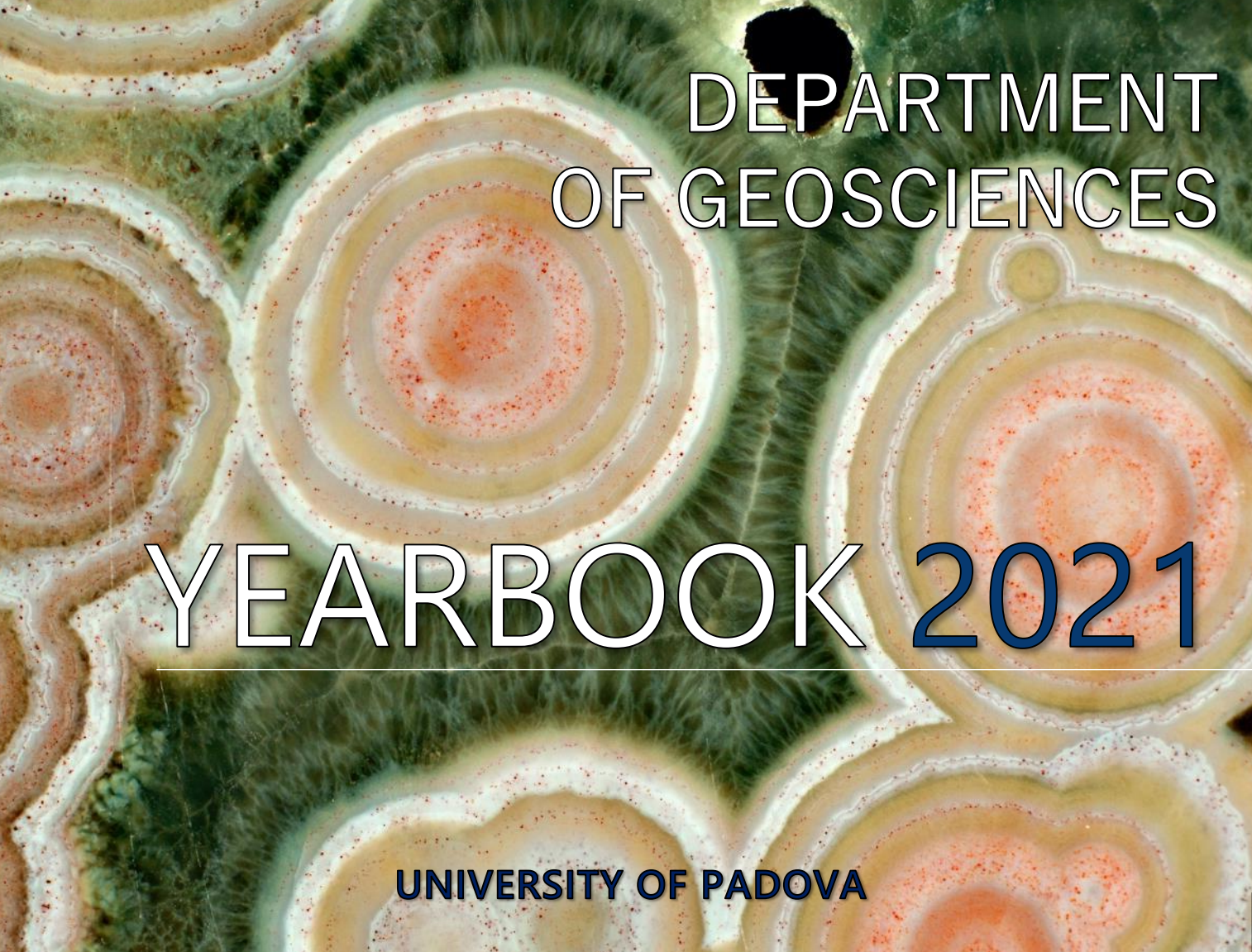

DEPARTMENT
OF GEOSCIENCES
YEARBOOK 2021
UNIVERSITY OF PADOVA

DEPARTMENT OF GEOSCIENCES

YEARBOOK 2021

UNIVERSITY OF PADOVA

A WORD FROM OUR DIRECTOR

Following the dramatic events of 2020, the year 2021 was marked by a slow recovery to pre-pandemic conditions. The previously deserted department building became populated again; students were finally allowed to attend lectures in class, conferences and meetings could be attended in person. In this third edition of the Yearbook of the Department of Geosciences, we wish to bring to light the numerous activities that we managed to organise and host during this transitional year, along with what we have learned from the pandemic period. First, a few numbers. In 2021, the Department of Geosciences counted 16 full professors, 30 associate professors and 12 researchers (including RU, RTDa ed RTDb), 44 postdoc and 47 PhD students. This staff provided teaching in 17 BSc and 35 MSc courses; however, our main commitment was devoted to the three courses hosted by the department, these being the BSc degree in Geological Sciences, the MSc degree in Geology and Technical Geology and the recently established MSc degree in Geophysics for Natural Risks and Resources. Altogether, these three degrees are attended by 287 students.

Also in 2021, the pandemic called for restrictions on teaching activity that were especially limiting during the springtime. Laboratories and field activities, crucial elements in the education of young geoscientists, were partly impeded. Fortunately, the situation ameliorated in due course, and the new academic year provided the opportunity to start fresh. A total of 31 and 36 students received their degrees in Geological Sciences (BSc) and in Geology and Technical Geology (MSc), respectively, and 43 additional students were supervised by our researchers to obtain their degrees in other courses from other departments. High-quality research carried out at the department attracted graduate students from abroad: in 2021, 13 out of 45 postdocs and 6 out of 14 PhD students were foreign citizens. The department could rely on 34 research laboratories that yielded a huge number of sample preparations and analyses. Part of the research activities were supported by 56 research projects. The department also hosts CIRCe, which is the only centre in Italy for investigating cement materials and the formulation of construction binders. This centre not only collaborates with several companies and institutions at the national and international levels, but it is also involved in the training and support of African

students and researchers and in consultancy for small companies in line with UNESCO's Sustainable Development Goals. The efficiency of our laboratories, combined with successful activities in fundraising, allowed the department to develop and maintain a relevant number of collaborations, which are estimated to include more than 102 European and extra-European and 46 Italian universities, institutions and private companies. A total of 192 papers were published in 2021, and our department ranked first in Italy in the Nature Index international ranking, which is only based on the number of papers published in high-impact journals; we have the 92nd position in the world in terms of score. The department is also involved in the museum network of the University of Padua, thanks to its collection of Italian and foreign rocks, fossils and minerals housed in the Museum of Geology and Palaeontology and in the Museum of Mineralogy. Finally, the department has been actively committed to promoting and offering the dissemination and divulgation of scientific knowledge through TV and radio interviews and laboratories with local schools and exhibits. In total, more than 60 events were organised, such as the Night of the Research 2021, thus demonstrating the specific dedication of the department to outreach and communication.

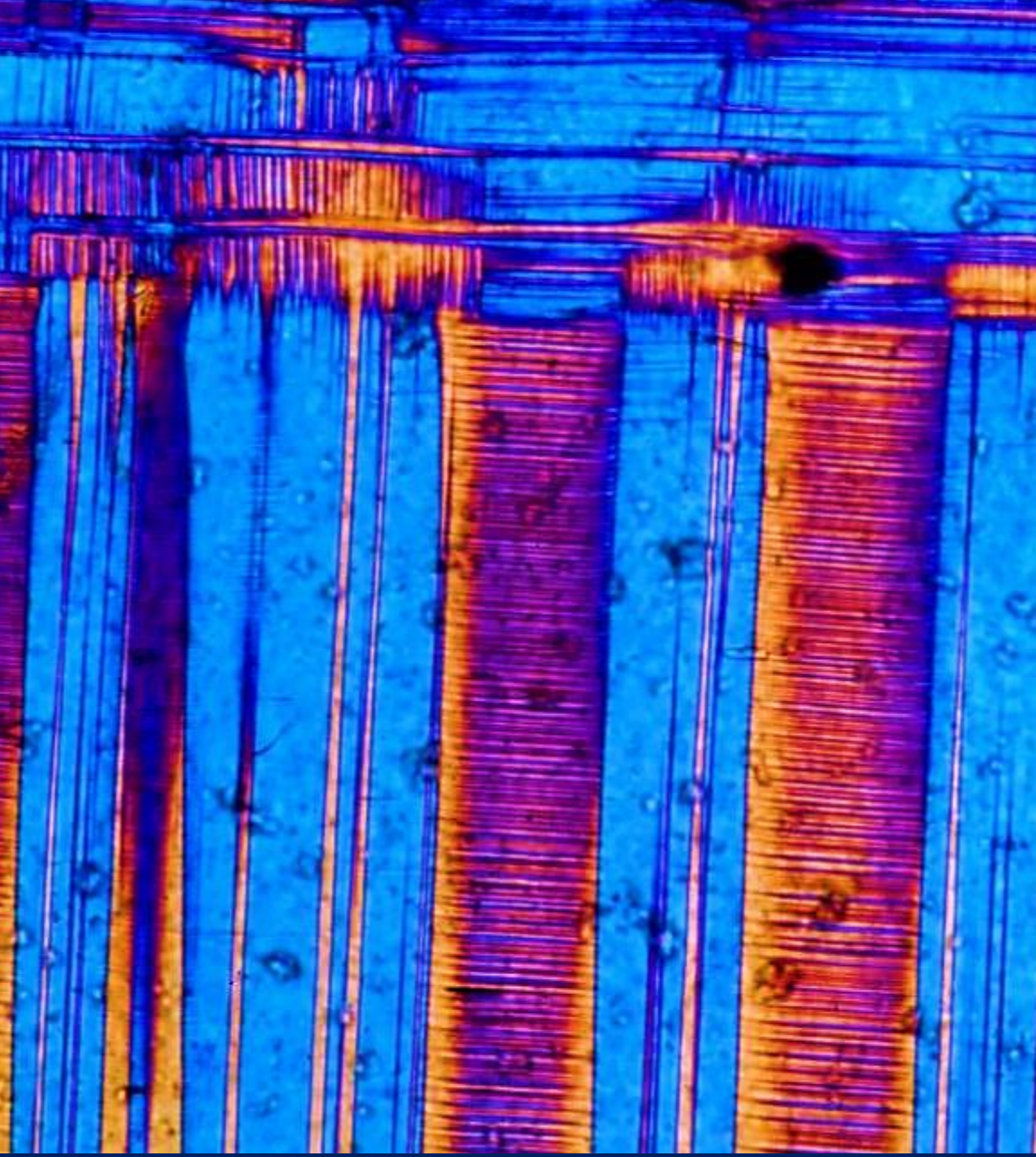
Prof. Fabrizio Nestola

Head of the Department of Geosciences

History

HISTORY *by L. Capraro*

The University of Padova played a fundamental role in promoting and advancing the development of modern Geology as we know it. Teaching of Earth Sciences at the University of Padova dates back to 1734, when A. Vallisneri Jr. bestowed to the "Magistrato dei Riformatori dello Studio di Padova" the extensive naturalist collections previously owned by his late father. In view of that, the course of study in "Storia Naturale Speciale" was established, this representing the ancestor of the modern Natural Sciences curriculum. Separation between biological (i.e., Zoology and Comparative Anatomy) and non-biological sciences occurred in 1869, when Giovanni Omboni was awarded the Chair of Mineralogy and Geology. In 1883, the geo-mineralogic collections, hitherto housed in the main building of the University (Palazzo del Bo), were further subdivided into a mineralogic and a geologic collection. The former Chair of "Storia Naturale Speciale" was accordingly converted and split into an Institute and Museum of Mineralogy (Chair Ruggero Panebianco) and an Institute and Museum of Geology (Chair Giovanni Omboni). In 1932, the mineralogic and geologic collections were moved to "Palazzo Cavalli" compound, where they are presently hosted. In the 1980s, Institutes were reformed into Departments, with further separations between the former institutions. At that time, Geosciences at Padova were structured into three separate Departments: the Department of Mineralogy and Petrology and the Department of Geology, Paleontology and Geophysics, both located at Palazzo Cavalli, and the Department of Geography, which was hosted in a separate building. In 2007, the Departments housed at Palazzo Cavalli merged into the Department of Geosciences, which is nowadays located in a building launched in late 2010. Since 2012, the Department also includes Physical Geographers previously afferent to the Department of Geography.



Management

FABRIZIO NESTOLA
Head of the Department

NICOLA SURIAN
Vice-Head of the Department

PAOLA SARACINO
Head of the Administrative Staff

CLAUDIA AGNINI
Coordinator of the PhD Programme

PAOLO MOZZI
Coordinator of first cycle degree in Geological Sciences and second cycle degree in Geology and Technical Geology

GIORGIO CASSIANI
Coordinator of the second cycle degree in Geophysics for Natural Risks and Resources

Technical and administrative staff

ADMINISTRATION AND GENERAL SERVICES

PAOLA SARACINO
Head of the
Administrative staff

ANNA RITA BASTIANELLI

KATIA BELCARO

LAURA CORAIN

CRISTIAN IOZZIA

MARIA LETIZIA MINOTTO

GIADA MIOTTO

MICHELA NORDIO

AMABILE PELOI

SERVICES TO TEACHING, POST-LAUREAM, RESEARCH AND OUTREACH

PAOLA SARACINO
Head of the
Administrative staff

CATERINA CONGIU

ANGELA DE FALCO

ELISA FACCIOLO

STEFANIA VEGRO

SARA VETTORE

TECHNICAL AND IT SERVICES

PAOLA SARACINO
Head of the Technical and IT staff

LAURA BUSATO

BRUNO CIERVO

ALBERTO DE LORENZI

MARIA ORNELLA ROSSIN

NICOLA PRATICELLI

ANTONELLA RASSU *

* Photo not published on request of the employee

LABORATORIES AND SPECIALIZED SERVICES

LEONARDO TAURO
Service coordinator

CARLOTTA BETTO

STEFANO CASTELLI

SILVIA CATTO'

MARCO FAVERO

GIAMPAOLO GIRARDI

NICOLA MICHELON

DARIA PASQUAL

ROBERTO MARIA ROSSI

LISA SANTELLO

Full Professors

GILBERTO ARTIOLI
My research interests are: the materials science of alternative and green building materials; Reuse and recycle of industrial materials for circular economy; solidification and stabilization of contaminated soils; the materials science of cultural heritage.

ALESSANDRO CAPORALI
My research interests are: Solid Earth Physics, Seismology; Seismic sources; Interpretation of space geodetic data for the measurement of surface deformation; Reference frames; Precision positioning; GNSS technology.

ALBERTO CARTON
Geomorphological investigations with particular attention to geomorphological surveying and mapping glacial and periglacial morphogenesis applications of geomorphology to slope stability investigations and hazard and risk processes in high-mountain.

GIORGIO CASSIANI
My research interests are: Geophysical methods for environmental applications; Seismological micro-scale zoning and other soil dynamics uses of exploration geophysics; Integration of hydrological modeling with geophysical methods; Geomechanics for environmental applications.

FILIPPO CATANI
My research interests are: landslide hazard, machine learning applied to geohazards, surface processes monitoring and modelling, applications of remote sensing to landslide studies, oil & gas environmental impact and risk, surface monitoring in open-pit mines, scaling processes.

BERNARDO CESARE
I work on metamorphic petrology, with special interest for: High-grade metamorphism and partial melting of pelitic rocks; Origin of Granites; Fluid and melt inclusions; Petrologic mineralogy.

FRANCESCA DA PORTO
My research interests are: Seismic vulnerability; Analysis, intervention and monitoring of historic and modern masonry buildings, RC structures and bridges; Development of procedures for large scale assessment of seismic risk.

GIULIO DI TORO
I investigate earthquake physics and faulting by integrating: Field studies of seismogenic fault zones; Rock deformation experiments; Microstructural/geochemical investigations of natural and experimental fault zone products.

FABRIZIO NESTOLA
My research interests are: Mineralogy under extreme conditions of pressure and temperature; Geothermobarometry of diamond-inclusion systems; Carbon phases in meteorites.

ANDREA D'ALPAOS
I am a hydraulic engineer who studies the biomorphodynamic evolution of coastal and fluvial landscapes in response to climate change and human pressure, through field observations, laboratory experiments, and mathematical modeling.

SILVANA MARTIN
My research interests are: Structural setting of the Alps; Geodynamics of subduction zones; Paleoseismogenic faults and material, Monitoring and dating alpine rock avalanches and landslides

CRISTIANO NICOSIA
I am a geoarchaeologist who studies Bronze Age domestic contexts and that analyzes the sediments in and around archaeological sites to reconstruct the anthropic impact on the paleo-environment.

GIORGIO PENNACCHIONI
My research interests are: Exhumed paleoseismic (pseudotachylyte-bearing faults); Nucleation and localization in ductile shear zones; Microstructures in mylonitic zones; Fluid-rock interaction in the ductile field.

NICOLA SURIAN
My research interests are: Geomorphic response to extreme flood events and assessment of flood hazard; Sediment dynamics and estimate of bedload transport in large gravel-bed rivers; Channel adjustments and their evolutionary trajectory and prediction of future scenarios

CRISTINA STEFANI
My research interests are composition and provenance of terrigenous sediments (sand composition and transparent heavy mineral associations) in different geological contexts for paleogeographic and paleoclimatic reconstructions.

MASSIMILIANO ZATTIN
My research interests are: Applications of thermochronology to tectonic evolution of orogenic chains, basin analysis, provenance studies and paleogeographic reconstructions; Feedbacks between tectonics, erosion, sedimentation and climatic variations.

Associate Professors

CLAUDIA AGNINI
My research field is micropaleontology and I particularly focus on the study of calcareous nannofossils both as biostratigraphic and paleoceanographic tools.

OMAR BARTOLI
My research interests are: High temperature metamorphism; Crustal melting and granite formation; Melt inclusions in magmatic and metamorphic rocks; P-T-t evolution of high-grade metamorphic terranes; Volatiles in crustal magmas.

JACOPO BOAGA
I'm an applied geophysicist. My research interests concern mainly engineering and environmental geophysics such as geophysics for natural hazard scenarios, electrical and electro-mag.

LAPO BOSCHI
I study how waves propagate in complex media, and apply this knowledge to a number of different fields of research, within the general domains of acoustics and seismology. I am interested in wave-based imaging in geology; sound localization in acoustics; acoustic display.

ANNA BREDA
Facies analysis and sequence stratigraphy of clastic and mixed sedimentary successions of continental to shallow-marine environments in terms of depositional processes and stratigraphic architecture.

LUCA CAPRARO
My research focuses on reconstructing the stratigraphy and climatic evolution of the Central Mediterranean during the Pliocene and Pleistocene based on the study of onland marine sediments from Southern Italy.

MARIA CHIARA DALCONI
My research activity focuses on mineralogy applied to the study of industrial materials and their impact on the environment. I mainly use powder diffraction technique to characterize raw materials, industrial materials and their by-products and wastes.

MANUELE FACCENDA
I am a solid earth geophysicist working on numerical simulations of plate tectonics and mantle convection processes. I aim at improving our understanding of the Earth's dynamics by reproducing the complex interplay of different geological processes.

ALESSANDRO FONTANA
I am a geomorphologist and Quaternary geologist with interest in the evolution of the alluvial and coastal environments and in the geoarchaeological aspects.

PAOLO FABBRI
My research field includes: Geostatistics in hydrogeology; Hydrogeology of geothermal areas; Hydrogeological parameterization of aquifers.

MARIO FLORIS
My research field includes: Probabilistic and deterministic modeling of rainfall-induced landslides; GIS-based landslide hazard analysis; Remote sensing techniques in landslide identification and characterization; A-DInSAR techniques for subsidence and landslide analyses.
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ELIANA FORNACIARI
My research interests are upper Cretaceous-Cenozoic calcareous nannofossil biostratigraphy, biochronology and paleoecology with special reference to tempo and mode of the extinction/recovery pattern of nannofossils during environmental perturbations.

ANTONIO GALGARO
My research interests are: Geothermics; Artificial Intelligence; Machine learning; Landslides risk, early warning and monitoring.

LUCA GIUSBERTI
I study foraminifera as tools for investigating the climatic variability in the Cretaceous and Paleogene. Secondarily, I am currently working on several aspects of Italian Cretaceous and Paleogene Fossil-Lagerstätte.

MATTEO MASSIRONI
My research interests are: Exploration and geology of planetary surfaces and small bodies of the Solar System; Geological mapping including Remote Sensing, GIS and 3D modelling; Fault architectures and regional tectonics.

MASSIMILIANO GHINASSI
I am a clastic sedimentologist working mainly on alluvial and coastal deposits. I aim at improving models to interpret the sedimentary record by linking sedimentary products with modern processes and experiments.

LARA MARITAN
I work on minero-petrographic application to cultural heritage materials and sites, archaeometry, new mix design for sustainable brick production.

CLAUDIO MAZZOLI
Petrography applied to archeological materials, and stone deterioration. New building materials using industrial waste. Petrography and geochemistry of carbonates in paleoclimate studies. Radon risk. Metamorphic petrology and monazite geochronology.

STEFANO MONARI
I focus on all aspects of paleontology of Mesozoic bivalves and gastropods, including systematics, phylogenetic analysis, stratigraphical significance, paleoecology and paleobiogeography.
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PAOLO MOZZI
My research fields are: Geomorphology; Quaternary geology; geoarchaeology; palaeopedology; alluvial, glacial and lagoon landforms and deposits; geomorphological mapping; mapping of Quaternary deposits.

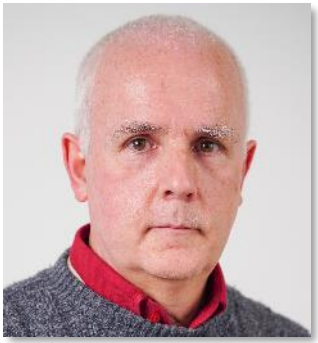
PAOLO NIMIS
My research fields are: Thermobarometry and geochemistry of mantle rocks and diamonds; Mafic-ultramafic-hosted seafloor massive sulfide deposits; Alpine copper metallogeny and provenancing.

LEONARDO PICCININI
My research focuses on applied geology and hydrogeology.

NEREO PRETO
My research fields are: Stratigraphy, sedimentology and cyclostratigraphy of carbonate platforms; isotopic geochemistry; petrology and diagenesis of carbonates aimed at paleoclimatic reconstructions and modelling the depositional architecture of carbonate platforms.

MANUEL RIGO
My cross-disciplinary research aims to decipher the evolution of the Earth, evaluating the role of the oceanic processes in the global climate and environmental changes on modern and geological timescales.

GABRIELLA SALVIULO
Application of iron oxide nanoparticles for waters and soils remediation from heavy metals and the role of soils mineralogical composition in the pollutants release. Relationships between mineralogy, sustainability human rights.



PAOLO SCOTTON
My research focuses on: Debris Flows; Snow avalanches; Geothermal heat exchange.

RICHARD SPIESS
Understanding the significance of microstructures within terrestrial and extraterrestrial rocks. Study of microstructures within experimentally formed and deformed rock analogues. Metamorphic petrology. Geodynamics. Microstructures in all materials.

RAFFAELE SASSI
My research fields are: Petrology; tectono-metamorphic evolution of crystalline basements; crystal chemistry of micas; Cultural Heritage materials; radon occurrence vs. geology s.l..

ALBERTA SILVESTRI
My research activity focuses on archaeometric studies of ancient glass (vessels, mosaic tesserae, stained glass and glazes), aiming at identifying raw materials, production technologies and alteration processes.

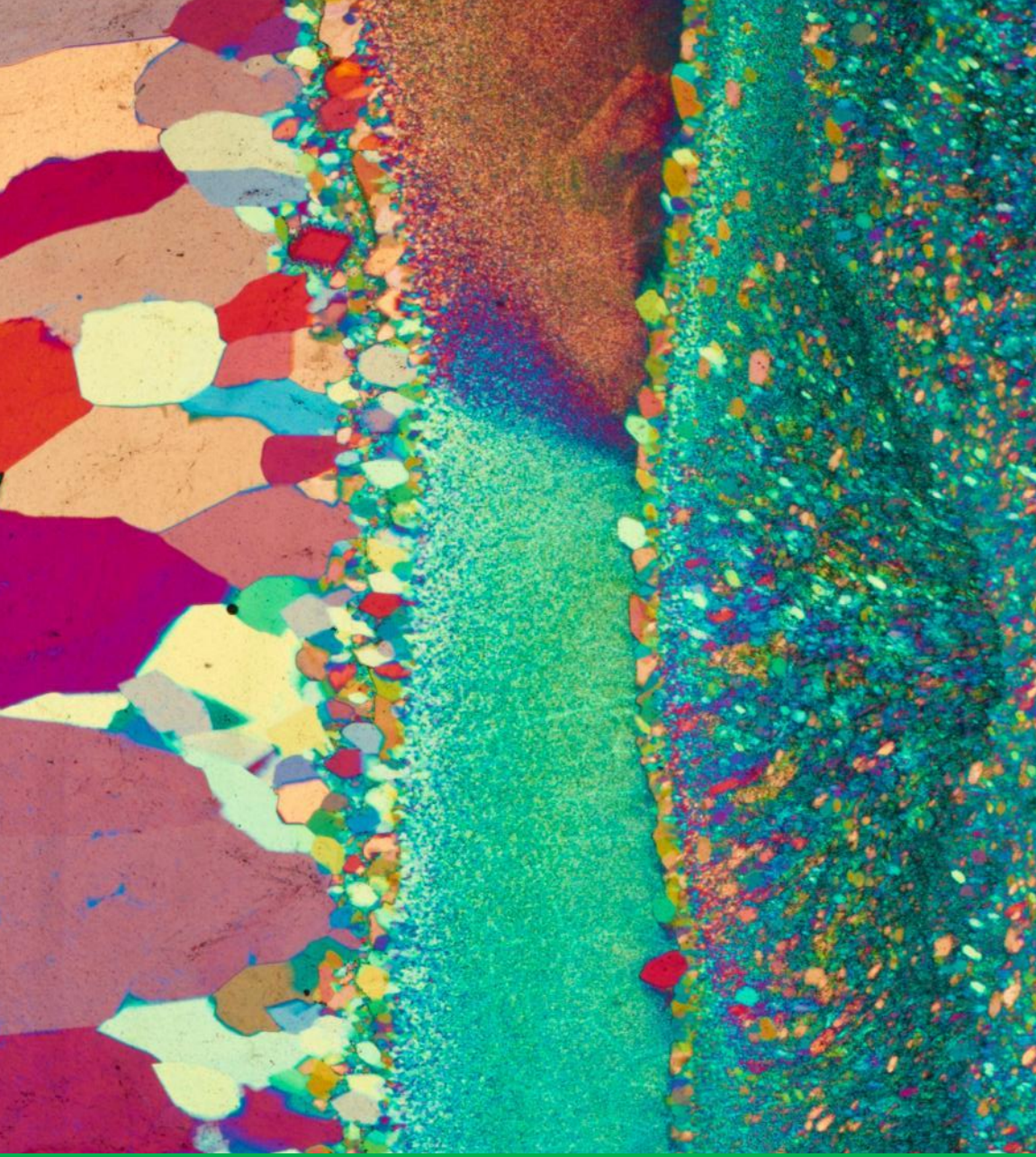
DARIO ZAMPIERI
brittle tectonics (kinematic analysis of faults, transfer zones, natural fracture systems, active tectonics, geological structure of geothermal fields, rockslide hazard), geological mapping, geodynamics of the Adria plate, humans as geomorphic agents.

Assistant Professors

ROBERTO GATTO
All aspects of paleontology of Mesozoic and Cenozoic benthic molluscs, especially gastropods, including systematics, paleoecology, paleobiogeography and evolution.

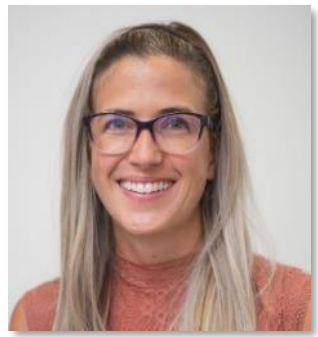
CHRISTINE MEYZEN *
Tectonic, magmatic, and hydrothermal processes at mid-ocean ridges. Composition, evolution and dynamic of the earth's mantle. Formation of the oceanic lithosphere and crustal evolution at ridges.

