**CORSI DI DOTTORATO IN**

**SCIENZE DELLA TERRA**

**E**

**EARTH AND PLANETARY SCIENCES**

**DIDATTICA INTERNA aa 2023-2024**

**CORSI PROPOSTI DALLA SEDE DI FIRENZE**

**AVANZINELLI RICCARDO (**[**riccardo.avanzinelli@unifi.it**](mailto:riccardo.avanzinelli@unifi.it)**)**

**Measurements of isotope ratios through TIMS and MC-ICPMS and applications to Geosciences (6 ore, 1 CFU)**

**(DATE: 2nd half of June 2024)**

The aim of the course is to provide the basics knowledge of the analytical procedures for themeasurements of isotope ratios via multicollector Thermal (TIMS) andPlasma-sourced (MC-ICPMS) Mass Spectrometer. The course consists in 1 lessons (3 hours)and a laboratory experience (3 hours) at the Radiogenic Isotope Geochemistry Laboratory ofthe Università degli Studi di Firenze.Lesson 1 (3 hours): brief introduction to isotopes; chemical methods for samplepurification through cation exchange chromatography; description of TIMS and MCICPMSand differences. Corrections and key issues related to the measurements ofisotope ratios (e.g. Mass Bias and its correction). Static vs. Multidynamicmeasurements. Isotope Dilution measurements. Description of the completeanalytical procedure for selected isotopic systematics (e.g. Sr, Pb, U-Th).Lab experience (3 hours): Visit to the Radiogenic Isotope Geochemistry Laboratoryof the Università degli Studi di Firenze with practical experience of operating a TIMSinstrument for the measurements of isotopic ratios.

**BELVEDERE MATTEO (**[**matteo.belvedere@unifi.it**](mailto:matteo.belvedere@unifi.it)**)**

**Close-range photogrammetry paleontology and museum heritage. From**

**pictures to 3D models basics (12 ore, 2 CFU)**

**(DATE:** **to be defined with the participants – end of January-1st week of February 2024)**

3D data production and visualization have become an integral part of archaeological,

paleontological studies and is increasing its importance in museum heritage

conservation.

Close-range photogrammetry (surface 3D digitizing from digital photographs) is one of

the most used, relatively cheap, and versatile method used for surface digitization.

This course will teach the basics of photogrammetry for paleontology and museum

heritage.

Lesson 1: theoretical basic knowledge of Structure-from-Motion photogrammetry and

how to take pictures

Lesson 2: workflow and comparison of the most commonly used software.

Lessons 3-4: practical lessons with samples brought by participants.

Participant number is limited to 10-15 (depending on next year’s distancing rules); the

course is primarily addressed to doctoral and master students; other participants are

also welcome, although priority will be given to the previous categories. On the base of

the nationality of participants, the course will be held in Italian or English.

Registration deadline 10 January 2024

For information, final dates and registration please contact Dr. Matteo Belvedere:

(matteo.belvedere@unifi.it)

**BIANCHINI SILVIA (**[**silvia.bianchini@unifi.it**](mailto:silvia.bianchini@unifi.it)**)**

**Tecniche di detection and mapping da dati radar interferometrici satellitari**

**applicate all’instabilità del terreno e dei manufatti (6 ore, 1 CFU)**

**(DATE: giugno – luglio 2024)**

Il corso consiste in lezioni frontali ed esercitazioni pratiche (su software ArcGIS pro) e si pone l'obiettivo di fornire conoscenze sui seguenti argomenti: cenni teorici di base di interferometria radar satellitare differenziale e multi-temporale PSI (Persistent Scatterers Interferometry); procedure e tecniche radar-interpretazione di dati radar interferometrici satellitari PSI per l’identificazione, mappatura e caratterizzazione di spostamenti del terreno a scala regionale e a scala locale.

