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May 2025

Bern-Fribourg Master in Earth Sciences

MSc-Projects offered in Bern and Fribourg

Specialization : **ELE**: Earth and Life Evolution, **EM**: Earth Materials, **ERG**: Environmental & Resource Geochemistry, **Geol**: Geology, **PAQS**: Pure & Applied Quaternary Sciences

ELE	EM	ERG	GEOL	PAQS	Title	Description	Advisor 1 / 2 / 3	Uni
☐	☐	☐	☒	☐	3D Fault Geometrie and Evolution of the Sax-Schwende fault (E-Switzerland)	Strike-slip faults are important brittle structures that dissect the upper crust and can act as fluid conduits. The latter is of particular interest for geothermal energy, but also for seismicity. This requires in-depth knowledge of the 3D fault architecture, which is often difficult to obtain from surface information. In this study, we will investigate the 3D fault geometry of the Sax-Schwende fault in the Helvetic Alps of eastern Switzerland. The fault will be studied using structural mapping (remote sensing, drone imaging, field work), structural field analysis and 3D structural modelling. Depending on the student's interest, modelling of fault kinematics/permeability or microstructural investigations (e.g. including U-Pb dating) can be carried out.	Prof. Marco Herwegh	BE

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☐	☒	☒	☒	☐	Alteration of the upper mantle – insights from 1.2 km of mantle rock recovered during IODP Exp. 399 from the Atlantis Massif	In spring 2023 the Joides Resolution, the scientific drilling vessel of the International Ocean Discovery Program, recovered a more than 1.2 km long section of upper mantle lithologies at the Atlantis Massif, located at 30°N along the Mid-Atlantic Ridge. Ocean floor drilling recovered primarily serpentinized peridotites (~70%), and gabbroic intrusions and magmatic veins (~30%), thus recovering a unique sequence of upper mantle lithologies never sampled before. Alteration of upper mantle rocks (peridotites) has wide-ranging implications for mineralogical, geochemical, biological to magmatic and tectonic processes. This includes that seawater-peridotite interaction influence ocean water chemistry over geological timescales, magmatic and ore forming processes in the volcanic arc, and through abiogenic production of hydrogen supports simple microbial lifeforms. Hence, these drill cores can provide insights into fluid-rock-microbe(-magma) interaction in the shallow upper mantle. Specific research topics may be 1) to investigate the elemental exchange between mafic magmatic veins and surrounding host rock, including magmatic degassing, on providing energy sources for microorganisms and their influence on providing fluid pathways, and 2) investigating the extent and impact of seafloor (serpentinite) weathering on geochemical cycles and microbial communities. These projects will be carried out within a SNSF-funded project that supports two PhD students. Analytics may involve petrographic characterization of thin sections, Raman spectroscopy, X-ray powder diffraction, electron microprobe analyses and/or laser ablation mass spectrometry. Students interested in this project or in any topic related to fluid-rock interaction processes and metamorphic petrology are welcome to discuss research possibilities with Esther Schwarzenbach.	Prof. Esther Schwarzenbach	FR
☐	☒	☒	☐	☐	Applied Topics in Environmental Mineralogy & Geochemistry	The research group Fachstelle Sekundärrohstoffe offers a broad variety of applied topics in the context of (i) recycling of mineral wastes in the cement, concrete and ceramics industries (circular economy), (ii) chemical and mineralogical characterization of industrial materials and its effects on the environment (e.g. in landfills). The topics involve classical methods of solid characterization (e.g., X-ray diffraction, X-ray fluorescence analysis, optical & scanning electron microscopy), wet-chemical characterization methods (extraction tests) and/or thermodynamic modelling. The topics vary depending on actual research questions from industry and offer a valuable insight into an applied research field. Interested students are encouraged to get in touch to discuss available topics and personal interests.	Dr. Mirjam Wolffers Dr. Gisela Weibel	BE
☐	☐	☐	☐	☒	Chasing the Early Pleistocene glaciations	The Swiss northern Alpine Foreland has been sculpted by at least 15 glacier advances during the Quaternary. To trace the pace of the Early Pleistocene glaciations, Deckenschotter deposits are investigated as they are considered to be the oldest Quaternary deposits being preserved as relict mesa-type hilltops in the northern Alpine Foreland. This MSc topic consists of fieldwork, laboratory work, and interpretations. The focus of this MSc thesis is on determining the timing of the Deckenschotter glaciations and reconstructing the landscape evolution during the Early Pleistocene. The Deckenschotter site, at which the study will be conducted, will be up for discussion. The objective is to first identify the origin, transport mechanism, and depositional environment of the Deckenschotter and second to select one or two suitable outcrops to collect samples for isochron-burial dating to determine the timing and finally to integrate all the obtained results into a landscape evolution history. To achieve this, the MSc student will perform sediment analysis, including clast petrography, morphometry, and fabric. Furthermore, the student will collect samples in the field and process them in the lab to analyze 10Be and 26Al in order to determine the deposition age using isochron-burial dating. The MSc student will present their findings at national conferences and submit their thesis in manuscript format, aiming to publish in an open-access scientific journal.	Prof. Naki Akçar	BE