* Photo not published on request of the employee



RTDa

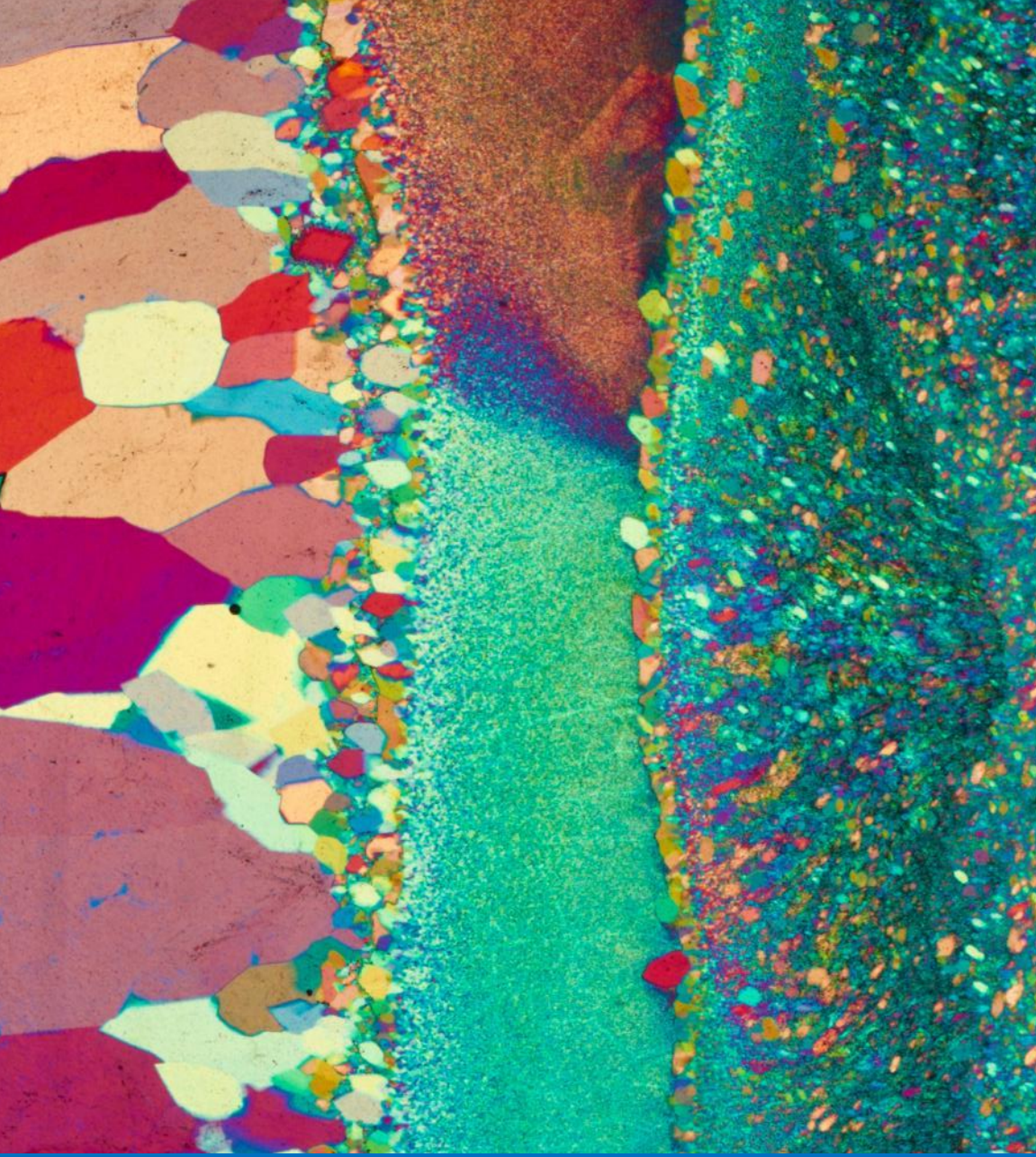
RICCARDO BIONDI
I use remote sensing to investigate extreme atmospheric events such as severe convection and volcanic clouds.



BRUNA BORGES-CARVALHO
My research interests are: Anatexis at high to ultra-high temperature and ultra-high pressure conditions; Melt and fluid inclusions in peritectic garnet; Volatile contents of granitic magmas; Fluid regime of the deep crust.

ELOISA DI SIPIO
My main research interests are geothermal energy resources, geophysics application to geothermal studies, petrophysical characterization of lithological materials and hydro-geological characterization (e.g. saltwater intrusion, isotope geochemistry).

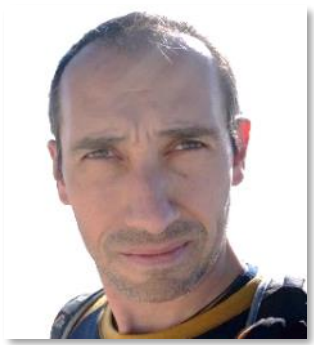
SANDRO ROSSATO
I am a geomorphologist interested in the evolution of Alpine valleys and alluvial plains in the late Quaternary. I mainly work in geological mapping, DEM analyses and geochronological investigations.



RTDb

SIMONE BIZZI
Fluvial Geomorphology in particular: the use of emerging remote sensing technology to develop model of sediment transport, sediment connectivity and fluvial processes in general. The use of this knowledge to support river management.

DAVIDE NOVELLA
I am interested in global geochemical cycles and magmatic processes occurring in the Earth's interior, with particular attention to the behavior of volatiles, trace elements and non-traditional stable isotopes.



VALERIO OLIVETTI
My main research interests are tectonics, orogenic processes, quantification of erosion, thermochronology.

TELEMACO TESEI
My research interests are: Structural geology of faults and shear zones; Experimental rock mechanics and earthquake mechanics; Microtectonics.

LUCA VALENTINI
I work on design, characterization and modelling of sustainable building materials based on clay and industrial waste.

Post-Doc

JACOPO AMALFITANO
My research interests comprise the evolution of fossil ichthyofaunas, in particular of northeastern Italy, during the Cretaceous climatic hypertermal events.

AIKATERINI ANESIADOU
My research work focuses on the analysis of extreme weather events with regard to aviation safety. My research interests are in atmospheric physics, air pollution, meteorology and remote sensing.

ELENA BACHINI
Development of a numerical model for the solution of strongly anisotropic flow and transport equations in porous media (two- and three-dimensional domains)..

ILARIA BARONE
The focus of my research are seismic waves, in particular surface waves, to derive information about the deep to shallow structures of the subsurface.

ELISA BOZZOLAN
My research focuses on identifying new tools and indicators that can better explain how rivers evolve in space and time. With that aim, we are now combining satellite images and physically-based models to track changes in the morphology of the Po river.

ANDREA BRENNA
I am a fluvial geomorphologist. My research interests focus on sediment dynamics in gravel-bed rivers, and responses of mountain streams to high-magnitude hydrological events.

ELISA CANDEO
My research deals with the application of photogrammetry techniques for the three-dimensional mapping of human skin and the use of IR thermography for the diagnosis of melanoma cancer.

DAVIDE CAPPELLARI
My research is focused on the hydrogeology of the Venetian Plain and on the sustainability of groundwater resources, evaluated through numerical modeling.

ALBERTO CARRERA
My research interests concern geophysical methods for environmental and engineer applications and shallow geothermal energy modeling.

CATERINA CANOVARO
My research is focused on the study of ancient copper and bronze artefacts. The main goal is to establish the geological origin of the metal employed, by investigating each sample from a mineralogical, metallurgical, chemical and isotopic point of view.

EDOARDO CARRARO
My research interests concern the improvement and integration of different slope monitoring methods for landslides hazard assessment, as well as the processing of monitoring data for ear-ly-warning purposes.

FEDERICA CHIMENTO
My research interest comprise the Eocene-Oligocene boundary stratigraphy and Oxygen and Carbon stable isotope analysis, in particular in the Berici Hills, Northeaster Italy. This work is in the framework of the Interreg Italia-Slovenia Project “Geokarst” as the study of a test area.

SANDY CHKEIR
A first stage researcher on ALARM project related to air traffic management and aviation safety in Europe. My research interests comprise machine learning applied in remote sensing and environmental risks, specifically nowcasting extreme weather events around Milano Malpensa and Brussel airports

CHIARA COLETTI
My main research interests are: Cultural Heritage decay and climate change; Green solutions for new mix design recycling waste; Radon occurrence in soils, rocks, and construction materials.

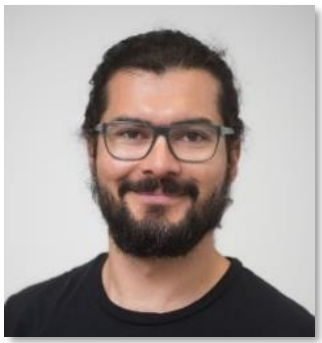
LUCA COLLANEGA
My main research interest is tectonics, with a special focus on the use of 3D seismic data to image complex fault patterns.

GIORGIA DALLA SANTA
My main research interests are: Shallow geothermal systems for building conditioning, mechanical and permeability effects induced by freezing-thawing processes in sediments, sediments and rocks thermal properties; FEM modelling of fluid and heat transfer processes in porous media.

HASSAN EZ-ZAKI
My research interests are focused on the use of natural resources and by-products such as calcium carbonate, slag, calcined clays, etc. in cementitious materials to study their effect on the fresh and hardened states.

ENRICO GARBIN
My research interests are: cement, lime and alkali activated binders. Mechanics of construction materials; Mechanics and structural retrofitting of modern and historic structures; Special applications: neutron shielding mortars and geothermal grouts and slurries.

LUIGI GERMINARIO
My research field is heritage science, e.g., stone decay and durability in historical buildings, caves, and geoheritage; impact of air pollution, climate change, microclimate, and water; provenance of archaeological stone.



RODRIGO ALFONSO GOMILA OLMOS DE AGUILERA
I am a Structural Geologist. My area of interest and research is the dynamic interaction between hydrothermal fluids and fault-zones in the crust at seismogenic structural levels.

BENJAMIN MARY
I study soil-plant interactions for water using geophysics.

OMAR GIANOLA
My research interests are: Origin and evolution of oceanic and continental crust; Geochemical differentiation of mantle-derived magma; Origin of anatectic crustal melts; Transport of melts through mantle and crus; Formation of crust-mantle transition zones.

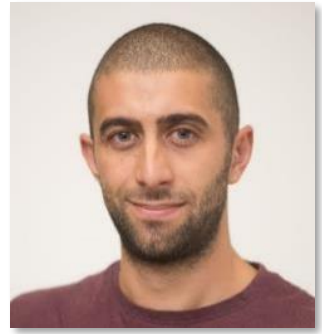
VERONIKA IVÁN
My main research interests are hydrogeophysics and sustainable water management. Currently I am investigating soil-water-plant interactions and hydrogeological processes by geophysical methods.

ALESSANDRA MASCITELLI
My research activity has been carried out within the project titled “SESAR-ALARM” funded by European Union. During my fellowship I worked with big datasets with different formats and from different sources and I worked on the selection of areas with high convective risk near airports.

MENA SANSAAR RAJ
My research interests are in using Remote Sensing and Geographic Information Systems for natural hazard and risk assessment with the focus on landslide problems, especially in the use of spatial information for landslide detection and hazard assessment.

JACOPO NAVA
I study spectroscopic properties and mineralogical composition of geological, planetary and stone materials.

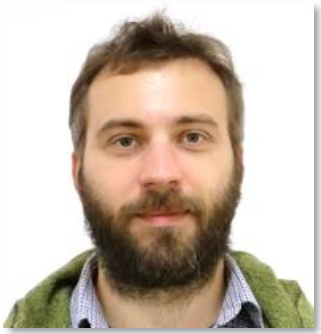
MARTHA PAMATO
I study unique samples forming in the deep Earth, such as inclusions in diamond. I also conduct experiments to determine the properties of mantle minerals. My research goal is to understand the structure, composition and evolution of the Earth.



SIMONE MOLINARI
Application of iron nanoparticles for industrial wastewater remediation. Use of an innovative system (HPSS) for stabilizing and recycling of highly polluted soils.

ALBERT DE MONTSERRAT NAVARRO
My research aims at understanding the development of mechanical anisotropy in multi-phase aggregates, and its role in geodynamic processes.

SIMONE PAPA
My research focuses on the microstructural record associated with earthquakes, both in natural (pseudotachylyte-bearing) and experimental faults, as a tool for understanding the rheology of the lower crust.



LUCA PENASA
My research interests are: Planetary geology; Small bodies; 3D geological modelling; Data science applications to geology; Python programming for geosciences; Dynamical modelling of brittle deformation.

GIACOMO PIREDDA
My research topic concerns seismic vulnerability assessment of structural and non-structural systems as well as energy performance of buildings.

DAVIDE QUAGGIOTTO
I am an energy engineer, and my research focuses on the cost-benefit analysis of using geothermal heat pumps coupled with different renewables systems in different building archetypes.

ELENA MERCEDES PEREZ MONTSERRAT
My research is focused on the archaeometric study of ancient ceramics using multi-analytical approaches, in order to reconstruct the dynamics of the societies that produced them and to highlight its cultural identity.

RICCARDO POZZOBON
My research focuses on planetary geology and structural geology. The main topics are 3D geo-modeling of planetary surface/subsurface, structures related to diapirism, mud volcanism and lava tubes and planetary analogues.

MICHELA REATO
My research interests cover the study of industrial materials, cementitious materials and hydraulic binders.
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GIULIA RICCI
I am an archaeological scientist working on the diagnostic of Cultural Heritage encouraging interdisciplinary connections. My current research is the characterization and radiocarbon dating of historical mortars aiming at contributing to the cultural valorization of the built heritage.

LIVIO RONCHI
I am mostly interested in the evolution of alluvial plains linked to the last marine transgression.

ELISA SALER
My research field focuses on seismic vulnerability assessment at large scale of masonry and r.c. school buildings, for the evaluation of seismic risk and damage scenarios.

HONAMI SATO
My research interests are: Geochemistry and stratigraphy of Mesozoic successions to understand environmental changes through Earth history and its trigger (e.g. extraterrestrial impact and volcanic events).

ROBERTO TONUCCI
Implementation of a hydrogeological numerical model of Venetian plain, starting from a dataset made up of the data collected from boreholes in Veneto region.

FILIPPO TUSBERTI
My research aims to develop and study 3D models of ancient coral reefs, located in the Berici hills.

BRANDON VANDERBEEK
My research focuses on improving seismic imaging strategies to better constrain the anisotropic structure of Earth's interior.

JIANFENG YANG
I am a geodynamicist working on the numerical modeling of subduction zone dynamics and intraplate volcanism. I apply the petrological-thermo-mechanical models to study the complex dynamics in the Mediterranean region.

PhD students

BEATRICE BASCHETTI
M. Massironi, C. Carli, F.Altieri
Understanding the Noachian-Hesperian transition in the area of Meridiani Planum, Mars: a stratigraphic, compositional and morphological study

KUSHANAV BHUYAN
M. Floris, C. Van Westen, F. Catani
Application of complex artificial intelligence models in landslide investigation and assessment

TEGAN BLOUNT
A. D'Alpaos, S. Silvestri, M. Marani
Salt marsh and seagrass meadow dynamics: sediment origin and carbon sequestration capacity

AMEDEO CAPRINO
F. Da Porto, M. Floris
Integrated monitoring and modelling approaches for better assessment of structural response to natural hazard

MIRIANA CHINELLO
G. Di Toro, E. Spagnuolo, O. Plümper
Formation of polished surfaces in natural rocks: experimental and field constraints

ANDREA CURTOLO
D. Novella
The distribution of volatile elements in the Earth's mantle

SEBASTIAN GRANADOS
N. Surian
Fluvial processes and flood hazard in humid tropical catchments of Costa Rica

XIAOQIN JIAO
M. Zattin, V. Olivetti, J. Wang
Single-grain multi-technique dating of sediments: a new approach to study the uplift and exhumation of the northeastern Tibetan Plateau

RICCARDO MAITAN
M. Ghinassi
Peak-discharge variability in meandering rivers: linking morphodynamics to sedimentary products

JUN REN
M. Faccenda, D. Novella
Mantle metasomatism and devolatilization from coupled thermo-mechanical and petrological simulations

QIANGWANG WU
M. Rigo
Upper Triassic conodont biostratigraphy and phylogeny in the Tethyan realm

LORENZO NAVA
F. Catani, E.M. Monserrat
Improving multi-scale landslide forecasting with machine intelligence.

FEDERICA VANZANI
A. Fontana, P. Mozzi
Remote sensing in the geomorphological and geoarchaeological study of alluvial plains

ELENA ZANOLA
L. Capraro, P. Ferretti, A. Di Stefano
Timing, mode and tempo of the major climatic transitions of the Early Pleistocene: a central Mediterranean perspective

ELEONORA BENÀ
R. Sassi, G. Ciotoli, E. Spagnuolo
Tectonic control on enhanced geogenic radon as a first order factor in radon hazard assessment

LINDSAY CAPITO
S. Bizzi, N. Surian
Geomorphic responses to sediment connectivity at the river network scale

MARIA ELENA GASTALDELLO
C. Agnini, L. Alegret
The latest Miocene-early Pliocene biogenic bloom: duration, causes and paleoceanographic implications

MASSIMO DOMENICO NOVELLINO
A. Fontana, C. Ravazzi
Landscape evolution in northern Adriatic regions in the late Pleistocene

MIRKO PAVONI
J. Boaga
Electrical and electromagnetic geophysical surveys in rock glacier environments

SILVIA PULIERO
M. Floris, F. Catani
Detection and monitoring of slope instabilities through satellite SAR data in areas affected by extreme climate events

LUKAS RETTIG
P. Mozzi, G. Monegato, M. Spagnolo
The equilibrium line altitude (ELA) in the southern fringe of the Alps during the Last Glacial Maximum

MICHELA SIMONATO
E. Fornaciari, S. Gardin, L. Giusberti
Calcareous nannofossil evolution during upper Cretaceous paleoenvironmental stress. Testing the impact of oceanic anoxic event (OAE2) and the Late Turonian Events on the synchronism of biohorizons

ANDREA BOSCAINI
A. Marzoli, N. Preto, J. Davis
Geochronology, geochemistry, and modelling of large magmatic events and global climate changes

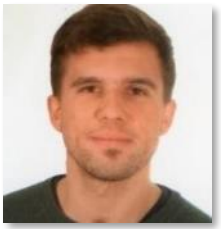
GIANLUCA CADELANO
A. Galgaro, A. Bernardi, G. Dalla Santa
Innovative solutions for ground heat exchangers

PIETRO CARPANESE
F. da Porto
Seismic risk assessment on a territorial scale based on bayesian approaches and machine learning

OLIVER CHRIST
F. Nestola, F.E. Brenker
Extraterrestrial diamonds in ureilites and meteorites

WEI FENG
G. Di Toro
Investigation of seismic slip in experimental faults under hydrothermal conditions

YIKAI LIU
G. Artioli, L. Valentini, M. Dalconi
Studies on the ionic transports in soil-binder systems
.



LUDOVICO MASCARIN
L. Valentini
Classical and alternative cement binders: New Approaches to investigate the reaction kinetics

SIMONE MASOCH
G. Di Toro, J. Cembrano, G. Pennacchioni
Structure, evolution and deformation mechanisms of large displacement seismogenic faults in the continental crust

ALICE PUPPIN
A. D'Alpaos, M. Marani
Marsh biomorphodynamics under natural and anthropogenic changes through field observations and their modelling interpretation

.

PAWEL MICHAL SLUPSKI
B. Cesare, O. Bartoli, J. Majka
Former melt inclusions from (U)HP gneisses of the Scandinavian Caledonides

ILARIA TOMASI
M. Massironi, C. Meyzen, F. Sauro
Formation processes and evolution of large size lava tubes

APSARA SHARMA DHAKAL
L. Boschi, I. Molinari
Constraining the source of earthquake using time reversal seismic data

TOFFOL GIOVANNI
G. Pennacchioni, L. Menegon, A. Camacho
Interaction between coseismic brittle deformation and ductile flow in the lithosphere

ALBERTO ZONTA
F. da Porto
Development of seismic isolation systems for industrial racks

XXXIV series (defense on 2022)

ELENA BELLIZIA
M. Ghinassi, A. D'Alpaos
Sedimentary facies variability along fluvial and tidal meanders: examples from the Holocene Venetian Plain

VALERIA CASCONE
J. Boaga, L. Boschi
Ground motion seismic monitoring by the use of distributed low-cost sensors

LUCA DEL RIO
G. Di Toro, M. Moro, M. Fondriest
Mechanism of formation of slip surfaces in carbonate-built rocks: seismic faulting vs. deep seated gravitational slope deformation

ROSALIA LO BUE
M. Faccenda, B. Vanderbeek
Geodynamic and seismological modelling of the central-western Mediterranean mid-late Cenozoic dynamics and structure

SOFIA LORENZON
F. Nestola, P. Nimis
Peering into the deep Earth through diamonds

LEONARDO PASQUALETTO
P. Nimis, F. Nestola
Genesis and thermobarometry of inclusions in diamonds from Voorspoed kimberlite (South Africa)

FRANCESCO RAPPISI
M. Faccenda, B. Vanderbeek
Seismological forward and inverse modelling for upper mantle seismic anisotropy studies

CINZIA SCAGGION
G. Artioli, N. Carrara, C. Scheib
Advanced analytical diagnostics applied to human osteological remains

XXXIV series (defense on 2022)

ALLYSON VIGANO'
C. Agnini
Are calcareous phytoplankton affected by the onset of the Antarctica Ice-Sheet at the Eocene – Oligocene transition?

YANG ZHICHENG
A. D'Alpaos, M. Marani, S. Silvestri
Analysis of the eco-geomorphodynamic evolution of the Venice Lagoon through remote sensing observations and ancillary field surveys

Joint degree with China University of Geosciences, Beijing (PRC)

XUE CHEN
M. Floris
Testing multi-temporal InSAR techniques for geohazards analysis and assessment in different geological and geomorphological environments

In 2021, the following PhD candidates defended their thesis:

ILARIA BARONE
G. Cassiani, J. Boaga, C. Strobbia
Seismic surface analysis and inversion: development and testing of tomographic algorithms.

MANFREDO CAPRIOLO
A. Marzoli, R.J. Newton
Carbon in the Central Atlantic Magmatic Province and its implications for the end-Triassic mass extinction

SILVIA CONTESSI
M. Dalconi, G. Artioli
Mineralogy and geochemistry of solidified metal-contaminated soil: case studies and leaching behavior.

YIXING DU
M. Rigo
Integrated studies on Upper Triassic conodonts: biostratigraphy, evolution, and extinction.

MARIE GENGE
M. Zattin, B. Vendeville, C. Witt
Tectonic evolution of the North-Central Patagonia: a thermochronological approach.

ARIANNA MARCOLLA
P. Mozzi, C. Stefani, A. Miola
Late Quaternary paleoenvironmental reconstruction of the Venetian Plain from multi-proxy analysis.

RODOLFO PEREGO
A. Galgaro, S. Pera
Shallow geothermal systems sustainability through a holistic approach: the Canton Ticino (CH) test site.

TORRESAN FILIPPO
L. Piccinini
Sustainability assessment of geothermal exploitation by numerical modeling.

Our commitment
beyond the Department

MEMBERSHIPS AND APPOINTMENTS

Accademia delle Scienze di Torino	Member	F. Nestola
Accademia Nazionale delle Scienze detta dei XL	Member	F. Nestola
American Geophysical Union	Member of the Tectonophysics Nominations (or Canvasing) Committee	G. Di Toro
ANVUR	Member of the panel for National Scientific Qualification	M. Zattin
ANVUR	Member of the evaluation panel of PON projects	M. Zattin
Arqus European University Alliance Action line 2.13 Task force: Common charters on Gender Equality, Inclusion and Sustainable Development Goals	Unipd Coordinator	G. Salviulo
Associazione Italiana di Cristallografia	Membro del Consiglio di Presidenza	G. Artioli
Associazione Italiana di Geografia Fisica e Geomorfologia	Member of the Executive Committee	N. Surian
Associazione Italiana di Geologia Applicata (AIGA)	Member of the Executive Committee	P. Fabbri
Board of the coordinators of the PhD courses, University of Padua	Member	C. Agnini
Carleton University, Canada	Referee for professorship Promotion	B. Cesare
CEASC (Centro di Analisi e Servizi Per la Certificazione Unipd)	Member of the board	G. Salviulo
CEGRN Central European Geokinematics Research Network	President	A. Caporali
Centro Ateneo Musei, Department of Geosciences (University of Padua)	Scientific Director of the Museum of Geology and Paleontology of the University of Padua	L. Giusberti
Centro di Protezione Civile dell'Università di Firenze	Scientific Panel Member	F. Catani
Centro Interdipartimentale CIRCe, UNIPD	Director	G. Artioli
Commissione Italiana di Stratigrafia	Member	L. Giusberti
Consiglio Nazionale delle Ricerche	Member - DPCNR 26/2019 - Committee for studying and drafting technical standards for constructions	F. Da Porto
Corso Diritti Umani e inclusione, Università di Padova	Member of the board	G. Salviulo
Council of the coordinators of the PhD courses, University od Padua	Member	C. Agnini
Council of the School of Science, University of Padua	Member	C. Agnini
Department representative "disability and inclusion" committee, Unipd	Member, delegate of the Department of Geosciences	G. Salviulo
Department representative "SAFI committee"	Member, delegate of the Department of Geosciences	G. Salviulo
Department representative “equal opportunities” committee, Unipd	Member, delegate of the Department of Geosciences	G. Salviulo
EUREF – Int. Association for Goedesy- Commission on European Ref. Frame	Honorary Member	A. Caporali
European Association for Earthquake Engineering	Member - EAEE-WG10 “Seismic aspects of monuments preservation”	F. Da Porto
European Research Council	Panel member of the PE-10 (Earth Sciences)	G. Di Toro
European Research Council	Panel member of the PE-10 (Earth Sciences)	F. Nestola
European Space Agency	Member of the Solar System Exploration Working Group	M. Massironi
Human Rights Centre "Antonio Papisca” Unipd	Head	G. Salviulo
INQUA – International Union for Quaternary Research	Member of the advisory board	A. Fontana

INQUA Commission on Stratigraphy and Geochronology (SACCOM)	Member	L. Capraro
Commissione Italiana di Stratigrafia	Member	L. Capraro
International Subcommission on Paleogene Stratigraphy	Secretary	C. Agnini
ISIS-RAL	Member of FAP-7, panel for neutron beamtime allocation	G. Artioli
Istituto Nazionale di Geofisica e Vulcanologia	Member of the Scientific Council of the Istituto Nazionale di Geofisica e Vulcanologia	G. Di Toro
Italian chapter of International Association of Hydrogeologists (IAH)	Member of the Executive Committee	P. Fabbri
IUCr International Union of Crystallography	Chair of the Commission on Crystallography in Art and Cultural Heritage	G. Artioli
Marie Curie Alumni Association Italy Chapter	Chair	R. Biondi
Metamorphic Studies Group (UK)	Member of the Barrow Award judging panel	B. Cesare
Mineralogical Society of America	Member of MSA Award Committee	B. Cesare
Ministère de la Culture, Direction générale des patrimoines - Service du patrimoine, France	Comité scientifique pour l'étude et la restauration de la vaisselle de bronze de Lavau	G. Artioli
National Science Center (Poland)	Member of the International Panel of Expert	M. Zattin
PEW Pew Research Center	External adviser for the report "The place of Science in Societies around the world".	G. Di Toro
Scuola Galileiana di Studi Superiori, University of Padua	Member of Executive Board	F. Nestola
Sub-Commission 4.3: Atmosphere Remote Sensing under the IAG Commission 4 "Positioning and applications" (2019 - 2023)	Member	R. Biondi
UNESCO Chair on Prevention and Sustainable Management of Geo-hydrological Hazards, Florence	Chair Associate	F. Catani
UNESCO site candidature: Val d'Alpone	Member of Scientific Committee	E. Fornaciari
UNI - Ente Italiano di Normazione	Member - UNI/CT 021/GL 08 (U730006) Structural Engineering Committee/Working Group 6 "Monitoring of structures"	F. Da Porto
UNI - Ente Italiano di Normazione; CEN - European Committee for Standardization	Vice-president. UNI/CT 021/SC6 (U7306) Structural Engineering Committee/Subcommittee 6 - Italian Delegate - CEN/TC 250/SC 6 "Masonry Structures"	F. Da Porto
Unione Geofisica Italiana	President	A. Caporali
Unipd sport activities	Advisor of the Rector	M. Zattin
University of Padua	Vice- Rector for Buildings and Safety	F. Da Porto
University of Padua	Member of the Rectoral Committee for regulation of PhD activities	M. Zattin
University of Padua	Member of the Academic Senate	F. Nestola
University of Padua	Member of the Executive Board of Heads of Departments	F. Nestola
University of Tübingen	Evaluation of "Competence Center Archaeometry - Baden-Wuerttemberg (CCA-BW)	L. Maritan
Veneto Region	Member of the technical-scientific committee on PFAS	P. Fabbri
Working Group on the Early/Middle Pleistocene Boundary (SEQS)	Member	L. Capraro

EDITORIAL BOARD MEMBERSHIPS

AIMS Environmental Science	P. Fabbri
American Mineralogist	F. Nestola
AMQ - Alpine and Mediterranean Quaternary	A. Fontana
Archaeological and Anthropological Sciences	G. Artioli
Archaeometry	G. Artioli
Authenticity Studies, International Journal of Archaeology and Art	G. Artioli
Bollettino Geofisica Pura e Applicata	J. Boaga
MDPI Minerals	S. Martin
European Journal of Post-Classical Archaeologies	G. Artioli
Geoenvironmental Disasters	F. Catani
Geologia Croatica	A. Fontana
Geologia Tecnica ed Ambientale	P. Fabbri
Geomatics Natural hazards and Risk	S.R. Meena
Geomorphologia Slovaca et Bohemica	N. Surian
Geomorphology	N. Surian
Geophysical Journal International	L. Boschi
Geosciences	M. Massironi
Geosciences	S.R. Meena (Guest Ed.)
Gortania	A. Fontana
Italian Journal of Groundwater	E. Di Sipio
Italian Journal of Groundwater	P. Fabbri
Journal of Cultural Heritage	A. Silvestri
Journal of Cultural Heritage	E. Garbin
Journal Of Earth Science (Springer)	M. Rigo (Guest Ed.)
Journal of Field Trips and Maps	M. Massironi
Journal of Metamorphic Geology	B. Cesare
Journal of Petrology	B. Cesare

Marine and Petroleum Geology	M. Zattin
Marine Micropaleontology	C. Agnini
MDPI Minerals	A. Silvestri (Guest Ed.)
MDPI Minerals	D. Novella
MDPI Minerals	P. Nimis
MDPI Remote Sensing	F. Catani
MDPI Remote Sensing	G. Cassiani
MDPI Remote Sensing	S.R. Meena (Guest Ed.)
MDPI Remote Sensing	R. Biondi (Guest Ed.)
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MDPI Sustainability	L. Piccinini
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Natural Hazards and Earth System Science	F. Catani
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Progettazione Sismica	F. Da Porto
Quaternary International	A. Fontana (Guest Ed.)
Rivista italiana di paleontologia e stratigrafia	L. Giusberti
Rivista Mineralogica Italiana	G. Artioli
Sedimentology	M. Ghinassi
Sensors	J. Boaga (Guest Ed.)
Stratigraphy	C. Agnini
Tectonophysics	Di Toro
Vadose Zone Journal	B. Mary
Water	N. Surian
Water Resources Research	S. Bizzi

Projects and funding

PROJECTS AND FUNDING

by M. Ghinassi

In 2021, research activities carried out by the staff of the department spread over 56 major projects, which span a vast range of research topics, from curiosity-driven science to applied science. Research work is carried out both in north-eastern Italy, e.g. Dolomites, Venetian and Friulian Plain, Venice Lagoon, and also in areas hosting the most geologically relevant site around the world (Africa, Asia, North and South America, Australia and Antarctica) and on other planets (Mars and Mercury). Over the past years, consolidation of research activities focusing on classical Earth Science research themes has been carried out in parallel with focusing on new research fields, e.g. planetary geoscience, and increasing of work in the frame of applied research. Most of the ongoing work connects with a research strategy outlined by the 'Project for the Development of the department (2018–2022)', that is funded by the University of Padova. This project places great emphasis on the role of geosciences in the Anthropocene period and on the link between science and society.

