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Curriculum for the
Master's Programme in Earth Sciences
at the Faculty of Geo and Atmospheric Sciences of the University of Innsbruck

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§ 1 Allocation of the study programme

According to §54 par. 1 Universities Act 2002, the Master's Programme in Earth Sciences is allocated to the group of natural science study programmes.

§ 2 Qualification profile

The Master's Programme in Earth Sciences is aimed at graduates of the Bachelor's Programme in Earth Sciences and at Austrian and international students with a comparable Bachelor's degree. A high-quality study of geological core competencies is offered as well as the opportunity to specialise in four different subject areas that reflect current developments in the core areas of earth sciences in an international context. In each chosen specialisation, the students learn to conduct scientific research at a high level, to proceed in a goal- and result-oriented manner and to work on a project-related basis in the course of their Master's Thesis. The occupational fields for graduates of the Master's Programme in Earth Sciences are diverse and range from civil engineering (geotechnical engineering and tunnel construction), the environmental and energy sector (e.g. geo-energies), public services (e.g. regional geology, natural hazards), raw material exploration, the materials and chemical industries to education and scientific careers.

(1) Specialisation "Alpine Geology"

The specialisation in "Alpine Geology" deals with the geodynamic processes of mountain formation in general, with particular attention to the regional geology of the Alps. Innsbruck's location in the heart of the Alps offers unique prerequisites for this. Correspondingly, a well-founded training in modern field methods is a focus of this specialisation. Another focus is on the interaction between large-scale (geodynamics / plate tectonics) and local processes (structural geology / rock structure / endogenous natural hazards). This combination opens up a broad field of activity for the graduates in the applied geoscientific field, the raw materials and energy industries, but also with various authorities, consulting companies and in research.

(2) Specialisation "Quaternary Geology and Applied Geology"

The specialisation in "Quaternary Geology and Applied Geology" offers an intensive examination of two highly topical geological topics. On the one hand, the focus is on the recent geological past, the Quaternary (the last 2.6 million years). The students gain deep insights into processes that have shaped landscapes such as those in the Alps. They also learn to reconstruct environmental and climate changes from sediments and thus have in-depth knowledge of natural climate change. On the other hand, they receive training in applied topics from engineering geology and geotechnics, e.g. relating to exogenous natural hazards. Through a combination of terrain and laboratory-related methods, the students are introduced to current issues for researching both topical areas. Graduates can assume the position of specialists and executives in various geo-relevant sectors in the economy as well as in the public service field.

(3) Specialisation "Petrology and Geochemistry"

The specialisation in "Petrology and Geochemistry" deals with basic scientific questions of mineral and rock-forming processes in a geodynamic context. The students get a deeper insight into theoretical concepts of the physical-chemical fundamentals and acquire special knowledge in selected modern methods of high-resolution chemical microanalysis and high-pressure, high-temperature synthesis processes in the course of the experimental simulation of mineralogical / petrological processes in the earth's crust and mantle. They will be introduced to current research questions on igneous and metamorphic rocks and will be able to critically evaluate research results. Graduates have knowledge and skills of state-of-the-art instrumental methods and their possible applications, which enable them to pursue a doctoral study programme in various research-related directions as well as to meet the requirement profile of highly qualified personnel in relevant industrial professions. Typical occupational fields are universities and research institutions, process and analysis-oriented branches of industry (e.g. building materials, refractories or chemical industry), but also authorities and museums.

(4) Specialisation “Materials and Raw Materials”

The specialisation in "Materials and Raw Materials" combines basic research with applied research on geomaterials and inorganic-mineral materials that are relevant for modern industrial societies or that have played an important role in the course of cultural history. The students are presented with a wide range of topics from the development of the raw material in the deposit to the processing of the material and the product. It is also taught how new materials can be tailored to a specified requirement profile taking into account aspects of sustainability (recycling, environmental compatibility). Various practical, analytical, chemical and crystallographic processes and techniques for characterising and evaluating the materials round off the content. The knowledge imparted opens up job opportunities for students in industrial or university research and development. Possible fields of activity include a broad spectrum, ranging from the sector of binding agents, the refractory and glass industry, high-tech ceramics, raw material evaluation, deposit research, archaeometry, circular economy to monument preservation.

§ 3 Scope and duration

The Master’s Programme in Earth Sciences covers 120 ECTS-Credits. This corresponds to a duration of the study programme of four semesters. One ECTS-Credit corresponds to workload of 25 hours.

§ 4 Admission

(1) Admission to the Master's Programme in Earth Sciences requires a relevant Bachelor's degree awarded by a university or a university of applied sciences ("Fachhochschule") or a relevant degree acquired at a recognised post-secondary educational institution home or abroad.

(2) In any case, the Bachelor’s Programme in Earth Sciences at the University of Innsbruck is a relevant study programme. The rectorate decides on study programmes in question or on the equivalence of a study programme passed at a post-secondary educational institution home or abroad for the admission to the master’s programme based on the regulations of the Universities Act 2002.

(3) In the event that equivalence has been established in principle but with certain qualifications missing for full equivalence, supplemental examinations may be required by the rectorate. These examinations must be passed during the master's programme.

