University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 1		**Supervisor**	**Sergio Andò**
			Andrea Cerri (Verallia Italia S.p.A.)
Title	**Advanced mineralogical analysis of quartz-rich sands used for the industrial production of glass**		
Glass is an infinitely recyclable material that is at the heart of the circular economy, has exceptional qualities and can play an essential role in building a sustainable future, for example by significantly reducing CO_2 emissions in different phases of the business production and accelerating innovation along the entire value chain. The aim of this research is the development of a quantitative approach for the identification and removal of accessory minerals other than quartz, which are undesirable during the glass preparation phase based on innovative Raman spectroscopy coupled with classical optical studies of quartz rich sands. This project is carried out as Advanced Apprenticeship PhD in collaboration with Verallia Italia, a company at the forefront for the production of high-quality glass. Part of the training may be carried out abroad in different laboratories or Institution based on the project needs.			
Supervisor webpage: https://www.unimib.it/sergio-ando			
Notes: Advanced Apprenticeship PhD at Verallia Italia S.p.A. (This type of contract is reserved for those who have not yet reached the age of 30 at the time of recruitment)			

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 2		**Supervisor**	**Eduardo Garzanti**
Title	**Provenance analysis of modern continental to marine sediments using classical and innovative techniques**		

The project is carried out in the Laboratory of Sedimentary Provenance and aims at quantitatively defining the processes that control the mineralogical, geochemical, and geochronological composition of orogenic and anorogenic sediments and at tracing sediment transport and dispersal at the continental and transcontinental scale. Potential study areas include central and southern Asia, the Middle East, Africa, South America and southern Europe. Methods involved include mineral separation, optical microscopy, Raman spectroscopy, scanning electron microprobe, geochemistry and geo/thermochronology. Time dedicated to field work highly depends on the target area of study.

Research is routinely carried out in strict collaboration with Chinese (e.g., Nanjing, Shanghai, Wuhan, Lanzhou, Beijing) and European Universities (e.g., UCL, Manchester, Lancaster, Erlangen, Genève, Grenoble) and Research Centers (e.g., Ifremer, Marum, GFZ, CRPG Nancy), and occasionally oil and service companies. Periods spent abroad in these, or other institutions depend on the target area of study.

Supervisor webpage: https://www.unimib.it/eduardo-aldo-franco-garzanti

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 3		**Supervisor**	**Alberto Resentini**
Title	**Detrital thermochronology of syn-orogenic sedimentary successions**		

Continent-continent collisions produce local changes in the thermal structure of the crust, in the distribution and intensity of rock uplift and exhumation and in the topography of the surrounding areas. The evolution through time and space of mountain building processes is best preserved in the adjacent sedimentary basins that accommodate sediments formed by the subsequent erosion of progressively deeper levels of the orogenic belt, as exhumation progresses. This project focuses on detrital thermochronology in sedimentary successions close to orogenic belts to reveal the evolution of continent-continent collision, the topographic growth of the orogen and its potential implications with climate. The candidate is expected to collect the samples in the field and spend most of the first 24 months preparing and analyzing the samples. Analytical techniques will include low-temperature thermochronology (detrital apatite fission tracks analysis), geochronology (detrital U-Pb dating), bulk petrography, single grain geochemistry and Raman spectroscopy.
The successful candidate is expected to spend 6 months to 1 year abroad.

Supervisor webpage: https://www.unimib.it/alberto-resentini

Notes: Exclusively for foreign students holding a grant from a foreign institution

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 4		**Supervisor**	**Giovanni Vezzoli**
Title	**A chemical and geological study of detrital and authigenic minerals in loess deposits: a key tool to reconstruct the glacial-interglacial climate of Northern Italy**		

This multidisciplinary research topic involves quantitative investigation of the link between sediment mineralogy, chemical processes, and the effects of climatic changes during the glacial and interglacial periods of the Quaternary, as recorded by the composition and structure of different soil profiles in loess of Northern Italy. The proposed study requires an integrated geochemical and geological approach to define and quantify the processes of alteration in outcrop sediments, soils, and wind-blown sediments (loess) that have recorded climatic changes in the Po Valley (Italy) in the last 2 million years. The proposed research involves intensive use of multiple techniques and equipment for the analysis of the mineral and organic fractions in sediments (e.g., optical microscope observations in transmitted and reflected light, Raman spectroscopy, FTIR, electronic microprobe, ICP-OES and chromatographic techniques, luminescence dating). The project indicatively includes 20% field and 80% laboratory activity. It will be carried out in collaboration with Dept. Earth Sciences, University of Uppsala, Sweden for geochemical, mineral magnetic and particle size analyses facilities and with Dept. Physics, Danish Technical University for quartz and feldspar-based luminescence dating during the (6 months) expected period abroad.