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☐	☒	☒	☐	☐	Experimental investigations of element and isotope fractionation in carbonate minerals to develop proxies for paleoenvironments	Concentrations and isotope compositions of trace metals (e.g., Zn, Cu, Li, Ni) in carbonate minerals provide valuable insight into paleoenvironmental conditions such as ocean pH and paleo-productivity. The robust interpretation of these proxies requires an understanding of the mechanism of trace metal incorporation and isotope fractionation and the impact of factors such as pH, solution composition, and growth rate on their incorporation. This project will involve experiments, analyses of fluids and solids by various techniques, and isotopic analysis and interpretation.	PD Dr. Vasileios Mavromatis	BE
☐	☐	☒	☐	☐	Exploration for blind geothermal systems in the Rhône Valley: Hydrogeological tracers of thermal waters applied to shallow groundwaters	Orogenic geothermal systems result from the topography-driven, deep circulation of meteoric water through the crystalline basement including the fast upflow of the heated water along permeable fault zones (Diamond et al., 2018). Such orogenic systems are responsible for the 15 thermal water occurrences in and near the Rhône Valley discharging at temperatures up to 65°C. Due to the abundance of deep-reaching structures, it can be assumed that there are also an unknown number of blind geothermal systems, i.e. systems without surface manifestations (e.g. warm spring). One approach to identify such blind systems is to identify areas where ions such as Na, K, Cl and SO4 are elevated compared to the geogenic background levels. Several such anomalies have been identified in the districts of Martigny, Sion and Sierre during the ongoing GeoTex Rhône project. However, all of these elements can also have anthropogenic sources (naturally occurring evaporites, contaminated sites, fertilisers etc.). In order to confirm the thermal nature of the anomalies, additional data on more specific thermal tracers (Si, Li and 4He) need to be collected and evaluated. Once confirmed as blind geothermal systems caused by the upwelling of deep basement fluids, several aspects need to be investigated in the areas of interest: - Structural setting (collaboration with tectonic research group) - Make-up of the unconsolidated Quaternary infill of the Rhône Valley (based on existing data from shallow wells and some seismic profiles) Together this will lead to the development of a detailed conceptual model of the blind geothermal system(s) present in the area investigated. This in turn will help to advance our understanding of orogenic geothermal systems present in inneralpine valleys and guide national as well as international exploration.	Dr. Daniela Van den Heuvel Dr. Daniel Rufer PD Dr. Christoph Wanner	BE
☒	☐	☐	☒	☐	Exploring paleoenvironments at the extremes: An example from the Jurassic Cañadón Asfalto paleolake, Argentina		Dr. Alicia Fantasia	FR
☒	☐	☐	☐	☒	Exploring the genomic diversity of the Dead Sea shores : metabolic potential and biotechnology applications	Environmental microbial communities hold in their DNA a range of poorly understood metabolic capabilities that can be investigated to better understand the interaction of life with the geosphere, and possibly be harnessed for biotechnological applications (e.g. bioremediation). We here propose to explore metagenomics data from the hypersaline Dead Sea to look for patterns that can help us understand the development of life in extreme conditions.	Dr. Camille Thomas Prof. Hendrik Vogel	BE

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☐	☐	☐	☐	☒	Exploring the phases of gravel accumulation in the Aare valley	During the Quaternary, the Aare valley drained the Alpine ice as result of repeated glaciations. This drainage is documented by the phases of gravel accumulations in the valley. The last phase of gravel accumulation that occurred during the advance of the Aare lobe during the Last Glacial Maximum is relatively well known whereas the older phases of accumulation is poorly understood. The goal of this MSc. Thesis is to identify phases of gravel accumulation, explore the depositional environment, and determine the timing of accumulation in the Aare valley in the selected sites and gather information about their source, catchment area and transportation. This project consists of fieldwork, laboratory work, modeling and interpretation. To achieve this goal, MSc. student will do detailed sedimentological analysis and collect samples in the field. Techniques to be applied both in the field and laboratory are as follows: grain size analysis, pebble petrography, pebble morphometry and fabric. The MSc student will present their findings at national conferences and submit their thesis in manuscript format, aiming to publish in an open-access scientific journal.	Prof. Naki Akçar Prof. Fritz Schlunegger	BE
☐	☐	☐	☒	☒	Fault gouges in the Clavaniev Zone: Microstructures and the relations to earthquakes	The Clavaniev Zone is located between the Aar and the Tavetsch Massifs and is interpreted as major deformation zone. The fault gouges and related tectonites should be mapped on a small scale (100m scale) using drone imaging. Some fault gouges display spectacular mirror planes potentially being indicative for near surface seismic slip. These samples can be stabilized and analyzed microscopically in terms of deformation geometries and processes. This includes detailed SEM work and detecting the newly formed phases by XRD. In addition, some AFM investigations might be possible. The natural microstructures can be compared to microstructures from experimentally deformed granitoid gouges. The final goal of the project is to identify evidence for paleo-earthquakes in the rock record.	Prof. Marco Herwegh Prof. Alfons Berger	BE
☒	☐	☐	☒	☐	Filling the gaps in the Jurassic paleoclimate and paleoenvironmental records to better understand Earth's climate sensitivity		Dr. Alicia Fantasia	FR
☐	☒	☐	☒	☐	Formation temperatures and ages of igneous, pegmatitic and migmatitic garnets from the Central Alps	Garnet is a key mineral to constrain magmatic and metamorphic processes in the Earth's interior. Recent progress in the study of garnet has shown that some garnet can be dated by the U-Pb method. This is a new and exciting tool to date high grade metamorphic and magmatic rocks. However, only a few garnets contain enough U for dating. Another new development is the use of Zr-contents in garnet as a measure for the temperature of formation. While this is established for granulite facies garnets, the calibration for amphibolite facies conditions is less robust. . The aim of this project is to investigate garnets from igneous, pegmatitic and migmatitic rocks from the Central Alps. The Zr contents of garnet will be systematically evaluated and linked to the determined formation temperatures of the rocks to establish the Zr content of garnet at the onset of melting and to improve the calibration of the Zr-in-garnet thermometer. Partial melts can be enriched in U, leading to garnet that can be dated. Where possible, we aim to date the onset of partial melting by U-P chronology to determine key events in the Alpine orogeny. . The project will include detailed microscopy, electron microprobe and laser ablation mass spectrometry analyses.	Prof. Jörg Hermann Prof. Daniela Rubatto	BE
☒	☒	☐	☐	☐	Garnet and crustal recycling in the lower crustal section of the Serre Massif, Calabria, Italy		Prof. Daniela Rubatto	BE
☐	☐	☐	☒	☒	General topics in lacustrine paleoseismology, other natural hazards	Different topics will be presented and discussed during an informal meeting and adapted to the interestets of the student.	Prof. Katrina Kremer	BE