§ 5 Type of courses and maximum number of students per course

(1) Types of courses without continuous performance assessment:

Lectures (VO) are courses held in lecture format. They introduce the research areas, methods and schools of thought for a given subject. Maximum number of participants: 200

(2) Courses with continuous performance assessment:

1. **Practical courses** (UE) focus on the practical treatment of concrete scientific tasks within an area. Maximum number of participants: 20
2. **Seminars** (SE) provide in-depth treatment of scientific topics through students' presentations and discussion thereof. Maximum number of participants: 25
3. **Lectures with integrated practical parts (**VU) focus on the practical treatment of concrete scientific tasks that are discussed during the lecture parts of the course. Maximum number of participants: 30
4. **Practical training courses** (PR) provide practical experience with concrete scientific tasks, complementing occupational and academic training. Maximum number of participants: 20
5. **Excursions (**EX) take place outside the university and serve to provide practical experiences outside the course and deepen course contents. Maximum number of participants: 20 (in difficult terrain: 12)
6. **Excursion with integrated practical elements** (EU): conducted outside the premises of the university, serve to demonstrate and deepen course contents through practical experience with concrete scientific tasks. Maximum number of participants: 20 (in difficult terrain: 12)

§ 6 Allocation of places in courses with a limited number of participants

In courses with a limited number of participants, course places are allocated as follows:

1. Students for whom the study duration would be extended due to the postponement are to be given priority.
2. If criterion no. 1 does not suffice for regulating the admission, then first, students for whom the course is part of a compulsory module are to be given priority, and second, students for whom the course is part of an elective module.
3. If the criteria in no. 1 and 2 do not suffice for regulating the admission, then the available places are raffled.

§ 7 Compulsory and elective modules

(1) The following compulsory modules covering 15 ECTS-Credits must be passed:

1.	**Compulsory Module: Master – Introductory Module**	**h**	**ECTS-Credits**
a.	**EU Introductory Seminar** Development of an earth sciences project idea within a multi-day introductory event with excursion, sampling and discussion of methods	2	3
b.	**PR Project Work** Independent implementation of the work steps in small groups in the laboratories of the two geological institutes	2	6
c.	**SE Project Presentation** The results and interpretations of the group projects are presented.	1	1
	Total	**5**	**10**
	Learning Outcomes: The students have sufficient knowledge to independently design, plan and carry out a scientific project in small groups and are familiar with selected geological methods.		
	Prerequisites: none		

2.	**Compulsory Module: Preparation of the Master's Thesis**	**h**	**ECTS-Credits**
	Concept for the Master's Thesis Agreement on the topic, scope and form of the Master's Thesis on the basis of a brief description of the content (synopsis) as well as agreement on the work processes and the course of study; planning a corresponding time frame for the implementation of the Master's Thesis	-	2.5
	Total	**-**	**2.5**
	Learning Outcomes: Having successfully passed this module, the students are able to write a brief description of the content of the planned Master's Thesis (synopsis) and to outline a schedule.		
	Prerequisites: none		

3.	Compulsory Module: Master's Thesis Defence	h	ECTS-Credits
	Master's Thesis Defence Final oral defence of the Master's Thesis in front of an examination board	-	2.5
	Total	**-**	**2.5**
	Learning Outcomes: The students are able to reflect on the results of the Master's Thesis in the overall context of the master's programme and can present them in the form of a lecture and defend them in a discussion.		
	Prerequisites: none		

(2) Elective modules covering altogether 80 ECTS-Credits must be passed as follows.

1. A specialisation (30 ECTS-Credits) and further modules covering 50 ECTS-Credits can be selected from the elective modules. Possible specialisations are
   a. Alpine Geology (elective modules 1 to 6)
   b. Quaternary Geology and Applied Geology (elective modules 7 to 12)
   c. Petrology and Geochemistry (elective modules 13 to 18)
   d. Materials and Raw Materials (elective modules 13 and 19 to 22
2. If no specialisation is selected acc. to §7 par. 2 no. 1, elective modules covering altogether 80 ECTS-Credits must be selected from the elective modules.
3. Instead of elective module 35 "Interdisciplinary Skills" and the "Individual Choice of Specialisation", a Minor (Complementary Subject Area) for master's programme (30 ECTS-Credits) may be passed, providing the availability of places. Minors are fixed modules from other disciplines covering 30 ECTS-Credits. They have been published in the University of Innsbruck Bulletin.

