



MEREMA 3rd edition

International School of Mantle Petrology

September 29th - October 2nd 2026, Volterra (Italy)

International School on Mantle Petrology:
from nano- to global scale

PROGRAM THEMES

- Sampling the Earth's mantle, what we achieved and what is missing. Messages from xenoliths, mantle outcrops, lithosphere drilling and insights from basalts compositions.
- Mantle processes at the nano- to micro- scale. Gain insights into the fine-scale dynamics of mantle materials through petrological, structural, and geochemical observations, supported by experimental studies and cutting-edge analytical techniques.
- Global scale mantle dynamics. Discover how petrology, geophysics, and numerical modelling come together to unravel the large-scale dynamics of the Earth's mantle, connecting small-scale processes to planetary evolution.

MEREMA3 SCHOOL PROGRAM

Day #0 (29th September)

18.30-20.30 Ice breaker party (buffet dinner and music)

Day #1

8.30-9.00 Welcome and Opening

9.00-10.30 **Sonja Aulbach** (Frankfurt, Germany): “Origin, evolution and structure of continental lithospheric mantle”.

This lesson will first review ancient continental lithosphere sampled by kimberlite-borne xenoliths as a witness to Earth’s earliest continent formation and evolution. It will then discuss orogenic peridotites and off-craton basalt-borne xenoliths as samples of continental subduction zones and rifts, respectively, and their significance as part of the orogenic cycle.

10.30-11.00 Coffee break

11.00-12.30 **Romain Tilhac** (Montpellier, France): “New geochemical perspectives on mantle magmatism: from field observations to numerical models”:

This lecture will revisit conceptual models of mantle magmatism, moving from classical frameworks developed from the study of oceanic basalts toward coupled thermodynamic and thermo-mechanical approaches. Through examples, we will show how numerical models can be implemented to better capture natural complexities documented in exposed mantle terranes (heterogeneities, channelized flow, chemical disequilibrium) and their geochemical implications.

13.00-14.00 Lunch at SIAF

14.00-15.30 **Daniele Brunelli** (Modena, Italy) – “Mid-ocean ridge basalts and abyssal peridotites: implications for mantle heterogeneity and partial melting”.

This lesson will examine the present-day compositional variability of the mid-ocean ridge mantle and MORBs, and its implications for mantle composition and partial melting. It also will show how temporal sections help constrain mantle source characteristics, and how low-temperature ridge regions allow the separation of mantle lithological components based on their solidus temperatures.

15.30-16.00 Coffee break

16.00-17.30 **Chuan-Zhou Liu** (Beijing, China): “Asthenospheric mantle heterogeneity recorded in mantle sequences from ocean ridges and ophiolites”.

This lecture will focus on asthenospheric mantle heterogeneity as recorded by peridotites from modern ocean ridges and from ophiolites, with particular emphasis on the Yarlung–Tsangpo ophiolites of the Tibetan Plateau. Drawing on decades of work and recent advances, the lesson will discuss how these records inform our understanding of mantle processes and variability.

17.30-19.30 One-slide flash talks for presenting the posters and poster section

20.00/20.30 Free dinner in Volterra

Day #2

9.00-10.30 **Andrea Tommasi** (Montpellier, France): “Mantle deformation: linking microstructures to flow dynamics”.

This course will focus on deformation mechanisms in the mantle, linking microstructural observations to rheological behavior (flow laws, and potentially anisotropy). The aim is to build a continuum with modelling approaches.

10.30-11.00 Coffee break

11.00-12.30 **Stephan Klemme** (Muenster, Germany) – “Simulating the Earth in the laboratory”.

This lecture will explore experimental methods with which mantle processes can be studied, ranging from classical melting experiments to simulations of mantle metasomatism and melting of exotic volatile-rich mantle compositions. We will also compare terrestrial mantle processes to those of the Moon, Mercury, and Venus.

13.00-14.00 Lunch at SIAF

14.00-15.30 **Carolina Lithgow-Bertelloni** (California, U.S.A.): “Thermodynamics and phase transitions in mantle convection: implications for flow and thermal evolution”.

This lecture will focus on the effects of thermodynamics and phase transitions on mantle flow and Earth’s thermal evolution. It will address the challenges of capturing sharp phase transitions in numerical models and the need to move away from traditional approximations.

15.30-16.00 Coffee break

16.00-18.00 **Lars Stixrude** (California, U.S.A.) – “HeFESTo: a practical session”.

HeFESTo is a code that uses the principles of thermodynamics combined with semi-empirical thermodynamic models of mantle phases to explore mineralogical models of Earth’s mantle. The purpose is to introduce participants to thermodynamic concepts and to explore the relationship between the properties of minerals, mineral assemblages (rocks) and Earth.

18.00-20.00 Poster section

20.30 Social dinner at Villa Nencini (Volterra)

Day #3

9.00-10.30 **Manuele Faccenda** (Padova, Italy) – “What it takes to model the Earth: multidisciplinary and multi-scale numerical modeling in Earth Sciences”.

This lesson provides a general introduction to numerical geodynamic modelling, with an emphasis on the physical, mathematical, and numerical ingredients required to construct realistic models of Earth dynamics. The second part of the presentation focuses on subduction-zone-related processes, illustrating how numerical models can be used to reproduce multidisciplinary and multi-scale mechanisms while highlighting their underlying assumptions and limitations.

10.30-11.00 Coffee break

11.00-12.30 **Marco Cuffaro** (IGAG, Roma, Italy): “Ridge-transform-ridge systems: from geophysical observations to thermo-mechanical modeling”.

This lesson will focus first on geodynamics and plate kinematics of the ridge-transform-ridge systems along divergent plate boundaries. It will briefly show geophysical data acquired at sea, some of them useful to constrain half spreading rates used as boundary conditions when modelling mantle thermal structure. A second part will explore thermo-mechanical numerical modelling utilizing different methods, rheologies, and flow laws.

13.00-14.00 Lunch at SIAF

14.00-15.30 **Andreas Stracke** (Muenster, Germany) – “A data science approach to chemical geodynamics”.

Extracting the underlying processes that shape the chemical geodynamic evolution of Earth’s mantle and crust from global, multi-dimensional data sets of oceanic basalts requires modern multivariate statistic and machine learning techniques. We will show how different data science approaches, based on proper treatment of geochemical data, can be used to extract quantitative information about mantle source compositions, and relate basalt compositions quantitatively to the geodynamic and geophysical parameters that influence melt generation, and mantle evolution in general.

15.30-16.00 Coffee break

16.00-17.00 Mantle Network informal meeting

17.00 Greetings and departures