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☐	☐	☒	☒	☒	General topics in paleoclimatology, paleoenvironments and sedimentary geochemistry	To be presented and discussed in an informal meeting upon interest.	Prof. Hendrik Vogel	BE
☐	☐	☐	☐	☒	General topics in Quaternary Geology and Paleoclimatology	To be presented and discussed in an informal meeting upon interest.	Prof. Flavio Anselmetti	BE
☐	☒	☐	☒	☐	Geochemical investigation of water-rock interaction at the ocean floor	Serpentinites are hydrated ultramafic rocks that play a crucial role in the transfer of water from the hydrosphere to the lithosphere and finally to the deep Earth via subduction. The chemical and isotopic signatures of serpentinites therefore provide crucial information for geochemical mass balances. In serpentinites, trace element concentrations depend on both protolith and water-rock interactions during serpentinisation, whereas oxygen isotopes are controlled by water composition and serpentinisation temperature. Correlations between these two chemical signatures can therefore help to elucidate the conditions of serpentinisation. The project will study serpentinites from the Ligurian Ophiolites to reconstruct their oceanic evolution using textural, chemical and isotopic information. The results will be compared with chemical evolution trends recently defined from the study of serpentinites from oceanic cores. The student will carry out petrographic investigations, trace element mineral and oxygen isotope analyses and geochemical modelling.	Prof. Daniela Rubatto Prof. Thomas Pettke	BE
☐	☒	☐	☒	☐	Geochemistry of gold-ore forming fluids in the Monte Rosa Gold District, NW Italian Alps	The Monte Rosa Gold District encompasses a series of late-orogenic gold quartz veins, with the most spectacular examples occurring in the Brusson area. This project aims at quantifying the ore-forming fluid chemistry via LA-ICP-MS measurements of individual fluid inclusions, in order to better constrain gold vein genesis in such a globally classical geotectonic setting. Field work, vein mineralogy, detailed fluid inclusion petrography, microthermometry, and petrochemistry of hydrothermal alteration envelopes will be investigated for selected ancient gold mines. Fluid LA-ICP-MS measurements will emphasize concentrations of Au, S, Cl, Br, and possibly I, so far unconstrained for such world class gold resources, and for which we currently develop new standard materials. Results will allow fundamental questions to be addressed, including the dissolved Au concentrations in orogenic ore forming fluids, hydrothermal element transport, the geochemical signal of fluid-rock interaction forming the hydrothermal alteration envelope around the veins, and potential sources of ore-forming fluids. This project is particularly suited for individuals with a strong interest in diverse geochemical measurement techniques as applied to open system hydrothermal processes.	Prof. Thomas Pettke	BE
☐	☐	☐	☒	☐	Geological Characterization of the City of Lucerne in light of Underground Heat Storage	There is a need to tap hydrothermal geothermal energy from deep underground as a new renewable energy source. On the other hand the City of Lucerne has industrial heat sources (waste incineration plant, steel industry) the waste heat energy of which could be stored in the underground over the year and be reused for heating purposes in winter time. This two topics requires profound knowledge of the 3D underground geological framework including the distribution of target rocks and their permeabilities or the occurrence of fault and fracture zones. Together with local industry partners, this MSc study will explore the suitability of Lucerne's deeper underground as a source of geothermal energy and for such heat storage capabilities. For this purpose, the MSc study requires the following seps. (1) Collection and compilation of available geological data from literature. (2) Remote imaging-based detection of potential fault zones. (3) Identification and quantitative analysis of fault zones and fault patterns in the field. (4) Building up of a 2D GIS model (map and database) based on the information gained during the previous steps. (5) Building of a 3D geological model of the underground of the City of Lucerne. The MSc study will be supervised by the group of Structural Geology and Tectonics (Prof. Dr. Marco Herwegh, Dr. Timothy Schmid) and closely accompanied by industry partners. Given the urgency of the project, there exists the opportunity for a half year employment for conducting steps (1-5) on which then in a second step the Master thesis can be written on.	Prof. Marco Herwegh Dr. Timothy Schmid Prof. Alfons Berger	BE