Supervisor webpage: https://www.unimib.it/giovanni-vezzoli

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 5		**Supervisor**	**Andrea Bistacchi**
Title	**Characterization and modelling of fractured reservoirs of geofluids**		

Fracture networks (FNs) control the hydraulic properties of fractured geofluid reservoirs. Unfortunately, in the subsurface the distribution and characteristics of small-scale structures forming FNs is hardly characterized by direct or geophysical observations, impacting on reservoir modelling uncertainty.

The PhD candidate will participate in a Joint Research Project between our University and Eni, aimed at the quantitative characterization and realistic modelling of fractured reservoirs important in the energy transition (Carbon Capture and Storage, Hydrogen Storage, geothermal energy, etc.). In this project, FNs will be characterized on large outcrops, analogues to subsurface reservoirs, using field techniques and photogrammetric Digital Outcrop Models. The ensuing quantitative analysis will allow defining the statistical distributions of FN parameters. Based on these datasets, innovative workflows will be developed to generate realistic stochastic models (Discrete Fracture Networks), which will be used for the upscaling of hydraulic properties with numerical methods. Improving this characterization and modelling workflow, and the geological realism of its results, is fundamental to successfully generalize structural observations and improve fluid flow simulations in reservoirs.

The PhD candidate will work within a large multidisciplinary team, including researchers from the industry and the academy, and will spend one/two period(s) abroad in partner universities and research centres.

Supervisor webpage: https://www.unimib.it/andrea-luigi-paolo-bistacchi

Notes: Might be funded with scholarship by ENI (to be confirmed)

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 6		**Supervisor**	**Pietro Sternai**
Title			**Probing links between Cenozoic geodynamics and climate changes**

Title	**Probing links between Cenozoic geodynamics and climate changes**

At timescales of millions to tens of millions of years, the geological carbon cycle modulates the storage of carbon into rocks and the release of carbon into the ocean and atmosphere, thereby linking the evolution of climate and life to plate tectonics. This call gathers projects aimed at constraining the extent to which major Cenozoic geodynamics events (e.g., closure of the Neo-Tethyan margin, opening of the north-eastern Atlantic, Mediterranean Messinian salinity crisis, etc.) are entailed with long-term climate trends. Analytical methods include, but are not limited to, studies of Melt Inclusions within magmatic products (e.g., Raman and/or SIMS), analyses of Hg anomalies within sedimentary sequences and geochronology (e.g., LA-ICPMS U-Pb dating). The newly produced data will be used to calibrate state-of-the-art numerical geodynamic and climate modeling to quantitatively assess causal links between Cenozoic geodynamics and climate changes (work allocation: ~0-10% field, ~45-50% analytical work and 45-50% modeling). Collaborations with external partners include J. Koornneef, University of Amsterdam, VU; P. Bouilhol, CRPG-Nancy, University of Lorraine; S. Castelltort, University of Geneva; P. Ballato, University of Roma TRE; J. Dai, University of Beijing; F. Farina, University of Milano, and many others, who will provide access to the analytical facilities in external Institutes and additional suitable rock samples during the (6-12 months) expected periods abroad.

Supervisor webpage: https://www.unimib.it/pietro-sternai

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 7		**Supervisor**	**Alessandro Tibaldi**
Title	**Volcano-tectonic evolution of the Andes of Northern Chile**		

Comparative analysis between the structural evolution of a sector of the Andes (segment between the Pica Gap 19º09'S and the Chile-Peru border 17º29'53''S) and the evolution of volcanism, with particular reference to the understanding of magmatic systems in relation to the uppermost Earth's crust deformation conditions and associated stress field. Particular attention will be paid to the analysis of the relationships between slope deformation associated with orogenic crustal thickening and tectonic- and magma-related stress. The study techniques will include: a morphostructural analysis of volcanic edifices; a chronostratigraphic subdivision based on field evidence, dating, and morphometric characteristics; structural analysis and mapping of faults and folds; reconstruction of the evolution of the stress tensor; analysis of the distribution of seismicity and focal mechanisms. Morphometric analysis will include the interpretation of satellite and DEM images from the ALOS satellite with a resolution of 12.5 m / pixel, and processing of the Hillshade image, Red Relieve Image Map, and similar.

