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Curriculum for the master's programme in Earth Sciences (2020 version)

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§ 1 Objectives and qualification profile

(1) In the course of the master's programme in Earth Sciences at the University of Vienna, students deepen and extend their competences in earth sciences and also acquire knowledge in a field of specialisation they choose from this Curriculum.

(2) Graduates of the master's programme in Earth Sciences of the University of Vienna have received a broad education in earth sciences and are specialised in one out of the four specialisations in Geology, Mineralogy and Geomaterials, Palaeobiology and Geobiology, and Applied Geosciences.
Graduates have acquired knowledge regarding field work in earth sciences, modern digital methods of observations in the field, working in the laboratory and instrumental analytics, computational data analysis and quantitative modelling. The consolidation of theoretical and practical knowledge is the basis for working independently in scientific and application-oriented fields. Graduates of the master's programme in Earth Sciences are especially qualified to think in an interdisciplinary way and across scales. The specialist knowledge and practical skills acquired fully qualify graduates for the profession. They are prepared in the best possible way for geoscientific practice in applied fields, in authorities and in scientific research.

Specialisation in Geology (G): Graduates of the specialisation in Geology have an integrative and system-oriented understanding of the composition, structure, formation of rocks and the dynamics of the Earth as well as its formation and developmental history. Students identify and investigate processes in the Earth's interior and on the Earth's surface. Students acquire this understanding of processes through data collection in the field and work in the laboratory as well as through analytical techniques and computer modelling. Students have specialist knowledge and investigate topics relevant to society, such as earthquakes, natural resources and changes in the environment and earth system throughout geological times.

Specialisation in Mineralogy and Geomaterials (M): Graduates of the specialisation in Mineralogy and Geomaterials are familiar with the material aspects of the system Earth and technical applications of mineral resources. They have profound knowledge in the fields of mineralogy, crystallography, geochemistry and petrology. They have practical skills in instrumental and analytical methods and are able to apply common procedures for synthesis. They are especially trained in the determination of material structures on the atomic and meso-scale level, of the composition of phases, fabric and physical and of chemical properties of minerals, rocks, glasses, magma and fluids. They are able to quantify the conditions of their formation and to assess and develop material behaviour.

Specialisation in Palaeobiology and Geobiology (P): Graduates of the specialisation in Palaeobiology and Geobiology are familiar with theories and fossil records on the origin and development of life, evolution and the phylogenetic and ecological relationship of relevant living and extinct animals, plants and protozoa. The specialisation focusses on the interaction between the evolution of life and the evolution of ecosystems in connection with the geological development of the Earth and its climate history. Relevant working methods are the applied subareas of functional morphology, evolutionary research, actuopalaeontology and geobiology.

SSt (Semesterstunde): hour per week per semester.
pi (prüfungsimmanent): continuous assessment.
npi (nicht prüfungsimmanent): non-continuous assessment.
Course types and their abbreviations: see § 9.

Graduates know the principles of stratigraphy and sedimentology and have the opportunity to consolidate their knowledge by specialising in the most important research areas of different geological time scales.

Specialisation in Applied Geosciences (A): Graduates of the specialisation in Applied Geosciences are able to apply geoscientific methods to solve practical problems in earth sciences. They are familiar with the fundamentals of geotechnical engineering, engineering geology, applied mineralogy of natural resources, hydrogeology and environmental geochemistry. They have profound knowledge of methods applied in the field and laboratory as well as digital and numerical knowledge to solve environmental, quantitative and qualitative technical issues in applied geosciences.

(3) Classes are held in German and English. The provisions of the University of Vienna apply to the level of German proficiency and the type of proof to be provided by the students. For English, command of English corresponding to level B2 of the Common European Framework of Reference for Languages is recommended. The provisions of the University of Vienna apply to the type of proof to be provided by the students.

§ 2 Duration and scope

(1) The workload for the master's programme in Earth Sciences comprises 120 ECTS credits. This is equivalent to a degree programme duration of four semesters.

(2) The programme is deemed completed if 15 ECTS credits as defined in the provisions on compulsory modules, 35 ECTS credits as defined in the provisions on one of the four alternative groups of compulsory modules (specialisations), 40 ECTS credits as defined in the provisions on the elective modules, 27 ECTS credits as defined in the provisions on the master's thesis and 3 ECTS credits as defined in the provisions on the master's examination have been obtained.

§ 3 Entry requirements

To be admitted to the master's programme in Earth Sciences students must have completed an eligible bachelor's programme or an eligible bachelor's programme at a university of applied sciences or an equivalent degree programme at a recognised Austrian or foreign post-secondary educational institution.

The bachelor's programme in Earth Sciences or the bachelor's programme in Biology with a specialisation in palaeobiology at the University of Vienna is certainly eligible.

If the qualification is basically equivalent and only certain supplementary qualifications are required to recognise equivalence, additional courses and examinations corresponding to no more than 30 ECTS credits may be prescribed for full equivalence, which must be taken during the course of the master's programme.

§ 3a Selection of the specialisation

(1) Within the master's programme, students have to select one of the following specialisations (alternative group of compulsory modules) subject to availability:

a) Geology (G)
b) Mineralogy and Geomaterials (M)
c) Palaeobiology and Geobiology (P)
d) Applied Geosciences (A)

(2) Students have to specify their specialisation (alternative group of compulsory modules) no later than following the completion of the orientation module (MA-ERD-1) in the record of exams.

§ 4 Academic degree

Graduates of the master's programme in Earth Sciences are awarded the degree "*Master of Science*", abbreviated as MSc.

Where the academic degree is stated this must be after the name.

§ 5 Structure – Modules with allocated ECTS credits

(1) Overview

(a) Structure and scope of the master's programme in Earth Sciences

	ECTS credits
Compulsory modules in the core subject	15
Compulsory modules from one of the four specialisations a) Specialisation in Geology (G) b) Specialisation in Mineralogy and Geomaterials (M) c) Specialisation in Palaeobiology and Geobiology (P) d) Specialisation in Applied Geosciences (A)	35
Elective modules	40
Master's Examination	3
Master's Thesis	27
Degree programme total	**120**

(b) Compulsory modules in the core subject comprising 15 ECTS credits

Students must complete the following compulsory modules:

Module code	**Title**	**ECTS credits**
MA-ERD-1	Current Advances and Instrumental Analysis in Earth Sciences (compulsory module)	9
MA-ERD-2	Master's Seminar (compulsory module)	6
	Core subjects total	**15**

(c) Specialisations (alternative groups of compulsory modules) comprising 35 ECTS credits

Subject to availability, students must choose a specialisation (alternative group of compulsory modules) from one of the following four specialisations (alternative groups of compulsory modules):

(c1) Compulsory modules for the specialisation in Geology (G)

Module code	**Title**	**ECTS credits**
MA-ERD-G-1	Mathematical Methods in Earth Sciences	5
MA-ERD-G-2	Thermodynamics of Geomaterials	5
MA-ERD-G-3	Sedimentology and Stratigraphy	5
MA-ERD-G-4	Lithospheric Dynamics	5
MA-ERD-G-5	Geochronology	5
MA-ERD-G-6	Quantitative Structural Geology and Tectonics	5
MA-ERD-G-7	Advanced Geological Mapping	5
	Total	**35**

(c2) Compulsory modules for the specialisation in Mineralogy and Geomaterials (M)

MA-ERD-M-1	Mathematical Methods in Earth Sciences	5

MA-ERD-M-2	Thermodynamics of Geomaterials	5
MA-ERD-M-3	Crystallography	5
MA-ERD-M-4	Structural Chemistry and Real Structure of Geomaterials	5
MA-ERD-M-5	Diffraction Methods	5
MA-ERD-M-6	Mineral Spectroscopy – Electronic Spectroscopy	5
MA-ERD-M-7	Mineral Spectroscopy – Vibrational Spectroscopy	5
	Total	**35**

(c3) Compulsory modules for the specialisation in Palaeobiology and Geobiology (P)

MA-ERD-P-1	Statistics in Earth Sciences	5
MA-ERD-P-2	Sedimentology and Stratigraphy	5
MA-ERD-P-3	Functional Morphology	5
MA-ERD-P-4	Actuopalaeontology	5
MA-ERD-P-5	Evolution and Diversity Research	5
MA-ERD-P-6	Climate Change through Time	5
MA-ERD-P-7	Geobiology	5
	Total	**35**

(c4) Compulsory modules for the specialisation in Applied Geosciences (A)

MA-ERD-A-1	Mathematical Methods in Earth Sciences	5
MA-ERD-A-2	Applied Tectonics and Structural Geology	5
MA-ERD-A-3	Geotechnical and Applied Mineralogy	5
MA-ERD-A-4	Groundwater Systems	10
MA-ERD-A-5	Biogeochemistry of Pollutants and Nutrients	10
	Total	**35**

(d) Elective modules comprising 40 ECTS credits

Subject to availability, students have to complete modules comprising 40 ECTS credits as elective modules from the modules listed in para. 2c if they do not complete these as compulsory modules as part of their specialisation.

MA-ERD-W-1.x MA-ERD-W-3.x MA-ERD-W-4.x	Elective modules	40
MA-ERD-W-2.x	To be completed as elective modules if students did not choose it as a compulsory module as part of their specialisation	
	Total	**40**

For the specialisation in Palaeobiology and Geobiology, the recognition of bachelor's modules not yet recognised from the other curriculum as elective modules is permissible to the extent of 5 ECTS credits based on convergence (students from the bachelor's programme in Earth Sciences and from the bachelor's programme in Biology with a specialisation in palaeobiology).

(2) Module descriptions

(a) Compulsory modules in the core subject

MA-ERD-1	**Current Advances and Instrumental Analysis in Earth Sciences (compulsory module)**	**9 ECTS credits**
Prerequisite	none	
Module outcomes	Students know research topics in the disciplines of geology, applied geosciences, mineralogy and geomaterials as well as palaeobiology and geobiology that are currently researched at the University of Vienna and that	

	are the most relevant in an international context.