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☐	☐	☒	☒	☐	Geometries of 3D Flow paths in fault-related hydrothermal systems	Orogenic hydrothermal systems often rely on recharge of meteoric water in mountainous areas, fluid circulation and heating of fluids down to depths of up to 10 km have to ascent and eventually leading to hot water springs. Such hydrothermal cells are of great interest for the exploration of geothermal energy within the Alps. In past research projects, we discovered the importance of brittle fault systems and associated kinematics in order to provide information on pathways allowing fluid circulation in quantities being substantial for the successful exploitation of heat. With this respect, quantitative information on the 3D geometries of flow paths, associated brittle tectonites and permeabilities is mandatory. In active hydrothermal systems, deep parts of hydrothermal cells are not accessible with enough spatial resolution by geophysical techniques. For this reason, we investigate in this study exhumed paleo-hydrothermal fault systems by means of quantitative mapping at a multitude of scales (remote sensing on aerial photographs, DEMS and drone images), on selected hand specimen and thin sections. This information allows the generation of 3D models visualizing and quantifying 3D pathways for fluid flow in a comprehensive manner. In addition, special emphasis can be paid to porosity forming (dilatancy by brittle deformation) and destroying (e.g. hydrothermal mineral precipitation) processes allowing to link porosity evolution to relative time sequences. In this sense, high-end analytical techniques such as light optical and scanning electron microscopy in combination with digital images analysis can be applied. This part of the project will be conducted in close collaboration with Prof. Beda Hofmann of the museum of natural sciences. There is opportunity for different MSc projects. Interested MSc students can select from different study sites (e.g. lower Engadin, upper Engadin, Grimsel pass, Furka pass, Wildhorn area, Lac de Fully). Also collaboration within the Geotex Rhône project (joint project between Structural Geology and RWI) is possible.	Prof. Marco Herwegh Prof. Alfons Berger Dr. Timothy Schmid	BE
☐	☐	☐	☐	☒	Geophysical monitoring of permafrost in high mountains		Prof. Christian Hauck	FR
☐	☐	☐	☒	☒	Ground ice content quantification using petrophysical models of electrical and seismic data		Prof. Christian Hauck	FR
☐	☐	☐	☒	☒	Holocene rock avalanches and evolution of the polygenic cones in the Mont Blanc Massif	When a glacially scoured high relief topography is combined with steep slopes and fractured rock walls, high rates of gravitational movements, such as rock avalanches, are inevitable. The Mont Blanc Massif is a good example for such geomorphologically active landscape. Several Holocene rock avalanches were recognized and studied in this region. This MSc topic consist of fieldwork, laboratory work, modeling and interpretation. The focus of this MSc. The focus of this MSc thesis is on deciphering the evolution of the rock avalanches and polygenic cone in the Ferret and Veny valleys in the Mont Blanc Massif. Our objective is to first select the most suitable polygenic cone, which is coupled with a rock avalanche event, and then reveal its extent and the timing of its deposition and finally reconstruct the rock avalanche and model the failure. To achieve this, MSc. student will take aerial photographs taken by unmanned aerial vehicle and process these with GIS and Remote Sensing software in order to produce high resolution orthoimages and DEM of the valley. Then, he/she will do detailed mapping and collect samples in the field and prepare samples for analysis of cosmogenic 10Be in the lab to calibrate the timing. The MSc student will present their findings at national conferences and submit their thesis in manuscript format, aiming to publish in an open-access scientific journal. In collaboration with Prof. Dr. Susan Ivy-Ochs (ETH Zurich), Philip Deline (Savoie University)	Prof. Naki Akçar	BE

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☐	☒	☐	☐	☐	Investigation of porous minerals for gas separation and sorption processes	Porous materials are particularly suitable in gas separation and sorption processes, e.g. CO2 removal, O2 purification, etc. The mechanisms behind these processes are dictated by the interplay of several factors (e.g. chemical composition of the porous framework, guest species into the pores, applied temperature conditions, etc.), the rationalization of which is often not straightforward. This project focused on the investigation of sorption properties of natural materials, i. e. framework aluminosilicate, previously modified by ion-exchange. The aim is to track the effect of the i) temperature and ii) composition of the counter-cations on the sorption capacity with respect CO2. The student will mostly apply X-ray diffraction techniques under variable temperature and humidity conditions. When necessary, the experimental results will be coupled with theoretical calculations based on Density Functional Theory.	PD Dr. Georgia Cametti	BE
☐	☒	☒	☐	☐	Leaching of contaminants from incineration bottom ashes: Experiments and models	The research group Fachstelle Sekundärrohstoffe is working on the save disposal of bottom ashes from waste incineration. Those ashes are heavily contaminated with different heavy metals and other substances. The quantinfication of long term release and the transport of heavy metals in already existing landfills is hindered by complex water transport in heterogeneous ashes and the incomplete understanding of chemical interactions of heavy metals with changing mineral constitutiens of the ashes. Release and transport of these contaminants is often quantified with standardized column leaching tests. From these tests, normally only part of the collected data is used, i.e. measured concentrations in solution. You will improve the analysis of such tests with coupled transport and chemical models. In order to expand the understanding of underlying processes and test the validity of the model concepts, you can develop and run specifically designed collumn tests as validation experiments. The student will become proficient in most advanced geochemical and reactive transport modelling methods, which can be complemented by practical lab work on collumn experiments. Simulations and the model development will be conducted in collaboration with PD Georg Kosakowski & Romana Boiger (Paul Scherrer Institut) and will be based on the GEMs ecosystem of codes which are developed by the Laboratory for Waste Management at the Paul Scherrer Institut (www.psi.ch/les).	PD Dr. Georg Kosakowski Dr. Gisela Weibel Prof. Sergey Churakov	BE
☐	☒	☒	☒	☐	Mineralogy and geochemistry of hydrothermal deposits from the Mid-Atlantic Ridge	Near mid-ocean ridges seawater circulation through the oceanic lithosphere leads to the formation of hydrothermal deposits and the venting of hydrothermal fluids that can range from ‘black smoker type’ high-T, acidic and sulfide-rich fluids to ‘Lost City type’ low-T, alkaline, and Ca- and H2-rich fluids. These hydrothermal fluids are the result of an extensive chemical exchange between seawater and basement rock lithologies and play a key role in the global geochemical cycles, mineral deposit formation, and in supporting simple life forms within the oceanic lithosphere. In spring of 2023 a sampling campaign lead by collaborators at NOAA and Oregon State University in Oregon, USA, will conduct a research cruise to the Mid-Atlantic Ridge in search of new hydrothermal systems. In this project, we will investigate hard rock samples and mineral deposits that will be collected during this cruise. The aim and outcome of the research project is largely dependent on the samples that will be recovered during the cruise. Though a focus will be on the mineralogical, petrological and geochemical examination of the samples to constrain the metasomatic processes in the basement rock, fluid-rock interaction temperatures, redox processes and/or the impact of fluid-rock interaction on geochemical cycles such as those of carbon and sulfur. Analytics may involve petrographic characterization of thin sections, Raman spectroscopy, X-ray powder diffraction, electron microprobe analyses and/or laser ablation mass spectrometry. Note, this project can be started no earlier than July/August 2023. Students interested in this project or in any topic related to alteration of the oceanic lithosphere and fluid-rock interaction processes are welcome to discuss research possibilities with the advisor.	Prof. Esther Schwarzenbach	FR