1.	Elective Module: Integrated Stratigraphy of Sedimentary Systems	h	ECTS-Credits
a.	**VU Sedimentary Geology** In the course, the basic skills for the interpretation of sediments and sedimentary rocks with regard to deposition processes and deposition environments are imparted.	1	2
b.	**VU Sequence Stratigraphy** The course deals with the principles of sequence stratigraphy.	1	1.5
c.	**EU Sedimentary Geology and Sequence Stratigraphy** Within the scope of the excursion, the field-related application of sedimentological and stratigraphic principles of interpretation and the formulation of working hypotheses for further investigations (e.g. with laboratory methods) should be practiced.	1	1.5
	Total	**3**	**5**
	Learning Outcomes: The students are able to predict the facies dynamics and stratigraphic development of deposit systems and to develop models about their behaviour in relation to external influences (e.g. climate, tectonics).		
	Prerequisites: none		

2.	Elective Module: Basins and Orogens	h	ECTS-Credits
a.	**VO Basins and Orogens** The course gives an overview of the different types of sedimentary basins and their general stratigraphic development as well as different types of mountain development and the resulting mountain structure.	2	3
b.	**SE Basins and Orogens** The seminar offers an advanced study of the content of the lecture. The participants apply the models from the lecture in a new context and present their ideas.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students have the ability to use the global concept of plate tectonics to recognise decisive differences in the development of different sedimentary basins and mountain types and to assess their importance for stratigraphic and tectonic development.		
	Prerequisites: none		

3.	Elective Module: Crystalline Geology	h	ECTS-Credits
a.	**VO Selected Topics in Crystalline Geology** This course provides an integrative understanding of the formation and development of igneous and metamorphic rocks in their respective special plate tectonic context.	2	3
b.	**EU Excursion - Crystalline Geology** This excursion offers students the opportunity to check and improve their theoretical knowledge of crystalline geology by studying model terrain examples.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students know which data are required for genesis models of igneous and metamorphic rocks and are able to apply them in the geodynamic context of an orogen such as the Alps. They can assess the quality of structural, mineralogical-petrological and geochemical data and concepts.		
	Prerequisites: none		

4.	Elective Module: Geodynamics	h	ECTS-Credits
a.	**VO Plate Tectonics** The course deals with the processes that shape the dynamic earth in the light of basic concepts and current research results.	2	3
b.	**VU Physical Geodynamics** The course deals with plate tectonic processes on a physical basis on a global scale.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students know the driving forces and models in plate tectonics and can apply these qualitatively and partially quantitatively.		
	Prerequisites: none		

5.	Elective Module: Regional Geology	h	ECTS-Credits
a.	**VO Alpine Geology** The course deals with the regional geology of alpine mountains as reflected in current research.	2	3
b.	**EU Excursion – Alpine Geology** The excursion deepens and expands the theoretical knowledge from the lecture on alpine geology.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students know the geology of mountains or regions and can recognise and describe the underlying geodynamic processes.		
	Prerequisites: none		

6.	Elective Module: Structural Geology	h	ECTS-Credits
a.	**VO Structural Geology and Microstructure** The course deals with the methods of analysing mesoscopic rock deformation as well as the deformation behaviour of rock-forming minerals, their microstructure and texture.	1	2
b.	**UE Structural Geology and Microstructure** Application of the methods for the analysis of mesoscopic rock deformation as well as study of the microstructure and texture and the deformation behaviour of rock-forming minerals	2	3
	Total	**3**	**5**
	Learning Outcomes: The students know methods for analysing mesostructural to microstructural rock deformation and can apply them to specific examples. The students understand the relevance of the results and can place them in an overall context.		
	Prerequisites: none		

7.	Elective Module: Quaternary Geology	h	ECTS-Credits
a.	**VO Quaternary Terrain Course (Theory)** The lecture deals with the principles of quaternary geology in the alpine region.	1	2
b.	**UE Quaternary Terrain Course (Practice)** In the practical terrain course, practical quaternary geological work with a focus on mapping and profiling is imparted.	2	3
	Total	**3**	**5**
	Learning Outcomes: The students can correctly recognise and map quaternary sediments and terrain forms and assign them to specific processes.		
	Prerequisites: none		

8.	Elective Module: Paleoclimatology	h	ECTS-Credits
a.	**VO Fundamentals of Paleoclimatology** This course deals with the evidence for quaternary climate changes using various marine and terrestrial climate archives and discusses the questions of causes and interactions.	2	3
b.	**SE Case Studies in Paleoclimatology** In this course, the students work on current research results using publications and take part in a discussion.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students have a profound knowledge of the global quaternary climate changes and the driving processes on which they are based.		
	Prerequisites: none		

9.	Elective Module: Isotope Geochemistry and Geochronology	h	ECTS-Credits
a.	**VO Concepts of Isotope Geochemistry and Geochronology** In this course, concepts and working techniques of isotope geochemistry with a focus on radiogenic isotopes and their importance for geochronological issues are imparted.	1	1.5
b.	**VO Concepts of the Geochemistry of Stable Isotopes** In this course, concepts and working techniques of isotope geochemistry with a focus on stable isotopes are imparted.	1	1.5
c.	**VU Selected Topics of Isotope Geochemistry and Geochronology** This course offers case studies and practical exercises on stable isotopes and methods of geochronology (e.g. luminescence dating, fissure trace analysis).	1	2
	Total	**3**	**5**
	Learning Outcomes: The students master the basics of isotope geochemistry and geochronology and can apply the methods and concepts of the geochemistry of stable and radiogenic isotopes to geological issues.		
	Prerequisites: none		

10.	Elective Module: Core Analysis and Applied Geology	h	ECTS-Credits
a.	**UE Core Analysis** Using various methods for drill core analysis (drill core recording and scanning) and data evaluation (statistics, correlation, data integration), the students develop the skills to independently record, display, analyse and correlate drill core data in the context of geological issues.	2	3.5
b.	**VU Selected Topics in Applied Geology** This course uses field, laboratory and / or data analysis exercises using case studies from practice to provide insights into current issues, methods and findings as well as basic skills for carrying out applied geological projects.	1	1.5
	Total	**3**	**5**