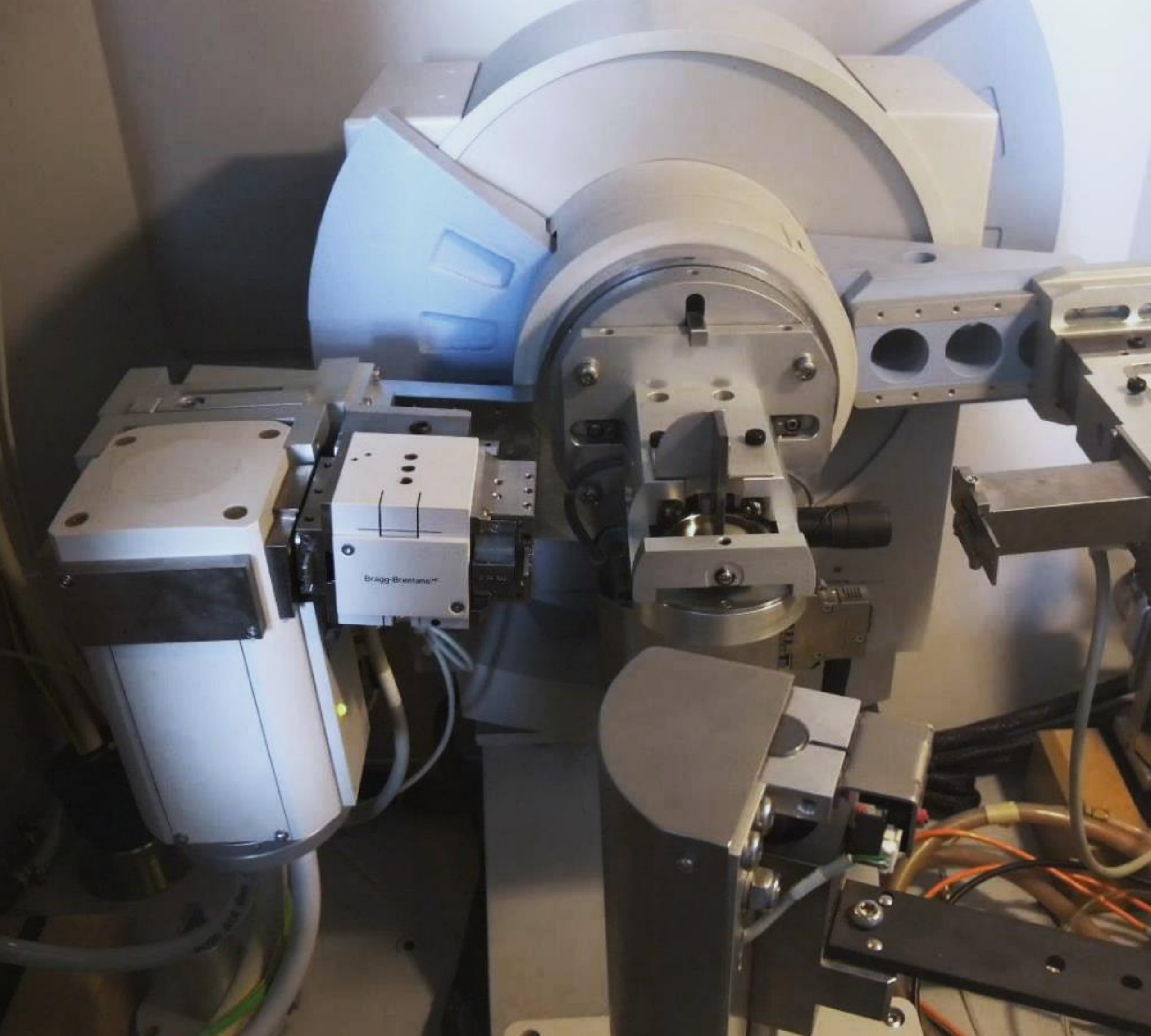
A wide range of funding schemes supports our studies, with research funds coming from the European Commission (e.g. ERC projects, collaborative H2020 projects, Marie Skłodowska-Curie Individual Fellowships), the Italian Ministry of University and Research (e.g. PRIN projects, PNRA projects dealing with Antarctica, Rita Levi Montalcini Programme), the University of Padova, public institutions and agencies, private foundations and companies. The staff if the department is also involved in some international projects, e.g. IODP – International Ocean Discovery Programme; ECZ Dry, Italy-Israel Scientific and Technological Cooperation Programme. These funding schemes highlight that the department is successful and attractive for ambitious projects, such as ERC grants and MSCA fellowships, and show the department staff has established solid research networks at the national and international levels. Projects funded or supported by private companies, e.g. Mapei SpA, and foundations (Cariparo and Cariplo) demonstrate how people from the department developed solid collaborations in the frame of applied research and studies on regional development. Annual research funds supplied by the University of Padova (BIRD funds) allow the department to support fundamental and basic science studies and research activities. In 2021, following a consolidated strategy, the BIRD funds were used to both provide per capita economical support to researchers and to open two internal calls. The first call (SID Research Projects) was for three research projects, which allowed applicants to consolidate their research lines or to provide bases to develop new ones. The second call (SID postdoc) was for three postdoc positions (2 years each), which allowed young researchers to join the ongoing research activities carried out at the department. In 2021, to further promote international research networks, the department opened an internal call to support outgoing researchers who were planning to spend time in foreign institutions to establish new collaboration or develop research projects.

Title	Handler	Funding body
A new global volcanic-driven carbon cycle perturbation at the Norian/Rhaetian Boundary, Late Triassic	M. Rigo	PRIN
Bricks manufacturing technologies to increase built heritage resilience and to raise common identities of peoples (CLAYONRISK)	E. M. Pérez-Monserrat	EU – H2020 Research and Innovation Programme (Marie Sklodowska-Curie Actions, Individual Fellowships)
Carbon minerals in Frontier Mountain ureilites of the Museo Nazionale dell'Antartide, Siena, Italy (COMMANDER)	F. Nestola	Programma Nazionale di Ricerca in Antartide - PNRA D.D. 1314
Crustal anatexis up to ultra-high temperature conditions in Antarctica	B. Borges Carvalho	MIUR-PNRA
Deep U-tube heat exchanger breakthrough: combining laser and cryogenic gas for geothermal energy exploitation	E. Di Sipio	EISMEA (HORIZON-EIC-2021-PATHFINDEROPEN-01-0)
ECZ-Dry: New technologies to monitor the Earth Critical Zone in water-limited ecosystems.	G. Cassiani	Italy-Israel Scientific and Technological Cooperation Programme (Sci. Track 2018).
Fluid-Rock Interaction at hydrothermal conditions during the seismic cycle (FRICTION)	G. Di Toro	EU – H2020 research and innovation program under the Marie Skłodowska-Curie
Fluvial and tidal meanders of the Venetian-Po plain: from hydrodynamics to stratigraphy	M. Ghinassi	CARIPARO
GEODAP - GEOarchaeology of DAily Practices	C. Nicosia	ERC
Geophysical Roots Observation for Water savING in arboriculture, viticulture and agronomy (GROWING)	G. Cassiani	Marie Skłodowska-Curie Individual Fellowships H2020 programme, Topic: MSCA-IF-2018
Geophysical surveys for permafrost characterisation	J. Boaga	LEONARDO DA VINCI CRUI MIUR
HYPEDAE: PalaeoHYdrological, -PEDological and -AEolian processes shaping Quaternary landscapes	A. Fontana	INQUA – Int. Union for Quaternary Research
Improving Thermal Efficiency of horizontal ground heat exchangers	E. Di Sipio	European Commission / H2020-MSCAIF-2014_ST
Macro to micro scale geological constraints on Geogenic Radon Hazard Assessment (HAZRAD)	R. Sassi	UniPD
Microscopic approach to the understanding of ultradeep crustal melting, diamond formation and carbon recycling in subduction zones	P. Slupski	ZEISS, The Geological Society of London
Mineral reactivity, a key to understand large-scale processes: from rock forming environments to solid waste recovering/lithification	G. Artioli	PRIN
Mutually consistent tomographic models of crust, upper mantle and the lithosphere-asthenosphere boundary region underneath Europe and the Mediterranean Basin.	L. Boschi	ETH Zurich
NEWTON	M. Faccenda	ERC StG
Single-grain multi-technique dating of sediments: a new approach to the study the uplift and exhumation of the northeastern Tibetan Plateau	M. Zattin	High-Talent Program, Shaanxi Province (China)
Sulphide INclusions in DIAmonds: A Window into The Earth's Interior Through Time	M.G. Pamato	EU – H2020-MSCA-IF-2017
The deep Earth oxygen cycke: tracing stable isotopes of Fe in the mantle	D. Novella	MUR - Programma per Giovani Ricercatori Rita Levi Montalcini

The Dynamic Mass Transfer from Slabs to Arcs - Dynastars	B. Cesare	PRIN
Underground temperature records for cLimaTe change and subsuRface geothermal Assessment	E. Di Sipio	UniPD
Venet-ONE	J. Boaga	POR FESR UE
WAVES: Waves and Wave-Based Imaging in Virtual and Experimental Environments. European Union ITN	L. Boschi	EU
An Integrative Study of the Chalcolithic Copper Production in the Southern Levant	G. Artioli	Israel Science Foundation
Approccio multimetodologico integrato per lo studio dei mosaici di Santa Maria dell'Ammiraglio in Palermo (BIRD 219478)	A. Silvestri	UniPD
Bando per acquisizione strumentazione tecnica necessaria per la attività di ricerca finalizzata alla percezione del Rischio Sismico	G. Di Toro	Dipartimento Protezione Civile
Bioconstructional organisms from the Ross Sea under Climate Change: ecosystems and 'oasis' of biodiversity to monitor and protect (BIOROSS)	C. Mazzoli	MUR – PNRA
Development of a Decision Support System for Improved Resilience and Sustainable Reconstruction of historic areas to cope with Climate Change and Extreme Events based on Novel Sensors and Advanced Modelling Tools (HYPERION)	C. Mazzoli	EU – H2020
Dynamics of transitional settings from Cretaceous to Eocene in the Southcentral Pyrenees	M. Ghinassi	PGC2018-101575-B-I00 - MCIU, Spanish Government
Europlanet 2024	M. Massironi	EU – H2020-INFRAIA
Fault segmentation and seismotectonics of active thrust systems: the Northern Apennines and Southern Alps laboratorie for new Seismic Hazard Assessments in Northern Italy (NASA4SHA)	D. Zampieri	PRIN
GEO4CIVHIC: Most Easy, Efficient and Low Cost Geothermal Systems for Retrofitting Civil and Historical Buildings	E. Di Sipio	EU
Geoplanet	M. Massironi	EU – H2020-Erasmus
Hot Antarctica	O. Bartoli	MIUR
HYDROSEM: Fluvial and tidal meanders of the Venetian-Po Plain: from hydrodynamics to stratigraphy	A. Fontana	CARIPARO Foundation
Intraplate deformation, magmatism and topographic evolution of a diffuse collisional belt: Insights into the geodynamics of the Arabia-Eurasia collisional zones	M. Zattin	MUR
Italic metalwork TechnIques during the Early IroN AgE. Rethinking cultural InteractionS.	G. Artioli	ANR Agence nationale de la recherche - Appel à projets générique - AAPG 2021
MAKEARTH - Making continental crust: a novel micro-scale perspective through Earth's history	B. Borges Carvalho	Fondazione Cariparo
Mechanism of seismic rupture propagation in the Longmen Shan fault belt, China	G. Di Toro	Nat. National Science Foundation of China
Micro to Macro - How to unravel the nature of the Large Magmatic Events	P. Nimis	PRIN
Micro to Macro - how to unravel the nature of the Large Magmatic Events	R. Spiess	PRIN
Mineral reactivity, a key to understand large-scale processes: from rock forming environments to solid waste recovering/ lithification	M. C. Dalconi	PRIN
Multi-hAzard monitoring and earLy wARning systeM (ALARM)	R. Biondi	EU – H2020
QUEST (quantitative estimation of Earth's seismic sources and structure, EU initial training network)	L. Boschi	EU
Research agreement between University of Padova and MAPEI Spa, research area: cementitious binders	M. C. Dalconi	Mapei

Rome aux siècles "obscurs". Les lumières de la communication visuelle, Ve-XIe siècles (http://p3.snf.ch/project-192854#).	A. Silvestri	Swisse National Science Foundation (SNSF)
Satellite-borne and IN-situ Observations to Predict The Initiation of Convection for ATM (SINOPTICA)	R. Biondi	EU – H2020.3.4.7 SESAR Programme
SourcE and impact of greeNhousE gasses in AntarctiCA (SENECA)	C. Mazzoli	MUR – PNRA
SPICE (Seismic wave propagation and imaging in complex media: a European network)	L. Boschi	EU
Study of Ornithogenic Soils to investigating the Palaeoenvironmental Evolution after the Last Glacial Maximum in Victoria Land (Antarctica)	L. Maritan	PNRA
WATer mixing in the critical ZONe: observations and predictions under environmental changes – WATZON	G. Cassiani	PRIN

Laboratories



LABORATORY FACILITIES

by M.C. Dalconi

The 2021 has been the year of gradual return to normal operational activity in departmental laboratories despite the ongoing COVID-19 pandemic that has occasionally determined delays in getting supplies and services.

The development plan of departmental laboratories has greatly advanced with installation of two state-of-the-art instruments, dual-beam FIB-FE-SEM and confocal Raman microscope, and with completion of administrative procedures for acquiring a high-performance X-Ray fluorescence spectrometer (XRF).

This has been a year of transformation of lab facilities with five new or renovated laboratories that started to become fully operational: Rock Crushing and Geological Sample Preparations laboratory, Experimental Petrology and Geochemistry laboratory, Dual Beam FIB-FE-SEM laboratory, Micro-Raman Spectroscopy laboratory. This year has also seen the commissioning of the Micromorphology laboratory intended for the study of archaeological sediments.

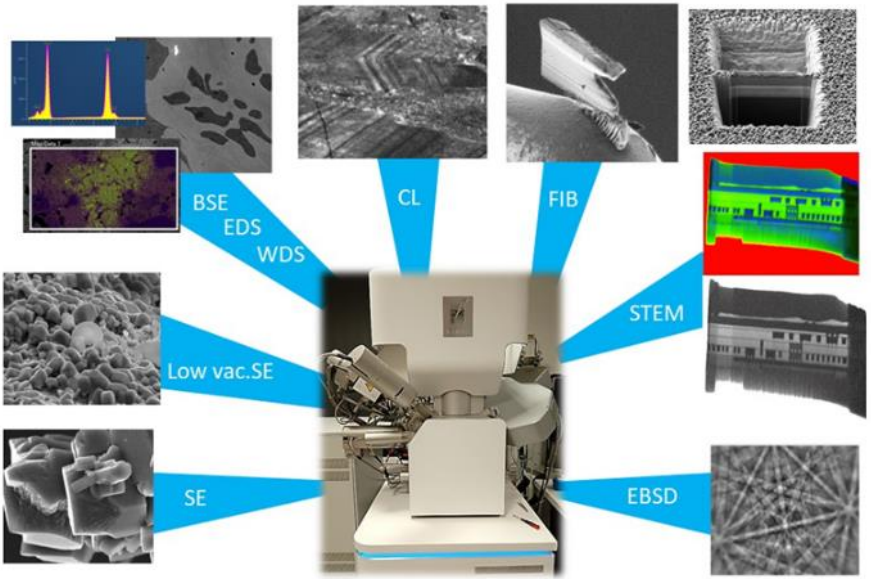
By the end of 2021, the technical staff of Geosciences Department was composed of 10 technicians operating in 22 laboratories. Operational activities in other twelve laboratories were supported by researchers and temporary staff.

DUAL BEAM FIB-FE-SEM LABORATORY

The TESCAN SOLARIS is a state-of-art dual beam FIB-FE-SEM for 2D and 3D characterization of geological samples and solid materials. Its unique instrumental geometry allows to combine multiple analytical techniques in one instrument:

- high precision focused ion beam (FIB – Ga source) for submicron-scale ion cutting and thinning to electron transparency; ultra-high-resolution SE and BSE imaging featured by immersion optics; panchromatic cathodoluminescence imaging; EDS and WDS microanalysis (Oxford Instruments); Electron Backscattered Diffraction EBSD (Oxford Instruments); STEM imaging and microanalysis; 3D FIB-SEM tomography.

These capabilities make FIB-FE-SEM a powerful tool for investigate mineral inclusions, grain boundaries, microfossils, for analysing microstructures and nanostructures of rocks, for elemental mapping and crystallographic orientation analysis, for observations at the subsurface of the specimens (3D-tomography).



LABORATORY OF EXPERIMENTAL PETROLOGY AND GEOCHEMISTRY

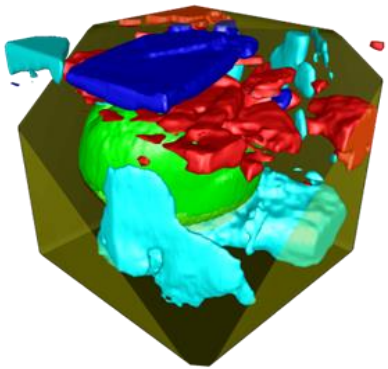
A new laboratory of experimental petrology and geochemistry has been recently set up at Geoscience Department. The QUICKpress non-endloaded piston cylinder apparatus equipped with two pressure vessels allows scientists to access pressures and temperatures in the range of 0.5 GPa to 2.5 GPa and 25° C to 1800 °C. The Temperature Controller sets and monitors sample temperature, furnace current and voltage, as well as over-limit alarms for current and cooling water flow stability. A Lampert PUK 5 fine welding devices is also present, equipped with welding microscope SM5.1 and electronically controlled eyeprotecting filter. Experiments may encompass applications ranging from metamorphic and igneous petrology, element partitioning, isotopic geochemistry and fluid/melt equilibria.

ROCK CRUSHING LABORATORY AND GEOLOGICAL SAMPLE PREPARATION LABORATORY

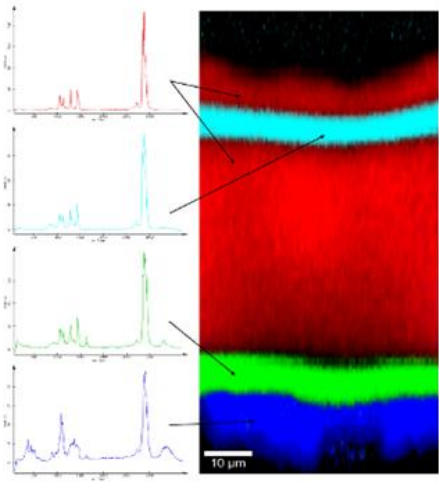
A part of a large building renovated by the University of Padova during the pandemic was allotted to Department of Geosciences in September 2021. The building is placed aside of the department, and the renovated spaces were designated for two news laboratories, formally the **Rock Crushing (RC)** and **Geological Sample Preparations (GSP)**. The **RC** is finalized to rock samples mechanical disaggregation and offers a crucial service to start most of the analytical work carried out in the frame of petrographic and mineralogical studies. Creation of the Rock Crushing Laboratory allowed optimize these procedures by assembling in a single laboratory all the different devices available at the department. The **GSP** has mainly been designed to carry out the ground-working preparations of loose sediments, especially on sedimentary cores, which are crucial for the studies on modern and Quaternary deposits carried out at the Department of Geosciences, like the recently-funded projects on the new geological map of Italy (CARG Project). In this new space, sedimentary cores can be effortlessly prepared for sampling, dry-peeling or forthcoming analyses. High-resolution orthophotos of cores and related dry-peels can be acquired by means of a simple transport sled, which can be equipped with different cameras. The laboratory has been prepared for classical grain-size analyses through dry-sieving with a sieve shaker, and in 2022 it will be equipped with a Malvern Mastersizer 3000 for laser granulometry. The Geological Sample Preparations Laboratory has also been prepared with a device for experimental fluvial geomorphology and stratigraphy, that is based on a water recirculation-system and is equipped with an adjustable sediment feeder. This simple apparatus, which can be organized to develop alluvial basins up to 5 m long and 1.5 m wide, will be used for both research and teaching purposes.

MICRO-RAMAN SPECTROSCOPY LABORATORY

The Raman effect is based on light interacting with the chemical bonds of a sample. Vibrations of chemical bonds interacting with photons produce specific energy shifts in the back scattered light that appear in a Raman spectrum. The Raman spectrum is therefore unique for each chemical composition and like a "fingerprint" capable to provide qualitative and quantitative information of the investigated material. Crucially, it is a non-invasive and non-destructive methodology and, generally, it does not require complex sample preparation. Our laboratory is equipped with a Raman WITec Alpha 300R (532 nm laser and 785 nm laser) coupled with a Zeiss microscope (10X, 20X, 50X LD, 50X, 100X objectives). The confocal microscope systems provide depth resolution and a strongly reduced background signal and facilitate the generation of depth profiles and 3D images with exceptional spectral and spatial resolution. Images are recorded point by point and line by line using a ultra-fast mode with a very small integration time per spectrum, while scanning the sample through the excitation focus. With this technique, the specimen can be analysed in segments along optical axes and depth profiles or 3D images can be generated. The laboratory at the Department of Geosciences is supervised by Dr. Davide Novella and Dr. Lisa Santello. Moreover, the 3D chemical characterization on rough or irregular samples can be carried out along or at a set distance from the surface, without particular sample preparation. With the TrueSurface application of the Witec system the surface of the sample can be kept constantly in focus during the entire acquisition, without the topography roughness. The optical sensor controls the distance between the objective and the sample surface with sub-micrometre precision. Thus, any variation occurring during measurements with long integration times is compensated for, resulting in perfectly sharp and detailed images.



3D Raman Image of a pollen in crystalline honey. Image parameters: 150 x 150 x 50 pixels = 1,125,000 Raman spectra, scan area: 50 µm x 50 µm x 50µm, integration time per spectrum: 12.2 milliseconds (https://raman.oxinst.com/products/raman-microscopes/raman-imaging-alpha300r)



Raman depth-profiling (x-z direction) of a multilayered polymer coating with corresponding spectra. 50 µm x 100 µm scan range, 120 x 200 pixels, 24 000 spectra, acquisition time per spectrum: 50 ms. (https://raman.oxinst.com/products/raman-microscopes/raman-imaging-alpha300r)

GRAPHIC AND PHOTOGRAPHY LABORATORY

By the beginning of 2021, the new drone DJI Phantom 4 rtk has reached full operational activity. The drone is a complete aerial imaging solution mainly used for photogrammetric monitoring and geomorphological mapping. It is integrated with a Gps RTK system offering centimeter-level accurate location coordinates. It has been extensively used in tracking riverbed morphology, in collecting data for mapping rock walls in quarries. The obtained aerial images are elaborated into 3D digital data by using photogrammetric softwares as Metashape and 3DFZephyr.

LIST OF LABORATORIES AT THE DEPARTMENT OF GEOSCIENCES, YEAR 2021

1	Applied Mineralogy
2	Applied Petrography
3	Catodoluminescence and fluid inclusions
4	Cleanroom- sample preparation for isotopic analyses
5	Confocal Optical Microscope
6	Dual beam FIB-FE-SEM
7	Exeperimental Petrology and Geochemistry
8	Fitoplancton
9	Geochemical Preparation laboratory
10	Geological sample preparations
11	Geophysics
12	Graphic and photography
13	Hydrogeology
14	Hyperspectral analysis
15	Fluid and melt Inclusions
16	Macropaleontology
17	Mass Spectrometry - IRMS
18	Micropaleontology
19	Micro-Raman Spectroscopy
20	Micro-Tomography
21	Mineral Resources
22	Mineral separation
24	Palynology
25	Rock mechanics
26	Scanning Electron Microscopy
27	Sedimentology
28	Rock Crushing
29	Thermal lab
30	Thermocronology
31	Thin section preparation
32	X-ray Fluorescence Spectroscopy (maintenance in 2021)
33	X-Ray Powder Diffraction
34	X-Ray Single Crystal Diffraction

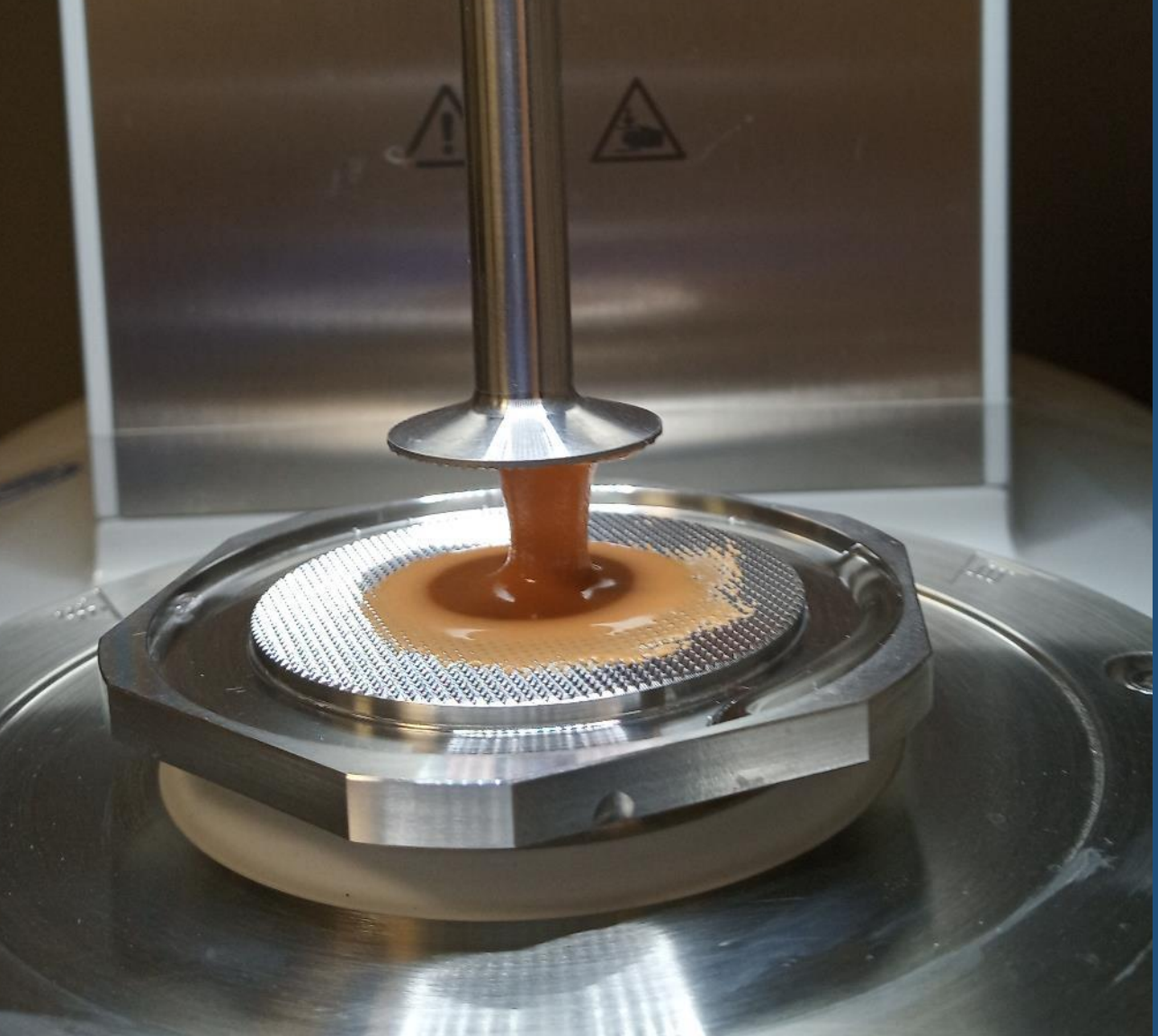
Museums

MUSEUMS

by L. Giusberti

The Department of Geosciences owns extensive collections of Italian and foreign rocks, fossils and minerals housed at "Palazzo Cavalli" in the Museum of Geology and Paleontology, and in the Museum of Mineralogy. Such huge scientific and cultural heritage has its roots in the old collections of the Natural History Museum of the University of Padova, founded in 1733 thanks to the donation by Antonio Vallisneri Jr.