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☐	☐	☒	☒	☐	Multiscale 3D Fault Patterns and their Role for Seismic Activity in Switzerland	Although not being a high-risk country, Switzerland experiences several hundred earthquakes a year because of the still stressed lithosphere. Given the Alpine orogeny, we know that the crustal structure is tectonically pervasively dissected by faults, reaching from the tens of kilometers down to the meter scale. Currently it is poorly understood how these preconditioned fault patterns control ambient seismic activity. SeismoTeCH, a project conducted by the Swiss Geophysical Commission (led by swisstopo, Swiss Seismological Survey and University of Bern) will unravel this link, providing opportunities for MSc students to participate. One important question to be solved is: Can near surface fault patterns be used to explain seismicity at depth? Based on remote sensing techniques and fieldwork (aerial photos, DEMs, drone images, ShapeMetrix3D), multi-scale fault maps will be generated and transferred into 3D structural models (MOVE). By fieldwork, deformation style, kinematics and paleo-stresses of individual faults will quantitatively be investigated. This part of the project is supervised by the Structural Geology group of University of Bern. In collaboration with the team from the Swiss Seismological Survey (Tobias Diehl, Federica Lanza), obtained results will then be compared and analysed in terms of recent seismic activity. There is opportunity for different MSc projects since studies can be conducted in a variety of field areas ranging from the Valais to the Grisons.	Prof. Marco Herwegh	BE
☒	☒	☐	☒	☐	New project in Isotope Geology	Topics of interest in Isotope Geology may be discussed with the student.	Prof. Suzette Timmerman	BE
☒	☐	☐	☒	☒	New projects in Carbonate Sedimentology	The research group carbonate sedimentology is focusing on carbonate systems in a broad sense, encompassing the tight interaction between the geosphere and the biosphere. Notably, the research group is putting emphasis on the thorough understanding of reef and mound systems (especially cold-water coral ecosystems in deep environments) through space and time in order to reconstruct palaeo-environmental settings and early diagenetic pathways. Another major focus is the study of microbial carbonates in different settings to reconstruct microbial-induced carbonate diagenetic pathways and the interaction between fluid-flow, petrophysical characteristics and early diagenesis. Many projects are in close interaction with industry and/or framed within international collaborative research efforts. Fieldwork (on land or at sea) is an important component in carbonate sedimentological studies and will be integrated with the potential MSc topics. Students interested in any topics related to the broad domain of 'Carbonate Sedimentology', are mostly welcome to discuss further research possibilities and potential MSc topics with the advisor.	Prof. Anneleen Foubert	FR
☒	☐	☐	☐	☒	New projects in Macropaleontology	The field of macropaleontology pertains to the evolution of invertebrates (e.g., trilobites, brachiopods, ammonites, and bivalves), vertebrates (i.e., fish, amphibians, mammals, birds, and reptiles), and plants. The most important tools for macropaleontologists are comparative anatomy, phylogenetic reconstruction, functional anatomy, histology, and isotope analysis. Fossil material is available for study at numerous Swiss museums, particularly from the Triassic, Jurassic, and Tertiary and a tight network of paleontologists are willing to support a broad pallet of projects. Students are encouraged to discuss potential topics with the adviser to ensure that a topic is found that best suits their interests.	Prof. Walter Joyce	FR
☒	☐	☐	☐	☒	New projects in Micropaleontology	The research group in micropaleontology investigates microfossils and microorganisms possessing biomineralized shells. Stratigraphy based on microfossils is the best tool to date and correlate sediments. Beside this classical aspect of micropaleontology widely applied in both industrial and private sectors, the Micropaleontology group in Fribourg broadly applies geology, sedimentology and geochemistry to reconstruct the environments of the past in collaboration with the international leading scientists in each field. One of the "hot topics" of our research deals with the still poorly known deep-sea cold-water coral ecosystems through space and time. Another important subject that we are currently developing in collaboration with biologists, is the identification of new tools for the biomonitoring of marine coastal pollution based on microorganisms. This approach has recently met the interest of environmental agencies. Students interested to acquire an academic knowledge but also an applied approach are welcome to directly contact the advisor to discuss potential and suitable Master topics.		FR