	Students are able to render the most essential issues, objectives, contents and previous results and explain current research concepts. They are prepared for selecting a scientific topic for their master's thesis based on their personal interest. Students are familiar with the spectrum of methods of instrumental analysis applied in earth sciences. They know the physical and chemical fundamentals of different analytical methods and know their fields of application in earth sciences. They are especially familiar with electron microscopy and electron probe microanalysis, analytical methods by means of X-rays and procedures of spectroscopy and mass spectrometry. Moreover, students know the fundamentals of the analysis of environmental pollutants and related methods of field analysis.
Module structure	VO Current Advances in Earth Sciences, 4 ECTS credits, 2 SSt. (npi) VO Instrumental Analysis in Earth Sciences, 5 ECTS credits, 3 SSt. (npi)
Proof of performance	Passing of the courses (npi) (9 ECTS credits)

MA-ERD-2	**Master's Seminar (compulsory module)**	**6 ECTS credits**
Prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students identify central steps for an academic thesis in general and for a master's thesis in geosciences in particular, ranging from the hypothesis to the research design. They define a research topic, develop problem-oriented research questions and reflect on the methodological procedure. The students broaden their competences by writing a research proposal, reading and critically evaluating academic literature and by presenting and discussing it as well as through peer feedback by students. The seminars accompany the preparation of the students' master's theses, help consolidate academic research and writing, provide support regarding progress and a quality assurance system characterised by peer feedback. Students are able to present their scientific findings. Critical discussions in the discipline broaden the students' research competence.	
Module structure	SE Master's Seminar 1, 3 ECTS credits, 2 SSt. (pi) SE Master's Seminar 2, 3 ECTS credits, 2 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (6 ECTS credits)	

(b) Compulsory modules in the specialisations (alternative groups of compulsory modules)

Subject to availability, students choose one of the following specialisations in the form of alternative groups of compulsory modules:

(b1) Specialisation (alternative group of compulsory modules) Geology (G)

MA-ERD-G-1	**Mathematical Methods in Earth Sciences (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to present geoscientific problems from the perspective of mathematics and to solve these by means of suitable procedures using specialist computer programs. They can use common and partial differential equations, in particular, and the numerical procedures to solve these problems.	

	Students know the fundamentals of numerical modelling. Moreover, they are experienced in analysing geoscientific data sets based on practical questions.
Module structure	VU Mathematical Methods in Earth Sciences, 5 ECTS credits, 3 SSt., pi
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-G-2	**Thermodynamics of Geomaterials (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are familiar with the phases in thermodynamics and are able to apply these to geological systems. They are able to determine stable phase associations under current conditions. Students know the thermodynamic description of mineral phases, fluids and melts that are relevant for geology. In computer-based exercises they gain experience in using specialist programs and apply the methods from thermodynamics to mineral reactions, melting reactiоns and the balance between minerals and aqueous solutions.	
Module structure	VU Thermodynamics of Geomaterials, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-G-3	**Sedimentology and Stratigraphy (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamentals of sedimentology and stratigraphy. They can classify sedimentary rocks by means of microscopic methods and interpret diagenetic structures with regard to their storing properties. They know the concept of biomarkers, understand the relationship between geosphere and biosphere based on molecular fossils and are able to assign certain biomarkers to biogeochemical processes and environmental conditions. Students have acquired further knowledge in the interpretation of sedimentary profiles, especially with regard to the analysis of basins, basin development and their applications. They know the most important methods in stratigraphy, especially chronostratigraphy, lithostratigraphy and chemostratigraphy and know their practical applications.	
Module structure	VU Sedimentology and Stratigraphy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-G-4	**Lithospheric Dynamics (compulsory module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-1: Mathematical Methods in Earth Sciences	
Module outcomes	Students know the drivers and processes of the endogenous dynamics of the lithosphere. They understand the heat balance in the Earth's interior and are able to develop quantitative models for the temperature distribution in the lithosphere. They know phase transformation and diagnostic mineral reactions and magmatic processes along characteristic subduction and exhumation paths. They are familiar with the mechanisms of subduction and exhumation and know the relevant structure-forming deformation processes and diagnostic microfabric. In exercises, students gain experience in the integrative analysis of mineralogical, petrographic, structural geological and geochronological data.	
Module structure	VU Lithospheric Dynamics, 5 ECTS credits, 4 SSt. (pi)	

Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-G-5	**Geochronology (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamentals of absolute age determination and the use of radiogenic isotopes as geochemical tracers. They know the methods of dating mineral growth, rock formation, metamorphosis, exhumation, surface formation and weathering. They are familiar with the analytical procedures used and the preparation of samples. In exercises, students gain experience in analysing geochronological data. They are also able to generate data on age relevant for earth sciences from the data analysed.	
Module structure	VU Geochronology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-G-6	**Quantitative Structural Geology and Tectonics (compulsory module)**	**5 ECTS**
Prerequisite	MA-ERD-G-1: Mathematical Methods in Earth Sciences	
Module outcomes	Students are able to quantify fragmented and viscous deformation based on stress and strain tensors. They are able to generate data sets from the findings in the field and quantify these with simple methods. They are familiar with modern processes of plate tectonics.	
Module structure	VU Terrain: Quantitative Structural Geology and Tectonics, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-G-7	**Advanced Geological Mapping (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to prepare a geological map, including a geological profile, in the field in a predefined area. They recognise different lithologies, series of strata, structures and phenomena related to geomorphology and Quaternary geology. Students are able to note them in a map, visualise field data in a digital format and write a comprehensive project report.	
Module structure	UE Advanced Geological Mapping, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

b) Specialisation (alternative group of compulsory modules) in Mineralogy and Geomaterials (M)

MA-ERD-M-1	**Mathematical Methods in Earth Sciences (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to present geoscientific problems from the perspective of mathematics and to solve these by means of suitable procedures using specialist computer programs. They can use common and partial differential equations, in particular, and the numerical procedures to solve these problems. Students know the fundamentals of numerical modelling. Moreover, they are experienced in analysing geoscientific data sets based on practical questions.	

Module structure	VU Mathematical Methods in Earth Sciences, 5 ECTS credits, 3 SSt., pi
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-M-2	**Thermodynamics of Geomaterials (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are familiar with the phases in thermodynamics and are able to apply these to geological systems. They are able to determine stable phase associations under current conditions. Students know the thermodynamic description of mineral phases, fluids and melts that are relevant for geology. In computer-based exercises they gain experience in using specialist programs and apply the methods from thermodynamics to mineral reactions, melting reactions and the balance between minerals and aqueous solutions.	
Module structure	VU Thermodynamics of Geomaterials, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-M-3	**Crystallography (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students have profound knowledge in symmetry, are able to describe symmetry operations, translational and non-translational symmetry groups in a three-dimensional or higher-dimensional room and visualise these by means of mathematical and graphic procedures. They are able to transfer aspects of symmetry to the description of atomic structures or the tensor concept used in crystal physics and apply group relationships to structural transformations in crystals.	
Module structure	VU Crystallography, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-M-4	**Structural Chemistry and Real Structure of Geomaterials (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the principles of the structure of crystals, glasses and melts from the perspective of solid-state chemistry, especially the structural chemistry of inorganic crystals and their three-dimensional long-range order. They are able to independently differentiate the principles of order in structural chemistry and structural topologies, give an overview of structural variations and visualise these graphically and interpret values related to stereochemistry. They know the characteristics in crystal chemistry and the real structure of minerals, such as lattice distortions, defects, inclusions and the effects on important physical and chemical properties. They are able to describe and interpret processes of alteration.	
Module structure	VU Structural Chemistry and Real Structure of Geomaterials, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-M-5	**Diffraction Methods (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences MA-ERD-M-3: Crystallography	

Module outcomes	Students have basic knowledge of the physical fundamentals of diffraction of X-rays, neutron and electron beams at crystals. They are able to interpret phenomena of diffraction and diffraction diagrams and deduce lattice geometries and simple atomic lattice arrangements.

	They are able to apply X-ray diffraction techniques to determine lattice parameters and structures, or for phase analysis. They are familiar with the application of simple methods in roentgenography to analyse single crystals and have the competence to select suitable methods for a specific question and to interpret selected measurement data.
Module structure	VU Diffraction Methods, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-M-6	**Mineral Spectroscopy – Electronic Spectroscopy (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students know the fundamentals and fields of application of the most important methods of analysis in mineral spectroscopy. Students know theories and principles of techniques in electronic spectroscopy. They know the physical causes for colours in minerals and materials and know the fundamentals of using an optical absorption spectrum for the assessment of colour causes. They also know the physical causes of phenomena of luminescence and are able to independently record and interpret excitation and emission spectra. Students acquire these competences by studying fundamental methodological contents, getting an introduction to using spectroscopy systems and completing exercises for data analysis and interpretation.	
Module structure	VU Mineral Spectroscopy – Electronic Spectroscopy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-M-7	**Mineral Spectroscopy – Vibrational Spectroscopy (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students are proficient in the theories and principles of vibrational spectroscopy in general and the techniques of infra-red and Raman spectroscopy in particular. They are skilled to independently use these two methods to identify minerals, fluids and raw materials, characterise the atomic structural order in these substances and render applications in industry and research. Students acquire these competences by studying fundamental methodological contents, getting an introduction to using spectroscopy systems and completing exercises for data analysis and interpretation.	
Module structure	VU Mineral Spectroscopy – Electronic Spectroscopy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

(b3) Specialisation (alternative group of compulsory modules) in Palaeobiology and Geobiology (P)

MA-ERD-P-1	**Statistics in Earth Sciences (compulsory module)**	**5 ECTS**
Prerequisite	none	
Module outcomes	Students know the theories and practical implementation of common statistical methods required for quantitative analyses in earth sciences, especially in palaeobiology. Students know the criteria to select suitable data formats and methods that are appropriate for different types of analyses and know their advantages and disadvantages.	