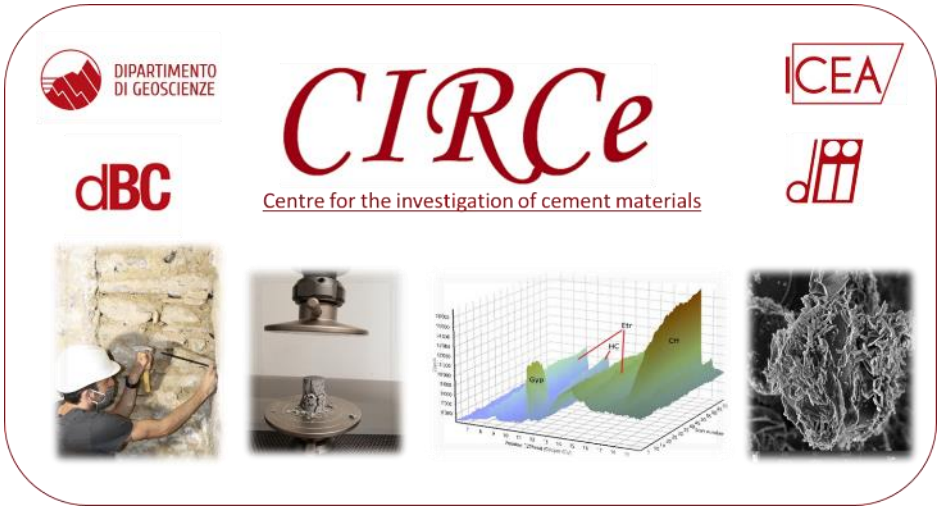
Besides the scientific activities, carried out by Italian and foreign researchers from all over the world, the Museum's staff, coordinated by CAM (Centro Ateneo Musei), carries on an intense activity of public engagement with the fruitful support of the Department's researchers. Also in 2021, museums' activities were strongly reduced due to COVID-19 pandemic. Nevertheless, is currently underway at Palazzo Cavalli the realization of the "Museum of Nature and Humankind" that will include the former Department's collections along with the University collections of Zoology and Anthropology. Since 2017, several Departments' researchers are strongly involved in such ambitious project that hopefully will represent the main legacy of the celebrations in 2022-2023 to mark 800 years of Padova University.



CIRCe

CIRCe – Centre for the Investigation of cement materials *by G. Artioli*

CIRCe Centre is the only centre devoted to the fundamental investigation of cement materials and the formulation of construction binders in Italy. The centre activity includes fundamental research, applied research and consulting. The centre started as a collaboration in the field of construction materials between the Department of Geosciences and the Department of Civil, Construction and Environmental Engineering (ICEA). Recently the Department of Cultural Heritage (DBC) and the Department of Industrial Engineering (DII) also joined. The Centre acts as research support and partner for a number of Institutions and Companies at the international level. Since 2020, The activity encompasses the following: (1) the archaeometric investigations of ancient building materials in collaboration with archaeologists, art historians and restorers; (2) the established collaborations with important companies such as MAPEI Spa, which involves the optimisation and development of innovative binders and admixtures; (3) the training of students and support of African researchers in the development of sustainable binders complying with the concepts of circular economy; and (4) the consultancy for small companies wishing to move towards UNESCO's Sustainable Development Goals. You can find more information on CIRCe website: https://circe.dicea.unipd.it/



PhD programme

PhD PROGRAMME *by C. Agnini*

In 2021, there were 48 PhD board members, including 35 members of the University of Padua faculty staff, 12 high-reputation foreign researchers and one Italian external member (INGV – Rome; https://www.geoscienze.unipd.it/corsi/phd-course/phd-board).

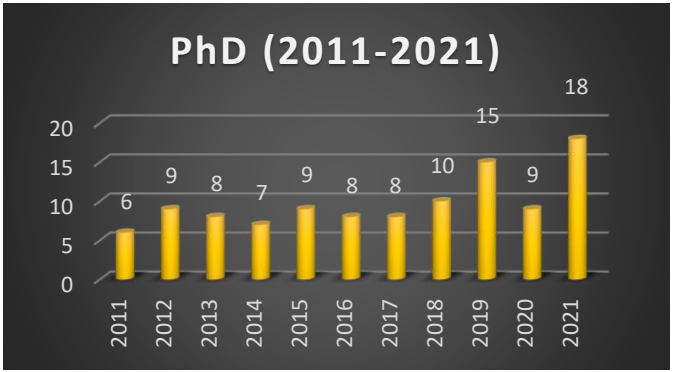
The active series were XXXIV, XXV, XXXVI and XXXVII, with XXXIV series officially finishing on September 30th and XXXVII series starting from October 1st. Due to the COVID-19 pandemic, PhD candidates enrolled in the XXXIV have obtained 3 to 6 months extensions to conclude their research projects effectively. The total number of PhD candidates was 52 (Figure 1).

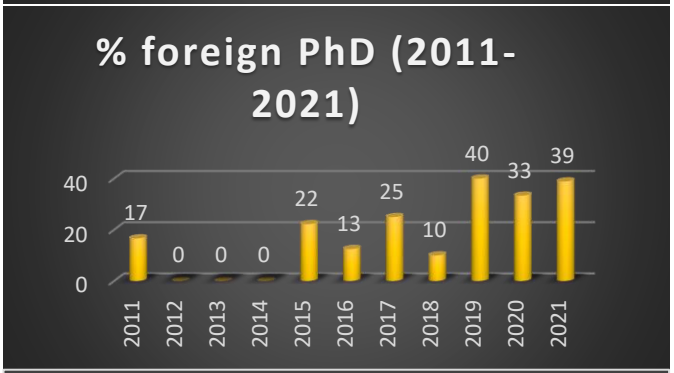
The active research projects cover all the disciplines of the geosciences spanning from pure research topics aiming to implement our understanding of Earth's system and applied research projects, which focus on natural and human-induced hazards to address ongoing geological, societal, economic challenges and risks.

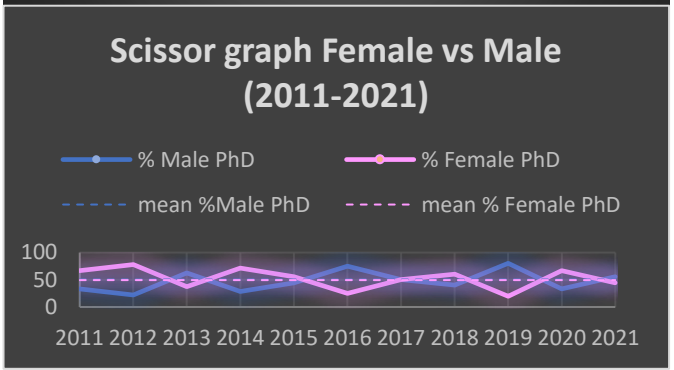
Although the publication of papers is not a mandatory requirement to finish the PhD programme, the outcomes of the PhD research are usually published in ISI-Scopus Q1 journals. Details on the research project of each PhD candidate are available in the People chapter.

Among the 18 scholarships available for 2021, a record-braking for us, six are funded by the University of Padova, two are supported by the Cariparo Foundation, three come from the UniPD-CSC joint programme, two are granted by National Research Institutes, i.e. INGV e INAF-IAPS, and one is provided by the Verona municipality. In the second part of the year, new funds related to PNRR (Piano Nazionale di Ripresa e Resilienza), which is part of the Next Generation EU (NGEU) programme to contrast the COVID-19 pandemic, have become available and a dedicated call was open to recruit four additional PhD candidates (PON grants).

In the past five years, the PhD board has decided to reserve two scholarships for foreign students, one from the University of Padua and one from the Cariparo Foundation. Together with other initiatives, this strategy has produced an increase in foreign students (mean approx. 30%) (Figure 2). Our PhD candidates come from four out of the five continents (Europe, America, Asia and Australia) and from different countries as well, e.g. USA, Germany, Poland, China, Costa Rica, Nepal, New Zealand and India, stimulating a cutting-edge environment where Italian and foreign students can interact in a positive mode that always respects each other's cultural background and identity. More than 40% of the current PhD students have earned their master's degree out of Padua in topics that are not exclusively geology-related, supporting a real multidisciplinary approach.







Geosciences belong to the STEM (science, technology, engineering and mathematics) disciplines that generally suffer from a gender imbalance. In the last 10 years, the scissor graph of the male versus female percentages (Figure 3) highlights a pretty high variance essentially due to the relatively low number of PhD positions. By contrast, the mean value of the same parameter, calculated on a 10-year time window (2011–2021), shows a substantial equality (50.5% female and 49.5% male) that, unluckily, undergoes dramatic changes in favour of males as one's career advances. Last, we have started to re-emerge from the COVID-19 pandemic in 2021, and this has allowed once again PhD students to visit national and international research institutes and universities as well attending national and international congresses and workshops of doing fieldwork. The meeting and collaboration with other scientists as well as the fieldwork are important elements for all geoscientists, but are essential for early researchers to build their own way.

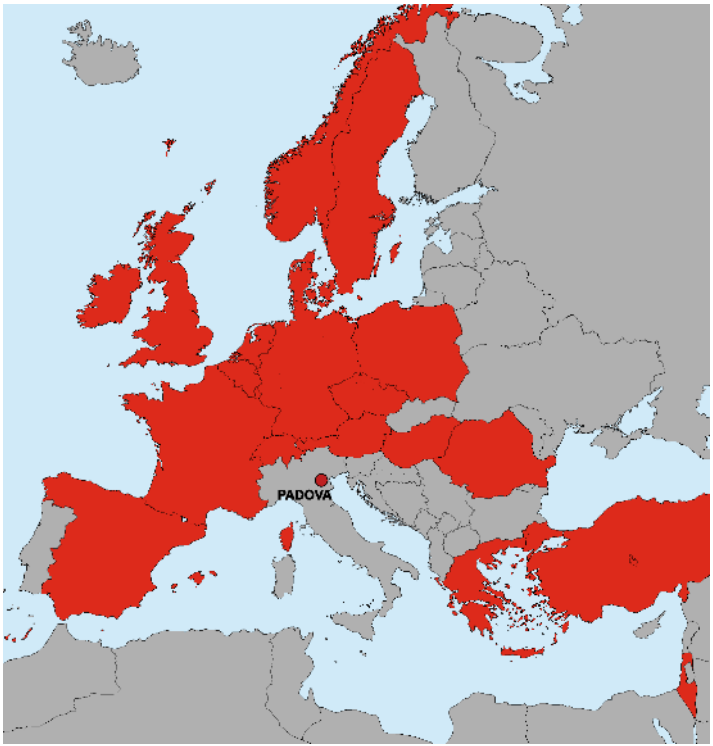
Collaborations

COLLABORATIONS *by L. Maritan*

The collaboration with both national and international institutions of the department was also reinforced in 2021, despite the limitations in travelling and meeting person in person. The strong inclination to share research experiences in the field or in the laboratory, and a team work with colleagues of institutions with complementary skills and/or facilities, is a base pillar in the everyday research activity of the scientists at the Department of Geosciences. This approach is perfectly consistent with the history of our university, open to guest and build strong links since its foundations, with scholars from every part of the world.

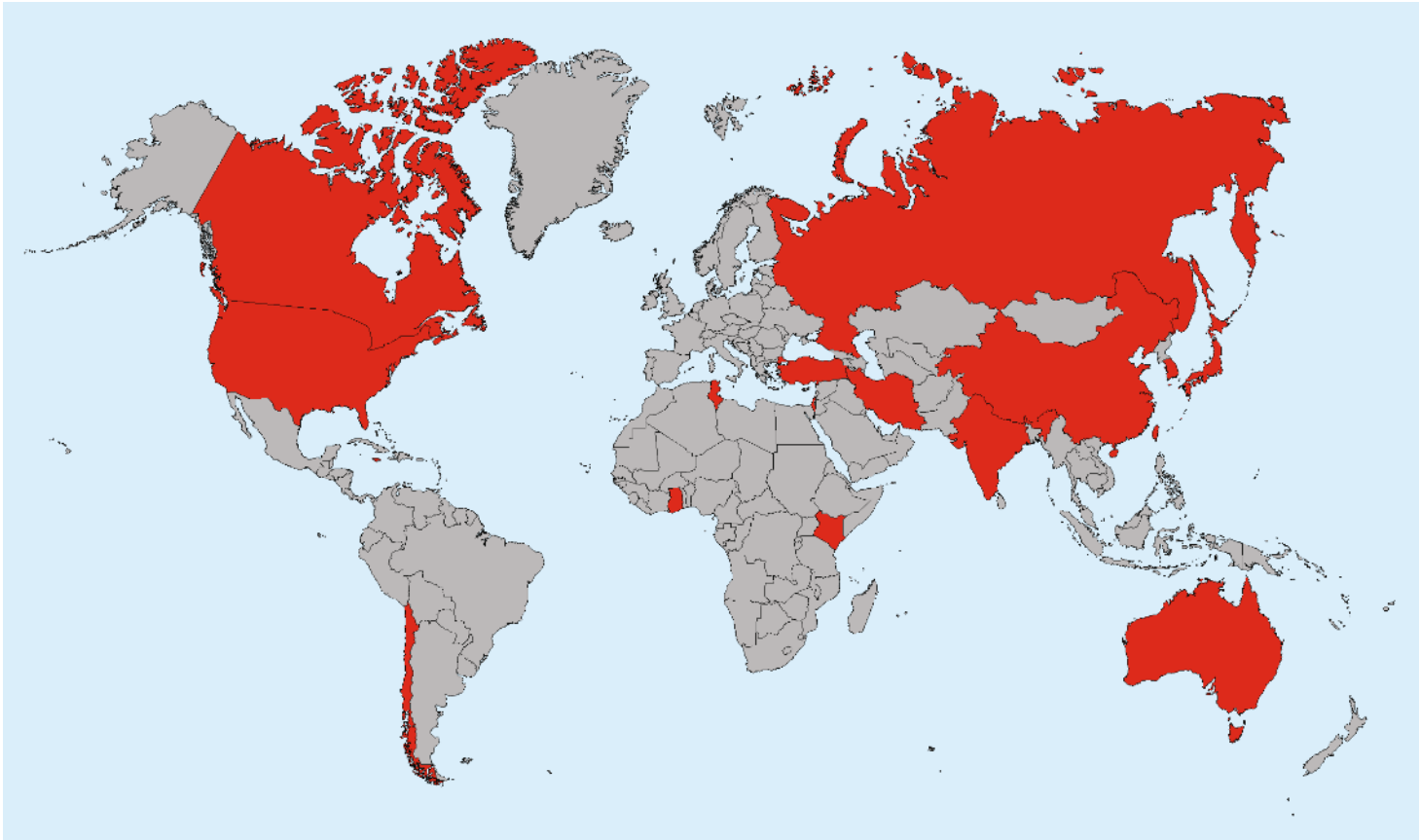
Going around the corridors, offices and laboratories of the department, it is very common to bump into small groups of researchers of different levels, such as PhD students, postdocs and professors, which also includes colleagues from other institutions, working or discussing together, sharing their knowledge, ideas and experience to promote collaborative research. This approach is also testified by the numerous activities organised in the field in collaborations with other universities, agencies and research institutions in general.

It is quite clear from the survey on our collaborations that many activities started in 2021 and were carried out with other national and European institutions, but also some new collaborations developed with extra-European universities and research centres. Part of the effort was addressed to develop new collaborations within cooperation projects, involving institutions working in emerging counties, organising teaching and training activities, guesting PhD students and researchers, and building new research projects.



Official agreements and relationships with other European countries

Thanks also to important projects, such as those supported by ERC, H2020, INTERREG and Marie Skłodowska Curie actions, as well as the more international composition of the master's and PhD students, have all favoured the development of intense relationships with European and extra-European countries.



Official agreements and relationships with other extra-European countries

ITALY

University of Bari, Department of Earth and Geoenvironmental Sciences
University of Bologna, Department of Chemistry "Giacomo Ciamician"
University of Bologna, Department of Cultural Heritage
University of Bologna, Department of Industrial Engineering, Laboratory of radioprotection
University of Bozen
University of Catania
University of Chieti-Pescara “D’Annunzio”
University of Ferrara
University of Modena and Reggio Emilia
University of Naples “Federico II”, Department of Civil and Environmental Engineering
University of Pavia
University of Rome “La Sapienza”
University of Salento, Department of Antiquity Sciences
University of Siena
University of Turin, Department of Earth Sciences
University of Tuscia, Department of Ecological and Biological Sciences
University of Venice “Cà Foscari”, Department of Environmental Sciences, Informatics and Statistics
University of Venice “Cà Foscari”, Department of Human Studies
University of Venice IUAV
University of Campania "L. Vanvitelli", Department of Environmental, Biological and Pharmaceutical Sciences and Technologies
Polytechnic of Milan
CNR-IGAG, Institute of Environmental Geology and Geo-Engineering, Milan
CNR-IGAG, Institute of Environmental Geology and Geo-Engineering, Rome
CNR-IGG, Institute of Geosciences and Georesources, Firenze
CNR-IGG, Institute of Geosciences and Georesources, Padova
CNR-IGG, Institute of Geosciences and Georesources, Pavia
CNR-IRPI, Institute for Geo-Hydrological Protection, Padova
CNR-IRSA, Water Research Institute, Bari
ENEA - SSPT, Department for Sustainability, La Spezia
NAF - Osservatorio Astronomico di Padova (OAPD), Padova
INAF - Istituto di Astrofisica e Planetologia Spaziali (IAPS), Rome
INGV - National Institute of Geophysics and Volcanology, Rome
INGV - National Institute of Geophysics and Volcanology, Bologna

ITT - Centre for Cultural Heritage Technology, Venice
OGS - National Institute Experimental Geophysical observatory, Trieste
Regione del Veneto
Soprintendenza Archeologica di Verona
Soprintendenza dei Beni culturali ed ambientali di Palermo
MUSE, Museo geologico delle Dolomiti di Predazzo, Trento
Museo di Storia Naturale di Verona
Museo Regionale della Sicilia – Galleria di Palazzo Abatellis
Centro Studi Sudanesi e Sub-Sahariani, Treviso
Eni SpA
MAPEI Spa, Milan
Geomatics Research & Development (GReD) srl, Italia
CIMA Research Foundation, Savona

EUROPE

Austria, Technical University of Vienna
Austria, University of Vienna
Belgium, Royal Belgian Institute for Space Aeronomy (BIRA-IASB)
Czech Republic, Czech Advanced Technology and Research Institute
Denmark, University of Copenhagen
France, BioSP, INRAE, Avignon
France, Institut de Physique du Globe, Paris
France, Université Bourgogne Franche-Comté, Laboratoire Biogéosciences
France, Université de Bretagne Occidentale
France, Université Sorbonne, Institut des Sciences de la Terre de Paris
France, Université Claude Bernard Lyon 1
France, CNRS/Université de Strasbourg, Laboratoire Image Ville Environnement (UMR 7362)
France, UFR Sciences of Nantes and Angers, Laboratory of Planetology and Geosciences
Germany, Federal Institute for Geosciences and Natural Resources BGR
Germany, Fraunhofer Research Institution for Additive Manufacturing Technologies IAPT
Germany, German Aerospace Center DLR
Germany, Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg
Germany, University of Aachen
Germany, University Bremen

Germany, University of Bonn
Germany, Friedrich Alexander University Erlangen Nuernberg, GeoZentrum
Germany, University of Frankfurt
Germany, University of Göttingen, Department Physical Geography
Germany, Westfaelische Wilhelms-Universitaet Muenster, Institut für Planetologie
Germany, Deutsches Zentrum für Luft- und Raumfahrt DLR
Greece, School of Rural & Surveying Engineering, National Technical University of Athens, Athens
Greece, Centre for Renewable Energy Sources and Saving (CRES), Athens
Hungary, Eötvös Loránd University, Budapest, Fac. of Science Lithosphere Fluid Research Lab, Res. and Industrial Relations Center
Hungary, Hungarian Natural History Museum, Budapest, Department of Palaeontology and Geology
Ireland, Trinity College Dublin, Department of Geology
Luxembourg, Musée National d'Histoire Naturelle
Norway, University of Oslo, Centre for Earth Evolution and Dynamics
Norway, Oslo Metropolitan University, Department of Civil Engineering and Energy Technology
Poland, Centrum Badań Kosmicznych Polskiej Akademii Nauk, Space Research Centre
Romania, University of Bucarest
Spain, Universitat Autònoma de Barcelona, Departament of Geology
Spain, Universidad Carlos III de Madrid
Spain, University of Granada, Department of Mineralogy and Petrology
Spain, University of Granada, Department of Mechanics, Structures and Hydraulics
Spain, Universitat Politecnica de Valencia
Spain, University of Zaragoza
Spain, Tecnalia Research & Innovation
Sweden, Uppsala University, Department of Earth Sciences
Switzerland, ETHZ, Zurich
Switzerland, WSL Institute for Snow and Avalanche Research SLF, Davos
The Netherlands, University of Twente, Faculty of ITC
The Netherlands, TU Delft
The Netherlands, Utrecht University
UK, University of Aberdeen, Department of Geography and Environment
UK, University of Bristol, School of Chemistry, Organic Geochemistry Unit
UK, University of Durham
UK, University of Durham, Geography Department
UK, University of Glasgow
UK, University of Lancaster
UK, University of Leeds, School of Earth and Environment

UK, University College of London UCL, Institute of Archaeology
UK, University College of London UCL, Earth Science Department
UK, University of Newcastle upon Tyne, School of History Classics and Archaeology

GLOBAL

Australia, Australian National University, Research School of Earth Sciences, Canberra
Australia, Curtin University, School of Earth and Planetary Science, Perth
Australia, Macquarie University, Department of Earth and Environmental Sciences, Sidney
Australia, Queensland University of Technology
Australia, University of Adelaide, Department of Earth Sciences
Australia, University of Melbourne
Australia, The University of Western Australia, Oceans Graduate School & Oceans Institute e ARC Centre of Excellence in Coral Reef Studies, Perth
Canada, University of Alberta, Department of Earth and Atmospheric Sciences, Edmonton
Canada, University of Victoria, School of Earth and Ocean Sciences, Victoria
Canada, Polytechnique Montréal
China, China University of Geoscience, Beijing
China, China University of Geosciences, Wuhan
China, Chinese Academy of Geological Sciences, Beijing
China, Chinese Academy of Sciences, State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry
China, China Earthquake Administration, Beijing
China, Guangzhou University, Institute of Geochemistry, State Key Laboratory of Isotope Geochemistry
China, Nanjing University
China, Northwest University of Xi'an, Department of Geology
China, Chengdu University of Technology, Institute of Sedimentary Geology
Ghana, Council for Scientific and Industrial Research, Building and Road Research Institute
India, Indian Institute of Technology, Kanpur
Iran, Art University of Isfahan, Department of Art Conservation and Archaeometry
Israel, Geological Survey of Israel, Jerusalem
Israel, Israel Antiquity Authority, Jerusalem
Jamaica, International Seabed Authority
Japan, Kyushu University, Department of Earth & Planetary Sciences, Fukuoka
Japan, Niigata University, Faculty of Science
Japan, Senshu University
Kenya, Meru University of Science and Technology
Russia, Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow

South Korea, Kangwon National University
South Korea, Sejong University, Seoul
Turkey, Istanbul Technical University, Department Geophysical Engineering
USA Berkeley University, California, Lawrence Berkeley National Lab
USA, Brown University
USA, Getty Conservation Institute, Los Angeles
USA, Kansas State University
USA, Lawrence Berkeley National Laboratory, Berkeley, California
USA, Rutgers University, Department of Earth and Planetary Sciences, Piscataway, New Jersey
USA, Smithsonian Institution, National Natural History Museum, Department of Mineral Sciences
USA, University of Chicago Marine Biological Laboratory, Woods Hole
USA, University of Minnesota
USA, University of Oregon, Department of Earth Sciences
USA, University of South Carolina, Department of Geography

VISITING SCIENTISTS

During the 2021 the possibility of travelling again, despite with some limitations, allowed to return to a kind of normality, so that we could clearly see an increase on the outgoing and incoming of scholars, especially of PhD and post-doc.

OUTGOING

USA, Massachusetts Institute of Technology
Switzerland, WSL Institute for Snow and Avalanche Research SLF
Switzerland, ETH Zurich
The Netherlands, TU Delft University
Chile, Pontificia Universidad Catolica de Chile, Santiago, Departamento de Ingenieria Structural y Geotecnica
USA, Lawrence Berkeley National Laboratory
Denmark, University of Aarhus
The Netherlands, University of Twente
China, Changdu University of Technology, SKLGP Lab

INCOMING

China, Chinese Academy of Geological Sciences, Beijing, Institute of Geology
France, Grenoble University
France, Institut de Physique du Globe, Paris
France, Université Claude Bernard Lyon 1
Germany, University of Frankfurt
Ghana, Building and Road Research Institute
Switzerland, University of Lausanne, Faculty of Letters- Section of Art History
Tunisia, University of Gabes

International Degree programme

INTERNATIONAL DEGREE PROGRAMME

by M. Zattin

Over the past few years, the University of Padua has spent a great deal of effort on the internationalization of its research and didactic activities. In this framework, in 2020, the department launched a couple of new projects that should be able to significantly increase the number of incoming foreign students, especially regarding the master's degree courses. A very innovative agreement (named the '3+1+1 Programme') was signed with the University of Lanzhou and the Northwestern University of Xi'an. The above-mentioned programme will offer the opportunity for 10 students who have completed the first three years curriculum of undergraduate-level courses to spend up to one academic year at the University of Padua as exchange students, attending course units within the Geology and Technical Geology second cycle degree course. At the end of the first year as exchange students, selected students may apply to pursue their studies as degree-seeking students within the Geology and Technical Geology degree course, following an evaluation by the academic board responsible for regular admission. The first four students from the University of Lanzhou successfully concluded their BSc in 2021 and are currently attending MSc courses as regular students. A further agreement has been signed with Goethe University of Frankfurt with the specific aim of implementing a two-year International Master Programme in Geosciences. The proposed programme (named 'Earth Dynamics') will consist of a first year at the home university, the third semester spent at the host university and a jointly supervised master's project in the fourth semester. Upon successful completion of the International Master's Programme, students shall be awarded a degree by their respective home university. The main objective is to train students in the field of geosciences with a multidisciplinary approach and to focus on active and fossil orogeneses and coupling processes from mantle to atmosphere. It also aims to provide students with the ability to tackle advanced problems using state-of-the-art theoretical and analytical tools. Students will benefit from a specific grant given by the department that will supplement the Erasmus+ mobility programme. The first couple of students moved to Frankfurt on September 2021 and are currently working on their MSc thesis.

Seminars

SEMINARS *By A. Fontana*

Several specific seminars are organised throughout the academic year for master's and PhD students and members of the department. The speakers are generally esteemed scholars who present recent developments in their discipline as well as introduce new tendencies and future directions. Some of the seminars are career related, showing students the range of options for geologists and geoscientists working as employees or consultants for private companies, industries and public administrations.

In 2021, the seminars still partly suffered from the anti-COVID-19 limitations, and thus, between March and May, the lectures took place as live webinars. Since October, the seminars have been in person, giving participants the opportunity to meet the speaker and exchange impressions and ideas after the question & answer period.

SEMINARS AT THE DEPARTMENT OF GEOSCIENCES, YEAR 2021				
Date	Speaker	Affiliation	Title	Type
13/04/2021	**Valentina Rossi**	Museo di Scienze Naturali dell'Alto Adige, Bolzano	Creature fantastiche e dove trovarle: lo studio paleontologico dei tessuti non mineralizzati	Webinar
20/04/2021	**Bernardo Cesare**	Università di Padova - Dipartimento Geoscienze	Garnet, the archetypal cubic mineral, grows tetragonal	Webinar
27/04/2021	**Kathryn Moore**	University of Exeter - Camborne School of Mines	Mining as a response to criticality in the supply chain	Webinar
04/05/2021	**Taras Gerya**	Institute of Geophysics, Department of Earth Sciences - ETH, Zurich	Influence of plate tectonics on life evolution and biodivesity: biogeodynamical modeling	Webinar
11/05/2021	**Viviana Re**	Università di Pisa - Dipartimento di Scienze della Terra	Socio-Hydrogeology and the power of transdisciplinary sciences	Webinar
18/05/2021	**Giovanni Battista De Giudici**	Università di Cagliari - Dipartimento di Scienze Chimiche e Geologiche	Inquinamento minerario storico nel Sud Ovest della Sardegna, biominerali resilienza ambientale ed elementi utili per l'analisi di rischio	Webinar
25/05/2021	**Alice Gabriel**	Munich University - Department of Earth and Environmental Sciences	Supercomputing of earthquakes: Unraveling the dynamics of multi-fault rupture cascades, tsunami earthquakes and induced seismicity	Webinar
27/05/2021	**Andrea Moscariello**	University of Geneva - Department of Earth Sciences Visiting prof. Università di Padova - Dipartimento di Geoscienze	Geosciences and geoenergy: will there be a future beyond the black gold era?	In presence
21/10/2021	**Michele Sapigni**	ENEL- GPG Engineering & Construction – Engineering	Scavi in sotterraneo: previsioni e riscontri	In presence
04/11/2021	**Honami Sato**	Università di Padova - Dipartimento Geoscienze	Geochemical characterization of extraterrestrial impact events recorded in sedimentary rocks	In presence
11/11/2021	**Annese Mauro**	Former consultant for oil industries	Hydrocarbons and environmental impact, from exploration to refining	In presence
18/11/2021	**Luca Valentini**	Università di Padova - Dipartimento Geoscienze	Dwelling in the Anthropocene: sustainable supply chains for the built environment	In presence
02/12/2021	**Gianluca Benedetti**	ENSER S.p.A.	The Reference Geological Model in the professional practice	In presence

Teaching

TEACHING

by P. Mozzi

The professorial and research faculty of the department covers a wide array of geoscience topics, ranging from palaeontology and stratigraphy to sedimentology, structural geology, geomorphology, physical geography, technical geology, mineralogy, petrology, geochemistry, georesources, planetary geology and geophysics of the solid earth and the atmosphere. All faculty members are active scientists in their field of expertise and their effort is to continuously transfer groundbreaking scientific and professional knowledge and skills to their students. This allows the department to offer a thorough, high-standard education cycle in the geosciences, entirely hosted in a modern and comfortable building where classrooms are adjacent to laboratories and research facilities. In academic year 2021/2022, 163 students are enrolled in the bachelor's degree (Laurea Triennale) in geological sciences and 78 students in the master's degrees in environmental geology and earth dynamics (first year) and geology and technical geology (second year).

The World University Ranking by Subject 2021 (QS Quacquarelli Symonds) ranks the department as the best place for studying geology, geophysics, and marine and earth sciences in Italy. The University of Padua is ranked among the 2021 top 40 universities in the field of geology and among the top 50 in the fields of geophysics and earth and marine sciences in Europe. Globally, it is among the best 150 universities in all three subjects.