**BUCCIANTI ANTONELLA (**[**antonella.buccianti@unifi.it**](mailto:antonella.buccianti@unifi.it)**)**

**Statistical Analysis of Compositional Data (6 ore, 1 CFU)**

**(DATE: September 2024, first week)**

Since Karl Parson wrote his paper on spurious correlation in 1897 a lot has been said about the statistical analysis of compositional data. The solution appeared in the 1980s when John Aitchison proposed to use logratios. Since then the approach has seen a great expansion, mainly building on the idea of the “natural geometry” of the sample space. Statistics is expected to give sense to our perception of the natural scale of the data, and this is made possible for compositional data using logratios. The aim of the course is to provide the basics knowledge of the statistical analysis of compositional data. It will be of interest of people working in different fields of science and includes information about methodology, case studies and user-friendly software.

**DELLA SCHIAVA ELENA (**[**elenadellaschiava@libero.it**](mailto:elenadellaschiava@libero.it)**)**

**Indagini sui beni culturali durante il restauro: le terre di fusione di alcune sculture**

**bronzee di Donatello e di altri autori del Rinascimento fiorentino (6 ore, 1 CFU)**

**(DATE: March 2024 to be defined with the students)**

- Introduzione

(spiegazione dei lavori eseguiti, foto, esempi di alcune indagini su varie opere,

obiettivi raggiunti)

- Cosa sono le terre di fusione nello specifico; le tecniche di fusione

(foto, esempi, campioni di terre, opere, realizzazione di una scultura)

- Le tecniche analitiche per caratterizzare le terre

- Lo stato dell'arte sulle terre di fusione delle sculture

(articoli di restauro, scientifici, bibliografie e letteratura)

- Considerazioni tecnologiche

(il contributo alle indagini tecnologiche dei bronzi dato dagli studi sulle terre)

- Problematiche di conservazione delle terre in situ nelle statue

(svuotamento, fenomeni di interfaccia metallo/anima)

- Come campionare le terre di fusione per ottimizzare i risultati analitici

- Campioni di terre: carrellata di esempi pratici di opere d'arte con visione di campioni

prelevati

- Le terre di fusione del San Giovanni Battista (1571) di Vincenzo Danti

(campionamento, indagini, obiettivi, risultati)

- Le terre di fusione di alcune sculture donatelliane realizzate fra gli anni '20 e '60 del

XV secolo (campionamento, indagini, obiettivi, risultati)

- Conclusioni.

**GOZZI CATERINA (1) (**[**caterina.gozzi@unifi.it**](mailto:caterina.gozzi@unifi.it)**)**

**Introduction & Basics of R (8 ore, 1,33 CFU)**

**(DATE: 2nd half of June 2024)**

R is both a programming language and an interactive environment for statistics with

an extensive catalog of statistical and graphical methods. Its flexibility, power,

sophistication, have made it an invaluable tool for scientists around the world. The

aim of the course is to provide the basics to start using the R software. The course is

organized in 2 lessons of 4 hours each and will be held at the Department of Earth

Science of the University of Florence.

Lesson 1: An Introduction to R: How to install R and RStudio, launching RStudio,

overview of the key components and features available, commands, operators and

functions, help window.

Lesson 2: R applications to Earth Sciences: practical exercises in R using a

geochemical dataset: reading data into the software, basics of research statistics,

exploratory data analysis and production of different types of plots in ggplot2 and

plotly packages (e.g. histograms, box-plots, bubble plots and correlations matrices)

**GOZZI CATERINA (2) (**[**caterina.gozzi@unifi.it**](mailto:caterina.gozzi@unifi.it)**)**

**Writing the PhD Thesis in LaTeX (4 ore, 0,66 CFU)**

**(DATE: 2nd half of May 2024 to be defined with the students)**

LaTeX is a powerful document preparation system for high-quality typesetting. It is

most often used for medium-to-large technical or scientific documents but it can be

used for almost any form of publishing. It was created by scientists for scientists and

it has a large and active community of users. The aim of the course is to provide the

basic knowledge to start typesetting a PhD thesis using LaTeX. The course is

organized in 2 lessons of 2 hours each and will be held at the Department of Earth

Science of the University of Florence.