	Students are aware that this understanding is a necessary precondition for planning and implementing a research project. They are able to apply analytical methods to practical examples by means of data sets available from literature, thereby concentrating on areas related to palaeobiology. They are able to visualise the results of univariate and multivariate statistics.
Module structure	VU Statistics in Earth Sciences, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-P-2	**Sedimentology and Stratigraphy (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamentals of sedimentology and stratigraphy. They can classify sedimentary rocks by means of microscopic methods and interpret diagenetic structures with regard to their storing properties. They know the concept of biomarkers, understand the relationship between geosphere and biosphere based on molecular fossils and are able to assign certain biomarkers to biogeochemical processes and environmental conditions. Students have acquired further knowledge in the interpretation of sedimentary profiles, especially with regard to the analysis of basins, basin development and their applications. They know the most important methods in stratigraphy, especially chronostratigraphy, lithostratigraphy and chemostratigraphy and know their practical applications.	
Module structure	VU Sedimentology and Stratigraphy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-P-3	**Functional morphology (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the structure, form and function of morphological adaptations in plants and animals and understand their anatomical, structural, functional, biochemical, ecological and evolutionary aspects as well as the relationship between morphology and form. They are familiar with patterns and processes of adaptive dispersal and choice of habitat. Moreover, students know the morphology (structure) of representative examples of fossil plants, invertebrates and vertebrates and compare the morphology of different organisms.	
Module structure	VU Functional Morphology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-P-4	**Actuopalaeontology (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know processes of actuopalaeontology through investigations in the field and the laboratory and methods to evaluate embedment processes, dispersal patterns of organisms and their remains as well as trace fossils. Students are able to recognise the influence of hydrodynamics, granulometry, porosity, oxygen, light and nutrition on the dispersal of organisms and are able to understand the relationship between sedimentary structures and fossils.	

Module structure	VU Terrain: Actuopalaeontology, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-P-5	**Evolution and Diversity Research (compulsory module)**	**5 ECTS credits**

Prerequisite	none
Module outcomes	Students know the theory and practical implementation of common analytical methods in phylogenetic systematics and the evolution of traits as well as in the quantitative investigation of diversity and diversification patterns to fully reconstruct and interpret the evolution of organisms. They are aware that this understanding of methodological procedures is a precondition for research projects in palaeobiology.
Module structure	VU Evolution and Diversity Research, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-P-6	**Climate Change through Time (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students understand the composition of the Earth's climate system, its drivers, interrelations and feedback mechanisms. They know different methods in climate reconstruction and the development, mechanisms and time scales of the past and current climate change. They are able to independently find and assess climatic and palaeoclimatic data in data bases and climate archives. They are able to understand current and future influences by humans on the climate and related feedback and assess forecast climate scenarios.	
Module structure	VU Climate Change through Time, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-P-7	**Geobiology (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are familiar with the interrelation between biosphere and geosphere and know the factors of biota that contributed to shaping planet Earth. They know the current scenarios that are likely for the evolution of life, the preconditions for life and its limitations and know how life developed on early Earth.	
Module structure	VU Geobiology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

(b4) Specialisation (alternative group of compulsory modules) in Applied Geosciences (A)

MA-ERD-A-1	**Mathematical Methods in Earth Sciences (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to present geoscientific problems from the perspective of mathematics and to solve these by means of suitable procedures using specialist computer programs. They can use common and partial differential equations, in particular, and the numerical procedures to solve these problems. Students know the fundamentals of numerical modelling. Moreover, they are experienced in analysing geoscientific data sets based on practical questions.	

Module structure	VU Mathematical Methods in Earth Sciences, 5 ECTS credits, 3 SSt., pi
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-A-2	**Applied Tectonics and Structural Geology**	**5 ECTS credits**

	(compulsory module)	
Prerequisite	none	
Module outcomes	Students know methods in structural geology to be applied for geological problems. They are familiar with methods in geotechnical engineering and structural geology as well as their application in applied geology and reservoir geology. Students know analytical methods to determine properties of surfaces of division and to characterise faults and fault rocks.	
Module structure	VU Terrain: Applied Tectonics and Structural Geology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-A-3	**Geotechnical and Applied Mineralogy (compulsory module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to use methods in mineralogy for applied problems related to geological engineering and the environment. They know the composition, structure and properties as well as the use of clay minerals and the mineral and chemical properties of the most important mineral phases in environmental systems. They are able to render the relationships between primary and secondary minerals for the reconstruction of weathering in soils, sediments and the transformation of solid phases in hydrothermal systems. They are able to apply appropriate methods and interpret measuring results.	
Module structure	VU Geotechnical and Applied Mineralogy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-A-4	**Groundwater Systems (compulsory module)**	**10 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the most important quantitative and qualitative methods for analysis in hydrogeology and have applied them. They are familiar with modern analytical and numerical procedures and are able to apply these to questions related to the environment.	
Module structure	VU for Groundwater Systems, 10 ECTS credits, 6 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (10 ECTS credits)	
Language	English	

MA-ERD-A-5	**Biogeochemistry of Pollutants and Nutrients (compulsory module)**	**10 ECTS credits**
Prerequisite	none	
Module outcomes	Students recognise the most important abiotic processes and processes catalysed by microbes that characterise the dispersal of inorganic pollutants and nutrients. They are able to apply quantitative and qualitative methods to parametrise these processes. They are familiar with numerical procedures to calculate the dispersal of pollutants and the uptake of nutrients and are able to use these procedures to solve problems.	
Module structure	VU Biogeochemistry of Pollutants and Nutrients, 10 ECTS credits, 6 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (10 ECTS credits)	

Language	English

(c) Elective modules

Subject to availability, students choose elective modules comprising 40 ECTS credits in total. They must not choose elective modules that are compulsory modules in their selected specialisation (alternative group of compulsory modules).

MA-ERD-W-1.1	**Individual Specialisation (elective module)**	**10 ECTS credits**
Prerequisite	none	
Module outcomes	Students have further developed their competences by completing additional modules and courses they selected from related master's programmes at the University of Vienna or other higher education institutions in Austria or abroad.	
Module structure	Subject to availability, students select courses comprising 10 ECTS credits in total. They have to select courses that complement the master's programme in Earth Sciences in a meaningful way: a) These include the elective modules of this Curriculum and courses or modules of the compulsory elements of the master's programme in Environmental Sciences. b) These also include relevant courses at the Technical University of Vienna and the University of Natural Resources and Life Sciences, Vienna as part of the Viennese university association as well as relevant courses in master's programmes of the University of Vienna and other universities in Austria and abroad. The selection of courses has to be approved by the directorate of studies in advance. The directorate of studies has to approve the completion of courses, provided that the module outcomes complement the master's programme in Earth Sciences in a meaningful way given the students' special interests.	
Proof of performance	Passing of the selected courses (npi or pi) (10 ECTS credits)	

MA-ERD-W-1.2	**Individual Research Project in Mineralogy, Geomaterials and Applied Earth Sciences (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Recommended prerequisite	MA-ERD-2: Master's Seminar	
Module outcomes	Students are able to plan and implement a small research project in the context of current research in mineralogy, geomaterials and applied earth sciences that prepares them for their master's thesis. Students conduct literature research, formulate testable hypotheses, apply analytical and statistical methods to address new issues, structure the necessary work (field, laboratory, modelling), present and interpret results and write a report in the form of a short publication.	
Module structure	PR Individual Research Project in Mineralogy, Geomaterials and Applied Earth Sciences, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-1.3	**Individual Research Project in Geology, Palaeobiology and Geobiology (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	

Recommended prerequisite	MA-ERD-2: Master's Seminar
Module outcomes	Students are able to plan and implement a small research project in the context of current research in geology, palaeobiology and geobiology that prepares them for their master's thesis. Students conduct literature research, formulate testable hypotheses, apply analytical and statistical methods to address new issues, structure the necessary work (field, laboratory, modelling), present and interpret results and write a report in the form of a short publication.

Module structure	PR Individual Research Project in Geology, Palaeobiology and Geobiology, 5 ECTS credits, 3 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-1.4	**Earth Science Excursions I (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students demonstrate their competences acquired during field trips to selected destinations in Austria and abroad during their degree programme and further develop their competences in issues and solutions related to scale in earth sciences.	
Module structure	EX Earth Science Excursions I, 5 ECTS credits, 5 SSt. (pi), 10 field-trip days	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-1.5	**Earth Science Excursions II (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students demonstrate their competences acquired during field trips to selected destinations in Austria and abroad during their degree programme and further develop their competences in issues and solutions related to scale in earth sciences.	
Module structure	EX Earth Science Excursions II 5 ECTS credits, 5 SSt. (pi), 10 field-trip days	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.1	**Mathematical Methods in Earth Sciences (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to present geoscientific problems from the perspective of mathematics and to solve these by means of suitable procedures using specialist computer programs. They can use common and partial differential equations, in particular, and the numerical procedures to solve these problems. Students know the fundamentals of numerical modelling. Moreover, they are experienced in analysing geoscientific data sets based on practical questions.	
Module structure	VU Mathematical Methods in Earth Sciences, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.2	**Statistics in Earth Sciences (elective module)**	**5 ECTS credits**
Prerequisite	none	

Module outcomes	Students know the theories and practical implementation of common statistical methods required for quantitative analyses in earth sciences, especially in palaeobiology. Students know the criteria to select suitable data formats and methods that are appropriate for different types of analyses and know their advantages and disadvantages. Students are aware that this understanding is a necessary precondition for planning and implementing a research project.

	They are able to apply analytical methods to practical examples by means of data sets available from literature, thereby concentrating on areas related to palaeobiology. They are able to visualise the results of univariate and multivariate statistics.
Module structure	VU Statistics in Earth Sciences, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-2.3	**Thermodynamics of Geomaterials (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are familiar with the phases in thermodynamics and are able to apply these to geological systems. They are able to determine stable phase associations under current conditions. Students know the thermodynamic description of mineral phases, fluids and melts that are relevant for geology. In computer-based exercises they gain experience in using specialist programs and apply the methods from thermodynamics to mineral reactions, melting reactions and the balance between minerals and aqueous solutions.	
Module structure	VU Thermodynamics of Geomaterials, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.4	**Sedimentology and Stratigraphy (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamentals of sedimentology and stratigraphy. They can classify sedimentary rocks by means of microscopic methods and interpret diagenetic structures with regard to their storing properties. They know the concept of biomarkers, understand the relationship between geosphere and biosphere based on molecular fossils and are able to assign certain biomarkers to biogeochemical processes and environmental conditions. Students have acquired further knowledge of the interpretation of sedimentary profiles, especially with regard to basin analysis, basin development and their application. They know the most important methods in stratigraphy, especially chronostratigraphy, lithostratigraphy and chemostratigraphy and know their practical applications.	
Module structure	VU Sedimentology and Stratigraphy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.5	**Lithospheric Dynamics (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-1, MA-ERD-M-1, MA-ERD-A-1, MA-ERD-W-2.1: Mathematical Methods in Earth Sciences	
Module outcomes	Students know the drivers and processes of the endogenous dynamics of the lithosphere. They understand the heat balance in the Earth's interior and are able to develop quantitative models for the temperature distribution in the lithosphere. They know phase transformation and diagnostic mineral reactions and magmatic processes along characteristic subduction and exhumation paths. They are familiar with the mechanisms of subduction and exhumation and know the relevant structure-forming deformation processes and diagnostic microfabric. In exercises, they gain experience in the integrative analysis of mineralogical, petrographic, structural geological and geochronological data.	