The Bachelor's Degree in Geological Sciences at our department provides a sound basis for understanding the main processes that control the evolution of the deep earth as well as the earth's surface dynamics. Particular attention is devoted to field activities and laboratories to provide students with challenging, hands-on experience. The aim is to allow the students to develop specific expertise in the observation and monitoring of geological processes, in geological mapping and in the analysis of rocks and minerals, challenging them to develop autonomous critical thinking. Students participate in several field trips and two field camps at the end of the second and third years, each lasting 7 – 10 days, in selected sites in Italy and abroad.

In academic year 2021/2022, the former Master's in Geology and Technical Geology was replaced with the new master's degree in Environmental Geology and Earth Dynamics. This latter represents the ideal prosecution of geological studies at UniPD. The aim of the degree course is to form geologists who can start and develop successful professional careers as freelance geologists or in private companies, public agencies and research institutions.

Very specialised classes, field activities and laboratories introduce the students to the multi-facet application of geological techniques and modelling. The experimental thesis work and traineeship occupy the whole last semester and allow focusing on specific topics of interest in the vast realm of the geosciences.

The new master's degree in Environmental Geology and Earth Dynamics is organised in two study tracks. The one in Earth Dynamics is entirely in English and combines solid fundamental knowledge on the earth's processes and history with the application of cutting-edge geological techniques and data processing. Through applied research-oriented teaching, field activities and laboratories, the programme offers advanced education and training in geosciences, with a focus on diverse issues that are crucial for future society, such as the prevention and mitigation of geohazards, land planning and environmental management, climate change, the prospection and sustainable exploitation of georesources, geomaterials, cultural heritage protection, and planetary exploration. An agreement with the University of Frankfurt allows a selection of the most meritorious students to spend 6 months in Frankfurt.

The study track in Geologia Applicata alla Difesa del Suolo e dell'Ambiente firmly keeps the focus on the formation of professional geologists dedicated to engineering geology, landslide monitoring and remediation and hydrogeology. This is a strategic need in Italy, given the fragility of the national territory in terms of geohazards, water resources and environmental protection. The courses of this study track focus on the most advanced techniques in data acquisition and processing, meeting the needs of evolving environmental law in Italy and the European Union.

To consolidate the international experience of our students and enhance their opportunities in the European and worldwide professional and research market, the Department of Geosciences is enthusiastically committed to the Erasmus+ Programme and SEMP – Swiss European Mobility Programme. Many grants have been available in 2021 for our best students to spend a semester in a choice of several European universities in Norway, Finland, Denmark, France, Germany, Hungary, Spain, and Switzerland.

The COVID-19 pandemics unfortunately continued in 2021, though much less severely than in 2020 in Italy. While lessons were held in the so-called dual mode, i.e., with students having the possibility of following the lectures both in the classroom and online, we managed to have all the laboratories in presence and to keep all field activities running. In this way, we have been assuring fully operative didactics both in the bachelor's and master's programmes since the very beginning of the AY 2020/2021. The recognition of the overall effectiveness of the didactics was provided by the students' opinion of both bachelor's and master's programmes, with

scores above eight on a scale of 10 that are at the top among all programmes of the School of Science of the University of Padova.

Other agreements with European universities are under definition, exploring the possibility of establishing double degrees. The curriculum in Geologia Applicata alla Difesa del Suolo e dell'Ambiente firmly keeps the focus on the formation of professional geologists dedicated to technical and engineering geology and hydrogeology. This is a strategic need for Italian society, given the fragility of the national territory in terms of geohazards and environmental protection. The courses of this programme are being deeply remodelled with the aim of keeping pace with the more advanced techniques in data acquisition and processing, as well as to meet the needs of evolving environmental regulations in Italy and the European Union. Teaching on the crucial issues of landslide monitoring and remediation is greatly strengthened thanks to new acquisitions of the faculty staff.

To consolidate the international experience of our students and enhance their opportunities in the European and worldwide professional and research market, the Department of Geosciences is enthusiastically committed to the Erasmus+ Programme and SEMP – Swiss European Mobility Programme. Up to 20 grants have been available in 2020 for our best students to spend a semester in a choice of fourteen European universities in Norway, Finland, Denmark, France, Germany, Hungary, Spain, and Switzerland.

MASTER'S COURSE IN GEOPHYSICS FOR NATURAL RISKS AND RESOURCES *by G. Cassiani*

In October 2020, the department activated the master's course in Geophysics for Natural Risks and Resources. The master's has the main goal of educating professionals and researchers capable of approaching in a multidisciplinary manner the theory and applications of physical methodologies for the exploration and characterisation of the subsoil. This exploration can take place at different spatial scales, from metres to hundreds of kilometres, with aims spanning a large number of applications and theoretical areas where the knowledge of soil and subsoil is crucial, such as: search for mining and energy resources; subsoil characterisation for renewable energies such as geothermal energy; non-invasive techniques for civil and environmental engineering, including geotechnical applications: engineering geology characterisation with specific attention to hillslope stability and hydrological risks in general; characterisation for seismic risk both at global (fault presence and nature) and local (amplification mechanisms) scales; application to built structures, with specific reference to the historical buildings, foundations and soil-structure interactions; applied Geodesy to study Earth's dynamics.

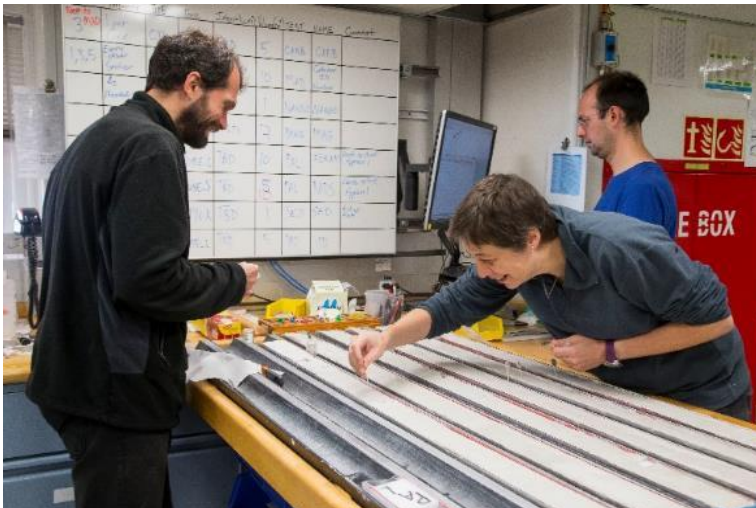
The courses on offer have been selected with two goals in mind: (i) educate professionals in the geophysical sector with a wide and solid quantitative background, thus capable of accessing careers in industry and research, and (ii) attract students from different backgrounds and produce graduates with a fluid interaction within the international geophysical community. To satisfy the requirements of the job environment, three majors (albeit informal) are foreseen: (a) a computational specialisation, directed towards large-scale geophysical applications, e.g. 3D and 4D seismics, with a predominant role in mining and energy subsoil exploration, (b) a field specialisation, with applications directed towards the management of natural resources and risks in the environmental and engineering areas, with the aim of educating independent professionals, (c) a large-scale solid-earth specialisation, for students interested in understanding Earth as a whole and progressing mainly in a research career. The master's course has had a growing success, from about 15 students in the first year (affected by heavy COVID restrictions) to over 35 in the second year (and growing numbers of pre-registered to come). A vast majority of international students have chosen the course, coming from some 20 different countries.

What we do

UNRAVELLING THE SECRETS OF PAST OCEANS

Claudia Agnini

My research field is micropaleontology, and I deal with the study of calcareous nannoplankton, which are calcareous algae adapted to planktonic life that secrete minuscule skeletons. Their fossil remains are often used as biostratigraphic and biochronological tools due to their abundance and wide geographical distribution in present and past oceans and their rapid evolution over time. Although their applications are historically linked to petroleum geology, they have also recently been used intensively as palaeoenvironmental and paleoclimatic proxies. In this context, my research activity essentially develops in two distinct but in some way complementary areas through the study of marine sediment outcroppings on land or recovered during ocean cruises (DSDP, ODP, IODP). The first is linked to paleoclimatic, palaeoenvironmental and palaeoceanographic topics. Within this vast line of research, I have developed a strong interest in the study of climatic variability during the Cenozoic with particular attention to the geo-biosphere interactions, or, in other words, between modifications of the abiotic system and changes in the palaeoecosystems. The second is dedicated to the application and implementation of the existing biostratigraphic schemes, with the final aim to build up robust age models of the investigated sedimentary successions. The use of quantitative methodologies allows for a better evaluation of the degree of reliability, reproducibility and synchronousness of the biohorizons used in different biozonations. My activity in recent years has focussed on a particular interval, the Paleogene, although I have also worked in other time intervals (Quaternary, Neogene, Mesozoic). In this context, the efforts of the Priabonian Working Group (ISPS) have led to the recent (2020) formal ratification of the Priabonian GSSP in the Alano di Piave section (NE Italy).



THE SCIENCE OF GEOMATERIALS, INDUSTRIAL PRODUCTS, AND CULTURAL HERITAGE

Gilberto Artioli

A major strategy adopted by ongoing research is the application of state-of-the-art integrated techniques to complex problems involving materials. It is often the case that complex materials and problems cannot be solved using one technique alone. Therefore, several techniques are being used to integrate and complement laboratory measurements, including advanced sources at large-scale facilities i.e. spallation neutron sources, synchrotron radiation). Applications are mainly focussed towards the following goals: (1) development and optimisation of industrial products, mostly relevant to the building and ceramics industry; (2) development of innovative stabilisation/solidification techniques involving contaminated soils; (3) CO2 storage in stable mineral products; (4) solution of materials-based problems in cultural heritage (archaeology, art history, authentication and restoration). The research group is very active and involves researchers from the Department of Geosciences, CIRCe and the affiliated departments, local CNR, and the OPIGEO spin-off. It is now a well-known reference group at the national and international levels. On the industrial side, collaborating companies include ENI SpA and Mapei SpA. On the cultural heritage side, active collaborations include the Getty Conservation Institute, the C2RMF at the Louvre, and the Israel Antiquity Authority.

HOT ROCKS

Omar Bartoli

The overall goal of my research is the investigation of melting processes in the deep continental crust, formation of granitic magmas and recycling of volatiles by means of 1) study of natural samples (migmatites and granulites), 2) experimental petrology and 3) thermodynamic modelling. My ongoing research is devoted to defining new protocols to investigate nanorocks, providing exciting new avenues to make these small data repositories talk, and obtaining a wealth of new information on melting of the orogenic crust. The multidisciplinary approach has allowed me to examine the foundations of long-standing concepts in petrology and to challenge paradigms, such as those on a fluid-absent regime during crustal anatexis.

ATMOSPHERIC EXTREME EVENTS, FROM VOLCANIC ERUPTIONS TO HURRICANES

Riccardo Biondi

Extreme weather events and volcanic eruptions annually cause death, injuries and damage to infrastructure, and they affect the climate and account for the major economic damage in several countries. The number and intensity of extreme weather phenomena have increased in the last decades in some areas of the globe and explosive volcanic eruptions frequently happen, threatening large parts of the world. In my research, I study these phenomena from the atmospheric point of view with remote sensing techniques: performing measurements campaigns, deploying new sensors, developing new monitoring and nowcasting models, and analysing data from different platforms. I focus my activity on tropical cyclone characterisation, thunderstorms nowcasting, volcanic cloud detection, and monitoring and support for aviation management and control. What is the tropical cyclones' inner structure? What triggers tropical cyclone formation? How can we predict quick and small-scale thunderstorms? What is the volcanic cloud particle size distribution and composition? How is it possible to provide an early warning to the aviation management system? These are some of the questions I am working to answer. My research group involves strict collaborations with INGV (Italy), CNR (Italy), Wegener Center for Climate and Global Change (Austria), the National Center for Atmospheric Research (USA), the Danish Technical University (Denmark), and several other public and private entities around the world. The funding collected with different projects allowed me to involve BSc, MSc, PhD students and young scientists in my research with a background in engineering, volcanology, geophysics and meteorology and to collect new interesting sensors/platforms, which are now used for campaigns, such as a visible/infrared prototype camera, model rockets, a lightning detector, a tethered balloon, optical particle counters, and several 'lab-made' IoT sensors.

RIVER MAPPING FROM SPACE

Simone Bizzi

The variety of existing river channel patterns and their functioning are nicely summarised in the river classification schemes, which tells us that river forms and patterns are generated by specific drivers, namely: channel gradient, amount of sediment supply, and grain size (calibre) of the sediment supply. The link between sediment transport and river morphology is well established from a conceptual point of view, but poorly characterised from a quantitative point of view.

My research line explores how to generate new geomorphic datasets from satellites, drones and smart sensors and provide modelling capacity regarding the study of the functioning of river systems and how this knowledge can be essential to support the challenges posed by modern river and water resource management. Our research group is composed of two postdocs and two PhD students, and case studies originate in Italy, France, Albania, Asia and Australia. We have active research collaborations with the Po Water Authority, Fondazione Sviluppo Sostenbile, Politenico di Milano, CNRS France, Lyon University, Durham University Department of Geosciences, and Berkley and Stanford Universities.

CATCHING THE CHANGING: GEOPHYSICAL CHARACTERISATION OF A DYNAMIC EARTH

Jacopo Boaga

Earth dynamic processes never stop, but we can take single frames to highlight these changes with applied geophysics. In my research, this involves recording the seismic motion with the cheapest possible instrumentation and highlighting the fascinating quick changes of the fragile glacial environments thanks to seismic, electric and electro-magnetic methods. My main (but not only) focus are the use of low-cost sensors for the detection of local earthquakes and the use of geophysical surveys for the characterisation of periglacial environments. I collaborate with several colleagues of the geophysics group, the sedimentological group and the applied geology group. For the seismological studies, I also collaborate with the OGS Institute (Trieste, Italy), while for the periglacial environment studies, I work with the WSL-SLF (Davos, Switzerland) and RWTH University of Aachen (Germany).

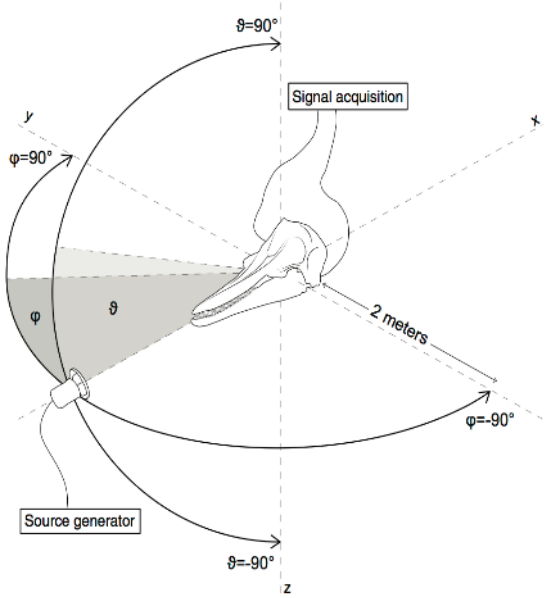
INVESTIGATING THE ORIGIN OF HIGHLY SILICIC MAGMAS

Bruna Borges Carvalho

I am currently involved in several projects investigating metamorphic and igneous rocks, in some of which I am the principal investigator. The PNRA Hot Antarctica focuses on the study of melt inclusions in ultra-high-temperature rocks from Antarctica. This project will provide a better understanding of anatexis, melt production and fluid regime under extreme crustal conditions. Additionally, I am working on melt inclusions from very explosive, highly silicic volcanic rocks. This study aims at understanding not only the volatile budget, but also at unravelling the origin of such massive amounts of magmas (crustal versus mantle derived). The last project, which is ongoing, concerns melt and fluid inclusions from metapelitic rocks that have been subducted to mantle depths. Understanding when and how the melting occurred will reveal new insights into the exhumation of ultrahigh pressure terranes. In these and other ongoing projects, I am collaborating with researchers from the University of Padova and other universities in Italy and several other countries, such as Australia, Japan, China, Hungary, Scotland and the United States.

SEISMOLOGY AND ACOUSTICS

Lapo Boschi



Phenomena explained by the physics of elastic waves are experienced every day, from the simple fact of communicating through speech to catastrophic events like earthquakes. In seismology, concepts in wave physics have been applied for over a century to localise hypocenters or make inferences on Earth's structure. After a thesis in tomography – a way of using seismograms to derive images of the earth's interior – I positioned myself at the interface between seismology and geodynamics: mapping the earth's structure to understand its functioning. I have explored questions such as the depth of subduction into the deep earth, the existence and role of mantle plumes, and the nature of the lithosphere-asthenosphere boundary region. My research shifted towards ambient-noise seismology, or how to record seismic data without earthquakes, on the basis of tiny ground oscillations generated by storms, ocean waves, and anthropic activities. These signals, properly treated, can be used to image and monitor the earth. My contribution to this topic focuses on its theoretical side. I participated in lab experiments to mimic and investigate aspects of noise theory. The idea of a new synergy between seismology and acoustics was central to the EU Training Network WAVES, which I coordinated from 2014 to 2018. Acoustics brought me to the problem of sound localisation. Seismologists are great at localising earthquakes via seismic networks. But how can living beings know where sounds come from, based on only two ears? The role of anatomy in localisation has been studied by bio-acousticians, but the auditory systems of some important species are not entirely understood. For instance, the high performance of the sonar of odontocetes is difficult to explain in terms of their anatomy. Understanding how cetaceans use their audition is crucial to marine environmental sustainability, and this has been the main motivation of my recent research.

SEDIMENTATION AND PAST CLIMATES IN THE CENTRAL MEDITERRANEAN

Luca Capraro

The current anthropogenic pressure on the Earth's climatic system is expected to wreak havoc on the natural climate variability, with aftermaths that are still to be ascertained. Yet, to paraphrase Charles Lyell, one of the founding fathers of modern Earth Sciences, the past is the key to the present - but also to the future. Understanding the inherent global and regional climate dynamics in the recent geological past is thus of the essence. In this perspective, my research is centered on the stratigraphic and paleoclimatic study of Pliocene to Pleistocene sediments of the central Mediterranean, a landmark area for this field of investigation. More specifically, I am committed in reconstructing the regional climatic evolution during the Early Pleistocene (ca. 2.6-0.8 Ma) by analyzing the expanded stratigraphic succession of recently uplifted, open-marine sediments that are spectacularly exposed along the coastlines of Southern Italy and Sicily. Our working group involves colleagues from national institutions such as the INGV of Rome, CNR-IAS, CNR-IGG, the Universities of Bologna, Catania, Chieti, Palermo, Urbino and Venezia, as well as specialists from foreign research centers such as CNRS (France), University of Missouri (USA), the Xi'an AMS center (PRC), and others. This manifold expertise allows for a multidisciplinary approach based on diverse tools such as physical stratigraphy, stable O and C isotopes, calcareous plankton biostratigraphy, paleomagnetism, and beyond.

NEAR-SURFACE GEOPHYSICS

Giorgio Cassiani

Most geological investigations face the obvious problem that soil and earth are (obviously) not transparent to visible light. Therefore, many reconstructions of the subsurface structure and processes are based on extrapolation of punctual data (from the surface or in boreholes) supported by assumptions. Luckily, exploration geophysics has long helped mankind to 'see' the subsurface for a number of practical and less practical purposes: from mining exploration to the general understanding of Earth's systems. If I had to give myself a research mission, it would be to remind all that without geophysics, there would be no sound knowledge of the earth. In particular, as the system is highly heterogeneous, as set in place by dynamic processes within the solid and fluid parts of the planet, we cannot rely upon assumptions of 'continuity', 'homogeneity' and interpolation. More specifically, my research work has been focussed, over the past 20 years, on the investigation of the structure and the dynamics of the shallow subsurface, where most engineering geology and environmental processes take place. In particular, I like: a) geophysical methods for environmental applications, with particular regard to the characterisation of hydrological systems and contaminated sites from the geological, hydrological and contamination viewpoints. The methods of choice are Electrical Resistivity Tomography (ERT) and Ground Penetrating Radar (GPR), especially in borehole and cross-borehole configuration. Novel Spectral Induced Polarisation (SIP) and microgravimetric time-lapse methods are currently under development; b) seismological micro-scale zoning and other soil dynamics use exploration geophysics, with particular reference to surface wave methods (MASW, MOPA); c) integration of hydrological modelling with evidence from geophysical methods and from classical hydrological measurements, both in the vadose zone and in the saturated zone, with the aim of calibrating the hydraulic and hydrological parameters of relevant geological formations; d) integration of invasive and non-invasive techniques for site characterisation, with particular reference to geostatistical techniques; and geomechanical issues related to the control of subsidence caused by the extraction of fluids from the subsurface, with particular regard to petrophysical and modelling aspects, including the geomechanical effects on 4D seismics.

TOWARDS GLOBAL LANDSLIDE MODELS - UPSCALING HAZARD FORECASTS IN SPACE AND TIME UNDER CLIMATE CHANGE FORCING

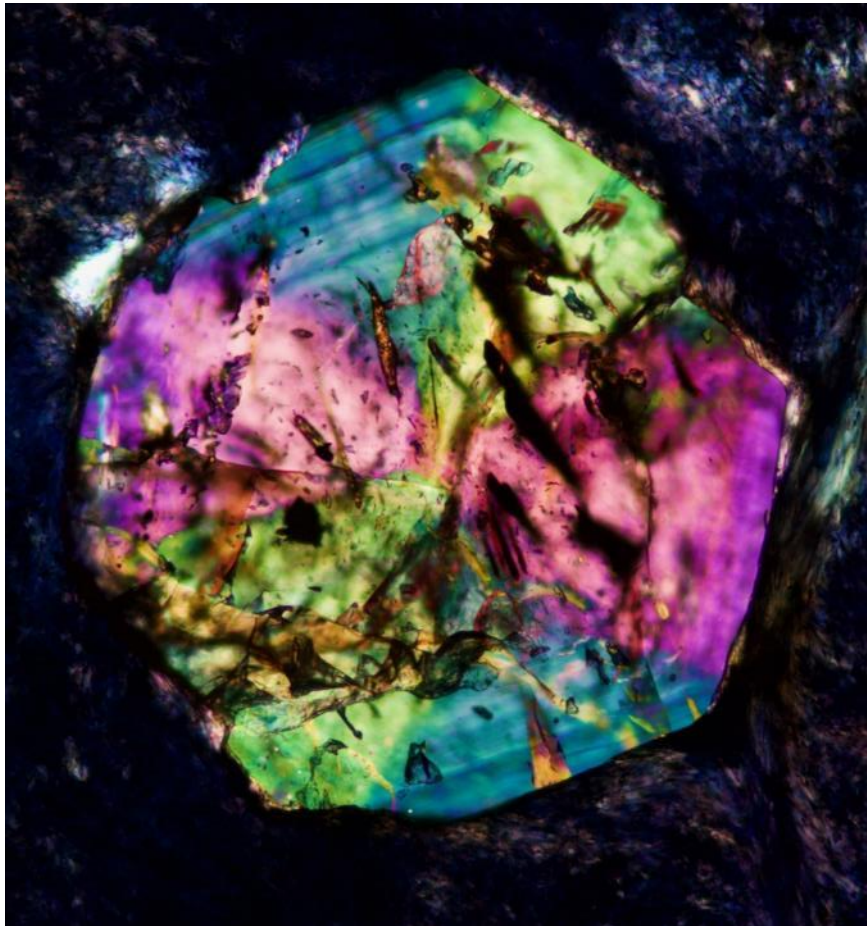
Filippo Catani

Slope hazards are ubiquitous, multifarious, and elusive as they are the result of a complex set of geological, geomorphological, biological and atmospheric processes interacting dynamically over a broad range of space and time scales. For these reasons, most of the available and established models for slope hazard assessment focus on local scales in space and on relatively short intervals in time. This hampers our capability of generalising the findings into a unique vision at larger scales and understanding what could be the impact of climate change on the risks induced by landslides globally. My research focuses on those gaps and tries to address possible sensing and artificial intelligence and datamining of crowdsourced digital information to improve our understanding of landslide dynamics in several geological settings, to exploit this knowledge to improve our capability of predicting the occurrence of slope failures and related disasters and to implement this capability into operational models and tools for risk mitigation. I operate towards those objectives by leading a digital laboratory on 'Machine Intelligence and Slope Stability (MISSLab)' at the Department of Geosciences that leverages Earth observation, slope monitoring with radars, GPS, laser scanners, drone surveys, artificial intelligence methods with neural networks, and numerical models to devise, test and apply new tools for the analysis of slope processes from local to global scales. The laboratory cooperates with several national and international research groups and institutes in Switzerland, South Korea, China, Australia and Japan, as well as several other department researchers, PhD and MSc students, and several research branches.

PROBING THE DEEP CRUST

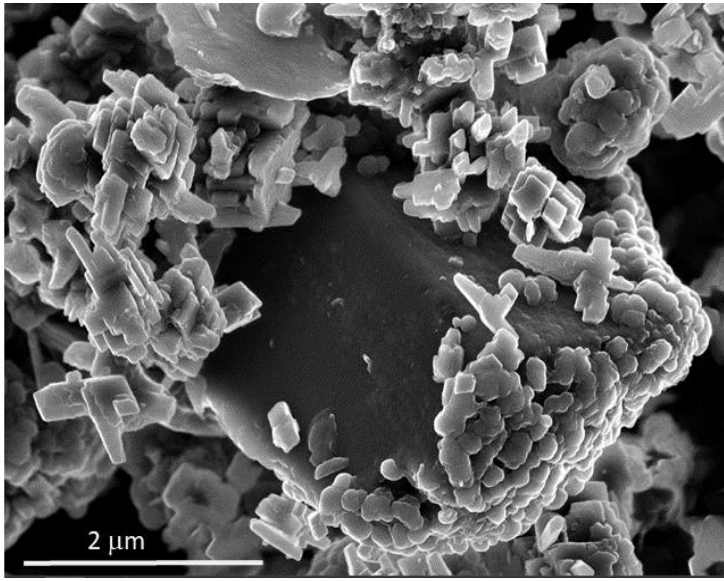
Bernardo Cesare

In the ACME (Advances in Crustal Melting) research group, including Profs O Bartoli and B Borges Carvalho and PhD candidate P Slupski, we study the how (processes) and the what (products) of partial melting of the deep crust. This is probably the main process that shapes the upper layer of our planet, which determines its geochemical differentiation and promotes its dynamic behaviour through the formation of granitic magmas. Using samples of worldwide provenance, but recently focussed on rocks from Antarctica, the Alps and the Swedish Caledonides, we apply the most innovative approach to the characterisation of natural crustal melts, i.e., the study of 'nanogranitoid' inclusions in peritectic minerals such as garnet. This novel approach, developed by our research group, utilises a series of analytical techniques ranging from conventional petrography to experimental petrology.



MINERALOGY APPLIED TO THE STUDY OF CEMENT

Maria Chiara Dalconi

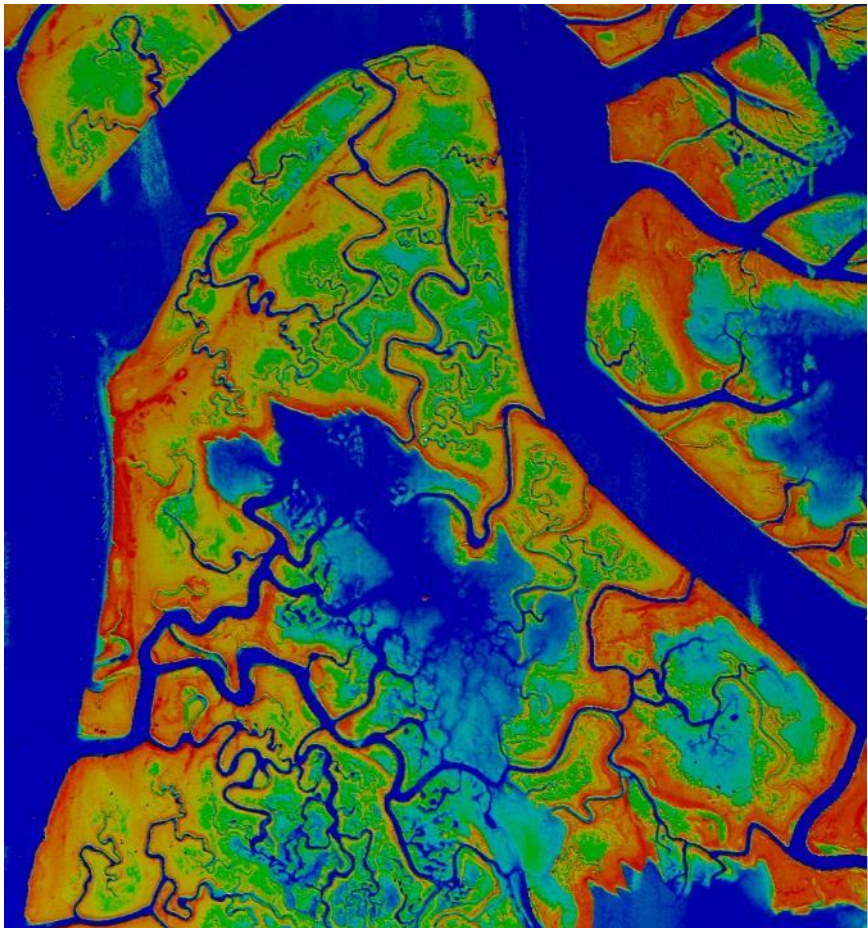


Cement is the most used industrial material, considering the enormous volumes produced and consumed yearly worldwide. It is generally considered a simple and cheap material; actually, it is a highly engineered material that has been optimised since the beginning of the 20th century. Cement is still the subject of extensive research and its technological content is increasing. The challenge of the present day is to make cement more sustainable, reducing the environmental impact related to its production. Academic research can make a valuable contribution to achieving these goals. My research activity is focussed on understanding the process involved in cement hydration, how cement composition impacts final mechanical properties, on elucidating the elusive structural details of C-S-H (the main product in hardened cement paste), and on how we can safely use industrial byproducts (waste) as cementitious materials and reduce the consumption of natural raw materials. A research activity that is feasible only thanks to collaboration with colleagues of the Geoscience Department, IGGC-CNR researchers and in cooperation with industrial partner Mapei SpA and an OPIGEO spin-off. I also have the opportunity to work with several postdocs enrolled at CIRCe. The main output of our research is scientific publications, in which a new crystalline phase has been discovered in cement pastes hydrated in the presence of organic admixture, and its crystal structure has been solved. We have also recently dealt with materials derived from carbon dioxide sequestration via mineralisation processes. The final product is composed of amorphous silica and magnesite, has promising pozzolanic activity and can be effectively used as a secondary cementitious material.