	Learning Outcomes: The students are able to deal competently with drill core data of various kinds and to apply these in combination with data from further exploration methods of applied geology to fundamentally scientific and applied questions.
	Prerequisites: none

11.	Elective Module: Engineering Geology and Geotechnics	h	ECTS-Credits
a.	**VU Engineering Geology** In this course, selected aspects of engineering geology are taught.	1	1.5
b.	**VU Introduction to Soil Mechanics** In this course, the basic principles of the technological and mechanical properties of the soil are taught.	1	1.5
c.	**VU Introduction to Rock Mechanics** This course deals with the basic principles of the technological and mechanical properties of rock.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students have knowledge of practical geology and can solve engineering geological and geotechnical problems.		
	Prerequisites: none		

12.	Elective Module: Applied Geophysics	h	ECTS-Credits
a.	**VU Applied Geophysics** Introduction to the methods of applied geophysics (refraction seismics, reflection seismics, gravimetry, radiometry, geothermal energy, geoelectrics, geomagnetics, electromagnetic induction) with an introduction to geophysical basics and application examples	2	3.5
b.	**EU Geophysical Terrain Exercise** This course includes the application of selected procedures in the field, including data processing, interpretation and presentation.	1	1,5
	Total	**3**	**5**
	Learning Outcomes: The students are able to apply geophysical methods to geological questions, to recognise specific advantages and limitations of the presented procedures, to solve simple calculations and interpretation tasks as well analyse geophysical data and models in technical reports and scientific publications.		
	Prerequisites: none		

13.	Elective Module: Analysis Methods of Mineralogy and Petrography	h	ECTS-Credits
a.	**VU Microprobe and Scanning Electron Microscopy** In this course, the basics of the microprobe and the scanning electron microscopes (e.g. wavelength and energy dispersive analysis) are taught. A main focus of the course is on the practical use of the devices.	1	2

b.	**VU Thermal Analysis** In this course, the theoretical basics and measurement principles of thermoanalytical processes (differential thermal analysis, differential scanning calorimetry, thermogravimetry, thermomicroscopy) are taught and supplemented by practical measurements and data evaluation.	1	1
c.	**VU X-ray Fluorescence Analysis** The course conveys the theoretical basics of X-ray fluorescence and includes practical aspects such as sample preparation, standardisation and correction procedures and quantitative analysis using XRF and μRFA.	1	1
d.	**VO Overview of Further Methods**	1	1
	The students get to know selected complementary methods for the characterisation of mineral samples from the fields of spectroscopy, calorimetry, electron microscopy, etc.		
	Total	**4**	**5**
	Learning Outcomes: The students have an overview of a pool of different analysis techniques as well as their application potential in answering questions from the field of mineralogy and petrography.		
	Prerequisites: none		

14.	**Elective Module: Systematic Mineralogy**	**h**	**ECTS-Credits**
a.	**VO Silicates** In this lecture, the chemical compositions, crystal structures and properties of the most important rock-forming silicates are taught.	2	3
b.	**VO Non-Silicates** In this lecture, the chemical compositions, properties and crystal structures of the most important rock-forming non-silicates (oxides, carbonates, phosphates, sulphates, halides, sulphides, etc.) are taught.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students know the systematics, chemical composition, crystal structure and important properties of naturally occurring minerals.		
	Prerequisites: none		

15.	**Elective Module: Theoretical Petrology**	**h**	**ECTS-Credits**
a.	**VU Theoretical Petrology** In this course, the theoretical basics of mineralogical equilibrium thermodynamics are taught and supplemented by practical exercises.	1	2
b.	**VU Geothermobarometry** The course deals with the theoretical basics of geothermobarometry of metamorphic rocks and their practical application on selected samples.	1	1.5
c.	**VU Kinetics** The course deals with the mechanisms of kinetic processes such as diffusion in solids, liquids and gases and their application to rock-forming and geodynamic processes.	1	1.5
	Total	**3**	**5**

	Learning Outcomes: The students understand the concepts of equilibrium thermodynamics and the kinetics of diffusion processes and can apply these to rock-forming and material science processes.
	Prerequisites: none

16.	Elective Module: High Pressure Synthesis and Processes	h	ECTS-Credits
a.	**VO Materials at High Pressures (Experimental Petrology)** In this course, the theoretical basics of the functioning of equipment for high pressure-high temperature synthesis as well as their possible uses within the framework of geological and material science issues are imparted	2	3
b.	**UE Materials at High Pressures** In this practical course, practical knowledge and skills in the planning, preparation and independent implementation of high-pressure, high-temperature experiments and the analysis of the synthesis products are imparted.	2	2
	Total	**4**	**5**
	Learning Outcomes: The students know the functionality and limits of various experimental synthesis methods and can independently plan and carry out high-pressure, high-temperature experiments.		
	Prerequisites: none		