Module structure	VU Lithospheric Dynamics, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-2.6	**Geochronology (elective module)**	**5 ECTS credits**

Prerequisite	none
Module outcomes	Students are proficient in the fundamentals of absolute age determination and the use of radiogenic isotopes as geochemical tracers. They know the methods of dating mineral growth, rock formation, metamorphosis, exhumation, surface formation and weathering. They are familiar with the analytical procedures used and the preparation of samples. In exercises, they gain experience in analysing geochronological data. They are also able to generate data on age relevant for earth sciences from the data analysed.
Module structure	VU Geochronology, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-2.7	**Quantitative Structural Geology and Tectonics (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-1, MA-ERD-M-1, MA-ERD-A-1, MA-ERD-W-2.1: Mathematical Methods in Earth Sciences	
Module outcomes	Students are able to quantify fragmented and viscous deformation based on stress and strain tensors. They are able to generate data sets from the findings in the field and quantify these with simple methods. They are familiar with modern processes of plate tectonics.	
Module structure	VU Terrain: Active Tectonics, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.8	**Advanced Geological Mapping (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to prepare a geological map, including a geological profile, in the field in a predefined area. They recognise different lithologies, series of strata, structures and phenomena related to geomorphology and Quaternary geology. Students are able to note them in a map, visualise field data in a digital format and write a comprehensive project report.	
Module structure	UE Advanced Geological Mapping, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.9	**Crystallography (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students have profound knowledge in symmetry, are able to describe symmetry operations, translational and non-translational symmetry groups in a three-dimensional or higher-dimensional room and visualise these by means of mathematical and graphic procedures. They are able to transfer aspects of symmetry to the description of atomic structures or the tensor concepts used in crystal physics and apply group relationships to structural transformations in crystals.	
Module structure	VU Crystallography, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.10	**Structural Chemistry and Real Structure of Geomaterials (elective module)**	**5 ECTS credits**
Prerequisite	none	

Module outcomes	Students know the principles of the structure of crystals, glasses and melts from the perspective of solid-state chemistry, especially the structural chemistry of inorganic crystals and their three-dimensional long-range order.

	They are able to independently differentiate the principles of order in structural chemistry and structural topologies, give an overview of structural variations and visualise these graphically and interpret values related to stereochemistry. They know the characteristics in crystal chemistry and the real structure of minerals, such as lattice distortions, defects, inclusions and the effects on important physical and chemical properties. They are able to describe and interpret processes of alteration.
Module structure	VU Structural Chemistry and Real Structure of Geomaterials, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-2.11	**Diffraction Methods (elective module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences MA-ERD-M-3, MA-ERD-W-2.9: Crystallography	
Module outcomes	Students have basic knowledge of the physical fundamentals of diffraction of X-rays, neutron and electron beams at crystals. They are able to interpret phenomena of diffraction and diffraction diagrams and deduce lattice geometries and simple atomic lattice arrangements. They are able to apply X-ray diffraction techniques to determine lattice parameters and structures, or for phase analysis. They are familiar with the application of simple methods in roentgenography to analyse single crystals and have the competence to select suitable methods for a specific question and to interpret selected measurement data.	
Module structure	VU Diffraction Methods, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.12	**Mineral Spectroscopy – Electronic Spectroscopy (elective module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students know the fundamentals and fields of application of the most important methods of analysis in mineral spectroscopy. Students know theories and principles of techniques in electronic spectroscopy. They know the physical causes for colours in minerals and materials and know the fundamentals of using an optical absorption spectrum for the assessment of colour causes. They also know the physical causes of phenomena of luminescence and are able to independently record and interpret excitation and emission spectra. Students acquire these competences by studying fundamental methodological contents, getting an introduction to using spectroscopy systems and completing exercises for data analysis and interpretation.	
Module structure	VU Mineral Spectroscopy – Electronic Spectroscopy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.13	**Mineral Spectroscopy – Vibrational Spectroscopy (elective module)**	**5 ECTS credits**
Prerequisite	none	

Recommended prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences

Module outcomes	Students are proficient in the theories and principles of vibrational spectroscopy in general and the techniques of infra-red and Raman spectroscopy in particular. They are skilled to independently use these two methods to identify minerals, fluids and raw materials, characterise the atomic structural order in these substances and render applications in industry and research. Students acquire these competences by studying fundamental methodological contents, getting an introduction to using spectroscopy systems and completing exercises for data analysis and interpretation.
Module structure	VU Mineral Spectroscopy – Vibrational Spectroscopy, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-2.14	**Functional Morphology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the structure, form and function of morphological adaptations in plants and animals and understand their anatomical, structural, functional, biochemical, ecological and evolutionary aspects as well as the relationship between morphology and form. They are familiar with patterns and processes of adaptive dispersal and choice of habitat. Moreover, students know the morphology (structure) of representative examples of fossil plants, invertebrates and vertebrates and compare the morphology of different organisms.	
Module structure	VU Functional Morphology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.15	**Actuopalaeontology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know processes of actuopaleontology through investigations in the field and the laboratory and methods to evaluate embedment processes, dispersal patterns of organisms and their remains as well as trace fossils. Students are able to recognise the influence of hydrodynamics, granulometry, porosity, oxygen, light and nutrition on the dispersal of organisms and are able to understand the relationship between sedimentary structures and fossils.	
Module structure	VU Terrain: Actuopalaeontology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.16	**Evolution and Diversity Research (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the theory and practical implementation of common analytical methods in phylogenetic systematics and the evolution of traits as well as in the quantitative investigation of diversity and diversification patterns to fully reconstruct and interpret the evolution of organisms. They are aware that this understanding of methodological procedures is a precondition for research projects in palaeobiology.	
Module structure	VU Evolution and Diversity Research, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.17	**Climate Change through Time (elective module)**	**5 ECTS**

		credits
Prerequisite	none	

Module outcomes	Students understand the composition of the Earth's climate system, its drivers, interrelations and feedback mechanisms. They know different methods in climate reconstruction and the development, mechanisms and time scales of the past and current climate change. They are able to independently find and assess climatic and palaeoclimatic data in data bases and climate archives. They are able to understand current and future anthropogenic influences on the climate and related feedback and assess forecast climate scenarios.
Module structure	VU Climate Change through Time, 5 ECTS credits, 3 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-2.18	**Geobiology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are familiar with the interrelation between biosphere and geosphere and know the factors of biota that contributed to shaping planet Earth. They know the current scenarios that are likely for the evolution of life, the preconditions for life and its limitations and know how life developed on early Earth.	
Module structure	VU Geobiology, 5 ECTS credits, 4 SSt. (pi).	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.19	**Applied Tectonics and Structural Geology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know methods in structural geology to be applied to geological problems. They are familiar with methods in geotechnical engineering and structural geology as well as their application in applied geology and reservoir geology. Students know analytical methods to determine properties of surfaces of division and to characterise faults and fault rocks.	
Module structure	VU Terrain: Applied Tectonics and Structural Geology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.20	**Geotechnical and Applied Mineralogy (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to use methods in mineralogy for applied problems related to geological engineering and the environment. They know the composition, structure and properties as well as the use of clay minerals and the mineral and chemical properties of the most important mineral phases in environmental systems. They are able to render the relationships between primary and secondary minerals for the reconstruction of weathering in soils, sediments and the transformation of solid phases in hydrothermal systems. They are able to apply appropriate methods and interpret measuring results.	
Module structure	VU Geotechnical and Applied Mineralogy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-2.21	**Groundwater Systems (elective module)**	**10 ECTS credits**
Prerequisite	none	

Module outcomes	Students know the most important quantitative and qualitative methods for analysis in hydrogeology and have applied them. They are familiar with modern analytical and numerical procedures and are able to apply these to questions related to hydrogeology.

Module structure	VU Groundwater Systems, 10 ECTS credits, 6 SSt. (pi)
Proof of performance	Passing of the courses (pi) (10 ECTS credits)
Language	English

MA-ERD-W-2.22	**Biogeochemistry of Pollutants and Nutrients (elective module)**	**10 ECTS credits**
Prerequisite	none	
Module outcomes	Students recognise the most important abiotic processes and processes catalysed by microbes that characterise the dispersal of inorganic pollutants and nutrients. They are able to apply quantitative and qualitative methods to parametrise these processes. They are familiar with numerical procedures to calculate the dispersal of pollutants and the uptake of nutrients and are able to use these procedures to solve problems.	
Module structure	VU Biogeochemistry of Pollutants and Nutrients, 10 ECTS credits, 6 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (10 ECTS credits)	
Language	English	

MA-ERD-W-3.1	**Elemental Analysis with the Electron Probe Microanalyser (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students are familiar with the physical and chemical fundamentals of elemental analysis by means of the electron probe microanalyser and know the set-up and functions of the analytical device. Students are able to independently formulate an analytical problem and prepare measurement protocols that serve as a basis for solving this problem by means of the electron probe microanalyser. The repertoire of methods acquired includes qualitative elemental analysis, imaging techniques, such as the production of optoelectronic images and elemental mapping, as well as quantitative elemental analysis by using standard substances.	
Module structure	UE Elemental Analysis with the Electron Probe Microanalyser, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.2	**Scanning Electron Microscopy (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students are introduced to scanning electron microscopy in a practice-oriented way and familiarise themselves with the opportunities of application of this method to address questions in earth sciences. Students are able to work in the high- and low-vacuum mode and are able to independently create optoelectronic images by means of the detection of secondary and backscattered electrons. Moreover, students are familiar with the practical application of energy-dispersive X-ray microanalysis. They are qualified to independently operate the device and use it for addressing own questions.	
Module structure	UE Scanning Electron Microscopy, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.3	**Field Emission Scanning Electron Microscopy and Ion Beam Applications (elective module)**	**3 ECTS credits**
Prerequisite	MA-ERD-1:	