ESTUARINE AND FLUVIAL ECO-MORPHODYNAMICS

Andrea D'Alpaos

Fluvial and coastal landscapes are shaped by intertwined physical and biological processes and are exposed to the effects of climate change and human interference. In my research, I try to unravel the dynamic response of fluvial and coastal landscapes to changes in environmental forcing and human activity and how biogeomorphic processes control such responses. My research is mainly carried out in collaboration with Prof Massimilano Ghinassi, but I also have ongoing collaborations with Profs. Jacopo Boaga, Francesca Da Porto, and Filippo Catani. I have collaborated with colleagues all over the world: University of Antwerpen; University of Granada; Trinity College Dublin; The University of Edinburgh; University of Auckland; Boston University; Virginia Institute of Marine Science; University of Minnesota; EPFL – Lausanne; Nanjing University; Duke University, and many others.



GEOTHERMAL ENERGY AND THERMAL PROPERTIES OF ROCKS

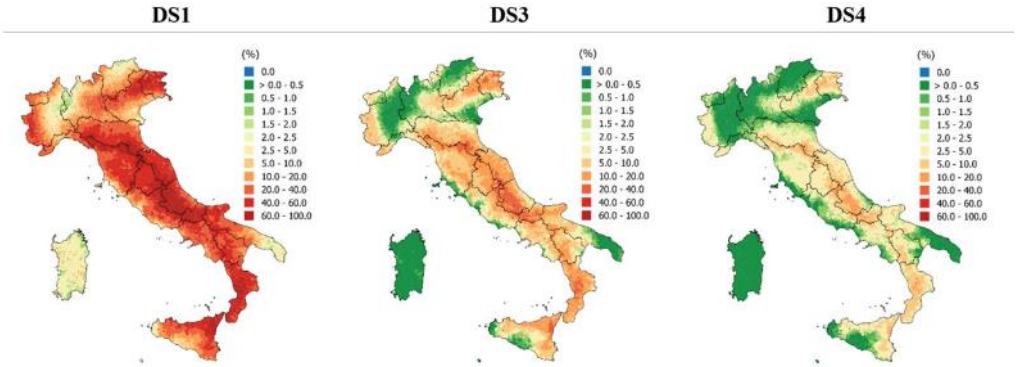
Eloisa Di Sipio

Continuously renewable, CO2-neutral, clean, affordable and modern energy for the benefit of humanity is the 7th United Nations Sustainable Development Goal. Geothermal energy, defined as the thermal energy stored in the earth, is considered a critical renewable energy source for the future, as approx. 99% of the earth's mass is hotter than 1000°C allowing to be tapped through environmentally friendly carbon-neutral energy conversion. To meet electricity and heating/cooling demand for modern society, innovative and emerging technologies must be developed to fully exploit the Earth's geothermal potential. Geothermal energy plays a key role, as it has two main advantages: i) facilitates a rapid transition to renewables and ii) contributes to reducing the thermal needs of the residential sector. Therefore, understanding heat transfer and fluid flow in deep and shallow geologic environments, with a focus on rock thermal behaviour, remains a top priority for my research. I work with the geothermal research group led by Prof Galgaro, which cooperates strictly with the Levi Cases Centre and the Industrial Engineering Department at the University of Padua and with several national and international research centres. Personally, I am the principal investigator of the DeepU European Project (HE 101046937) and the ULTRA departmental project. The former concerns the combination of laser and cryogenic gas for geothermal energy exploitation to create a deep closed-loop, self-supporting, U-tube shaped heat exchanger; the latter is devoted to underground temperature record analysis for climate change and subsurface heat island assessment. My experience as a researcher both in laboratory and in field activities brought me to work in interdisciplinary, multicultural and international teams in Europe involving enthusiastic young B Sci M Sci and Ph D students, postdocs, senior researchers and professionals with backgrounds in geology, geophysics, hydrogeology, geochemistry, engineering and monument conservation.

SEISMIC VULNERABILITY OF STRUCTURES AND SEISMIC RISK

Francesca da Porto

Earthquakes represent a major threat for the built environment and for the safety of people. My research activities focus on understanding the seismic vulnerability of structures, to propose new design procedures and develop mitigation strategies for existing constructions, in particular Cultural Heritage buildings. To this end, I carry out on-site tests with several non- and minor-destructive techniques, including tests for the dynamic dentification of buildings, and I use systems for the Structural Health Monitoring of buildings and monuments. These results are used to calibrate numerical models for the analysis of structural behaviour and the assessment of seismic vulnerability. I also work on developing and evaluating the effectiveness of techniques aimed at reducing seismic vulnerability. Starting from the seismic response analyses of single and clustered buildings, I moved to the seismic vulnerability assessment of urban centres and, more recently, to the seismic risk assessment at a territorial scale. In this field, I actively contributed to the first "National Risk Assessment" delivered by the Department of Civil Protection in 2018, and I am working on the subsequent three-year updates of the same document. In my work, I have many collaborations with the DPC, as well as ReLUIS, the Ministry of Culture, and many other public administrations and private companies. I also have many collaborations with research institutions abroad, in particular in Israel and in China.



National Seismic Risk Assessment. Unconditional damage map of masonry buildings at 50 years.

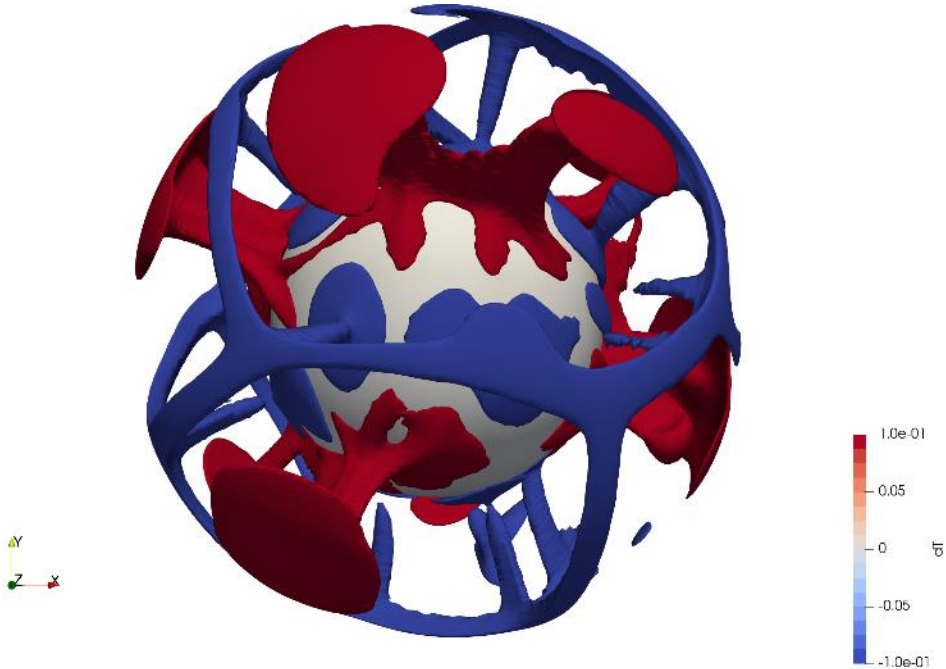
MECHANICS OF NATURAL AND HUMAN-INDUCED EARTHQUAKES

Giulio Di Toro

Mankind has been a victim of earthquakes for millennia and is now also able, often accidentally, to induce them. Clearly, our knowledge of the seismic cycle and earthquake mechanics is still in its infancy. In my research, I tried to look inside at the earthquake engine (= the fault) by performing (1) field studies of faults exposed at the earth's surface, (2) investigations of rocks from drilling projects of active fault zones, (3) microanalytical and microstructural studies of natural and experimental fault products, (4) laboratory experiments that reproduce the deformation conditions during the seismic cycle and (5) numerical models that integrate the above data (see figure below) to address questions like what is the structure of a seismogenic fault, and how does it evolve in space and time? Which faultzone deformation mechanisms are active during the seismic cycle? How do seismic ruptures nucleate, propagate and arrest in the upper and lower crust? Why do some upper crustal faults slip almost silently and others rupture in damaging earthquakes? How is deep, often aseismic, crustal deformation coupled with upper crustal seismic activity? How are tsunamigenic earthquakes generated? Why do so many earthquakes remain small and only a few become large? My research group in the years involved a variegated group of people from INGV (Rome) and Padua University, including young BSc, MSc and PhD students; postdocs; and senior researchers with backgrounds in geology, seismology, geophysics, geochemistry and engineering. Thanks to their enthusiastic support and to the grants from the European Research Council, the Italian Department of Civil Protection and the Fondazione Ca.Ri.Pa.Ro., we installed two unique, versatile and complementary machines (SHIVA and ROSA) in Italy to study the seismic cycle over a wealth of deformation and environmental conditions. The results of these research activities, published in approximately 120 scientific papers, have also been applied to the mechanics of landslides, e.g. Vajont 1963, and to human-induced seismicity, e.g. CO2 underground storage.

STUDY OF THE DEEP EARTH'S INTERIOR

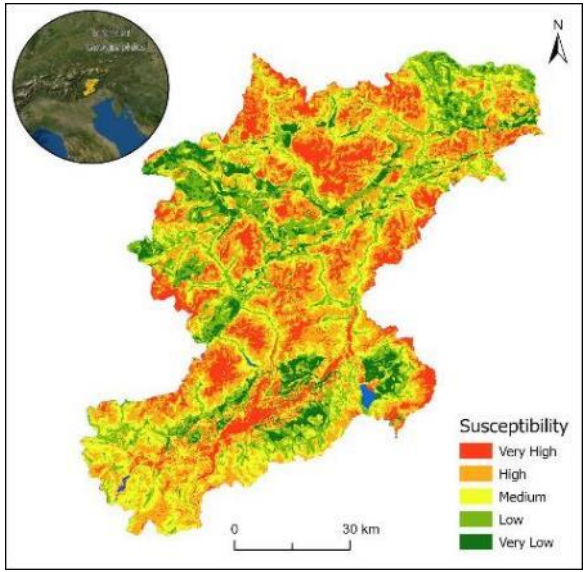
Manuele Faccenda



The earth's interior remains mostly inaccessible to direct exploration, and as such, we must rely on indirect investigation methods such as laboratory experiments, geophysical surveys and geodynamic numerical modelling. My research activities focus on understanding the earth's internal dynamics and present-day structure through (i) geodynamic numerical modelling of processes such as mantle convection, metamorphism, magmatism, orogenesis, deep earthquakes, viscous deformation, development of mechanical anisotropy, and (ii) seismological forward and inverse modelling of mantle structures. With this respect, and thanks to the European Research Council (ERC) Starting Grant NEWTON, we have installed an HPC cluster in our department and have been involved in the research activities of several MSc, PhD, postdoctoral and senior researchers. Although I am a geodynamicist by formation, I like to interact and collaborate with colleagues from different scientific disciplines (petrology, mineralogy, structural geology, seismology, computational science, engineering, mathematics) based in our department and/or in other international institutes (UCL, Kangwon Uni., Monash Uni, ETH Zurich, University of Illinois, Chinese Academy of Sciences).

GEOHAZARD EVALUATION AND MITIGATION

Mario Floris



I am part of the engineering geology group of the department. The group is composed of one full professor, me, one assistant professor, three PhD students and two visiting PhD students from China. In the last year, we have developed a machine intelligence laboratory dedicated to the analysis and assessment of geohazards using the most recent artificial intelligence (AI) techniques. Financially and technically supported by the Veneto region, and in collaboration with researchers from the Department of Land, Environment, Agriculture and Forestry of the University of Padua and the National Research Council, we are currently carrying out surveys on landslide hazards affecting Belluno Province (NE Italian Alps). We are analysing the effects of extreme meteorological events on the variation in susceptibility to landslides in the study area. To this end, we are performing field geological and geomorphological surveys, GIS-based landslide hazard analyses, SAR satellite data processing, detection and characterisation of landslides through machine learning techniques applied to high-resolution optical data. Of particular interest is the Vaia windstorm that hit the Northeast Italian Alps in 2018 and caused huge damage to environmental and anthropic elements. Due to climate changes, this kind of dangerous phenomenon seems more frequent in the last year, and great attention must be paid to the short- and long-term effects on the stability of slopes and, consequently, on the elements at risk, such as anthropic structures and infrastructures. Our group is establishing and consolidating relationships with numerous foreign academic and governmental institutions located in Europe, Central America, and East Asia to realise a scientific network dedicated to geohazard risk assessment and mitigation and to explore the possibility of finding common strategies and solutions for human resilience at the world level in a climate change context.

CENOZOIC AND LATE CRETACEOUS CALCAREOUS NANNOFOSSIL BIOSTRATIGRAPHY AND PALEOECOLOGY

Eliana Fornaciari

Since the 2000s there was an increasing concern on global changes issues and on the possible rebounds for Earth's Life and for the global ecosystem. The study of the past climate changes and its interactions with the biota is vital because it could provide useful indications on the future state of our planet. In Earth History, a few intervals characterized by geologically brief transient episodes of globally elevated temperatures (e.g., Paleogene hyperthermals, Late Cretaceous OAE) that can be considered as roughly analogues of current climatic stress have been identified. Their study and the understanding of feedback, triggering mechanisms and the recovery phases involve many disciplines of Earth Sciences. Within the research group to which I belong with my research, I tried contributing to the knowledge of Cenozoic global changes effects performing quantitative counting of calcareous nannoplankton assemblages mainly by means of optical microscope to establish: (1) the age and timing of these "warming episodes" by exploiting the rapid evolution of this group which, thanks to occurrences and extinctions, can be employed to create scales ("calendars") of Geological Time; (2) the variations of the assemblages in terms of abundance and biodiversity before, during and after these episodes and (3) its sensitivity to dissolution and presence of heavy metals. The aim is to address, albeit partially, some crucial questions such as: 1) Are there any relationship between calcareous nannofossil changes of abundance and the environmental changes? 2) Are these variations synchronous with that documented in others biota? 3) Are global changes driving evolution or viceversa? A strong collaboration among different branches of Earth Sciences is essential to answer these and other questions. Therefore, several collaborations have been developed with others University (Urbino, Chieti, Ferrara, Modena) and Research Institutions (Italian and French CNR).

SYSTEMATIC PALAEONTOLOGY AS A KEY TO UNDERSTAND THE TRIASSIC-JURASSIC EVOLUTIONARY HISTORY OF THE WESTERN TETHYAN GASTROPODS

Roberto Gatto

The response of the biota to environmental perturbations is a very timely topic. In the geological past, the Earth witnessed a series of major extinctions events in terrestrial and marine ecosystems induced by endogenous and exogenous factors, such as, for example, climatic oscillations, disruption of biogeochemical cycles, massive eruptions or extraterrestrial impacts. As a palaeontologist I study the evolution of fossil marine benthic communities in order to understand tempo and mode of recovery of marine life during these intervals of environmental disturbances. Benthic molluscs, and gastropods in particular represent an important source of information on evolutionary processes linked to extinction events because of their excellent fossil record, high diversity and strict dependence on environmental factors. The use of this potentially rich archive is often hampered by the lacking of updated systematic revisions, but recent researches show that when subjected to a detailed taxonomic analysis, gastropod faunas are a useful tool in assessing diversity trajectories during and after major faunal turnovers. My current research focuses on studying the taxonomy of gastropod faunas from Hettangian and Aalenian strata (Jurassic) of continental Europe, in order to elucidate the faunal recovery in the aftermath of both end-Triassic and Lower Toarcian extinction events. I collaborate with Stefano Monari, Department of Geosciences, University of Padua, Cris Little, School of Earth and Environment, University of Leeds (UK), and Robert Weis, Musée national d'histoire naturelle, Luxembourg.

SEDIMENTOLOGY AND MORPHODYNAMICS OF FLUVIAL AND TIDAL MEANDERING CHANNELS

Massimiliano Ghinassi

Highly populated lowland and coastal areas are drained by sinuous fluvial, fluvio-tidal and tidal channels, which, over the past millennia, shaped present-day landscapes. In times of noteworthy environmental changes, management of lowland and coastal areas is tightly linked to the understanding of evolution of these sinuous channels, both to live by their side and to manage the landscape, which they chiselled over the past millennia. Additionally, understanding deposits generated by their morphodynamic evolution can provide crucial insights to balance massive industrial carbon dioxide production through subsurface storage. In recent years, I have addressed my research interest in these channels by collaborating with researchers from different countries and integrating classical sedimentological principles with modern approaches, such as drone photogrammetry and 3D virtual outcrops. These studies allowed me to work on world-class locations, like the Torridonian succession of Scotland, planform exposures of the Jurassic Scalby Formation in England, and the paramount outcrops of the Tremp Basin in Spain. Since 2016, my interest in meandering channels has moved to Holocene successions and modern systems, with particular focus on the Venice Lagoon and the Venetian Plain. Here, I currently investigate deposits of fluvial, fluvio-tidal and tidal channels through integration of geophysical, remote sensing and sedimentological approaches in collaboration with departmental colleagues. Results from these studies provide insights to understand propagation of pollutants and saltwater intrusion in coastal areas. I am now developing an interest in experimental sedimentology, and, in collaboration with Andrea D'Alpaos, we are developing a new facility to replicate sedimentation in meander bends under controlled conditions.

PETROLOGY OF CULTURAL HERITAGE MATERIALS: DISCLOSING THEIR PROVENANCE AND THE PRODUCTION TECHNOLOGY

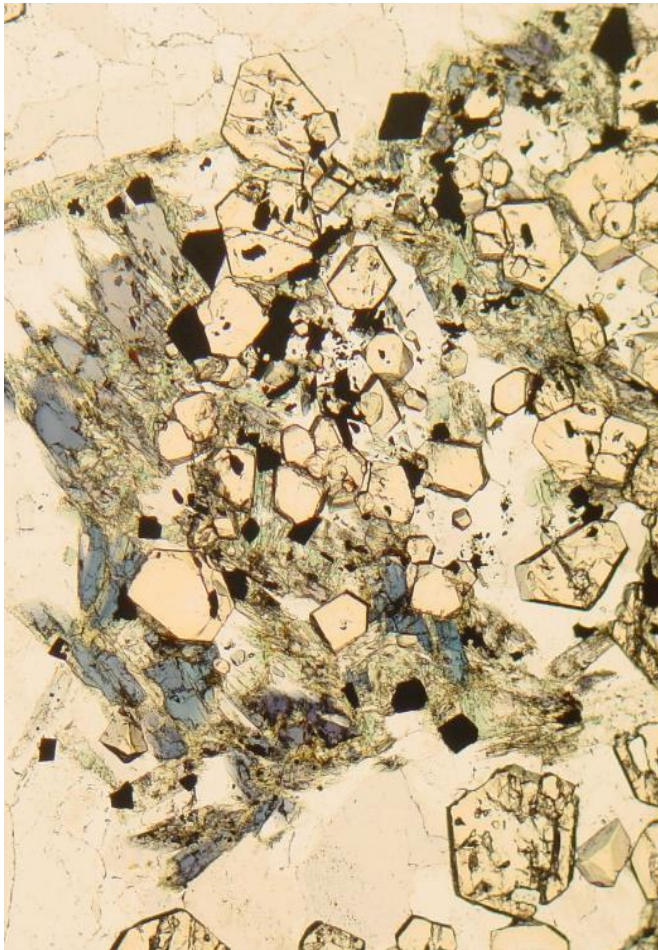
Lara Maritan

Behind their beauty, ancient artefacts represent the material culture of past communities. They record in their petrographic, mineralogical, chemical and microstructural features information on both the type of raw materials used and all the transformations they underwent during their production, use and abandonment. The analysis of these materials, using the typical methods adopted in geosciences, can reveal the secrets they shield, contributing to a deeper knowledge of ancient societies and their practices. My research, therefore, couples mineralogical, geochemical, isotopic and petrographic analysis to disclose the provenance, production technology, and alteration state of ancient artefacts, particularly archaeological ceramics, mortars, pigments and stones, coming from various regions of the world and dating back to the Palaeolithic. In addition to laboratory analyses, field activities contribute to properly sampling the ancient artefacts, as well as studying the environment in which they laid down for century or millennia, or the possible geological area from which the raw materials used were supplied. The use of standard analytical procedures and the application of advanced methods to better solve specific problems, also in view of a sustainable research plan, represents an important aspect of my activity, which therefore explores the possibility of using non-conventional methods and defines the limits of application in archaeological and history of art materials. To better interpret the ancient records, experimental reproductions of past technology or alteration processes in the laboratory, under controlled conditions, are fundamental.

ALPINE GEOLOGY

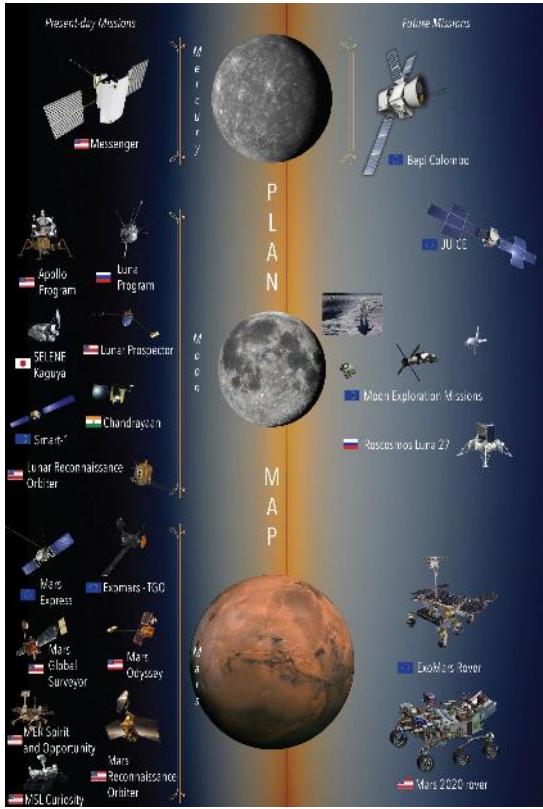
Silvana Martin

My personal research regards the Alps, in particular tectonics, metamorphism, magmatism and paleolandslides. I have a excellent collaboration with Sandro Rossato and Manuel Rigo of the Geoscience Department and Susan Ivy Ochs (ETHZ) for studying and dating carbonatic rocky landslide deposits in the Dolomites, and with Giovanni Monegato (CNR-IGG) for studying and dating Quaternary deposits in the Alps, i.e. Lago d'Orta, Lago Maggiore, Cima d'Asta. I also have a strong collaboration with Omar Bartoli and Bruna De Carvhalo (Geoscience) for research regarding post-orogenic magmatism, in particular the Adamello Alpine and the Cima d'Asta prealpine magmatic complexes, and with Paolo Nimis (Geosciences Dep.), Paola Tartarotti and Simone Tumiati (Milano Statale University) for high-pressure metamorphism and mining studies. I worked in the recent past with Giorgio Ranalli (Carleton University), Alfio Viganò (Provincia di Trento) and Jacopo Boaga (Geoscience Department) in the Trentino-Alto Adige region for geophysical monitoring and survey, and with Fabio Gabrieli (Dicea) and Livio Franz (Insubria University) for monitoring landslides in the Dolomites. I am also a member of the UNESCO Dolomiti Project Committee. I have also recently accepted participation in an IPGP, Paris project with Benedicte Menez and Baptiste Debret regarding the storage of carbon in high-pressure rocks.



GEO-MAPPING OTHER WORLDS

Matteo Massironi



In the last years we have witnessed an exponential increase of space missions to diverse planetary bodies of the Solar System, including in situ robotic and crewed explorations led by different National Space Agencies. This trend is going to further increase in the years to come and is consequently leading to an urgency in the production of planetary geological maps to define observational strategies of orbital missions, assuring safe landing and fruitful traverses of robotic and human missions and scientifically exploiting the retrieved data. Our team is actively working in producing geological maps and 3D geological model of the subsurface to exploit the data from past mission on planetary and small bodies and to sustain future planetary exploration on the Moon, Mars, Mercury and Jupiter's satellites. In particular our aim is aggregating morphological and compositional information on wider region of diverse planetary surfaces and integrate 3D geological models into virtual environments. To correctly interpret planetary geology is, however, essential to refer to reliable field analogues and we are indeed studying volcanic fields in Lanzarote, fluvial sedimentary environment on the Alps and lunar highland-like rocks in Lofoten Island (Norway). Both the study of field analogues and the production of planetary geological maps and virtual environments are of prominent importance to prepare future crewed and robotic missions on Moon and Mars. For this reason, some members of our group have been deeply involved in the PANGAEA field geological training of ESA-Astronauts since 2016. The research team is nowadays also actively participating to the Bepi Colombo mission to Mercury, the JUICE mission to the Jovian Satellites, and the Exo-Mars Trace Gas Orbiter.

APPLIED PETROGRAPHY IN THE STUDY OF CLIMATE CHANGE EFFECTS ON MATERIALS AND THE ENVIRONMENT

Claudio Mazzoli

One of the major challenges in humanity is tackling the effects of climate change through mitigation and adaptation actions and strategies. Most of us are now aware of the risks we are increasingly facing, although the effects of climate change remain somehow intangible and most noticeable impacts are still too far from our daily lives. Adequate risk management and effective policy decisions require a thorough understanding of climate change, knowledge and quantifying the effects. This represents the main goal of all my research interests, which brings me from historic cities to Antarctica. Cultural heritage assets (historical buildings, monuments, archaeological sites) are a legacy from our past and it is our responsibility to pass them down to future generations. They are continuously subjected to interactions with their environment; thus, understanding weathering processes and rates of decay are essential for restoration projects and preservation actions, based on reliable evaluation of cultural heritage vulnerability under future climate scenarios. For this reason, I am studying the environmental parameters, the microclimate conditions, and the textural features controlling the deterioration mechanisms of carbonate rocks, which are the most widely used stones in architecture and are also the most vulnerable to deterioration. The aim of these studies is therefore to refine the functions used to predict the recession rate in carbonate rocks through measurements on the monuments and experiments both in the laboratory and outdoor (HYPERION). One important aspect of climate change refers to the potential feedback. For example, permafrost thaw in the Arctic is already releasing huge amounts of greenhouse gases into the atmosphere, further increasing the global warming effect. Permafrost thaw in Antarctica can also potentially have a dramatic impact on global warming. Thus, it is essential to evaluate the gas concentrations and emissions from permafrost in Antarctica (SENECA).

SYSTEMATIC PALAEONTOLOGY AS A KEY TO UNDERSTAND THE TRIASSIC-JURASSIC EVOLUTIONARY HISTORY OF THE WESTERN TETHYAN GASTROPODS

Stefano Monari

Gastropods are an important component of the past and living benthonic communities with a history of evolutionary vivacity and of intense ecological diversification that makes the study of this group a good target to recognise the global faunal crises and to outline the modalities of recovery. Research is mainly directed to identify the main changes in the diversity and abundance of gastropod faunas in the Upper Triassic and Jurassic. In this time span, the gastropods experimented with a slow and long-lasting Late Triassic (post-Carnian) decline of biodiversity, a relatively fast Lower Jurassic recovery, an abrupt change of taxonomic diversity across the T-AOE and a subsequent Middle Jurassic radiation. The main goal of the research is to assemble a large database, mainly based on detailed systematic studies, combining taxonomic information with data on facies and geographic distributions. The questions we seek to answer are: What were the causes of the persistent (more than 20 Ma) Late Triassic loss of diversity? What was the actual contribution of the end-Triassic mass extinction? How much did this loss affect the subsequent Lower Jurassic recovery? What was the effect of the articulated geodynamic history of the western Tethys on the taxonomic and geographical diversification of gastropod faunas both in the European shelf and in the central part of western Tethys? These research projects are carried out in collaboration with Roberto Gatto (this department), Robert Weis and Mara Valentini (Musée national d'histoire naturelle de Luxembourg), Crispin Little (University of Leeds, UK), Janós Szábo (Natural history museum, Budapest, Hungary), Maria Alessandra Conti (University la Sapienza, Rome) and Elio Dellantonio (Museo Geologico delle Dolomiti di Predazzo, MUSE, Trento). They also benefited from the collaboration of Pascal Neige and Jean-Louis Dommergues (Université de Bourgogne Franche-Comté, CNRS, France) as coordinators of a wide study on the Sinemurian Stratotype.

DEEP EARTH, TERRESTRIAL AND EXTRATERRESTRIAL DIAMONDS

Fabrizio Nestola

My ongoing research activities mainly focus on mineral physics, diamond research, meteorites and new minerals discovery using cutting-edge analytical techniques in X-ray diffraction, micro-Raman spectroscopy, and scanning electron microscopy. My main target is the use of mineralogy and crystallography to solve geological unsolved problems at small and large scale. My main contributions are about the development of elastic geobarometry applied to the diamond-inclusion systems to determine the depth of diamond formation and to the investigation of the temporal growth relationships between diamond and its mineral inclusions with the final aim to comprehend under which geological environment diamond crystallised. More recently, I also focussed my research on meteorites and more in detail on extra-terrestrial diamonds to understand the space processes at the base of extra-terrestrial diamond formation. The research outputs in 2021 resulted in 14 peer-reviewed papers. These research activities were funded by the ERC, by the National Research Programme in Antarctica (PNRA) and by a few grants provided by the University of Padova. My present research gained important benefits from my scientific collaborations with several colleagues around the world, mainly from Canada, the USA, Russia, Germany, France and Australia. In the last ten years, I have had the great opportunity to conduct a research group comprised of nine postdocs, six PhD students, 15 master's students and 20 bachelor's students.