17.	Elective Module: Magmatic and Metamorphic Petrology	h	ECTS-Credits
a.	**VU Magmatic Petrology** This course deals with the mechanisms of formation and crystallisation of magmas in the earth's interior as well as basic techniques and concepts of quantitative modelling and geotectonic classification of magmatic processes.	1	2.5
b.	**VU Metamorphic Petrology** This course deals with the physicochemical basics of mineral reactions and the metamorphic development of different rock types as well as the classification of metamorphic rocks in the context of geodynamic models.	2	2.5
	Total	**3**	**5**
	Learning Outcomes: The students understand metamorphic and magmatic processes and can independently apply relevant work techniques for the analysis of petrological processes.		
	Prerequisites: none		

18.	Elective Module: Geochemistry and Isotope Geochemistry	h	ECTS-Credits
a.	**VO Concepts of Isotope Geochemistry and Geochronology** In this course, concepts and working techniques of isotope geochemistry with a focus on radiogenic isotopes and their importance for geochronological issues are imparted.	1	1.5
b.	**VO Concepts of the Geochemistry of Stable Isotopes** In this course, concepts and working techniques of isotope geochemistry with a focus on stable isotopes are imparted.	1	1.5

c.	**VU Selected Topics in Magmatic and Metamorphic Geochemistry** With the help of case studies and practical exercises, knowledge about the application of geochemical concepts and working techniques to questions of igneous and metamorphic petrology is imparted in this course.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students master the basics of isotope geochemistry and geochronology and can apply the methods and concepts of the geochemistry of stable and radiogenic isotopes to igneous and metamorphic processes.		
	Prerequisites: none		

19.	**Elective Module: Material Science Mineralogy**	**h**	**ECTS-Credits**
a.	**VO Material Science Mineralogy** In this course, material classes and manufacturing processes are presented that play a central role in the building materials, glass and ceramics industries.	3	6
b.	**EX Material Science Mineralogy** Building on the content of the lecture, industrial companies are visited that produce various products from the sectors relevant to technical mineralogy.	1	1.5
	Total	**4**	**7.5**
	Learning Outcomes: The students understand practical relationships between chemical composition, crystal structure and physical properties of important products of technical mineralogy and know the processes involved in their manufacture.		
	Prerequisites: none		

20.	**Elective Module: Mineral Raw Materials**	**h**	**ECTS-Credits**
a.	**VU Metal Ore Deposits and Industrial Minerals** This course deals with the occurrence, characteristics and formation of important metal ores and industrial minerals as well as aspects of raw material supply.	3	4
b.	**VU Metals and Alloys** This course covers the production, properties, nomenclature, use and recycling of metal materials (steels, non-ferrous metal and high-tech alloys).	1	1
	Total	**4**	**5**
	Learning Outcomes: The students know the mineral raw materials of important branches of industry and understand the basics of natural development processes, technical processing as materials and recycling. The students can evaluate the criticality of the primary and secondary raw material supply in the context of historical, current and future resource management.		
	Prerequisites: none		

21.	Elective Module: Experimental Synthesis Methods	h	ECTS-Credits
a.	**VO Experimental Synthesis Methods** In this course, important processes are presented that play a role in the growth of crystals and the production of polycrystalline materials.	1	3
b.	**UE Experimental Synthesis Methods** This course offers an advanced study of the content of the lecture through practical work.	2	2
	Total	**3**	**5**
	Learning Outcomes: The students know the most important synthesis processes in technical mineralogy and can apply them to practical examples.		
	Prerequisites: none		

22.	Elective Module: Structures of Crystalline Materials	h	ECTS-Credits
a.	**VO Crystallographic Diffraction Methods** This course deals with the theory of the structure determination of materials by means of diffraction of X-rays, synchrotron radiation, neutrons and electrons. In addition, basic knowledge about the use of crystallographic databases is imparted.	3	6
b.	**PR Practical Course – Diffraction Methods** In this course, the methods of single crystal X-ray structure analysis and powder diffractometry are studied in-depth through practical work. Another component is the computer-aided evaluation, the interpretation of the measurement results and the data visualisation.	2	1.5
	Total	**5**	**7.5**
	Learning Outcomes: The students know the theoretical basics of diffraction methods for determining the structure of materials and can apply them in practice.		
	Prerequisites: none		

23.	Elective Module: Geo-Scientific Master's Excursion	h	ECTS-Credits
a.	**SE Geo-Scientific Excursion** In this course, geoscientific topics on relevant and suitable locations for the excursion are independently developed, presented and discussed.	0.5	1
b.	**EX Geo-Scientific Excursion** The excursion deals with aspects of all geological disciplines on the basis of selected localities in the field and interprets the observations in the light of current doctrines.	2.5	4
	Total	**3**	**5**
	Learning Outcomes: The students can identify, independently work on and present questions relevant to the earth sciences for selected locations. They can recognise these aspects in the field, discuss them and place them in a larger context.		
	Prerequisites: none		