	Current Advances and Instrumental Analysis in Earth Sciences
Recommended prerequisite	MA-ERD-W-3.2: Scanning Electron Microscopy
Module outcomes	Students are familiar with the special characteristics of the instrument of high-resolution field emission scanning electron microscopy in theory and practice and with the application methods of the focussed ion beam (FIB). Students are able to independently create high-resolution optoelectronic images by means of different detectors (SED, BSED, FSD, STEM) and create FIB cross sections. Moreover, students get an insight into the practical application of the EBSD method. They are able to use different methods for the analysis of microstructures and textures using a high spatial resolution to address own questions in earth sciences.
Module structure	UE Field Emission Scanning Electron Microscopy and Ion Beam Applications, 3 ECTS credits, 3 SSt. (pi)
Proof of performance	Passing of the course (pi) (3 ECTS credits)

MA-ERD-W-3.4	**Phase Analysis with Powder Diffractometry (elective module)**	**4 ECTS credits**
Prerequisite	MA-ERD-1: Current Advances and Instrumental Analysis in Earth Sciences	
Module outcomes	Students know the fundamentals of the qualitative and quantitative analysis of solids to determine the phases by means of X-ray powder diffractometry. They know the theoretical fundamentals of this procedure and are able to use modern concepts of this method to determine and quantify mineral phases or phase parts in rocks, soil samples and raw materials. They are able to render their use in industry and research and have the competences to select a suitable method for a specific question, to independently carry out the analysis and interpret the data by means of digital methods.	
Module structure	VU Phase Analysis with Powder Diffractometry, 4 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (4 ECTS credits)	

MA-ERD-W-3.5	**Experimental Mineralogy and Petrology (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-2, MA-ERD-M-2, MA-ERD-W-2.3: Thermodynamics of Geomaterials	
Recommended prerequisite	MA-ERD-G-1, MA-ERD-M-1, MA-ERD-A-1, MA-ERD-W-2.1: Mathematical Methods in Earth Sciences	
Module outcomes	Students know the most important experimental methods to determine thermodynamic and physical properties and the kinetic behaviour of minerals, fluids and melts. They are familiar with the relationship between measurable values and thermodynamic and mineral physical parameters and are able to extract these from experimental results. They have acquired skills in conducting mineralogical and petrological experiments.	
Module structure	VU Experimental Mineralogy and Petrology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.6	**Kinetics of Geological Materials (elective module)**	**5 ECTS credits**

Prerequisite	MA-ERD-G-2, MA-ERD-M-2, MA-ERD-W-2.3: Thermodynamics of Geomaterials
Recommended prerequisite	MA-ERD-G-1, MA-ERD-M-1, MA-ERD-A-1, MA-ERD-W-2.1: Mathematical Methods in Earth Sciences

Module outcomes	Students are familiar with the kinetics of mineral reactions. They are able to extract the underlying processes from microstructures and phases as well as the zones in terms of mineral chemistry and phenomena, such as the increase in coarse granularity and overgrowth in an orderly way and to analyse these applying a suitable method. With this repertoire of instruments, they are able to draw quantitative conclusions about the dynamics of geological systems.
Module structure	VU Kinetics of Geological Materials, 5 ECTS credits, 3 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-3.7	**Magmatic Processes and Crust Formation (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the most important processes of magma formation ranging from the melt formation and magma mixes, fractional crystallisation and assimilation to the emplacement or its eruption through volcanism and solidification. They are able to model the relationships of phases and the resulting magma development in a quantitative way and apply the results to igneous rocks. They are able to make statements about the geodynamic situation of magma formation based on the findings from the field and from petrological and geochemical data.	
Module structure	VU Terrain: Magmatic Processes and Crust Formation, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.8	**Mineral Deposits and Economic Geology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the geological processes leading to the concentration of elements in mineral deposits (ores, industrial minerals, energy resources). They are familiar with the problems of the global mining and energy industry (distribution, prospection, extracting, mining, processing, markets and strategic, ecological and social aspects). They know the geology and mineralogy of characteristic types of deposits and have an overview of important deposits in Austria and abroad in terms of global economy and history.	
Module structure	VU Terrain: Mineral Deposits and Economic Geology, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.9	**Reflected Light Microscopy of Ore Deposits (elective module)**	**3 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-W-3.8: Mineral Deposits and Economic Geology	
Module outcomes	Students have knowledge of the paragenesis of ore minerals in economically important ore deposits. They acquire these competences through exercises using the microscope and selected polished ore sections.	
Module structure	VU Reflected Light Microscopy of Ore Deposits, 3 ECTS credits, 2 SSt. (pi)	

Proof of performance	Passing of the course (pi) (3 ECTS credits)

MA-ERD-W-3.10	**Planetary Geology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students have knowledge of the formation of the solar system and the resulting distribution of elements as well as the composition of planets. They acquire knowledge of the most important phases for every planet that play an essential role in the field of time (development), chemistry, pressure and temperature.	

	Students understand the structure and dynamics of the Earth in a bigger context and combine findings from observation of nature in the field and experimental simulation.
Module structure	VU Terrain: Planetary Geology, 5 ECTS credits, 3 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-3.11	**Regional Geology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the geology of Austria and the Alps and the geological structure and orogenesis on a European and global scale. They know characteristic orogenic cycles and basic litho-tectonic units and are able to discuss the connection between regional geology and aspects of applied geology (hydrogeology, the geology of deposits, engineering geology, geothermal energy).	
Module structure	VO Regional Geology, 5 ECTS credits, 3 SSt. (npi)	
Proof of performance	Passing of the course (npi) (5 ECTS credits)	

MA-ERD-W-3.12	**Digital Field Methods (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to collect, process and interpret digital field data on multiple scales. They are proficient in techniques for the analysis of linear and planar thin section, hand samples and rock sequences. They are experienced in using methods in photogrammetry, including unmanned aerial vehicles and are introduced to working with satellite data in research and exploration. They have practical knowledge of processing geological data in geographic information systems (GIS) and application-oriented exercises in the field to collect, process and interpret own data.	
Module structure	VU Terrain: Digital Field Methods, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.13	**Glacial Sedimentology and Quaternary Geology (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-3, MA-ERD-P-2, MA-ERD-W-2.4: Sedimentology and Stratigraphy	
Module outcomes	Students are able to recognise, examine and systematically describe the geological evidence of previous climate variability, especially during glacial periods and the Quaternary. They have knowledge of glacial sedimentology. Regional aspects of the Quaternary are discussed and identified in the field. Students are able to apply advanced methods in quaternary research.	
Module structure	VU Terrain: Glacial Sedimentology and Quaternary Geology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.14	**Advanced Stratigraphy and Carbonate Sedimentology (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-3, MA-ERD-P-2, MA-ERD-W-2.4: Sedimentology and Stratigraphy	

Module outcomes	Students are able to apply modern methods in stratigraphy in practice. They are able to apply qualitative and quantitative methods in chronostratigraphy, biostratigraphy and cyclostratigraphy. They are able to apply sequence stratigraphy and stratigraphic palaeobiology to cases. Students are able to classify carbonate microfacies by applying methods in microscopy and are able to interpret these in different contexts, including palaeoecosystems and deposit geometries.

	Students are able to apply these methods in the field.
Module structure	VU Terrain: Advanced Stratigraphy and Carbonate Sedimentology, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-3.15	**Applied Petroleum Geology and Seismic Interpretation (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-3, MA-ERD-P-2, MA-ERD-W-2.4: Sedimentology and Stratigraphy	
Module outcomes	Students know the methods of basin analysis and principles of crude oil exploration. They identify the possibilities for the development of hydrocarbons and are able to characterise and evaluate crude oil systems. They know methods of exploration and are able to interpret case studies. They are familiar with practical methods in hydrocarbon exploration and extraction and have basic knowledge of petrophysics. Students are able to recognise geological structures and trap geometries in seismic diagrams and apply and interpret seismic stratigraphy.	
Module structure	SE Applied Petroleum Geology and Seismic Interpretation, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.16	**Karst Hydrology, Karst Morphology and Water Extraction (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the most important morphological, hydrological and geological functions and types of karst. They are familiar with the origin of karstic caves and know their importance as archives for palaeoclimatics, archaeology and palaeontology as well as for questions related to geology and hydrology. They know the most important hydrogeological methods and assessment of karst aquifers to derive essential parameters for the extraction of drinkable water and know the challenges of construction projects in karst. They have gained further knowledge through exercises in the field and know types of karst and caves in the field as well as the challenges of using karst water.	
Module structure	VU Terrain: Karst Hydrology, Karst Morphology and Water Extraction, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.17	**Active Tectonics (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-G-1, MA-ERD-M-1, MA-ERD-A-1, MA-ERD-W-2.1: Mathematical Methods in Earth Sciences	
Module outcomes	Students know the most important methods for the identification and quantification of active deformation and understand the fundamental processes and phenomena of seismotectonics. They have an overview of recent global plate tectonics and profound knowledge of active tectonics in Europe, especially in the Mediterranean and Alpine, Pannonian and Carpathian area.	
Module structure	VU Terrain: Active Tectonics, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.18	**Microstructures in Geomaterials (elective module)**	**5 ECTS credits**
Prerequisite	none	