Lesson 1: An Introduction to LaTeX: The advantages of using LaTeX, typesetting

text, font types, LaTeX environments, packages and templates.

Lesson 2: How to Write the Thesis in LaTeX: basic structure, sectioning, crossreferences, tables and figures, bibliography generation with Bibdesk.

**LEPORE GIOVANNI ORAZIO (**[**giovanniorazio.lepore@unifi.it**](mailto:giovanniorazio.lepore@unifi.it)**)**

**Practical introduction to X-ray absorption spectroscopy (XAS) with applications to mineralogical and environmental sciences - Introduzione pratica alla spettroscopia di assorbimento di raggi X (XAS) con applicazioni alla mineralogia e all’ambiente**

**(12 ore, 2 CFU)**

**(DATE: to be defined with the students)**

- Introduzione alle sorgenti di luce di sincrotrone.

- Introduzione teorica alla spettroscopia di assorbimento di raggi X (XAS).

- Tutorial pratico sull’analisi di dati XAS.

- Applicazioni alla mineralogia e alle scienze ambientali.

Il corso prevede lezioni frontali ed esercitazioni.

- Introduction to synchrotron light sources.

- Introduction to X-ray Absorption Spectroscopy (XAS).

- Practical tutorial on XAS data analysis.

- Applications to mineralogical and environmental sciences.

Class lectures and exercises.

**MAESTRELLI DANIELE (**[**daniele.maestrelli@gmail.com**](mailto:daniele.maestrelli@gmail.com)**)**

**Analogue modelling of volcano-tectonic processes: from nature to lab**

**(12 ore, 2 CFU)**

**Date: June, to be defined with students.**

The aim of the course is to provide PhD students with an introduction to the study of

volcano-tectonic processes in various tectonic contexts, from local- to regional-scale,

through the use of advanced analogue modelling techniques and dedicated analyses.

Main topics:

• Introduction to analogue modelling techniques applied to the study of volcano-tectonic processes.

• The volcano-tectonic processes and magma-related deformations seen through analogue models: case studies and practical implications. From magma migration to magma emplacement/eruption and associated deformations: magma versus rifting (magma assisted rifting); magma emplacement in compressive and transcurrent settings; the structural control of local- to regional- scale tectonics on the formation and evolution of collapsed calderas and volcanic edifices; volcanic edifices and post collapse calderas deformation, caldera resurgence-associated deformation.

• Practice: modelling volcano-tectonic processes, lab exercises and analyses.

**MANCA ROSAROSA (**[**rosarosa.manca@unifi.it**](mailto:rosarosa.manca@unifi.it)**)**

**Applications of X-rays based techniques for the non-invasive characterization of geomaterials in cultural heritage (6 hours, 1 CFU)**

**(date: March-June 2024 - to be defined with the participants)**

The course aims at providing an overview of the possible applications of X-ray Fluorescence (XRF) spectroscopy and Particle-Induced X-ray Emission (PIXE) analysis to the non-invasive characterization of geomaterials, with a specific focus on the field of cultural heritage.

The principles of the two techniques will be presented and compared. The cases of ancient gold jewellery and glazed pottery will be examined. The course includes a visit to the XRF lab of the Earth Sciences Department (Unifi) and to the LABEC, INFN, Sesto Fiorentino.

Part 1: Introduction on Geomaterials and Cultural Heritage. Non-invasive approaches: advantages and limitations. X-rays Fluorescence (XRF) spectroscopy, Particle-Induced X-ray Emission (PIXE) and Particle-Induced Gamma Emission (PIGE) analyses: introduction to basic theory.

Part 2: Case studies in the field of Cultural Heritage:

a) XRF and PIXE analysis of gold jewellery. Quantification and ternary diagrams. Secondary filters for detection of trace elements. Study of compositional gradients from the surface to the subsurface.

b) XRF and PIXE-PIGE analysis of glazes. The problems of light elements and overlapping X-rays lines. Indirect information on the layer structure.