Supervisor webpage: https://www.unimib.it/alessandro-tibaldi

Notes: Exclusively for foreign students holding a grant from a foreign institution

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 8		**Supervisor**	**Valter Maggi**
Title	**Paleoclimatic reconstruction of the polar and mid-latitude ice cores**		
Deep ice cores offer a unique opportunity to study the role of eolian mineral dust aerosol on climate evolution, as they preserve a pristine atmospheric input from the past. This information is somewhat altered at great depth where post-depositional processes likely occur. The aim of this research is to understand the microphysical properties of eolian mineral dust in ice cores which can be of use for reconstructing the atmospheric circulation in the past and climate variability at high southern latitudes. Traditional Coulter Counter techniques as well as novel continuous Single Particle Extinction and Scattering Method (SPES) coupled with laser Abacus device in a continuous flow analysis system in will be used to extract key physical parameters from Antarctic ice core dust and to detect possible in situ formation of artefacts altering the pristine paleoclimatic sequence. Laboratory work will be carried out at EUROCOLD laboratory of DISAT (UNIMIB). Collaborations with IGE-CNRS and with University of Milan are expected.			
Supervisor webpage: https://www.unimib.it/valter-maggi			
Notes: Project on Polar Sciences			

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 9		**Supervisor**	**Alessandra Savini**
Title	**Southern Ocean seabed geomorphology from consistent exploitation of opportunistic bathymetric and seismic datasets in the Antarctic region and surrounding areas**		

It is generally known that even if the 71% of the earth's surface is covered by oceans and represent a new frontier for research and resource exploitation (Duarte 2014), only the 20% of the seabed has been mapped with an acceptable resolution (Mayer et al., 2018); the remaining 80% is still completely unexplored (https://www.scar.org/science/ibcso/home/). In the Southern Ocean, especially in the waters surrounding the Antarctic continent, the known seabed morphology is even lower. Antarctic remote position isolates it from commercial routes and access difficulties due to the presence of sea ice for most of the year that obstacles the exploration of the area during winter period. Nevertheless, detailed bathymetry is a key information that improves and supports new discoveries in marine sciences.

The project aims at defining an innovative and systematic approach that can exploit in an efficient and consistent manner the full potential of seafloor data sets collected within the Antarctic region and surrounding areas, during transit times of the R/V Laura Bassi (back and forth New Zeland and Mario Zuccheli Stations, approved PNRA projects of the R/V Laura Bassi and in contiguity with existing Italian bathymetric datasets). Data collection plan has been designed allowing the optimization of resources with an effective saving in the use of infrastructural support and logistic. Furthermore, the proposal aims at defining a high-standard protocol and best practices for bathymetric and high-resolution seismic data acquisition and processing, that can be shared at international level, ensuring at the same time the quality of acquired data. A case study area (i.e., the Emerald Fracture Zone in the SW Pacific Ocean) will be targeted by the research project in order to demonstrate the powerful potential of transit acquisition in remote areas normally affected by adverse weather conditions that make difficult to plan a survey. The Emerald FZ is close to Laura Bassi regular route between New Zeland and MZ Station and is poorly investigated due to its difficult accessibility. It represents a strategic location to investigate the crustal and geodynamic evolution of the oceanic lithosphere of the Pacific and of the Antarctica plate, and their relationship with the underneath mantle.

The project integrates the collaboration of national (CNR-IGAG; OGS) and foreign partners through participation in international projects (SCAR, CONMAP, IHO and Seabed 2030 and in particular the 2021 funded PNRA project IsoBata) and in international Task-Force promoted by The International Lithosphere Programme (ILP – TF2021.5 LithoMar - Assessing the relationships between lithospheric processes and seafloor topography at oceanic hotspots and divergent margins). The candidate is expected to spend a period abroad of at least 6 months abroad and to participate on-board R/V Laura Bassi oceanographic expedition.

Supervisor webpage: https://www.unimib.it/alessandra-savini

Notes: Project on Polar Sciences

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38ᵗʰ cycle - Curriculum Geological Sciences

Nr 10		**Supervisor**	**Federico Agliardi**
Title	**Mass movement identification and prediction through remote sensing and artificial intelligence**		

Alpine settings are complex systems of glacial, paraglacial and periglacial environments, rapidly changing due to global warming. In this context different types of mass movements (rock slope deformations, rock and debris slides, rock glaciers), evolving under different controls and at different rates, threaten human lives, activities, and infrastructures. Managing related risks requires advanced capabilities to rapidly map and classify these processes over large areas, assess their evolution towards destabilization, and predict interactions with elements at risk.
Current analyses rely on geomorphological techniques supported by remote sensing to capture processes and their spatial and temporal evolution. These approaches are accurate but time consuming and difficult to update over wide areas in the dynamic Alpine environment. On the other hand, applications of artificial intelligence techniques to this field are still few and missing a robust process-oriented approach.
This PhD project will combine spaceborne remote sensing (InSAR, optical, thermal), machine learning techniques, and multi-scale geomorphological data to develop automated tools to map and classify different types of mass movements over a wide portion of the Alps, to support their monitoring and modeling in a risk mitigation perspective.
The research will be carried out in collaboration with researchers of CNR (Itay) and WSL (Switzerland), where the PhD student will spend at least six months.

