spectra. X-Ray diffractometry. X-Ray fluorescence. General criteria for macro- and microscopic description of rocks. Microscopic determination of evolution of the given magmatic rock on the basis of solid solution minerals (particularly pyroxenes).
29	Study of more than 50 macroscopic samples of magmatic rocks. Classification, petrogenetic aspects, Thin section study of around 10 samples of igneous rocks, with description of their geological context and crystallization history.
2	Arenaceous rocks in thin section and macroscopic samples.
14	Macroscopic study of more than 30 samples of metamorphic rocks: (a) protolith, (b) metamorphic conditions, (c) type of metamorphism. Study in thin section of 7 metamorphic rocks: (i) classification, (ii) protolith, (iii) metamorphic facies, (iv) whenever possible: P-T-t paths.