ARCHAEOLOGY MEETS EARTH SCIENCES

Cristiano Nicosia

I am the PI of the ERC Consolidator project 'GEODAP' (Geoarchaeology of Daily Practices), which focuses on the reconstruction of daily lives during the Bronze Age (2nd millennium BCE). The project involves an interplay of analytical techniques (soils/sediment micromorphology, palaeobotany, organic chemistry) on a set of selected archaeological sites spanning NE Italy, the Balkans, and the Carpatho-Danubian Basin. The project began in October 2021 and will last until 2026. A laboratory for the production of soil/sediment thin sections is under construction at the Department of Geosciences. The GEODAP team consists of three PhD students, two postdocs (a palaeobotanist and an organic chemist beginning in April and October 2022 respectively) and a laboratory technician to be hired in due course. My remaining research activity concerns the Bronze Age pile dwellings of the Garda region and, more generally, wetland and peat bog geoarchaeology. I participated in a Brown University (USA) mission in Petra (Jordan) focusing on ancient agricultural terraces and in central western Sardinia with the same University. Since 2019, I have carried out palaeoenvironmental research in the Berici Hill area (Vicenza), using historical peat quarrying as a 'window' to access environmental and archaeological information and involve local communities in our research.

RESOURCES FOR GEOLOGY - GEOLOGY FOR RESOURCES

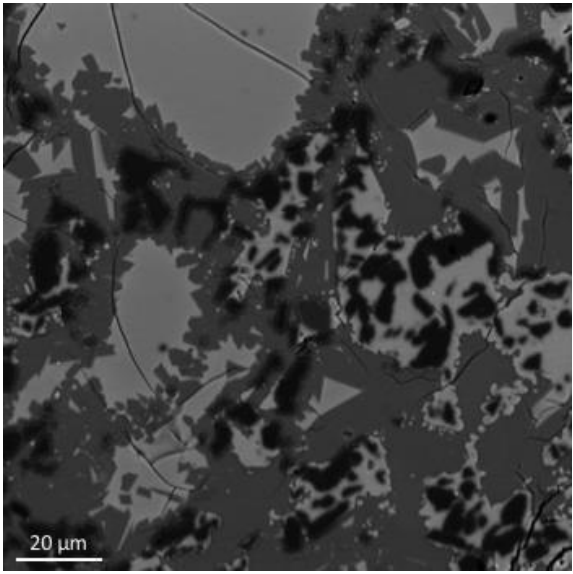
Paolo Nimis

Geological resources that serve as a foundation for the life of modern human society are increasingly sought after to satisfy human needs. This is particularly true for critical raw materials, i.e. commodities that are at high supply risk for some or most countries. Geology is at the foundation of ore deposit models, which are essential to direct mineral exploration. The study of ore deposits in turn provides insight into specific geological processes that are crucial for our understanding of Earth's functioning. My current research activity has a strong interdisciplinary character. It combines topics and methods that are typical of mineralogy, ore geology, petrology and geochemistry, and is mostly aimed at investigating ore-forming processes in mafic and ultramafic environments. The main research programmes include (a) the geochemistry, mineralogy and thermobarometry of mantle rocks and diamonds, with implications on the interpretation of the genesis and distribution of diamond within the earth and of related mantle processes, and on the assessment of diamond potential of kimberlitic rocks (partly in collaboration with other researchers and PhD students of the department, international colleagues and mining companies); (b) the study of (Cu, Zn, Co, Ni) massive sulphide deposits in mafic-ultramafic complexes, with special regard to the interpretation of their geochemical variability and comparison with present-day seafloor analogues. In the last few years, I have collaborated with other colleagues, PhD students and postdocs of the department in the study of alpine copper metallogeny and in archaeological copper provenancing studies. Most recently, a programme has been started for the modelling and economic assessment of Italian carbonatite-associated deposits, in which one MSc student is currently involved.

DEEP EARTH GEOCHEMISTRY

Davide Novella

I am a solid-earth geochemist, and the main goal of my research is to better understand geological processes occurring in the deep Earth interior, which is fundamental to understand how our planet formed and evolved through time. In my research, I conduct high-pressure and high-temperature experiments to recreate, in the laboratory, the conditions of the deep mantle and produce synthetic minerals and rocks that we can study with state-of-theart techniques, e.g. XRD, Raman and FTIR spectroscopy, SEM. To better interpret and understand the experimental results, I also study rare, natural samples that form at hundreds of kilometres of depth in the mantle, such as natural diamonds and their inclusions. In particular, I am interested in the geochemical properties of the deep mantle, including the behaviour of stable isotopes in minerals and rocks. This topic is the subject of a research project I have recently been awarded through the 'Rita Levi Montalcini' programme of the Italian Ministry of University and Research. I am very interested in understanding the recycling and behaviour of volatile elements, e.g. C-O-H, in the deep Earth. At the Department of Geosciences, I collaborate with many researchers and young students from different fields, including mineralogists, petrologists, geochemists, mineral physicists, geodynamicists and structural geologists. I also have active collaborations with colleagues from different world-leading institutions in Germany, France, the UK and the USA that I developed through the years as a student and a postdoc.



POLAR GEOLOGICAL AND LANDSCAPE EVOLUTION THROUGH AN ENHANCED GLACIAL FORCING

Valerio Olivetti

During the late Cenozoic, the climate of the earth recorded a constant descent towards colder condition. The consequent growth of large continental ice volumes deeply shaped the topography of high latitude and mountain regions, producing deep valleys and fjords that characterise the present polar and mountain landscape. In my research, I trace the provenance of sediment in marine sequences to detect episodes of continental ice volume changes and variation of mechanism of transport. Provenance of sediment is constrained using a multi-methodology dating that allows the location of the area of source and the elevation. Marine sediments collected in front of the Greenland coasts allowed us to detect a progressive increase in elevation of the focussed erosion, in response to increase of the periglacial erosion processes during the last 6 Myr. In Antarctica, the provenance of sediments sheds light on a glaciation event during the mid-Miocene period. Collaboration with the Trinity College laboratory of Dublin allowed us to improve the multi-methodology approach to provenance analysis consisting of a coupled fission track, U-Pb and geochemical analysis.

UNDERSTANDING DEFORMATION PROCESSES IN THE EARTH'S INTERIOR FROM EXHUMED ROCKS - ZOOMING FROM THE REGIONAL TO THE SUB-GRAIN SCALE

Giorgio Pennacchioni

My main research interest is understanding the deformation processes occurring at depth in the earth's lithosphere. These processes include either the abrupt brittle yielding of rocks, which may cause earthquakes, or the slow creep of rocks at high temperatures flowing like highly viscous fluids. My studies are strongly based on field work and quantitative mapping of rocks tectonically exhumed to the earth's surface from deep structural levels (inaccessible to direct investigation). To understand the mechanisms at the grain/subgrain scale underneath deformation, I analyse samples using different techniques of scanning electron microscopy. Specific topics addressed in my recent research are: (i) nucleation and growth of ductile shear zones and interplay between brittle and ductile processes under metamorphic conditions, and (ii) origin of seismicity at mid-lower levels in the continental crust and of intermediate-depth subduction earthquakes in dry oceanic slabs. For the study of fossil earthquakes, I investigate unique fault rocks (pseudotachylytes) representing quenched frictional melts produced during the seismic slip of a fault. To address these topics, I work in several areas worldwide with some of the most spectacular exposures of structures, e.g. deglaciated areas of the European Alps; desert regions in the Musgrave Ranges, central Australia, and Atacama Desert in northern Chile; Lofoten Islands, Norway; Sierra Nevada cordillera, California.

RENEWABILITY ASSESSMENT OF GEOTHERMAL SYSTEMS

Leonardo Piccinini

Renewable natural resources are strategic in reducing greenhouse gas emissions and reducing the human footprint. The renewability of these resources is a crucial aspect that should be evaluated in the use of scenario planning. In this context, geothermal resources are one of the most profitable and environmentally friendly sources of energy supply, but their renewability is strictly related to the physical and geological processes that favour water circulation and heating. In the Veneto region, the thermal waters of the Euganean Geothermal System (EuGS) are a typical case study, and its evaluation of renewability involves the evaluation of fluid and heat recharges, regional and local geological settings, and physical processes controlling the development of the system. In particular, its renewability assessment aims to define both the importance of such components and the amount of water that can be exploited without compromising future preservation. In fact, in the second part of the twentieth century, the EuGS was threatened by server overexploitation, which caused a sharp decrease in the potentiometric level of the thermal aquifers. Consequently, a right balance between regulation and exploitation is fundamental for managing these peculiar systems. The research activities developed in recent years have been devoted to hydrogeological/geothermal characterisation and numerical simulation of the EuGS. In the former case, potentiometric surveys, pumping tests, thermal logs, and geochemical investigations were carried out with the aim of defining a conceptual geothermal/hydrogeological model. In the next step, numerical simulations of fluid flow and heat transport were based on a detailed hydrogeological reconstruction that reproduced the main regional geological heterogeneities through a 3D unstructured mesh, while a heterogeneous permeability field was used to reproduce the local fracturing of the thermal aquifers. Future goals are focussed on the downscaling of the numerical simulation from the whole system (EuGS) to the local extraction field (EuGF), with the scope of implementing a management tool for the exploitation of the thermal water.

CARBONATES AND PALEOCLIMATE RECONSTRUCTIONS; GEOHERITAGE

Nereo Preto

My latest research focuses on two main broad themes. Earth ecosystems were turned upside down some 230 Ma during the early Mesozoic, and one of my research topics is the causes and effects of climate change during the Carnian Pluvial Episode. I am working especially on the disruption of carbonate depositional systems and the geochemical signal associated with the event. Related to this is the management of the Isotope ratio mass spectrometer lab, and collaborations in the department related to this topic are with Profs. Agnini, Breda and Rigo. Other ongoing collaborations are mainly with the Chengdu University of Technology in China and the Universities of Trieste and Ferrara in Italy. A main and well-known problem of sustainable development is to ensure economic growth, while preserving natural environments and biodiversity – but preserving geodiversity should be considered important as well. I am actively working on this topic, in collaboration with Profs. Breda, Giusberti, Massironi and Mazzoli, by maintaining the list of geosites of the Veneto region. We also have an ongoing project for the management of geoheritage in Berici Hills, which involves BSc and MSc students.

INTEGRATED STRATIGRAPHY TO DECIPHER THE EVOLUTION AND DYNAMIC OF THE PLANET EARTH

Manuel Rigo

My key areas of research interest encompass the fields of stratigraphy, geochemistry and palaeontology, including palaeoclimatology and palaeoceanography. My approach to geological problems is both field-and lab-oriented, and multidisciplinary at the same time, tackling problems in climate changes at geological timescales and the relative feedbacks in ancient biosphere, and facing early Mesozoic geochronology and palaeoreconstructions by using integrated stratigraphy and innovative methodologies. My stratigraphical, geochemical and palaeontological expertise has yielded a new understanding of the interrelationships between the role of oceanic processes in global climate change, geological processes, and biological events (extinctions, radiations and biotic turnover) during important periods in Earth history, such as early Mesozoic. I have recently focussed my studies on protracted intervals of carbon cycle instability during Late Triassic and Early Jurassic, in particular the Carnian Pluvial Event (CPE) and the late Norian to Rhaetian interval, both characterised by huge carbon isotope excursions and mass extinctions, associated with oscillations in the biological pump efficacy and/or in ocean stratification, a possible newly identified OAE. Recently, I have documented the geochemical evidence (Os and PGE) of meteorite impact events in sedimentary rocks. Other research projects employ a suite of geochemical proxies to deconvolve seawater chemistry from modern and fossil biogenic carbonate and phosphates to better understand ocean environmental change and system processes on modern and geological timescales. I also studied the isotopic composition (C and N) of early Medioeval human bones and teeth for palaeodiet investigations.

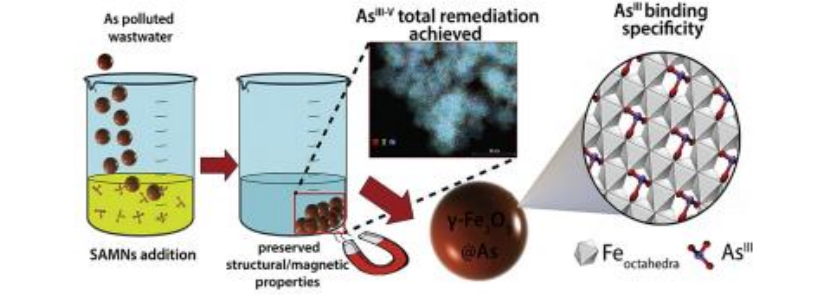
TIME, SEDIMENTS AND MORPHOLOGIES

Sandro Rossato

As a geomorphologist, I deal with systems that evolve at a scale that is normally more rapid than what is commonly intended as 'Geological time scale'. Investigating such a system is of utmost interest to me. In my research, I focus on highlighting the connections and mutual influences between different systems. I dealt with glacier advances, alluvial plain evolution, landslides and flood reconstruction. Field surveys and remote sensing are pivotal approaches, along with the dating of sediments and geological events. To reconstruct the evolution of sedimentary systems and to unveil the chronology of geological events, or phases, is of utmost interest to me. How can the occurrence or development of a specific phenomenon in the mountain sector affect the subtended alluvial plain? In what amount of time? Of course, answers to such questions require a wide range of expertise and knowledge, and collaboration with other experts is required. During the years, I worked with many other researchers from the Department of Geosciences, especially geomorphologists and Quaternary geologists. The interaction with structural geologists, sedimentologists, geochronologists, archaeologists and engineers is also very fruitful. Amongst the various collaborations with other institutions, those with the CNR and ETH Zurich were the most continuous ones. In the last years, a relevant part of my research was devoted to geological mapping in NorthEast Italy, especially with the Friuli-Venezia Giulia and Veneto region, with the CARG and GEO-CGT projects.

NANOMATERIALS: A KEY ROLE FOR SUSTAINABLE WATER REMEDIATION APPROACH

Gabriella Salviulo



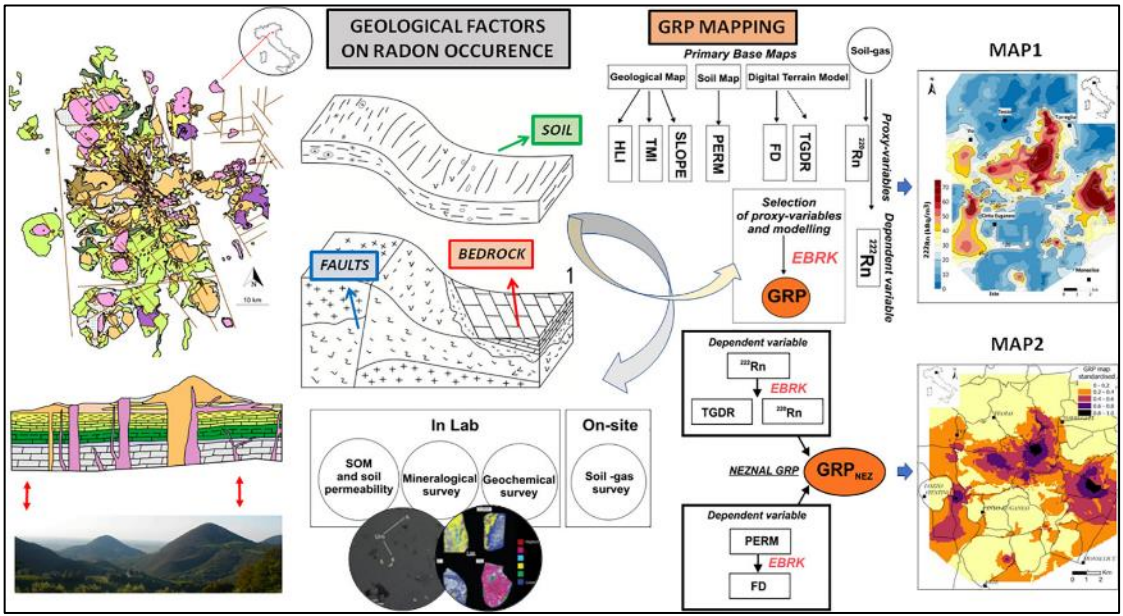
Molinari et al., 2020

The sustainable management of polluted groundwater is one of the most widespread environmental issues of the last century. Pollution scenarios characterised by different contaminants, such as heavy metals and inorganic and organic compounds, make remediation particularly challenging. The use of conventional water treatment methods (i.e. chemical precipitation, ion exchange, flotation) undergoes several drawbacks, such as high costs, social and environmental impacts, partial effectiveness and generation of secondary sludges, leading to hardly sustainable remediation approaches. The growth of nanotechnology research has opened the way to new opportunities for the use of engineered nanomaterials aimed at rapid and effective water remediation due to the high selectivity, adsorption capacity, low toxicity and the possibility to couple remediation with the recovery and recycling of critical metals. Magnetic nanomaterials have gained remarkable interest thanks to their high selectivity and adsorption capacity and easy implementation in traditional pump and treat systems due to the possibility of easy manipulation under the influence of a magnetic field. Notably, a detrimental factor for environmental applications of nanomaterials is the need to ensure high colloidal stability without any cumbersome organic superficial coating. Recent results of the research group (G. Salviulo, S. Molinari Department of Geosciences; F. Vianello, M. Magro BCA Department, UniPD) demonstrated that a novel and green synthetic approach, followed by a deep structural and chemical characterisation, led to the implementation of naked colloidal maghemite nanoparticles (SAMNs) for the remediation of water contaminated by heavy metals, even in complex industrial in situ scenarios. The high performance as a sorbent material and the opportunity to magnetically recover the bound metal make this nanomaterial an attractive and economically sustainable option for moving to large-scale applications.

RADON AND GEOLOGY

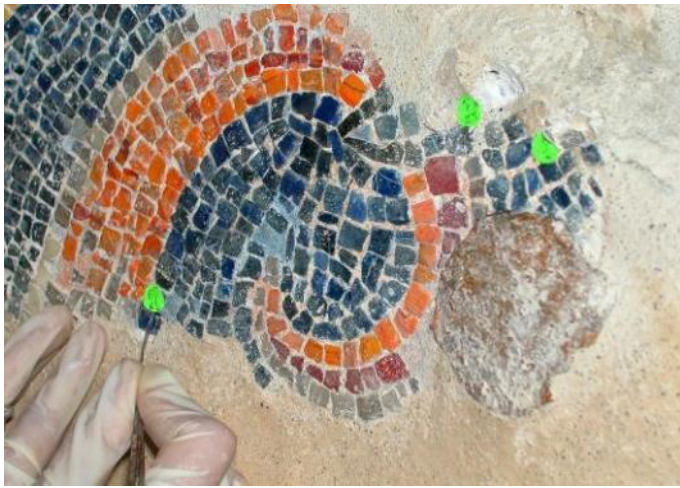
Raffaele Sassi

Living organisms are constantly exposed to radiation from several natural sources. Among them, Radon, an odorless, colorless and radioactive noble gas, is considered the second cause of lung cancer after smoking. The composition and the structure of the earth's surface have a strong influence on the local level of natural radiation; for this reason, the geological parameters (e.g. lithology, fractures, grain size) exert an important control on Radon mobilisation, migration and exhalation. My research activity is mainly focused on three different research lines: (a) The effect of grain size on Radon exhalation; (b) the role played by faults as preferential pathways for soil gases; (c) rock damage control on Radon mobility in fault zone with experimental approach at HP-HT laboratory of INGV to study Radon mobility conditions. In collaboration with PhD student E. Benà; Dr C. Coletti; Profs A. Galgaro, M. Massironi and C. Mazzoli; MSc Environmental Engineering Student M. Padoan (Dept. Geosciences UniPD); Profs D. Mostacci, L. Tositti (University of Bologna); Drs Gc. Ciotoli (IGAG-CNR, Roma); Drs G. Galli, A. Piersanti, L. Ruggiero, E. Spagnuolo (INGV, Roma).



ONCE UPON A GLASS: ARCHAEOMETRIC STUDIES ON A NEVER-ENDING MATERIAL

Alberta Silvestri

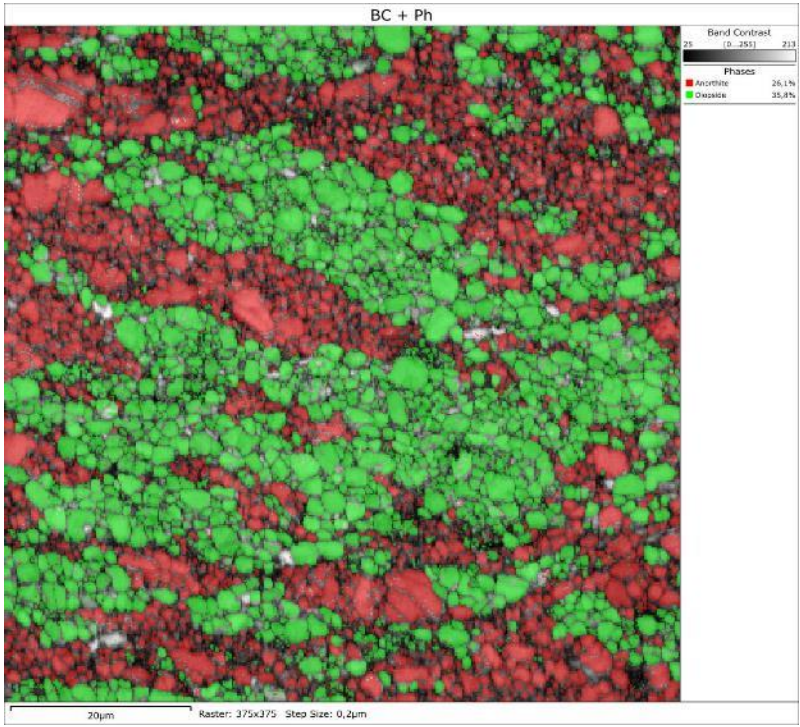


The research activity of Alberta Silvestri falls within mineralogical petrographical applications for cultural heritage, with a particular interest in the archaeometric study of glass and vitreous materials. As ancient glass results from the melting of natural raw materials, the scientific background of earth sciences appears to be the most suitable to solve archaeometric problems related to the source, type and provenance of raw materials and to reconstruct the production technologies of such kinds of materials. The methodological approach, which considers ancient glass completely comparable to a natural igneous rock, was applied to the archaeological and historic-artistic samples analysed. The rationale for this approach lies in the analogies that exist between a glass and a natural magma. In furnaces, as in geological processes, the heating of a mixture of natural crystalline phases (minerals) produces melts and the cooling of melts may produce minerals or glass or an association of minerals and glass, like commonly found in vitreous materials, such as mosaic tesserae, depending on chemical composition, time, temperature, pressure and oxygen fugacity. Furthermore, since most of the ancient glass artefacts commonly show signs of deterioration due to prolonged exposure to the environment, the study of alteration processes is of fundamental importance to guide the restoration and to define a suitable conservation environment. In detail, the following research topics are carried out: a) Archaeometric characterisation of archaeological and historical-artistic glass (objects, windows, beads); b) archaeometric characterisation of glass mosaic tesserae and chemical-mineralogical study of the crystalline phases identified within; c) chemical-mineralogical characterisation of raw glass materials; d) geochemical-isotopic study of glass and possible raw materials; and e) the parameterisation of glass alteration processes in different conservation environments.

UNDERSTANDING ROCK MICROSTRUCTURES AND EXOTIC MINERAL PHASES USING SEM BASED ANALYTICAL TECHNIQUES

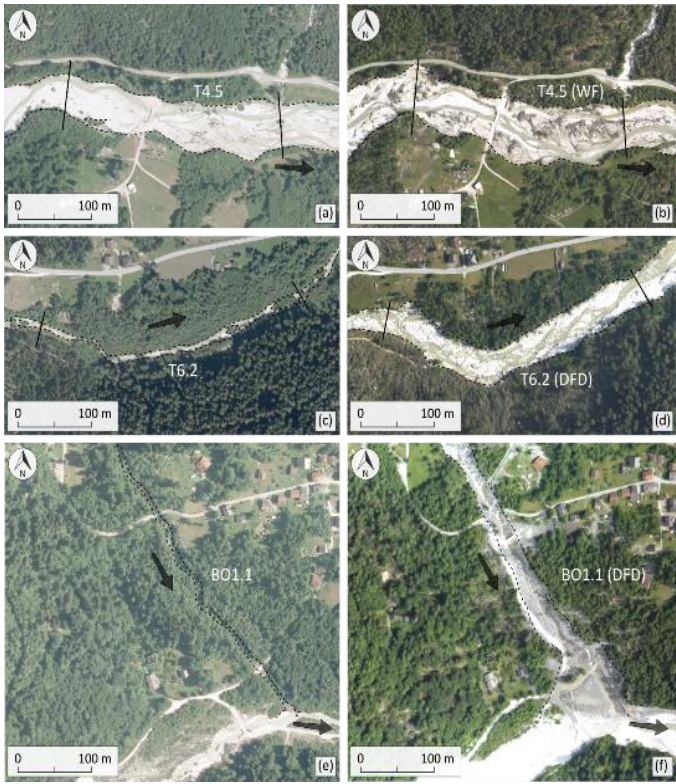
Richard Spiess

The primary topic of my research activity during the last few years was dedicated to the understanding of deformation, recrystallisation and growth mechanisms within rock samples from Earth and micro-to mini meteorites. The key point in my scientific approach is the application of SEM-based analytical techniques, and in particular electron backscatter diffraction (EBSD) analysis. As a starting basis, field work and traditional microstructural analysis, aided by detailed observations under the petrographic microscope, were applied to terrain-based geological-petrological studies. The principal topics investigated during the last years span from the detection of exotic mineral phases within micro- to minimeteorites, microstructures of diamond , thermal controlled modification of garnet inclusions, ductile deformation of granites during extensional exhumation, detection of growth rates within olivine controlled by the lattice orientation, plagioclase deformation within volcanic plumbing systems, analysis of experimentally deformed gabbro-analogues, and deciphering the tectonic and metamorphic evolution of the Calabrian basement in the Serre Massive.



FLOOD HAZARD AND EXTREME EVENTS IN MOUNTAIN STREAMS

Nicola Surian



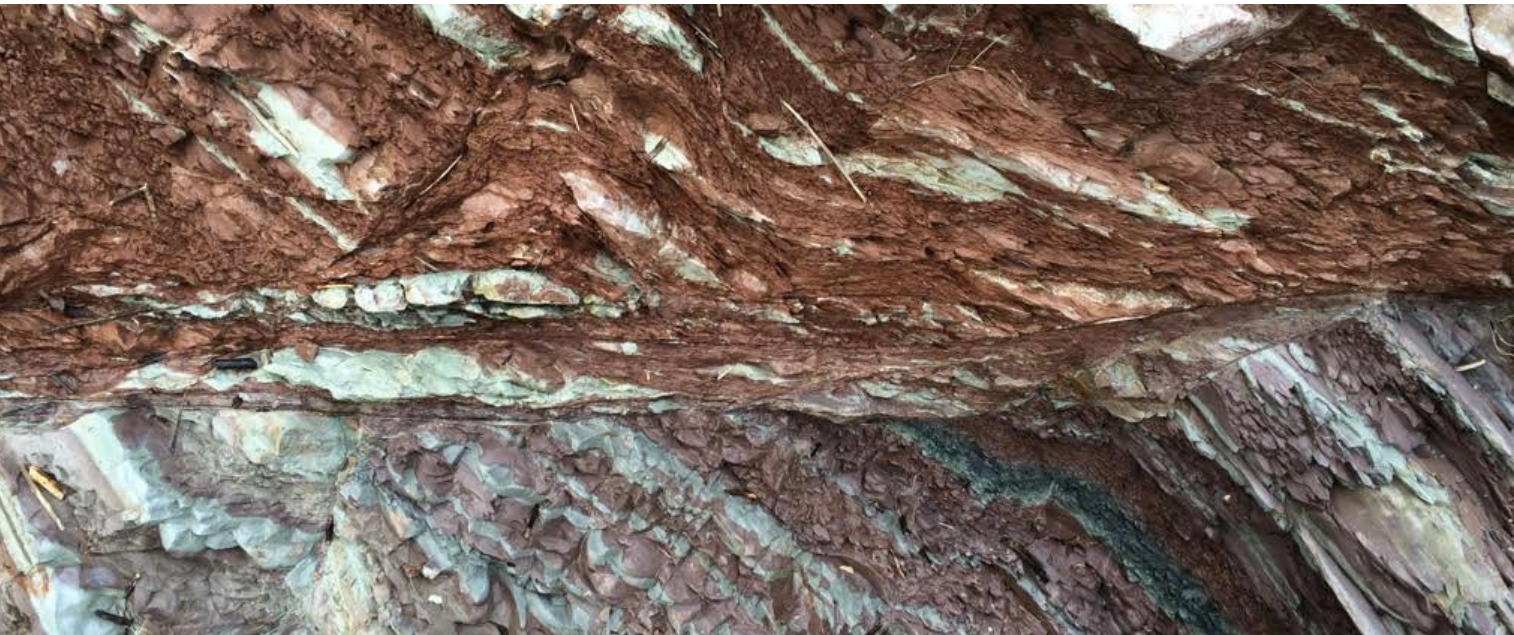
Flood hazard in mountain streams: the key role of geomorphic processes during high-magnitude events. The main goals of this research are: (i) to investigate channel response to floods of different magnitudes, and in particular to extreme floods; (ii) to improve hazard assessment, that is, our capability of predicting geomorphic effects of floods. Besides morphological changes, e.g. channel widening, we have recently focussed the research on the different sediment-water flows occurring during high-magnitude floods and, specifically, on debris floods. The research benefits from strong collaboration with colleagues having different skills and expertise, in particular with L Marchi (CNRIRPI) and M Borga (Dept. TESAF, Univ. of Padova) for hydrological and hydraulic issues, and M. Ghinassi (Dept. of Geosciences) for sedimentological issues. Over the last three years, the research was focussed on two flood events: the Vaia Storm that occurred in the Eastern Alps (Italy) in October 2018 and the flood that occurred in the Albedosa River catchment (Piedmont, Italy) in 2019. Besides the above collaborations, Andrea Brenna (postdoc) played a key role in most of the activities, e.g. field work, GIS analysis. Andrea and I have supervisedseveral BSc and MSc students: F Cancel, G Gastaldi, L Dudine and R Boniardi (Vaia Storm) and M Valizadeh and G Nichele (Albedosa flood). In October 2021, I started to supervise Sebastián Granados Bolaños (PhD student), who is dealing with fluvial processes and flood hazards in humid tropical catchments of Costa Rica.

