



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare		
ACADEMIC YEAR	2023/2024		
MASTER'S DEGREE (MSC)	GEORISKS AND GEORESOURCES		
SUBJECT	VOLCANIC ACTIVITY SURVEILLANCE		
TYPE OF EDUCATIONAL ACTIVITY	C		
AMBIT	21015-Attività formative affini o integrative		
CODE	19834		
SCIENTIFIC SECTOR(S)	GEO/08		
HEAD PROFESSOR(S)	CALABRESE SERGIO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)			
CREDITS	6		
INDIVIDUAL STUDY (Hrs)	86		
COURSE ACTIVITY (Hrs)	64		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	CALABRESE SERGIO Tuesday 10:00 13:00 Via Archirafi 36, terzo piano, stanza III-8 Thursday 10:00 13:00 Via Archirafi 36, terzo piano, stanza III-8		

DOCENTE: Prof. SERGIO CALABRESE

PREREQUISITES	Basic background on Earth Sciences; Basic principles of physics and chemistry of the Earth; Geochemistry and Volcanology.
LEARNING OUTCOMES	Aim of the course is to supply a robust knowledge and skills concerning the theoretical and experimental aspects of monitoring of active volcanoes. Starting from chemical-physics laws ruling the magmatic degassing, the necessary tools to evaluate the most correct geochemical parameters will be treated. Looking at real cases and considering a set of geochemical tracers, the course aims to give to students the correct skills to evaluate the hazard level of a particular volcano in a particular moment.
ASSESSMENT METHODS	Oral exam with practical exercises focused and geochemical data processing; evaluation of a written report focused on discussion of data processed during the course. The test will ascertain: (I) the adoption of an appropriate technical language, (ii) a critical and independent reasoning, (iii) ability to make connections between various topics of the course.
EDUCATIONAL OBJECTIVES	The aim of the course is to give a robust knowledge and skills concerning the theoretical and experimental aspects of geochemical and geophysical monitoring of active volcanoes, finalized to the comprehension of eruptive dynamics, to the definition of the main geophysical and geochemical parameters that are crucial for volcanic surveillance. In particular, the course aims to give to students the correct skills on modern techniques using analysis of discrete and continuous signals acquired by integrated geochemical networks (UV cameras, MultiGas stations, etc.). Acquisition of theoretical and practical backgrounds, on modern geochemical monitoring techniques of active volcanoes. Laboratory and field activities activity.
TEACHING METHODS	Frontal lessons and practical exercises on processing of geochemical data; Educational laboratories aimed at understanding the principle of data acquisition and processing in volcanic environment using modern geochemical instruments and software; working table; problem based learning approach; laboratory and field activities.
SUGGESTED BIBLIOGRAPHY	<p>Volatiles in Magmas. Volume 30. Michael R. Carroll and John R. Holloway, editors 1994, i-xviii + 517 pages. ISBN 0-939950-36-7; ISBN13 978-0-939950-36-2 - http://www.minsocam.org/MSA/RIM/rim30.html</p> <p>The Encyclopedia of Volcanoes. ISBN 978-0-12-385938-9. - https://www.sciencedirect.com/book/9780123859389/the-encyclopedia-ofvolcanoes#book-info</p> <p>R. Scarpa, R. I. Tilling, Monitoring and Mitigation of Volcano Hazards. Springer</p> <p>Sigurdsson H. ed. 2000, Encyclopedia of Volcanoes. Academic Press - https://www.springer.com/gb/book/9783642800894</p> <p>Recent scientific articles on geochemical monitoring of active volcanoes will be provided.</p>

SYLLABUS

Hrs	Frontal teaching
2	presentation and introduction to the course;
5	Preliminary Concepts: Volcanoes and geodynamics; types of volcanoes and volcanic eruptions; volcanic risk, hazard and vulnerability; volcanic surveillance and monitoring; approaches to volcanic monitoring: geophysics, geochemistry, geodesy; monitoring networks; pre- and post-eruptive monitoring; continuous and discrete, in situ and remote monitoring.
5	Theoretical principles The geochemical approach and general principles: fluid release from magmas, processes of exsolution, decompression and crystallisation. Outgassing processes thermodynamics, concepts of gas fugacity, chemical and isotopic equilibrium. Chemical and isotopic fractionation processes - Fluid migration and evidence of outgassing: volcanic plumes, fumaroles, gases diffused from soils, hydrothermal fluids and dissolved gases.
3	"Applications Identification of the magmatic component, contamination of surface/atmospheric fluids, mixing of magmatic and hydrothermal and surface fluids, interactions with thermal aquifers, use of isotopic markers - Estimation of magma exsolution pressure with major and inert species, geothermometry and geobarometry and redox conditions with reactive volatile species, use of isotopic systems (C, S) - Budgeting of magmatic volatiles, fluid/magma ratios and degassing magma volumes".
6	Impact of volcanic activity and effects on the environment and human health; volcanic emissions, gases, particulate matter and the impact of volcanic ash. Classical atmospheric deposition monitoring techniques, deposition estimation. Active and passive biomonitoring techniques.
5	Introduction to geophysical monitoring and general principles. Basic information on the main geophysical disciplines such as seismology, ground deformation and geodesy, infrasound and thermal analysis. Case studies

SYLLABUS

Hrs	Frontal teaching
6	Instrumental networks for geochemical and geophysical monitoring: water and gas, atmospheric deposition, permanent and mobile seismic networks, permanent and mobile GPS networks, clinometric networks. The main Italian and foreign volcanic monitoring networks. Surveillance and monitoring activities within the framework of memoranda of understanding with the Civil Protection Department. H24 operational rooms: their functioning and purpose; educational visit to the monitoring rooms of the National Institute of Geophysics and Volcanology in Catania (Etnean Observatory) and to the laboratories of the Palermo section.
Hrs	Workshops
12	Teaching workshop on the use of instrumentation for volcanic monitoring: accumulation chamber for diffuse gases; MultiGAS equipment for volcanic gas sampling; natural water and dissolved gas sampling. Geochemical data processing and statistical analysis using spreadsheets and dedicated software. Construction of graphs for the representation of geochemical data and realisation of process curves using calculation codes. Laboratory analysis experience (sample handling and preparation; volumetric titrations, ion chromatography, spectrophotometry, mass spectrometry)
20	Educational field laboratory experience: excursions and didactic exercises with field demonstrations and practical activities on the use of instrumentation dedicated to volcanic monitoring and surveillance (accumulation chamber for diffuse gases; MultiGAS equipment for volcanic gas sampling; sampling of natural waters and dissolved gases; discrete sampling of fumaroles and volcanic plumes). Potential study areas will be Etna, the island of Vulcano, and the thermal area of Alcamo. The activities will vary depending on weather conditions, volcanic activity, the availability of means of transport and financial availability of the CDS; in the absence of resources, adverse conditions, provisions and restrictions related to the pandemic evolution, the activities will be rescheduled and will be carried out at the laboratories and facilities of the DiSTeM