Module outcomes	Students are able to apply their theoretical knowledge of deformation, crystallisation and mineral reactions in rocks based on thin sections of rocks by means of polarised light microscopy to interpret microstructures with regard to deformation conditions and mechanisms of active deformation. They are also able to determine relative sequences of deformation, crystallisation and reactions. Students know advanced methods in microstructure analysis and are able to interpret data sets generated by means of scanning electron microscopy.
Module structure	VU Microstructures in Geomaterials, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-3.19	**Mineral Physics and Mineral Transformations (elective module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-M-3, MA-ERD-W-2.9: Crystallography	
Module outcomes	Students acquire the ability to describe properties in tensorial terms, to independently deduce the anisotropy of properties and to calculate the direction dependencies of physical values. They are aware of structural variations, stability criteria and the transformation of solid bodies related to changing environmental conditions. They recognise relationships between structure and properties and the atomic mechanisms of structural transformations. They are able to interpret these in mineral phases that significantly contribute to the Earth's composition.	
Module structure	VU Mineral Physics and Mineral Transformations, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.20	**Applied Crystal Structure Determination (elective module)**	**5 ECTS credits**
Prerequisite	none	
Recommended prerequisite	MA-ERD-M-3, MA-ERD-W-2.9: Crystallography MA-ERD-M-5, MA-ERD-W-2.11: Diffraction Methods	
Module outcomes	Students have basic practical skills for selecting and preparing suitable crystal samples for analysing single crystals and to independently measure X-ray diffraction intensities on a single-crystal diffractometer. They learn to use different methods for structure solution or structure refinement in practice, to interpret the results of model adjustments in a critical way and to prepare them for academic visualisations.	
Module structure	UE Applied Crystal Structure Determination, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.21	**Gemstones as Geomaterials (elective module)**	**5 ECTS credits**
Prerequisite	none	

Module outcomes	Students have fundamental knowledge of mineral and biogenic semi-precious stones and gemstones. They are able to determine these by means of simple tests in gemmology or by means of modern methods in crystal physics in a non-destructive way. Students have profound knowledge of the historical development of the discipline and of the development, extraction and treatment of semi-precious stones and gemstones. They know the most important procedures for their treatment, synthesis and imitations. Students acquire these competences through acquiring fundamental gemmology contents, completing practical exercises for identifying these stones and carrying out analyses as well as for the demonstration of devices.

Module structure	VU Gemstones as Geomaterials, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-3.22	**Nuclear Waste Repository and Radiation Damage (elective module)**	**3 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamental phenomena of radioactivity and the radioactive decay of unstable nuclides. They know which physical and chemical changes are caused by the radiation of minerals, how to quantify these changes and which effects they have on the immobilisation of nuclear waste. Students know the requirements and assessment criteria for geological nuclear waste repositories. They know which methods are used in earth sciences to select suitable host rocks and to assess the long-term stability of repositories.	
Module structure	VU Nuclear Waste Repository and Radiation Damage, 3 ECTS credits, 2 SSt. (pi)	
Proof of performance	Passing of the course (pi) (3 ECTS credits)	

MA-ERD-W-3.23	**Vertebrate Evolution (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are familiar with macroevolutionary events and the development of all important vertebrate groups. They have a broad understanding of vertebrate lines and know the fundamentals of their trait development. They are able to assess the data used (fossils, morphology, genes) and apply these to test hypotheses. Students are able to assess current changes in vertebrate diversity and formulate hypotheses for its future development.	
Module structure	VU Vertebrate Evolution, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.24	**Microorganisms and their Applications (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know important groups of eukaryotic microorganisms as well as their characteristics and are able to apply this knowledge independently to prepare and interpret sediments and soil material.	
Module structure	VU Microorganisms and their Applications, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-3.25	**Palaeobotany**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to apply the most important analytical methods in palaeobotany and classify plant fossils in geological time scales and the history of evolution. They are able to reconstruct palaeovegetations and their edaphic and palaeoclimatic conditions based on different fossil plant organs and amber. They have specialist knowledge of angiosperm vegetations in the Cenophytic.	

Module structure	VU Palaeobotany, 5 ECTS credits, 4 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-3.26	**Palaeobiological Environmental Protection and Historical Ecology (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to analyse sediments or sedimentary rocks in terms of ecology and deposition and are able to reconstruct the initial habitats and their biological communities on the basis of geohistorical data (e.g. fossils, sediment cores, geochemical data). Students are able to interpret these data and use them to restore ecosystems disturbed by humans and to protect biodiversity.	
Module structure	LP Palaeobiological Environmental Protection and Historical Ecology, 5 ECTS credits, 4 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

MA-ERD-W-4.1	**Field and Laboratory Course: Geochemistry of Bio-Mineral Interactions (elective module)**	**10 ECTS credits**
Prerequisite	none	
Module outcomes	Students recognise the traces of the interaction between organisms and their inanimate nature in the field. They know methods in the biogeochemical elucidation or processes, such as biomineralisation, weathering, soil formation and biofilm development. Students are able to apply quantitative and quantitative methods in the laboratory to assess the effects of assimilatory and dissimilatory processes as well as the reactivity of biogenic substances in environmental systems in practice.	
Module structure	EX Geochemistry of Bio-Mineral Interactions, 5 ECTS credits, 3 SSt. (pi), LP Geochemistry of Bio-Mineral Interactions, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (10 ECTS credits)	
Language	English	

MA-ERD-W-4.2	**Inorganic and Organic Pollutants in the Environment (elective module)**	**10 ECTS credits**
Prerequisite	none	
Module outcomes	Students are able to describe the behaviour of selected inorganic and organic types of pollutants in terms of environmental chemistry. They have a profound understanding of the substance-specific behaviour of relevant pollutants with regard to processes in the environment. Students know the relevant analytical methods of current trace analysis of environmental pollutants.	
Module structure	VU Inorganic Pollutants, 5 ECTS credits, 3 SSt. (pi) VU Organic Pollutants, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (10 ECTS credits)	
Language	English	

MA-ERD-W-4.3	**Soil and Groundwater Remediation (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-W-4.2: Inorganic and Organic Pollutants in the Environment	
Module outcomes	Students know modern techniques of soil remediation and groundwater remediation and are able to independently solve practice-related case studies in remediation.	
Module structure	VU Soil and Groundwater Remediation, 5 ECTS credits, 3 SSt. (pi)	

Proof of performance	Passing of the course (pi) (5 ECTS credits)
Language	English

MA-ERD-W-4.4	**Field and Laboratory Course: Groundwater and Pollutants (elective module)**	**10 ECTS credits**
Prerequisite	MA-ERD-A-4, MA-ERD-W-2.21: Groundwater Systems MA-ERD-W-4.2: Inorganic and Organic Pollutants in the Environment	
Module outcomes	Students are familiar with methods and the preparation of sampling for issues in hydrogeology and environmental chemistry and have applied these in the field. They are able to analyse selected samples with regard to environmentally relevant parameters.	
Module structure	EX Groundwater and Pollutants, 5 ECTS credits, 3 SSt. (pi) LP Groundwater and Pollutants, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (10 ECTS credits)	
Language	English	

MA-ERD-W-4.5	**Fate of Emerging Organic Pollutants (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-W-4.2: Inorganic and Organic Pollutants in the Environment	
Module outcomes	Students are familiar with the most important representatives of the group of emerging organic pollutants and have a deep understanding how they behave in the environment. They know sources, transformation and transportation processes of this group of pollutants as well as important methods for analysis and their limitations.	
Module structure	VU Fate of Emerging Organic Pollutants, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	
Language	English	

MA-ERD-W-4.6	**Environmental Interface Chemistry (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-A-5, MA-ERD-W-2.22: Biogeochemistry of Pollutants and Nutrients	
Module outcomes	Students know the influence of interface processes on the behaviour of pollutants and nutrients in the environment. They are able to describe these processes on mineral surfaces, biological surfaces, redox reactions, etc. in a quantitative way. Students know different procedures to analyse surfaces.	
Module structure	VU Environmental Interface Chemistry, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	
Language	English	

MA-ERD-W-4.7	**Methods in Environmental Chemistry and Biogeochemistry (elective module)**	**5 ECTS credits**
Prerequisite	MA-ERD-A-5, MA-ERD-W-2.22: Biogeochemistry of Pollutants and Nutrients	
Module outcomes	Students know modern analytical methods in environmental chemistry and biogeochemistry. They understand the fundamental principles of measuring techniques and methods for analysis. They know the application fields of methods, such as isotope geochemistry, synchrotron and X-ray spectroscopy as well as methods in molecular biology for the elucidation of processes and for environmental forensics.	
Module structure	VU Methods in Environmental Chemistry and Biogeochemistry, 5 ECTS credits, 3 SSt. (pi)	
Proof of performance	Passing of the course (pi) (5 ECTS credits)	

Language	English

MA-ERD-W-4.8	**Nanoparticles in the Environment (elective module)**	**5 ECTS credits**
Prerequisite	none	

Module outcomes	Students know the central processes determining the behaviour of nanoparticles in the environment. They know natural, anthropogenic and technical nanoparticles and are able to differentiate them. Students are familiar with modern methods to analyse nanoparticles and know their capabilities and limitations.
Module structure	VU Nanoparticles in the Environment, 5 ECTS credits, 3 SSt. (pi)
Proof of performance	Passing of the course (pi) (5 ECTS credits)
Language	English

MA-ERD-W-4.9	**Geomorphology, Natural Hazards and Risk Research (elective module)**	**7 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamentals and applications of geomorphology, natural hazards research and risk research. Students have profound and complementary knowledge and skills in the areas of geomorphology, natural hazards research and risk research. They are aware of the importance of the chain of effects theory, the findings in the field and laboratory results and are able to interpret these results. This way students acquire the ability to apply practical methods of mapping in the field to geomorphology, natural hazards research and risk research.	
Module structure	PR Specialist Practical Course and Mapping in the Field for Geomorphology, Natural Hazards Research and Risk Research, 3 ECTS credits, 2 SSt. (pi) VU Current Research Topics in Geomorphology, Natural Hazards Research and Risk Research, 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Passing of the courses (pi) (7 ECTS credits)	

MA-ERD-W-4.10	**Geoecology and Quaternary Research (elective module)**	**6 ECTS credits**
Prerequisite	none	
Module outcomes	Students know the fundamentals and applications of geoecology and quaternary research. They acquire profound knowledge of system-theoretical interrelations with regard to space-time questions and reflect on recent research results. They know the further development in methodology and are able to prepare geoecological questions in terms of theory and practice, thereby focussing on terrestrial geoecosystems.	
Module structure	VO Current Research Topics in Field Ecology and Quaternary Research, 3 ECTS credits, 2 SSt. (npi) PR Specialist Practical Course and Mapping in the Field for Geoecology and Quaternary Research, 3 ECTS credits, 2 SSt. (pi)	
Proof of performance	Passing of the courses (npi, pi) (6 ECTS credits)	