FAULT PROCESSES AND THE SEISMIC CYCLE

Telemaco Tesei

Tectonic faults are the fractures that break up Earth's crust. Sudden slips of rock masses along faults generate earthquakes and allow for the movement of fluids (water, gas, hydrocarbons, magmas, mineralisations). In my research, I try to identify the processes that lead either to fault ruptures (earthquake or slow slips) or quiet aseismic slips. In particular, I am interested in how rocks recover their prerupture strength after an earthquake, a process called 'fault healing' that is crucial to understanding the seismic cycle.

I use a combination of field observations of the structure of some major tectonic faults and laboratory friction experiments to understand the mechanical behaviour of rocks.



GEOSCIENCE FOR THE SUSTAINABLE BUILT ENVIRONMENT

Luca Valentini

Reconciling the need to ensure the fundamental human right to a shelter and secure house, as well as basic infrastructures, with that of safeguarding the environment from the threats of climate change and resource depletion poses a societal conundrum and an extraordinary technological challenge. The supply of raw materials necessary to sustain our society is strongly affecting Earth's landforms, so much so that the world geological community is currently discussing the definition of a new geologic epoch, named Anthropocene, in which the geomorphic action of human activities is comparable to that of geophysical forces. I believe the geoscientist can play a fundamental role in addressing these issues and with my research, I intend to deploy knowledge into the basic physical and chemical processes that control the formation of minerals, with the aim of designing and manufacturing geomaterials for the sustainable built environment. Currently, I am investigating the use of clays for the development of low-CO2 building materials, focusing attention on the exploitation of locally available resources for the sustainable development of emerging economies in sub-Saharan countries. I have recently established collaborations with institutions such as the Building and Road Research Institute (Ghana) and Meru University of Science and Technology (Kenya), by which we are assessing the potential of local clay soils for the above goals. This requires an in-depth knowledge of clay mineralogy and dissolution-precipitation processes controlling the reactivity of clay minerals in aqueous solution. The collaboration with African institutions is also aimed at establishing new shared activities into knowledge transfer and capacity building, and a recent staff and student mobility flow between the Department of Geoscience and Meru University of Science and Technology has been funded by the Erasmus+ programme.

SOCIETAL IMPORTANCE OF FAULTS

Dario Zampieri

Faults are intriguing structures representing challenges associated with several practical issues, such as fluid migrations in the brittle crust leading to mineral deposition, oil and gas trapping and hot water surface spill. They also control slope stability and its suitability for waste repositories and tunnel operations. Active faults are closely associated with earthquakes and seismic hazards. Although faults are usually portrayed on geological maps and sections as single lines, in detail, they are complex structures. Typically, they consist of a volume of rocks containing several structural elements and they are segmented with various geometric arrangements, producing local contraction or extension zones. In populated areas such as the Veneto plain and Fore-Alpine valleys, the study of the subsurface structural setting and of palaeo- and active faults is therefore essential. Any infrastructural design can not regardless the accurate assessment of the subsurface faults. Therefore, faults have economic and societal significance. The study of these structures is conducted in cooperation with the INGV (Rome) to upgrade the database of Italian seismogenic sources (DISS). Cooperation with hydrogeologists and geophysicists is devoted to improving the knowledge of the potentiality of the fault-controlled EuGS.

MOUNTAIN BUILDING AND CLIMATE CHANGE

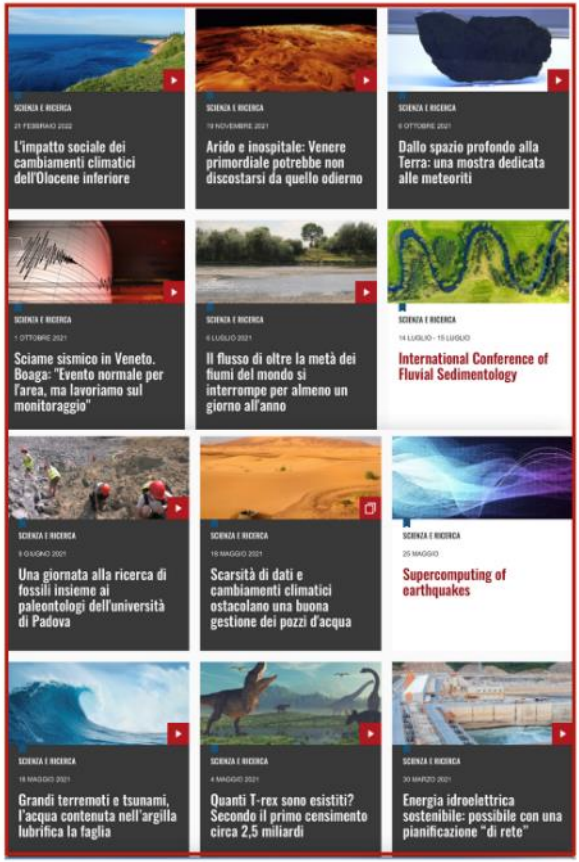
Massimiliano Zattin

Several studies in the past few years support the idea of strong feedback between the growth of mountain ranges and spatial and temporal variations in climate. The identification of plausible correlations between orogen behaviour and external climatic processes requires, among other factors, that the initiation and duration of any deformation event be precisely constrained. More specifically, mountain building in cordilleran-type orogens like the Andes is controlled by various processes that include (i) continental shortening, (ii) accretion of oceanic materials, (iii) dynamic topography linked with the opening of asthenospheric windows, (v) crustal weakening and deformation related to mantle plumes, and (vi) forearc coastal uplift due to co-seismic and post-seismic lithospheric stretching associated with large earthquakes, and (vii) isostatic rebound related to the retirement of ice masses. This line of my research aims to study different sectors of the Andes through the integration of different methodologies such as structural geology, tectonic geomorphology, low-temperature thermochronology, and thermal and geodynamic modelling. The research group is therefore truly interdisciplinary and involves at least a couple of PhD students and researchers from Italy, France, Chile, Argentina and Ecuador. The work is based on annual field campaigns and laboratory activities, mainly in Padova and in some French institutes.

Dissemination and outreach

DISSEMINATION & OUTREACH *by J. Boaga*

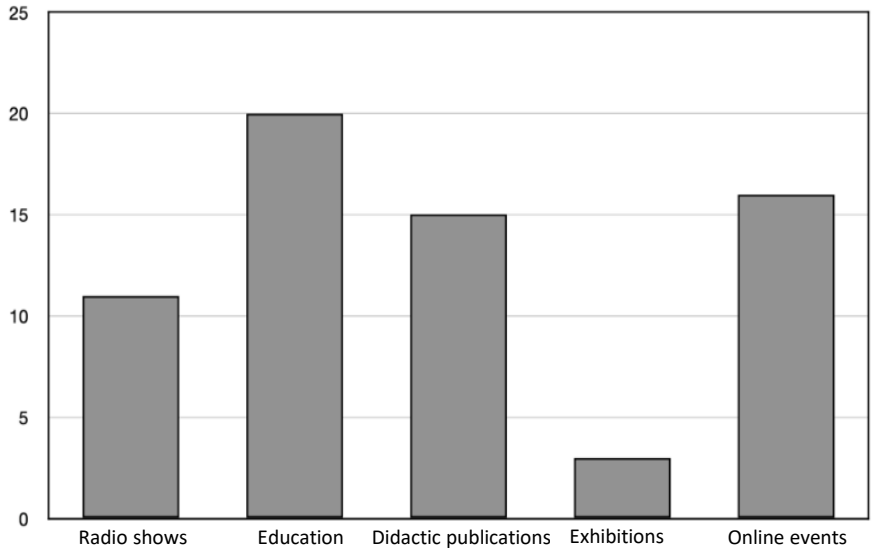
The Department of Geosciences is always actively committed to promoting and offering dissemination and divulgation of scientific knowledge. It is currently agreed that a pervasive and effective outreach of the research is as important as the usual scientific dissemination. The scientific dissemination is in fact mainly achieved via publication of the theoretical and experimental results in specialistic journals and congresses, far from public involvement. Our aim is to go beyond the restricted scientific community, bringing this information to the interested citizenship and not specialists. Therefore, the Department of Geosciences promotes the sharing of scientific knowledge to a broader audience through divulgation and dissemination activities, especially in this pandemic period. We are aware that public visibility and reputation nowadays are based not only on our scientific research and teaching ability, but also on communication to the public. In this respect, TV coverage, radio broadcasts, printed and online documents, and video and digital contents, such as interviews and documentaries, on social media are exceptionally efficient. For these reasons, the Department of Geosciences has considerably increased in recent years its commitment to social media with new social accounts in the most used platforms available. We promote public events, exhibitions, and educational activities, as well as the distribution of publications specifically addressed to a generic audience. Here are some 2021 Department of Geosciences dissemination videos: Living in the Cretaceous – how many chances do you get to meet a T-Rex? Water as a green energy resource? Will supercomputing help earthquake comprehension? Stay tuned on our YouTube channel!



Just some of the Department of Geosciences 2021 dissemination video. Living in the Cretaceous, how many chances to meet a T-Rex? Water as a green energy resource? Will supercomputing help earthquakes comprehension? Stay tuned on our Youtube channel!

Even if hardly limited by the pandemic conditions due to COVID-19, during 2021 the Department of Geosciences promoted several initiatives, with sensible improvement respect to the previous years. Specifically, our researchers were hosted in 12 radio/TV interviews to explain their research topics, ranging from national news broadcasts to local radio stations. Three exhibits for a generic audience were organised, with an especially great success in the Meteorites exhibition.

Dozens of events with schools and educational institutions took place. In total, more than 30 events aimed at promoting and presenting scientific results to the public community were organised. Among them, the Department of Geoscience participated actively in the Night of the Research 2021 event. Webinars and online experiments for the wide public were promoted, from lab experiences dedicated to generic audience to topic seminars of our activities. The department has selected a new team for communication technology with dedicated personnel. New social accounts on the main platforms used, such as Instagram, Facebook, Twitter, WhatsApp, YouTube were specifically developed to share with a large audience the science we build during our everyday work. We now have hundreds of likes and followers on our Instagram profile, with thousands of visualisations of the videos there promoted. In this framework, the Department of Geosciences website was deeply redesigned, becoming our main external façade, especially during the forced social distance period imposed by the pandemic. News about events, publications, discoveries, and activities were constantly updated, do not miss them! In the graph below, the Department Dissemination and Divulgation activities are summarised for 2021. Despite the pandemic conditions, the message is still clear: We keep serving science and our community, and we do not intend to stop!



GeoContest

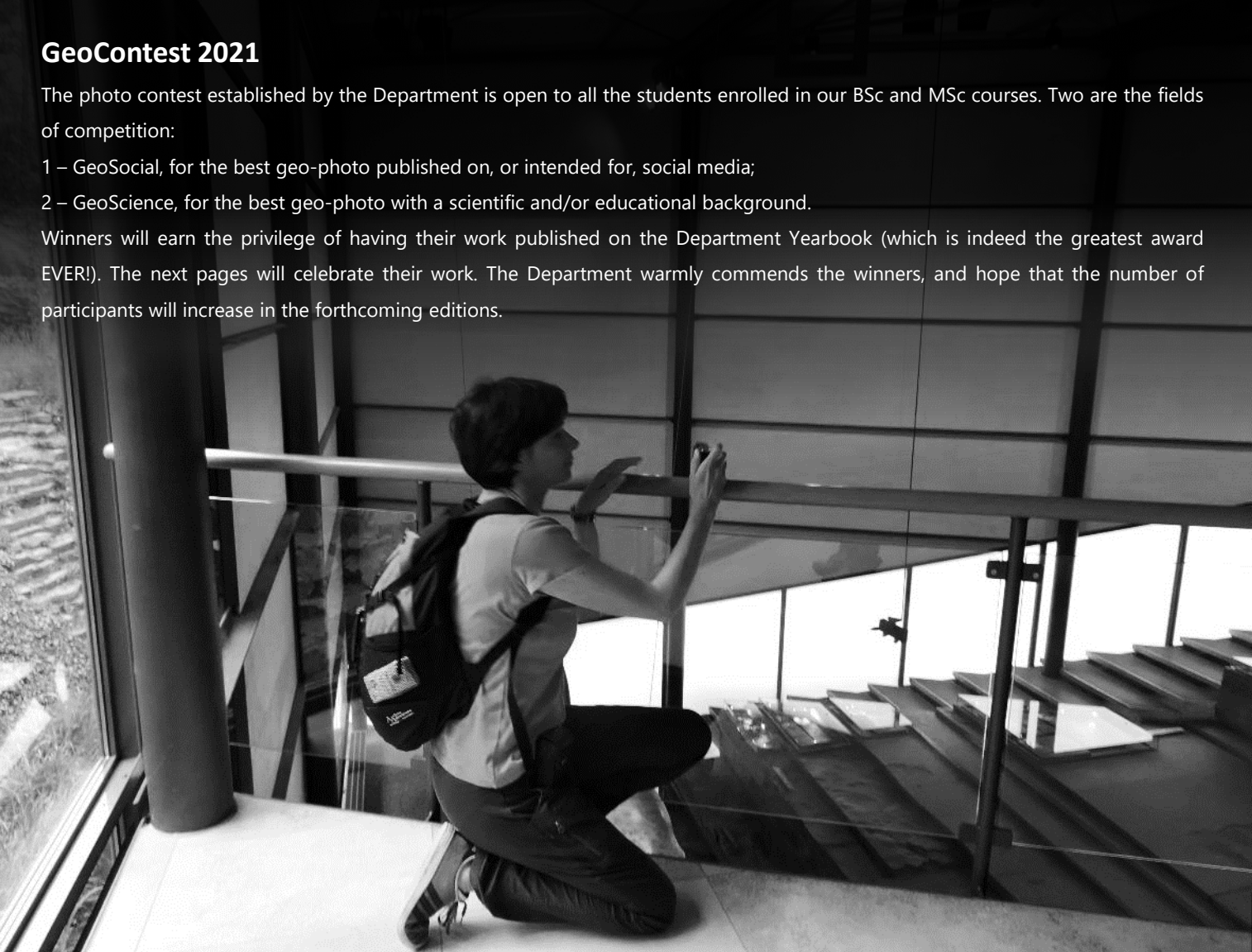
GeoContest 2021

The photo contest established by the Department is open to all the students enrolled in our BSc and MSc courses. Two are the fields of competition:

1 – GeoSocial, for the best geo-photo published on, or intended for, social media;

2 – GeoScience, for the best geo-photo with a scientific and/or educational background.

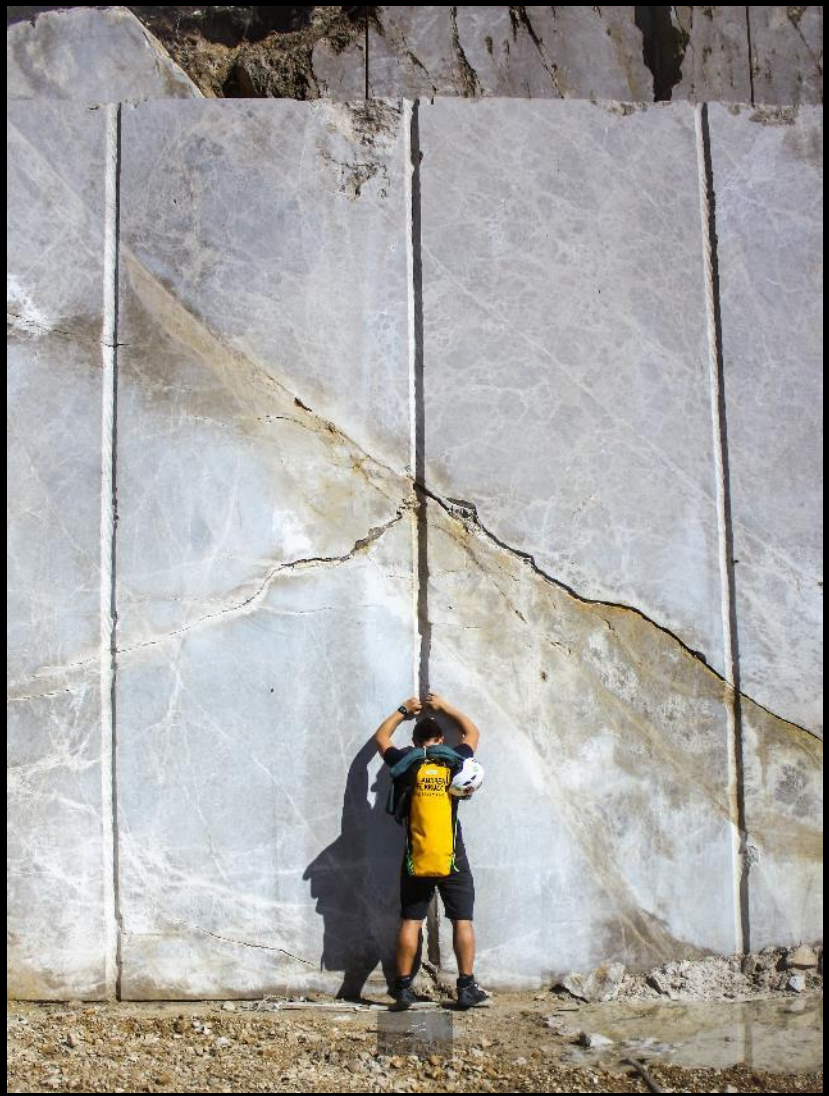
Winners will earn the privilege of having their work published on the Department Yearbook (which is indeed the greatest award EVER!). The next pages will celebrate their work. The Department warmly commends the winners, and hope that the number of participants will increase in the forthcoming editions.



Linda
Lambertucci
MSc student

WINNER
GeoSocial photo contest

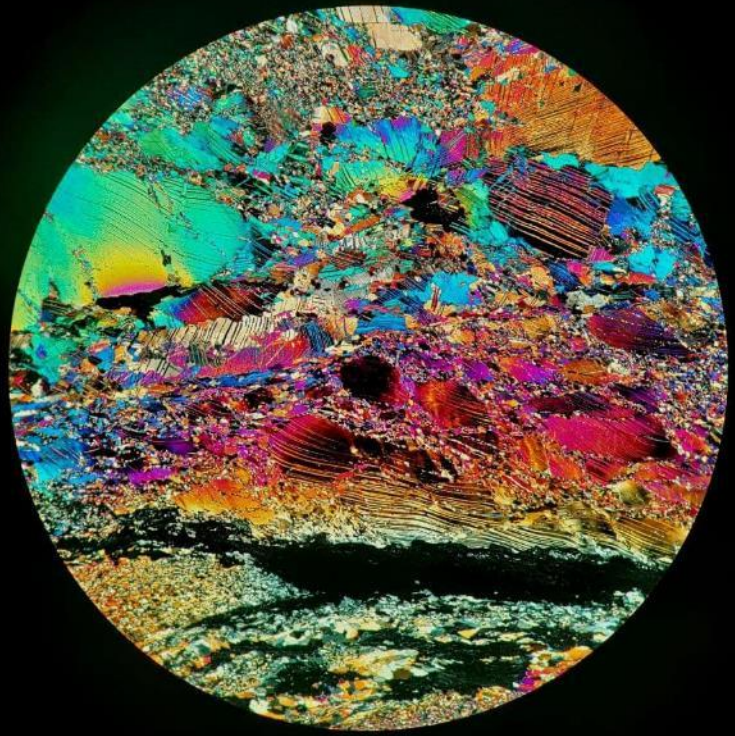
«Split"

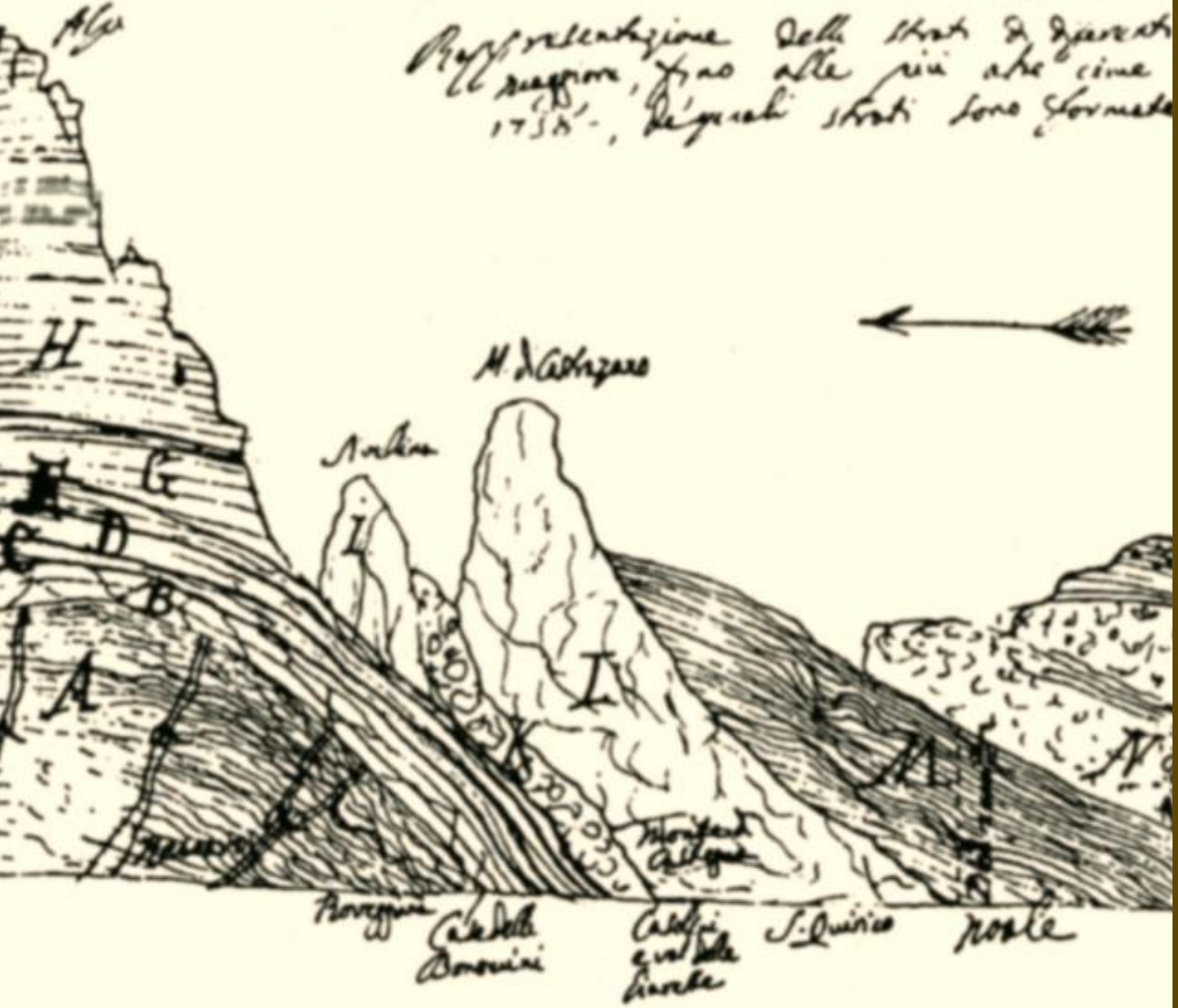


Silvia
Aldrighetti
MSc student

WINNER
GeoScience photo contest

«rainbow"





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2021
A year in a nutshell
at the Department of Geosciences

Nine researchers from the Department of Geosciences are among the 100.000 most impactful Authors in the scientific field, according to a study published in Plos Biology.

January

Geology & Planetary Mapping
Winter School

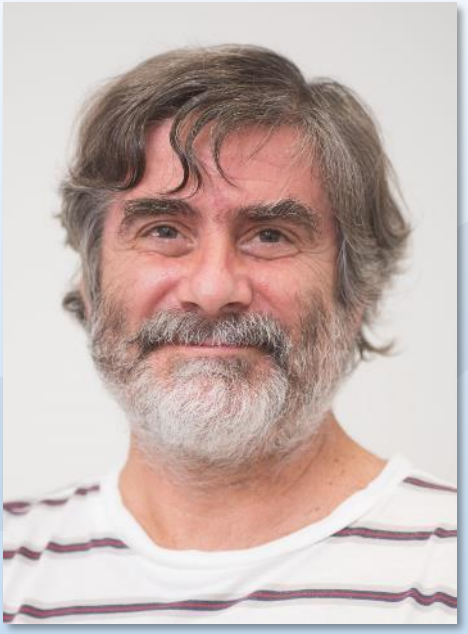
Geology & Planetary Mapping Winter School

The first Planmap Winter School was attended by more than 200 students from 22 countries worldwide. The school is part of the PLANMAP (PLANetary MAPping) project, led by Prof. **Matteo Massironi**, is designed to train the next generation of planetary mappers.

February

AWARD

Gilberto Artioli



Waltrude and Friedrich Liebau Prize for the Promotion of Interdisciplinarity in Crystallography from the German Society for Crystallography (DKG)

March

The Department of Geosciences welcomes

Riccardo Biondi

Researcher in Atmospheric physics

March

The Department of Geosciences welcomes

Bruna Borges-Carvalho

Researcher in
Crustal petrology

April

AWARD

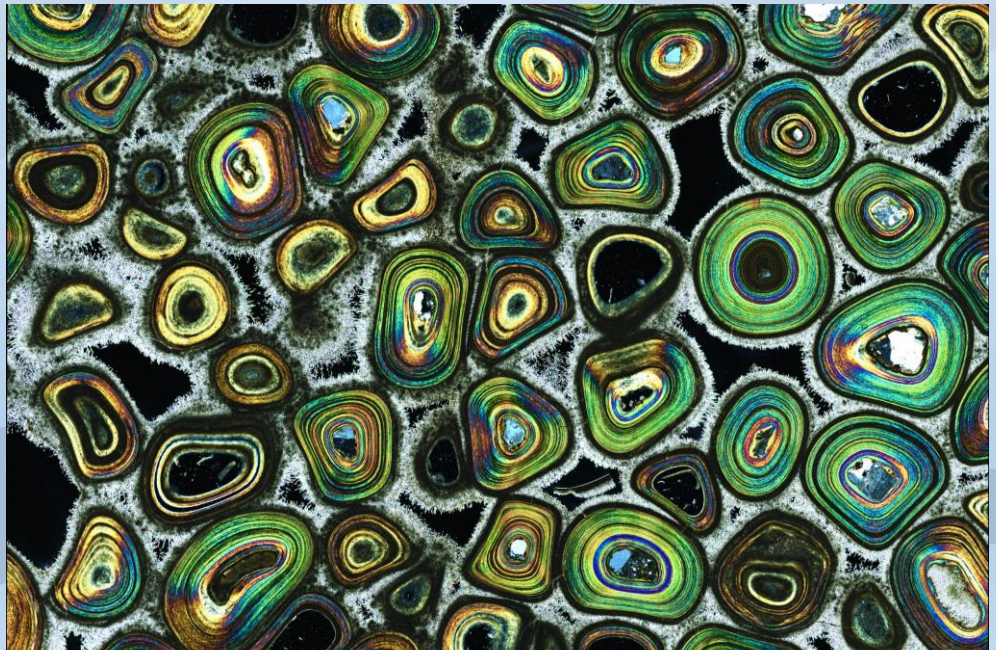
Giorgia Dalla Santa

2021 Energy, Resources and the Environment (ERE) Division Outstanding Early Career Scientist Award for her research on shallow geothermal systems for building conditioning

April

Bernardo Cesare

The image of a thin section of Karlsbader Sprudelstein, obtained during the beta testing of the new "Axioscan 7" instrument, made the cover of the May/June 2021 issue of Microscopy and Analysis



May

AWARD

Marta Cosma

Early-Career Poster Award at the 35th IAS Meeting of Sedimentology for her research on tidal networks carried out during her PhD at the Department of Geosciences

June

AWARD

Alvise Finotello

British Society for Geomorphology (BSG), Dick Chorley Medal 2021 for his work on meandering channels carried out during his PhD at the Department of Geosciences

July

The University of Padova ranked first in Italy and among the Top 150 Universities in the world in the field of Earth Sciences, according to the 2021 Global Ranking of Academic Subjects (GRAS) established yearly by the Shanghai Ranking Consultancy

August

The Department of Geosciences welcomes

Katia Belcaro

Caterina Congiu

New members of the Technical and Administrative staff

September

The Department of Geosciences welcomes

Cristiano Nicosia

Full Professor in Geoarchaeology and soil micromorphology

October

Profs. **Francesca da Porto** and **Massimiliano Zattin** were appointed as Vice Rector for Sustainability and Vice Rector for the Doctorate and post graduate, respectively, in the governance team of the new Rector Daniela Mapelli

October

The Department of Geosciences welcomes

Sandro Rossato

Researcher in Geomorphology

November

The Department of Geosciences hosted the temporary exhibition "Meteorites: a journey from the Deep Space to the Earth". The exposition witnessed the attendance of almost 1200 visitors, and involved nearly 400 students from 10 different schools

December

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