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☒	☐	☐	☒	☐	Paleoenvironmental conditions in the aftermath of past hyperthermal events (e. g., Paleocene-Eocene Thermal Maximum, Toarcian Oceanic Anoxic Event)		Dr. Alicia Fantasia	FR
☐	☒	☒	☐	☐	Poromechamical behaviour of clay-rocks from atomistic simulations	Thanks to the permanent structural charge and large surface area clay minerals are able to adsorb toxic metals and organic matter. Because of these properties, clays are used as hydraulic barriers to confine hazardous waste and to retard migration of pollutants in the environment. The ability of clays the selectively adsorb hazardous metals depend on pore water composition. In this project molecular dynamics simulations will be used to investigate the ions retention by clay minerals in presence of LiCl, NaCl, KCl and Cs rich electrolytes.	Prof. Sergey Churakov	BE
☐	☐	☐	☒	☒	Porosity estimates of near surface rocks using complementary geophysical data sets		Prof. Christian Hauck	FR
☐	☒	☐	☒	☐	Pressure dependence for the compositions of accessory phases in the Bergell tonalite?	The Bergell tonalite intruded the Alpine nappe stack at 32 Ma just north of the Insubric line. The tonalite has a peculiar geometry with a tail close to Bellinzona and a roof in Val Malenco, Italy. The pressure estimates range from 7-8 kbar in the tail to 3.5 kbar in the roof, showing that the tonalite magma crystallized at different depth. Titanite, zircon, allanite and apatite are common accessory phases in the tonalite. The Ti-in-zircon and the Zr-in-titanite thermometers are widely used in the literature. These thermometers were mainly calibrated at 10 kbar. In this project the tonalite is used as a natural laboratory to investigate the response of accessory phases to different pressures. In a sample suite from the tail to the roof of the pluton, the composition of the accessory phase titanite, zircon and apatite will be measured for major and trace elements. Based on this data we will evaluate the effect of pressure on the Ti-in-zircon, Ti-in quartz and the Zr-in-titanite thermometers and we will investigate if there is a systematic distribution of Zr and Ti in allanite and apatite. Additionally the REE partitioning between all these phases will be investigated. Apatite, allanite and titanite can host also volatiles such as H2O, F, Cl, S and CO2 and thus might provide information on the evolution of volatiles in the magma. The project will include fieldwork, mineral separation, petrographic characterization of thin sections, electron microprobe and laser ablation mass spectrometry analyses and SIMS analyses.	Prof. Jörg Hermann Prof. Daniela Rubatto Prof. Alfons Berger	BE
☐	☒	☒	☐	☐	Research topics in Aqueous Geochemistry	Topics of interest in environmental and aqueous geochemistry may be discussed with the student.	PD Dr. Vasileios Mavromatis	BE
☐	☐	☒	☐	☐	Research Topics in Environmental Geochemistry	In addition to offering specific, pre-defined thesis projects, the ERG Speciality offers students the chance to design new projects that fit their scientific interests and career goals. Typically, such projects are attached to large team investigations now being carried out by academics at Bern, in conjunction with industry partners. Current projects include groundwater contamination (e.g. heavy metals), geochemical studies to support selection of radioactive waste repositories, CO2 sequestration, geothermal energy, and genesis of hydrothermal ore deposits. Master theses in these fields may involve combinations of field, analytical, experimental or modelling work. Interested students are welcome to contact Prof. Larryn Diamond. Advisors are members of the Institute of Geological Sciences at Bern and research partners from industry.		BE

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☐	☐	☐	☒	☐	Storm deposits recorded by Molasse sequences	Orkanartige Wetterbedingungen, wie der Wirbelsturm Katarina (2005 in New Orleans) sind Ereignisse, deren Ablagerungen in der Geologie als Tempestite bezeichnet werden. Sturmereignisse sind aber nicht nur rezent bekannt sondern finden sich in vielen fossilen küstennahen Ablagerungen, wie z.B. der basalen Trias der Zentralschweiz oder der oberen UMM. Besonders die Sturmlagen der UMM sind sehr interessant, finden sich dort doch eine grosse Anzahl von Ereignissen in einer ca. 15 m mächtigen Abfolge, die von der Sturmwellen-Basis bis zum Strand reicht. Mittels Geländeaufnahme (Marbach, Entlebuch) und Laboruntersuchungen (Anschliffe, Radiographie) sollen die einzelnen Ereignisse sedimentologisch charakterisiert werden, sowie eine Abschätzung der Häufigkeit, Intensität und Energie der Sturmereignisse erstellt werden.	Prof. Fritz Schlunegger	BE
☐	☒	☐	☒	☐	Subduction zone history of an oceanic slab unit in the tectonic accretionary channel of the Alps	Along the subduction plate interface melange series occur that contain fragments of subducted hydrous oceanic lithosphere, its sedimentary cover, and mantle wedge material, all variably modified in response to fluid-rock interaction during the subduction cycle. The fate of such fragments during subduction and exhumation has remained controversial, however, with models proposing that such fragments remain coherent during the entire cycle and models proposing that the units we now find exposed are the product of late amalgamation during exhumation along the plate interface. This project will investigate in detail one body (to be identified) of hydrous mantle rocks associated with basaltic eclogite and ±sediments from the Central Alps (Ticino) to decipher its metamorphic history during the subduction cycle and to constrain the trace element inventory of the different rock units. Such results are essential to our better understanding of subduction zone geochemical cycling and geodynamics. Sample materials will be collected and detailed outcrop mapping will be performed during field work in the Central Alps; hence, safe mountaineering in steep, pathless terrains is of advantage. Petrographic characterization of thin sections forms the basis for electron probe and laser ablation-ICP-MS measurements and chemical mapping to constrain the petrochemistry of the diverse fragment constituents. Continuing research can focus either on mineral stabilities and transformations employing modelling, on dating subduction metamorphism, or on chemical interactions between different rocks in the oceanic fragment – to be decided according to student's interests.	Prof. Thomas Pettke Prof. Jörg Hermann	BE
☐	☒	☒	☒	☐	Sulfur and carbon signatures in oceanic lithosphere from the Alpine belt	The oceanic crust and upper mantle undergo significant hydrothermal alteration upon interaction with seawater along mid-ocean ridge spreading centers. During this process sulfur and carbon are incorporated into the altered lithologies and are eventually transported into Earth's interior through subduction. Both sulfur and carbon are essential components in the Earth's system as they occur in mineral phases in rocks, are abundant in ocean water, occur in trace amounts in the atmosphere, and are major constituents of biogenic processes. Thus, it is essential to understand the cycling of these elements between different Earth reservoirs. This project will include field work in exhumed ocean lithosphere lithologies in the Swiss Alps (e.g., Saas-Zermatt Zone, Antrona ophiolite, Platta Nappe). Carbon and sulfur isotope signatures will be used to track the source and speciation of C and S during ocean floor to subduction zone processes. The analytical work will include petrographic characterization of rock samples and the analyses of C and S isotope ratios. Additional analytical methods may include electron microprobe analyses, scanning electron microscopy, Raman spectroscopy, X-ray powder diffraction, and/or laser ablation mass spectrometry. Students interested in this project or in any topic related to alteration of the oceanic lithosphere and fluid-rock interaction processes are welcome to discuss research possibilities with Esther Schwarzenbach.	Prof. Esther Schwarzenbach	FR