Supervisor webpage: https://www.unimib.it/federico-agliardi

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 11		**Supervisor**	**Marcello Campione**
Title	**Simulation of space weathering of carbonaceous substrates by high-energy pulsed laser techniques**		

Carbon-based nanoparticles occur in various astrophysical environments, being among the most common dust species. During its lifetime in the interstellar medium, dust experiences extreme events such as grain-grain collisions, irradiation and shocks. The structure and chemical evolution together with the origin of these grains are still poorly understood and intensively debated.

This research program consists in a laboratory focused activity aimed at the production of an analogue material for astronomical carbonaceous nanoparticles by high power pulsed laser techniques applied on purposedly designed targets in different environments, followed by a multimethodological characterization of both target sample and ablated nanoparticles taking advantage of optical spectroscopy analyses, x-ray photoemission spectroscopy, X-ray diffraction and high-resolution transmission electron microscopy and analysis.

Laser ablation experiments will be performed with the support of the University of Messina (Prof. Lorenzo Torrisi); dynamic laser shock compression experiments will be performed at the international radiation facilities Eu-XFEL (HED instrument, Germany) and ESRF (HPLF-1, ID24 beamline, France). The photoemission spectroscopy analyses will be performed in collaboration with the Politecnico di Milano. A six-month period to be spent at ESRF (Raffaella Torchio) or Eu-XFEL (Ulf Zastrau) in the context of the shock dynamic compression experimental activities is also envisaged.

Supervisor webpage: https://www.unimib.it/marcello-campione

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 12		**Supervisor**	**Rosario Esposito**
Title	**Origin of CO_2 degassing from magmas associated to Italian arc magmatism**		

The research proposed for this doctorate aims to investigate the origin of the CO_2 degassing from magmas associated to past eruptions of the Italian arc magmatism (es., Campi Flegrei, Mt. Somma-Vesuvius, Aeolian Islands) based on the melt/fluid inclusion technique. In addition, the research goal is to study the correlation between the type of degassing, the magma composition, and the style of selected eruptions. In particular, the goal is to assess the role of the addition of CO_2 to the ascending magmas driven by crustal decarbonation. Expected results of this project have implications for the volcanic risk as the behavior of volatiles as CO_2 is associated to the possible ascent and eruption of magmas. The training associated to this PhD project will initially include field work (10% of the total PhD duration) to collect samples at the active volcanoes (e.g., Mt. Somma-Vesuvius). The rest of the PhD project (90% of the total PhD duration) will be mainly focused on laboratory activities such as fluid and melt inclusion petrographic/microthermometric analysis, Raman spectroscopy, chemical microanalysis, and stable isotope analysis by mass spectrometry. The student research will be based at UNIMIB (Milano) but will include training time (at least 6 months) at other Italian or international laboratories (e.g., INGV, Milano e/o Palermo and University of Alberta, Canada).

Supervisor webpage: https://www.unimib.it/rosario-esposito

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Call for Interest 38th cycle - Curriculum Geological Sciences

Nr 13		**Supervisor**	**Simone Pilia**
Title	**The role of continental lithosphere in subduction zones**		

United Arab Emirates (UAE) and Oman are worldwide known for the obducted Semail Ophiolite, less known for underthrusting of the Arabian continental crust. The metamorphic conditions of the underthrust crust varies from granulite facies conditions in the UAE and northern Oman to high-pressure conditions in the area located South of Muscat (Oman), in the Saih Hatat area. An extensive passive-seismic dataset is available from temporary and permanent stations in the UAE and Oman. The aim of the project is to combine multiple classes of seismic data, including local earthquake, regional and teleseismic traveltimes, and surface-wave dispersion extracted from ambient noise and earthquakes, to jointly constrain the 3-D seismic structure of the crust and upper mantle beneath the seismic network. Various software packages already exist to achieve this goal, although it is likely that the student will want to further develop some of these codes for their own analysis. Well-established collaborations with the University of Cambridge and University of Oxford exist, which the student can harness to their benefits, including spending time abroad in both institutions.

Supervisor webpage: https://www.unimib.it/simone-pilia