24.	Elective Module: Spatial Analysis of Geospatial Data	h	ECTS-Credits
a.	**VO Spatial Data in Earth Sciences** The students learn the theoretical and practical basics of professional data acquisition, processing, presentation and interpolation in the earth sciences. Using various software, the students develop the skills to independently analyse, model and display spatial data in 2D and 3D.	1	2
b.	**UE Analysis of Spatial Data in Earth Sciences** Using various software, the students develop skills for independent analysis, modelling and presentation of spatial data in 2D and 3D in the context of geological issues.	2	3
	Total	**3**	**5**
	Learning Outcomes: The students are able to deal competently with spatial data of various types. They can create data models, analyse and model data in 2D and 3D, and design visualisations for various purposes.		
	Prerequisites: none		

25.	Elective Module: Paleobiology	h	ECTS-Credits
a.	**VU Biostratigraphy and Evolution** This course deals with the biostratigraphy, evolution and ecology of key fossils of alpine sediments as well as their detection.	2	2.5
b.	**VU Micropalaeontology** This course deals with the morphology, systematics, evolution and ecology of microfossils.	1	2.5
	Total	**3**	**5**
	Learning Outcomes: The students can determine and interpret macro- and microscopic fossils and classify them in terms of evolution and paleoecology.		
	Prerequisites: none		

26.	Elective Module: Marine and Lacustrine Geology	h	ECTS-Credits
a.	**SE Selected Topics in Marine Earth Science** This course provides an interactive introduction to the specialist literature and data from scientific ocean drilling projects and works on selected topics in marine geology, geophysics and geochemistry, which among other things deal with questions about the long-term development of the ocean/climate system and marine geohazards.	1	1.5
b.	**VU Limnogeology** In the theoretical part and the accompanying practical part, the methods and concepts of marine and lacustrine geology, from project planning to drilling core extraction, analysis and interpretation of the data, are taught and practiced.	2	3.5
	Total	**3**	**5**

	Learning Outcomes: The students know the methods and concepts of marine geology and are able to identify overarching geo-scientific issues in geomarine research projects, work on them independently and present and discuss their scientific results. They can design and carry out similar projects using local lakes and develop concepts for them to be considered as "models for the ocean".
	Prerequisites: none

27.	**Elective Module: Hydrogeology**	**h**	**ECTS-Credits**
a.	**VO Hydrogeology and Hydrogeochemistry** This course deals with selected aspects of hydrogeology and hydrogeochemistry and the state of research in this area is imparted.	1	3
b.	**EU Hydrogeology** These field exercises serve to deepen the theoretical principles and concepts discussed in the lecture.	2	2
	Total	**3**	**5**
	Learning Outcomes: The students have advanced knowledge of hydrogeology and hydrogeochemistry.		
	Prerequisites: none		

28.	**Elective Module: Advanced Crystallography**	**h**	**ECTS-Credits**
a.	**VU Methods for Powder Diffraction** In this course, selected chapters on powder diffraction and the diffraction analysis of polycrystalline materials in the field of materials science are presented.	2	2.5
b.	**VU Selected Chapters of Structural Research** This course deals with the description and analysis of solids that have an aperiodic structure or a disturbance of the long-range order, such as quasicrystals, modulated structures and compounds with severe imperfection.	2	2.5
	Total	**4**	**5**
	Learning Outcomes: The students know current trends in diffraction analysis of single crystal and polycrystalline solids and can carry out and evaluate practical analyses for this purpose.		
	Prerequisites: none		

29.	**Elective Module: Excursion – Industry and Raw Materials**	**h**	**ECTS-Credits**
a.	**EX From Raw Material to Product** This excursion combines aspects of regional geology and deposits with visits to industrial companies.	2	3.5
b.	**SE Seminar on the Excursion** In this course, topics and processes are dealt with that are directly related to the outcrops and establishments visited in the excursion.	1	1.5
	Total	**3**	**5**

	Learning Outcomes: The students understand the connection between geology and natural raw materials and their processing in industrial companies. The students have advanced skills in the context of basic geological research and applied materials science and can present them.
	Prerequisites: none

30.	**Elective Module: Selected Chapters of Geological Research**	**h**	**ECTS-Credits**
a.	**VU Selected Chapters of Geological Research** In this course, current questions from a geological research area are examined in detail by means of field and laboratory exercises and their meaning is placed in a larger context.	2	3
b.	**SE Selected Chapters of Geological Research** In this course, current issues from a geological research area are examined in seminar papers and their meaning is placed in a larger context.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students can describe complex current questions and projects in geological research, place them in a larger context and independently develop strategies for answering and implementing them.		
	Prerequisites: none		

31.	**Elective Module: Physico-Chemical Mineralogy**	**h**	**ECTS-Credits**
a.	**VU Crystal Physics** The aim of the course is the introduction to the tensorial description of crystal-physical phenomena, which are of fundamental importance for a multitude of practical applications. Thermal, dielectric, magnetic, elastic and optical properties of crystals are discussed.	2	2.5
b.	**VU Thermodynamic Modelling** Introduction to P-T Determination of materials and metamorphic rocks Fundamentals and types of reactions between solid phases. Chemography of solid state reactions. Thermodynamic modelling of chemical systems as a function of P, T and X (chemical composition). Phase diagrams and pseudosections as a function of P-T-X. Activity models of solid phases, Experimental calibration of geothermal barometers. Internally consistent thermodynamic data sets.	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Teaching physical and thermodynamic aspects of crystalline phases.		
	Prerequisites: none		