**MARCHETTI EMANUELE (emanuele.marchetti@unifi.it)**

**Infrasound array analysis of gravity currents (12 ore, 2 CFU)**

**(June-September 2024 to be defined with the students)**

- Introduction to time series analysis (spectral analysis, filtering, coherence and

crosscorrelation)

- Infrasound acoustics, source mechanisms and array analysis.

- Source mechanisms of different gravity currents, (snow avalanches, debris flows,

calving events, PDC)

- Fluid dynamics modeling of pressure waveforms.

- Real-time application for event detection, identification and notification.

- Implication for research and monitoring.

**NATALI CLAUDIO (claudio.natali@unifi.it)**

**Identificazione di tenori di fondo geogenici e anomalie di origine**

**antropogenica in sistemi ambientali (6 ore, 1 CFU)**

**(DATE: to be defined with the students – 2 last weeks of July)**

Il Corso si articola in 3 lezioni della durata di 2 ore che riguarderanno metodi di

indagine per lo studio della variabilità naturale e l’identificazione dei contributi di

origine antropogenica in diversi contesti ambientali (suoli, fiumi, lagune costiere).

Saranno presentati vari casi di studio in cui si è potuto identificare il legame fra la

matrice investigata (acqua, solido sospeso, sedimento di fondo, suolo) e le rocce del

bacino di provenienza, gli accumuli preferenziali di alcuni metalli pesanti in relazione a

diversi contesti deposizionali ed i contributi di origine antropogenica. Saranno illustrate

le potenzialità dell’approccio di studio petrografico-geochimico a tali problematiche, e

si affronteranno inoltre aspetti relativi alla vigente normativa ambientale.

**MORANA MARTA (**[**marta.morana@unifi.it**](mailto:marta.morana@unifi.it)**)**

**1) High-pressure experimental techniques**

**Metodi sperimentali ad alta pressione**

**12 ore, 2 CFU Date: to be defined with the participants**

Introduction to high-pressure experimental techniques; piston-cylinder and multianvil techniques; diamond anvil cells techniques; probing techniques based on electromagnetic radiation; pressure and equation of state; dynamic compression; synchrotron and neutron studies in Earth and planetary sciences.

Only class lectures.

Introduzione ai metodi sperimentali ad alta pressione; dispositivi piston-cylinder e multianvil; celle a incudine di diamante; tecniche di caratterizzazione ad alta pressione; pressione ed equazioni di stato; compressione dinamica; applicazioni con neutroni e luce di sincrotrone nelle scienze delle Terra e planetarie.

Il corso prevede solo lezioni frontali.

**2) Physical aspects of color**

**Fisica del colore**

**12 ore, 2 CFU Date: to be defined with the participants**

Light and color; polarization and crystals: refraction, dichroism, pleochroism; color from atoms and ions: crystal field theory; impurity colors; luminescence.

Only class lectures.

Luce e colore; polarizzazione e cristalli: rifrazione, dicroismo, pleocroismo; colore, atomi e ioni: teoria del campo cristallino; colore e impurezze; luminescenza.

Il corso prevede solo lezioni frontali.

**RIZZO ROBERTO EMANUELE (robertoemanuele.rizzo@unifi.it)**

**Faults and fractures networks in geoenergy applications**

**(6 ore, 1 CFU)**

**(DATE: 2nd half of June 2024** **to be defined with the students)**

Faults and fracture zones are fundamental features of geological reservoirs that control the physical properties of the rock. As such, understanding their role in in-situ fluid behavior and fluid-rock interactions can generate considerable advantages during exploration and management of reservoirs and repositories.

Review on the physical properties such as frictional strength, cohesion of faulted and fractured rock masses.

Statistical analysis of fault and fracture networks and their implications in fluid transport in the subsurface.

Modelling of fluid permeability of fractured rock masses.