MA-ERD-W-4.11	**Applied Geophysics (elective module)**	**5 ECTS credits**
Prerequisite	none	
Module outcomes	Students know important methods in applied geophysics and environmental geophysics. They acquire further knowledge of methods in applied geophysics through a practical course for taking measurements in the field.	
Module structure	VU Terrain: Applied Geophysics, 5 ECTS credits, 3 SSt. (pi)	

Proof of performance	Passing of the course (pi) (5 ECTS credits)

MA-ERD-W-4.12	**Introduction to Environmental Chemistry (elective module)**	**15 ECTS credits**
Prerequisite	none	

Module outcomes	Students have profound knowledge of environmental and geochemical processes and mechanisms that play a key role in environmental systems. They know methods of analytical environmental chemistry.
Module structure	VU Introduction to Environmental Chemistry, 15 ECTS credits, 8 SSt. (pi)
Proof of performance	Passing of the courses (pi) (15 ECTS credits)
Language	English

MA-ERD-W-4.13	**Individual Research Project in Environmental Sciences (elective module)**	**10 ECTS credits**
Prerequisite	MA-ERD-A-4, MA-ERD-W-2.21: Groundwater Systems MA-ERD-A-5, MA-ERD-W-2.22: Biogeochemistry of Pollutants and Nutrients	
Module outcomes	Students are able to plan and implement a small research project in the context of current research that prepares them for their master's thesis and includes all necessary steps. Students conduct literature analysis, formulate testable hypotheses, apply analytical and statistical methods to address new issues, structure the experimental approaches and laboratory work, present and interpret results and write a report in the form of a short publication.	
Module structure	UE Individual Research Project, 10 ECTS credits, 6 SSt. (pi)	
Proof of performance	Passing of the course (pi) (10 ECTS credits)	
Language	English	

§ 6 Master's thesis

(1) The master's thesis serves to demonstrate the student's ability to achieve adequate standards of content and methodology when independently addressing academic topics. The assignment for the master's thesis must be so chosen that the participant can reasonably be expected to complete it within six months.

(2) The topic of the master's thesis must be taken from one of the compulsory modules in the specialisation. If a different topic is selected or if there is uncertainty regarding allocation of the selected topic, the competent body responsible for study matters should decide on whether or not it is admissible.

(3) The master's thesis comprises 27 ECTS credits.

§ 7 Master's examination

(1) To be admitted to a master's examination the student must have successfully passed all required modules and examinations and the master's thesis must have been positively assessed.

(2) The master's examination is a public defence and an examination on the academic disciplines related to the master's thesis as well as an examination covering 2 subjects. Students have to choose two subjects for the examination from the following list: Regional geology, historical geology, tectonics, sedimentology, hydrogeology, crystallography, mineralogy, petrology, geochemistry, palaeontology - palaeobiology, geobiology, environmental chemistry and applied geosciences. Grading will be conducted as stipulated in the Statutes of the University of Vienna.

(3) The master's examination comprises 3 ECTS credits, including 1 ECTS credit for the public defence and the examination on the academic disciplines related to the master's thesis and 1 ECTS credit for the examination in both subjects.

§ 8 Mobility during the master's programme

Students enrolled on the master's programme in Earth Sciences are encouraged to make use of the

mobility schemes offered by the University of Vienna, taking into account the relevant application deadlines.

The competent body responsible for study matters is responsible for the recognition of academic achievements completed abroad.

§ 9 Course classification

(1) All courses with non-continuous assessment (npi) have to be offered as one of the following types of courses:

Lectures (*Vorlesungen*, VO) are courses with non-continuous assessment of student performance and aim at giving an introduction to facts, methods and doctrines in different fields of earth sciences. Moreover, existing relevant knowledge and skills are consolidated. They also address the practical relevance of the subject and teach students how to use and deal with diverse information media and methods. Lectures take the form of oral presentations. Students have to achieve the learning outcomes specified for a lecture partially also beyond classes through self-study. The course is completed with an oral or written examination.

(2) All courses with continuous assessment (pi) are offered as one of the following types of courses:

Lectures with exercises *(Vorlesung verbunden mit Übung, VU)* are courses with continuous assessment (pi) that contain lecture and exercise parts. The exercise parts are held parallel to the lecture and primarily address the practical relevance and application of the contents presented in the lecture. They thus serve to improve understanding and competences. Lectures with exercises whose title include the designation 'terrain' encompass lecture and exercise parts in the field (possibly for several days). The exercises in the field accompanying the lecture part primarily address the practical relevance and application of the contents presented in the lecture. They thus serve to improve understanding and competences.

Exercises (*Übung, UE*) serve the purpose of practising skills that are necessary for understanding the contents taught. This includes concrete tasks and problems in practical courses in the laboratory or field. During exercises, students work on tasks as well as create or use application programs. Students are supervised in small groups. Lecturers are mainly tasked with guiding and monitoring students' work.

Practical courses (*Praktika, PR*) complement lectures, exercises and seminars and aim at consolidating practical skills and knowledge. In practical courses, students work on small projects in the laboratory and/or the field. The tasks are carried out under supervision over a longer period, or even over several consecutive days. Usually, participants have to submit several written reports that conform to the requirements of a full-fledged research paper regarding form and content. Practical courses may also be held in periods when there are no classes.

Practical laboratory courses *(Laborpraktika, LP)* allow students to practice the acquired knowledge and skills in practical assignments and by carrying out experiments or analyses. The activities are guided and supervised by teaching staff, e.g. in the laboratory or in the field. Practical laboratory courses may also be held in periods when there are no classes.

Seminars *(Seminare, SE)* serve to induce academic debate. In seminars, students should acquire the skill to gain detailed knowledge of a problem in earth sciences through self-study of specialist literature and data sources, to present these in an intelligible presentation and to discuss these in a critical way.

Field trips *(Exkursionen, EX)* allow students to acquire and deepen subject-specific knowledge in the field. Usually, participants have to submit a written interim and/or final report. Field trips may also be held in periods when there are no classes.

§ 10 Courses with a limited number of participants and registration procedures

(1) The following general limits on the number of students apply in the following courses:

VU: 20 participants
UE 20 participants
PR: 20 participants
LP: 20 participants
SE 20 participants
EX 20 participants

Deviating from this rule, the number of participants in the modules MA-ERD-W-3.1, MA-ERD-W-3.2, MA-ERD-W-3.3, MA-ERD-W-3.4, MA-ERD-W-3.5 and MA-ERD-W-4.4 is 10 persons and in the module MA-ERD-W-4.1 8 persons.

Courses from other curricula that students take are subject to the specified limited number of participants in the relevant curriculum.

(2) Modalities concerning the registration for courses and examinations as well as the allocation of places in courses are governed by the stipulations in the Statutes.

§ 11 Examination regulations

(1) Proof of performance in courses
The lecturer of a course is responsible for making the necessary announcements according to the stipulations in the Statutes.

(2) Examination content
The examination content relevant to preparing and holding examinations must be in line with the required number of ECTS credits. This also applies to module examinations.

(3) Examination procedure
The examination procedure is subject to the stipulations in the Statutes of the University of Vienna.

(4) No double recognition and no dual use
Courses taken and examinations passed in the three-year bachelor's programme, which constitute entry requirements for the master's programme, cannot be recognised again in the master's programme. Courses taken and examinations passed from another compulsory or elective module of the degree programme cannot be recognised within another module within the same degree programme. This also applies to recognition procedures.

(5) Examination results must be allocated to the relevant module by the stated ECTS figure and must not be allocated to different proofs of performance.

§ 12 Entry into force

This Curriculum will enter into force upon announcement in the University Gazette of the University of Vienna as of 1 October 2020.

§ 13 Transitional provisions

(1) This Curriculum applies to all students who commence their degree programme as of the winter semester of 2020/2021.

(2) If, at a later stage of the degree programme, courses are no longer offered which were compulsory under the original curricula, the competent body responsible for study matters decides ex officio (equivalence regulation) or at the request of the student which courses and examinations have to be completed instead.

(3) Students who have started the master's programme in Earth Sciences before this date may voluntarily accept the provisions of this Curriculum by simple confirmation.

(4) Students who started the master's programme in Earth Science which entered into force prior to this Curriculum (University Gazette of 30 June 2014, 40th edition, no. 248) are entitled to complete their degree programme by 30 November 2022.

(5) The competent body responsible for study matters specified in the organisational regulations is entitled to determine in general or on a case-by-case basis which of the courses taken and examinations passed will be recognised for this Curriculum.

Appendix

Recommended path through the master's programme:

(a) Specialisation in Geology (G)

Semester	Module	Course	ECTS credits	Total ECTS credits
1.	MA-ERD-1	Current Advances in Earth Sciences	4	
	MA-ERD-1	Instrumental Analysis in Earth Sciences	5	
	MA-ERD-G-1	Mathematical Methods in Earth Sciences	5	
	MA-ERD-G-2	Thermodynamics of Geomaterials	5	
	MA-ERD-G-3	Sedimentology and Stratigraphy	5	
	MA-ERD-W	Elective subject	5	
				29
2.	MA-ERD-2	Master's Seminar 1	3	
	MA-ERD-G-4	Lithospheric Dynamics	5	
	MA-ERD-G-5	Geochronology	5	
	MA-ERD-G-6	Quantitative Structural Geology and Tectonics	5	
	MA-ERD-G-7	Advanced Geological Mapping	5	
	MA-ERD-W	Elective subject	10	
				33
3.	MA-ERD-2	Master's Seminar 2	3	
	MA-ERD-W	Elective subject	25	
				28

4.		Master's Thesis	27	

		Master's Examination	3	
				30
Total				**120**

(b) Specialisation in Mineralogy and Geomaterials (M)

Semester	**Module**	**Course**	**ECTS credits**	**Total ECTS credits**
1.	MA-ERD-1	Current Advances in Earth Sciences	4	
	MA-ERD-1	Instrumental Analysis in Earth Sciences	5	
	MA-ERD-M-1	Mathematical Methods in Earth Sciences	5	
	MA-ERD-M-2	Thermodynamics of Geomaterials	5	
	MA-ERD-M-3	Crystallography	5	
	MA-ERD-M-4	Structural Chemistry and Real Structure of Geomaterials	5	
				29
2.	MA-ERD-2	Master's Seminar 1	3	
	MA-ERD-M-5	Diffraction Methods	5	
	MA-ERD-M-6	Mineral Spectroscopy – Electronic Spectroscopy	5	
	MA-ERD-W	Elective subject	20	
				33
3.	MA-ERD-2	Master's Seminar 2	3	
	MA-ERD-M-7	Mineral Spectroscopy - Vibrational Spectroscopy	5	
	MA-ERD-W	Elective subject	20	
				28
4.		Master's Thesis	27	
		Master's Examination	3	
				30
Total				**120**