32.	Elective Module: Systematic Mineralogy 2	h	ECTS-Credits
a.	**VU Gemstones** In this course, economically relevant gemstone types are presented with regard to their genesis, characterisation and evaluation.	1	1.5
b.	**VU Environmental Mineralogy** This course imparts specialist knowledge of the environmentally relevant mineral phases as well as the analytical methods for characterizing natural samples in order to determine, reconstruct and predict weathering processes in natural samples.	1	1.5
c.	**VU Selected Topics in Applied Mineralogy** Current trends from the field of applied mineralogy will be presented by representatives from the industry using case studies.	1	2
	Total	**3**	**5**
	Learning Outcomes: The students know the most important gemstones and their formation conditions and can evaluate gemstones using standard commercial criteria. The students know the most important environmentally relevant minerals and can identify current case examples.		
	Prerequisites: none		

33.	Elective Module: Practice	h	ECTS-Credits
	To test and apply the acquired knowledge and skills or to provide orientation about the conditions of professional practice and the acquisition of additional qualifications, a practice amounting to 5 ECTS-Credits (or 120 hours) in a geological, mineralogical or materials science company or in an official institution is to be passed.	-	5
	Total	**-**	**5**
	Learning Outcomes: Students can apply acquired knowledge and skills in a professional environment.		
	Prerequisites: Approval by the Director of Studies before the start of the practice is required.		

34.	Elective Module: Mineral Spectroscopy	h	ECTS-Credits
a.	**VU IR-Spectroscopy** In this course the theoretical basics of IR-spectroscopy as well as detailed knowledge in practical work with the device are imparted, using selected examples for the qualitative and quantitative analysis of geo-relevant samples.	1	1.5
b.	**VU Raman-Spectroscopy** In this course, the theoretical basics of Raman spectroscopy as well as detailed knowledge of practical work with the device are imparted, using selected examples for the qualitative and quantitative analysis of geo-relevant samples.	1	1.5
c.	**UE Project Work – Mineral Spectroscopy** In this course, the content of mineral spectroscopy is deepened through independent implementation of series of measurements and the results are critically evaluated.	1	2

	Total	**3**	**5**
	Learning Outcomes: The students have detailed knowledge and practical experience with vibration spectroscopic methods and can apply them independently to geoscientific issues. The students know the errors and limits of the various methods and can correctly interpret measurement results and place them in a scientific context.		
	Prerequisites: none		

35.	**Elective Module: Interdisciplinary Skills**	**h**	**ECTS-Credits**
	Courses from the field of "Equality and Gender" covering 10 ECTS-Credits are to be selected from the Master's Programmes at the University of Innsbruck.	-	10
	Total	**-**	**10**
	Learning Outcomes: Further qualification of the students of their choice		
	Prerequisites: none		

36. Individual Choice of Specialisation

For individual specialisation, modules corresponding to a maximum of 20 ECTS-Credits can be freely selected from the master's programmes offered at the University of Innsbruck. The prerequisites specified in the respective curricula must be met. In combination with the 10 ECTS-Credits of elective module 35 (Interdisciplinary Skills), a Minor (Complementary Subject Areas) covering 30 ECTS-Credits may be passed.

§ 8 Master's Thesis

(1) In the master's programme a Master's Thesis amounting to 25 ECTS-Credits must be written. The Master's Thesis is a scientific piece of work that proves the ability to work on a scientific topic independently and in a justifiable way in terms of content and methodology.

(2) To complete a specialisation acc. to §7 (2), the topic of the Master's Thesis must be allocated to the respective field.

§ 9 Examination regulations

(1) Modules are evaluated by module examinations. Module examinations are examinations that proof the knowledge and skills acquired in a module. With successful completion of all parts of the module examination, the respective module is passed.

(2) Courses of modules – with the exception of compulsory modules 2 and 3 – are evaluated by course examinations. Course examinations are

a. examinations that assess the knowledge and skills covered in the lectures in which course assessment is based on a single examination at the end of the course. The course instructor has to determinate the examination method (written or oral) before the start of the course.

b. courses with continuous assessment, for which course assessment is based on regular written and/or oral contributions by participants. The course instructor has to determinate and announce the evaluation criteria before the start of the course.

(3) Elective module 33 – "Practice" – is evaluated by the supervisor based on a report of the student, which not only includes the objectives, the work plan and activities, but also the learning experiences. A certificate from the institution must be submitted regarding the duration, scope and the content of the work performed. Furthermore, an additional statement from the external supervisor about the content of the practice and the commitment of the student must be

submitted. Positive evaluation reads “successfully completed”, negative evaluation “unsuccessfully completed”.

(4) Compulsory module 2 “Preparation of the Master’s Thesis” is evaluated by the supervisor based on a synopsis. Positive evaluation reads “participated with success”, negative evaluation reads “participated without success”.

(5) Compulsory module 3 “Master’s Thesis Defence” is evaluated by an oral exam before an examination board. The exam covers a lecture on the most important findings of the Master’s Thesis and a public discussion.