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☐	☒	☒	☐	☐	Sustainable cements: investigation of the recycling- and CO2 savings potential through the use of calcined clays from secondary raw materials	To achieve the goal of climate-neutral cement by 2050, Swiss cement plants are increasingly relying on the use of calcined clays as clinker substitutes, which can save up to 40% CO2 in the cement production. Beside the reduction in CO2-emission, a further environmental advantage can result if the clay-containing raw materials are not extracted from quarries (primary raw materials), but recycled from mineral waste (secondary raw materials). In Switzerland, gravel washing sludge, a fine residue from gravel processing with a relatively high clay content, is a secondary raw material with high potential for this purpose. Within this MSc thesis, the recycling potential of gravel washing sludge as a raw material for calcined clays will be investigated with laboratory experiments. The main research questions are 1) mineral reactions as a function of temperature 2) reactivity and potential as a clinker substitute material. Beside initial mineralogical-geochemical characterization, the experimental setup involves heating experiments in non-ambient XRD and lab-scale rotary kilns combined with mineralogical analysis and reactivity tests of the calcined material. The understanding of the mineralogical-geochemical material properties of the gravel washing sludge and its calcination and reactivity behavior is key to enable its use on an industrial scale. This applied MSc thesis is thematically embedded in a multi-year research project investigating the recycling potential of secondary raw materials in the cement industry. There will be a close collaboration with cement plants as well as other research institutions in Switzerland (e.g. EMPA).	Dr. Mirjam Wolffers PD Dr. Georgia Cametti Prof. Sergey Churakov	BE
☐	☒	☐	☒	☐	The peridotites and serpentinites of Antrona	The Antrona ophiolite is a slice of former oceanic crust from the Piemont-Ligurian ocean that was subducted to eclogite facies conditions during Alpine conversion. This MSc project will focus on the ultramafic rocks of the Antrona ophiolite that crop out to the northeast of Antronapiana. In this locality there are still relic mantle rocks with fresh olivine, whereas orthopyroxene is replaced by talc and tremolite, and spinel by chlorite. The relic mantle rocks are surrounded by serpentine mylonites, where new metamorphic olivine and titanian clinohumite have formed during Alpine subduction. The main aims of the project are to distinguish the major, minor and trace element composition of mantle olivine from metamorphic olivine, including hydrogen contents and oxygen isotopes. While the serpentinites were dehydrated during burial, the peridotites were hydrated during this subduction event. This interplay of fluid production and consumption serves as a natural analogue of what is expected between the subducting plate and the overlying mantle wedge. The project will combine petrographic and petrologic studies of ultramafic rocks. The project will include fieldwork, petrographic characterization of thin sections, electron microprobe, infrared spectroscopy, laser ablation ICP-MS and SIMS analyses.	Prof. Jörg Hermann Prof. Daniela Rubatto	BE
☐	☐	☒	☒	☐	The subduction plate interface: Geodynamics, chemical cycling and more	In addition to specific, pre-defined MSc projects, research theme proposals by students or together designing a research topic in the broad framework of subduction geochemical cycling are highly welcome. Focus in such projects should be on Geochemistry and Petrology, and they will be collaboratively supervised, involving experts from within the institute that are to be contacted from case to case. Field and analytical techniques are at the core of the research, combined with modelling and possibly some experiments if desirable. See project "The subduction zone history of an oceanic slab unit in the tectonic accretionary channel of the Alps" for an example. Please contact Thomas Pettke for further information.	Prof. Thomas Pettke	BE
☐	☒	☒	☐	☐	Thermal activation of secondary raw materials for recycling in sustainable cements		Dr. Mirjam Wolffers Prof. Sergey Churakov	BE

ELE	EM	ERG	GEOL	PAQS	Title	Description	Advisor 1 / 2 / 3	Uni
☐	☒	☐	☒	☐	Ti-Clinohumite and Chondrodite dikes in Zermatt: Metasomatism of Ti-rich basalts	The ophiolite rocks of Zermatt are an excellent natural laboratory to study processes during the formation, hydrothermal alteration and subduction of former oceanic crust of the Piemont ocean in the Alpine orogeny. The Piemont ocean was a slow spreading system, in which dykes of gabbros and basalt intruded the mantle rocks. These dykes experienced extensive alteration during seafloor metasomatism leading to rodingites and chlorite-rich rocks, followed by recrystallization during subduction-related metamorphism. Former Ti-rich basalt dikes in the peridotites are metamorphosed to Ti-clinohumite and Ti-chondrotite-rich rocks. The aim of this project is to reconstruct the evolution of this peculiar rock types from the magmatic emplacement at the mid-ocean ridge, to the alteration during sea-floor metasomatism and Alpine recrystallization during subduction. A special focus is placed on the phase relations of Ti-rich minerals and accessory minerals. The project will include fieldwork, petrographic characterization of thin sections, electron microprobe, infrared spectroscopy and laser ablation ICP-MS.	Prof. Jörg Hermann Prof. Daniela Rubatto Dr. Francesca Piccoli	BE
☐	☐	☐	☒	☒	Unveiling the Dynamics of the 1717 AD Rock Avalanche: Pioneering Cosmogenic 39Ar Surface Exposure Dating	In the Ferret Valley (Mont Blanc Massif, Italy), a massive historical rock avalanche in AD 1717 deposited chaotic boulders and irregular ridges along the valley floor. These deposits, spanning a 2 km-long area, have been extensively studied using radiocarbon and cosmogenic surface exposure dating techniques. However, the potential of surface exposure dating with cosmogenic 39Ar, a novel and innovative method, remains unexplored. This MSc topic focuses on employing this technique to reconstruct the extent, processes, and dynamics of the 1717 AD rock avalanche deposits. The project involves fieldwork, laboratory analysis, and modeling, integrating whole-rock and mineral-separate (feldspar) analyses of cosmogenic 39Ar to evaluate their comparative effectiveness. The primary objectives are to perform detailed mapping of the rock avalanche deposits, determine the precise timing of deposition using 39Ar surface exposure dating, compare dating outcomes of whole-rock and mineral-separate analyses, and model the depositional processes using Dan3D® to reconstruct the evolution of the rock avalanche. To achieve these objectives, the MSc student will conduct detailed field mapping supported by UAV-based high-resolution orthoimages and DEMs. They will also collect and prepare samples for cosmogenic 39Ar surface exposure dating, targeting both whole rocks and feldspar separates. Subsequently, the student will analyze and model the results to refine the understanding of this event's dynamics and contribute to advancing the methodological development of cosmogenic 39Ar surface exposure dating, for example production rate calibration. The MSc student will present their findings at national conferences and submit their thesis in manuscript format, aiming to publish in an open-access scientific journal. In collaboration with: Prof. Dr. Susan Ivy-Ochs (ETH Zurich), Dr. Philip Deline (Savoie University), Prof. Dr. Werner Aeschbach (Heidelberg University)	Prof. Naki Akçar	BE