(c) Specialisation in Palaeobiology and Geobiology (P)

Semester	Module	Course	ECTS credits	Total ECTS credits
1.	MA-ERD-1	Current Advances in Earth Sciences	4	
	MA-ERD-1	Instrumental Analysis in Earth Sciences	5	
	MA-ERD-P-1	Statistics in Earth Sciences	5	
	MA-ERD-P-2	Sedimentology and Stratigraphy	5	
	MA-ERD-P-3	Functional Morphology	5	
	MA-ERD-W	Elective subject	5	
				29
2.	MA-ERD-2	Master's Seminar 1	3	
	MA-ERD-P-4	Actuopalaeontology	5	
	MA-ERD-P-5	Evolution and Diversity Research	5	
	MA-ERD-P-6	Climate Change through Time	5	
	MA-ERD-W	Elective subject	15	
				33
3.	MA-ERD-2	Master's Seminar 2	3	
	MA-ERD-P-7	Geobiology	5	
	MA-ERD-W	Elective subject	20	
				28
4.		Master's Thesis	27	
		Master's Examination	3	
				30
Total				**120**

(d) Specialisation in Applied Geosciences (A)

Semester	Module	Course	ECTS credits	Total ECTS credits

1.	MA-ERD-1	Current Advances in Earth Sciences	4	
	MA-ERD-1	Instrumental Analysis in Earth Sciences	5	
	MA-ERD-A-1	Mathematical Methods in Earth Sciences	5	
	MA-ERD-A-2	Applied Tectonics and Structural Geology	5	
	MA-ERD-A-3	Geotechnical and Applied Mineralogy	5	
	MA-ERD-W	Elective subject	5	
				29
2.	MA-ERD-2	Master's Seminar 1	3	
	MA-ERD-A-4	Groundwater Systems	10	
	MA-ERD-A-5	Biogeochemistry of Pollutants and Nutrients	10	
	MA-ERD-W	Elective subject	10	
				33
3.	MA-ERD-2	Master's Seminar 2	3	
	MA-ERD-W	Elective subject	25	
				28
4.		Master's Thesis	27	
		Master's Examination	3	
				30
Total				**120**

[List of modules/courses by semester, see compendium, chapter 5]

Due to the prerequisites specified, it is recommended to complete the compulsory modules in the core subject (MA-ERD-1, MA-ERD-2) and the compulsory modules in the selected specialisation within the first three semesters.

German and English version of the module titles:

German	**English**
Pflichtmodule	**Compulsory modules**
Aktuelle Fortschritte und instrumentelle Analytik in den Erdwissenschaften	Current Advances and Instrumental Analysis in Earth Sciences
Master-Seminar	Master's Seminar

Alternative Pflichtmodule	**Alternative compulsory modules**
Mathematische Methoden in den Erdwissenschaften	Mathematical Methods in Earth Sciences
Thermodynamik von Geomaterialien	Thermodynamics of Geomaterials
Sedimentologie und Stratigraphie	Sedimentology and Stratigraphy
Lithosphärendynamik	Lithospheric Dynamics
Geochronologie	Geochronology
Quantitative Strukturgeologie und Tektonik	Quantitative Structural Geology and Tectonics
Geologische Kartierung für Fortgeschrittene	Advanced Geological Mapping
Kristallographie	Crystallography
Strukturchemie und Realbau von Geomaterialien	Structural Chemistry and Real Structure of Geomaterials
Diffraktionsmethoden	Diffraction Methods
Mineralspektroskopie – Elektronische Spektroskopie	Mineral Spectroscopy – Electronic Spectroscopy
Mineralspektroskopie – Schwingungsspektroskopie	Mineral Spectroscopy – Vibrational Spectroscopy
Statistik in den Erdwissenschaften	Statistics in Earth Sciences
Funktionsmorphologie	Functional Morphology
Aktuopaläontologie	Actuopalaeontology
Evolutions- und Diversitätsforschung	Evolution and Diversity Research
Climate Change Through Time	Climate Change Through Time
Geobiologie	Geobiology
Angewandte Tektonik und Strukturgeologie	Applied Tectonics and Structural Geology
Geotechnisch angewandte Mineralogie	Geotechnical and Applied Mineralogy
Groundwater Systems	Groundwater Systems
Biogeochemistry of Pollutants and Nutrients	Biogeochemistry of Pollutants and Nutrients
Wahlmodule	**Elective modules**
Wahlmodul Individuelle Vertiefung	*Elective module:* Individual Specialisation
Wahlmodul Individuelles Forschungsprojekt Mineralogie, Geomaterialien und Angewandte Erdwissenschaften	*Elective module:* Individual Research Project in Mineralogy, Geomaterials and Applied Earth Sciences
Wahlmodul Individuelles Forschungsprojekt Geologie, Paläobiologie und Geobiologie	*Elective module:* Individual Research Project in Geology, Palaeobiology and Geobiology
Wahlmodul Erdwissenschaftliche Exkursionen I	*Elective module:* Earth Science Excursions I
Wahlmodul Erdwissenschaftliche Exkursionen II	*Elective module:* Earth Science Excursions II
Wahlmodul Elementanalytik mit der Elektronenstrahlmikrosonde	*Elective module:* Elemental Analysis with the Electron Probe Microanalyser
Wahlmodul Rasterelektronenmikroskopie	*Elective module:* Scanning Electron Microscopy
Wahlmodul Feldemissionsrasterelektronenmikroskopie und Ionenstrahlanwendungen	*Elective module:* Field Emission Scanning Electron Microscopy and Ion Beam Applications
Wahlmodul Phasenanalyse mit Pulverdiffraktometrie	*Elective module:* Phase Analysis with Powder Diffractometry
Wahlmodul Experimentelle Mineralogie und Petrologie	*Elective module:* Experimental Mineralogy und Petrology
Wahlmodul Kinetik von geologischen Materialien	*Elective module:* Kinetics of Geological Materials
Wahlmodul Magmatische Prozesse und Krustenbildung	*Elective module:* Magmatic Processes and Crust Formation
Wahlmodul Lagerstättenlehre	*Elective module:* Mineral Deposits and Economic Geology
Wahlmodul Auflichtmikroskopie von Erzlagerstätten	*Elective module:* Reflected Light Microscopy of Ore Deposits

Wahlmodul Planetare Geologie	*Elective module:* Planetary Geology
Wahlmodul Regionale Geologie	*Elective module:* Regional Geology
Wahlmodul Digitale Geländemethoden	*Elective module:* Digital Field Methods
Wahlmodul Glaziale Sedimentologie und Quartärgeologie	*Elective module:* Glacial Sedimentology and Quaternary Geology
Wahlmodul Advanced Stratigraphy and Carbonate Sedimentology	*Elective module:* Advanced Stratigraphy and Carbonate Sedimentology
Wahlmodul Angewandte Erdölgeologie und Seismikinterpretation	*Elective module:* Applied Petroleum Geology and Seismic Interpretation
Wahlmodul Karsthydrologie, Karstmorphologie und Wassergewinnung	*Elective module:* Karst Hydrology, Karst Morphology and Water Extraction
Wahlmodul Aktive Tektonik	*Elective module:* Active Tectonics
Wahlmodul Mikrostrukturen in Geomaterialien	*Elective module:* Microstructures in Geomaterials
Wahlmodul Mineralphysik und -transformationen	*Elective module:* Mineral Physics and Mineral Transformations
Wahlmodul Angewandte Kristallstrukturbestimmung	*Elective module:* Applied Crystal Structure Determination
Wahlmodul Edelsteine als Geomaterialien	*Elective module:* Gemstones as Geomaterials
Wahlmodul Nuclear Waste Repository and Radiation Damage	*Elective module:* Nuclear Waste Repository and Radiation Damage
Wahlmodul Evolution der Wirbeltiere	*Elective module:* Vertebrate Evolution
Wahlmodul Mikroorganismen und ihre Anwendungen	*Elective module:* Microorganisms and their Applications
Wahlmodul Paläobotanik	*Elective module:* Palaeobotany
Wahlmodul Paläobiologischer Umweltschutz und Historische Ökologie	*Elective module:* Palaeobiological Environmental Protection and Historical Ecology
Wahlmodul Field and Laboratory Course "Geochemistry of Bio-Mineral Interactions"	*Elective module:* Geochemistry of Bio-Mineral Interactions Field and Laboratory Course
Wahlmodul Inorganic and Organic Pollutants in the Environment	*Elective module:* Inorganic and Organic Pollutants in the Environment
Wahlmodul Soil and Groundwater Remediation	*Elective module:* Soil and Groundwater Remediation
Wahlmodul Field and Laboratory Course "Groundwater and Pollutants"	*Elective module:* Groundwater and Pollutants Field and Laboratory Course
Wahlmodul Fate of Emerging Organic Pollutants	*Elective module:* Fate of Emerging Organic Pollutants
Wahlmodul Environmental Interface Chemistry	*Elective module:* Environmental Interface Chemistry
Wahlmodul Methods in Environmental Chemistry and Biogeochemistry	*Elective module:* Methods in Environmental Chemistry and Biogeochemistry
Wahlmodul Nanoparticles in the Environment	*Elective module:* Nanoparticles in the Environment
Wahlmodul Geomorphologie, Naturgefahren und Risikoforschung	*Elective module:* Geomorphology, Natural Hazards and Risk Research
Wahlmodul Geoökologie und Quartärforschung	*Elective module:* Geoecology and Quaternary Research
Wahlmodul Angewandte Geophysik	*Elective module:* Applied Geophysics
Wahlmodul Introduction to Environmental Chemistry	*Elective module:* Introduction to Environmental Chemistry
Wahlmodul Individual Research Project Environmental Sciences	*Elective module:* Individual Research Project in Environmental Sciences