ELE	EM	ERG	GEOL	PAQS	Title	Description	Advisor 1 / 2 / 3	Uni
☐	☐	☐	☒	☒	Unveiling the Onset and Long-Term Evolution of Rock Glaciers in Macun, Val Zeznina (GR)	Val Zeznina, located within the Swiss National Park in the canton of Grisons, hosts active rock glaciers that are globally significant as indicators of alpine permafrost and climatic changes. Despite their importance, the timing of their formation and the processes driving their long-term evolution remain poorly understood. Understanding these factors is key to reconstructing the paleoenvironmental conditions of high-altitude regions and the role of permafrost in shaping alpine landscapes. This MSc thesis aims to determine the timing of rock glacier formation in Macun, reconstruct their long-term evolution, and establish their paleoenvironmental context. To achieve this, detailed mapping of the post-Last Glacial Maximum landforms and rock glaciers will be conducted using UAV-derived high-resolution orthoimages and digital elevation models. Samples will be collected from rock glacier boulders for surface exposure dating to constrain the timing of their onset and significant evolutionary phases. Sedimentological and petrographic analyses will be performed to investigate the internal dynamics and long-term stability of these landforms. Finally, the results will be integrated with regional paleoclimatic records to identify links between climate oscillations and rock glacier development. By combining geomorphological, geochronological, and sedimentological approaches, this study will contribute to a deeper understanding of the processes shaping the alpine periglacial landscape. This study aims to uncover the temporal framework and environmental drivers of rock glacier formation in Val Zeznina. The findings will contribute to our understanding of periglacial processes in alpine regions, with implications for reconstructing Quaternary landscape evolution and permafrost dynamics. The MSc student will present their findings at national conferences and submit their thesis in manuscript format, aiming to publish in an open-access scientific journal.	Prof. Naki Akçar	BE
☐	☐	☐	☐	☒	Using cosmogenic nuclides to determine landscape change: amplitude, timing and frequency	This MSc topic spans broad spectrum of geological settings and sites. Depending on the scientific interest, goals and expectations of the MSc student, the specific sub-project will be designed. Each sub-project will consist of fieldwork, laboratory work, modeling and interpretation. Our objective is to determine the landscape change in the selected geological setting and site. To achieve this, MSc. student will do detailed geological mapping (with support of UAV and GIS technologies) and collect samples in the field, prepare samples for analysis of cosmogenic nuclides (10Be, 26Al and 36Cl) in the lab to calibrate the timing, calculate the amplitude and frequency, and model the change. MSc. Student is expected to present his/her research (both the work in progress and results) in national conferences. The ultimate scientific goal would be a publication. Research topics for individual sub-projects may be such as Quaternary glaciations, catchment-wide erosion rates, paleo-erosion rates, paleo-earthquakes, uplift rates (isostatic and neotectonic), paleo-discharge of fluvial systems etc… The sites for these are mainly located in the Alps. The MSc student will present their findings at national conferences and submit their thesis in manuscript format, aiming to publish in an open-access scientific journal.	Prof. Naki Akçar Prof. Fritz Schlunegger	BE
☒	☒	☐	☒	☐	Xenocrystic zircons from the Jwaneng kimberlite: a window into Archean mantle?	Zircon is a robust recorder of magmatic processes and its occurrence in kimberlites offers the opportunity to study deep mantle processes. The Jwaneng kimberlite (Botswana) contains a young kimberlite-related zircon population as well as an older population with Paleoproterozoic-Archean ages. For the older population it is unclear whether these zircons were formed at 3.2-3.6 Ga (Hf model age) with Pb retention between 2.8 and 2.1 Ga, or were formed between 2.8 and 2.1 Ga with an inherited older Hf component. This project will consist of a comprehensive study on a larger number of zircons with the aim to determine the process responsible for zircon formation by i) a detailed description of the zircons for their morphology, colour, and growth structure (CL imaging), ii) trace element analysis of each sub-population (LA-ICP-MS), iii) U-Pb geochronology (via LA-ICP-MS). Time permitting, Lu-Hf could be set up for in-situ LA-MC-ICP-MS analyses or Lu-Hf isotope systematics of a smaller selection of homogeneous zircon growth zones could be obtained via dissolution, column chemistry, and MC-ICP-MS analyses.	Prof. Suzette Timmerman Prof. Daniela Rubatto	BE