§ 10 Academic degree

Graduates of the Master’s Programme in Earth Sciences are awarded the academic degree “Master of Science”, abbreviated “MSc”.

§ 11 Coming into force

This curriculum comes into force as of 1 October 2021.

§ 12 Transitional provisions

(1) This curriculum applies to all students commencing the Master’s Programme in Earth Sciences as of the winter semester 2021/22.

(2) Regular degree students who have started the Master’s Programme in Earth Sciences acc. to the curriculum of 2007, University of Innsbruck Bulletin of 27 April 2007, Issue 45, No. 211 at the University of Innsbruck before 1 October 2021, are entitled to finish this programme within a maximum of eight semesters from this point in time onwards.

(3) If the Master’s Programme in Earth Sciences acc. to the curriculum of 2007 is not completed in time, the students are subject to the curriculum for the Master’s Programme in Earth Sciences, University of Innsbruck Bulletin of 25 May 2021, Issue 70, No. 791 (curriculum 2021). In addition, the students are entitled to subject to the curriculum of 2021 on a voluntary basis.

(4) The recognition of examinations acc. to §78 par. 1 Universities Act 2002 is regulated in the appendix.

Appendix 1: recognition regulation acc. to §78 par. 1 Universities Act 2002

The successfully passed examinations within the scope of the Master's Programme in Earth Sciences at the University of Innsbruck (curriculum published in the University of Innsbruck Bulletin of 16 October 2019, Issue 3, No. 32) listed below are recognised as equal for the Master's Programme in Earth Sciences at the University of Innsbruck (curriculum published on 25 May 2021, Issue 70, No. 791) acc. to §78 par. 1 Universities Act 2002 as follows:

Positively evaluated exam:			**Recognised as:**		
Master's Programme in Earth Sciences 2019	**h**	**ECTS-Credits**	**Master's Programme in Earth Sciences 2021**	**h**	**ECTS-Credits**
Module 1			**Elective Module 5**		
VO Geology of Tyrol (Module 1)	1	2.5	VO Alpine Geology	2	3
EU Geological 'Excursion	2	2.5	EU Excursion – Alpine Geology	1	2
Module 1			**Elective Module 2**		
VO Geology of Europe	1	2.5	SE Basins and Orogens	1	2
Module 2			**Elective Module 13**		
VO Analytical Methods (1) (Electron Microprobe)	1	2	VU Microprobe and Scanning Electron Microscopy	1	2
Module 2			**Compulsory Module 1**		
VO Analytical Methods (1) (1) Powder Diffraction UE Analytical Methods (2) X-Ray Diffraction	1 2	2 3.5	PR Project Work	2	6
Module 3			**Elective Module 4**		
VO Plate Tectonics	2	4	VO Plate Tectonics VU Physical Geodynamics	2 1	3 2
Module 3			**Elective Module 6**		
VU Microfabrics	2	3.5	VO Structural Geology and Microstructure UE Structural Geology and Microstructure	1 2	2 3
Module 4			**Compulsory Module 1**		
EU Geological Excursion	1	1.5	EU Introductory Seminar SE Project Presentation	2 1	3 1
Module 4			**Elective Module 17**		
VO Magmatic Petrology	2	2.5	VU Magmatic Petrology	1	2.5
Metamorphic Petrology	2	3.5	VU Metamorphic Petrology	2	2.5
Module 5			**Compulsory Module 2**		
Preparation of the Master's Thesis	-	7.5	Concept for the Master's Thesis	-	2.5

Module 6			**Elective Module 27**		
VO Hydrogeology (2)	1	2	VO Hydrogeology and Hydrogeochemistry	1	3
UE Hydrogeology (2)	1	1	EU Hydrogeology	2	2
Module 6			**Elective Module 36**		
VO Engineering Geology (2) EU Engineering Geology (2)	2 1	4 0.5	Individual Choice of Specialisation	-	4.5
Module 7			**Elective Module 25**		
VU Biostratigraphy	2	4	VU Biostratigraphy and Evolution	2	2.5
VU Micropalaeontology	2	3.5	VU Micropalaeontology	1	2.5
Module 8			**Elective Module 8**		
VO Quaternary Geology & Palaeoclimatology	2	4	VO Fundamentals of Paleoclimatology SE Case Studies in Paleoclimatology	2 1	3 2
Module 8			**Elective Module 7**		
VU Quaternary Field Course	2	3.5	VO Quaternary Terrain Course (Theory) UE Quaternary Terrain Course (Practice)	1 2	2 3
Module 9			**Elective Module 1**		
VU Clastic Sediments	2	3.5	VU Sedimentary Geology	1	2
Module 9			**Elective Module 2**		
VU Carbonate Rocks	2	4	VO Basins and Orogens	2	3
Module 10			**Elective Module 1**		
VO Sequence Stratigraphy	1	2.0	VU Sequence Stratigraphy	1	1.5
EU Geological Excursion	1	1.0	EU Sedimentary Geology and Sequence Stratigraphy	1	1.5
Module 10			**Elective Module 36**		
VO Sedimentary Facies	2	4.5	Individual Choice of Specialisation	-	4.5
Module 11			**Elective Module 24**		
VU Geographical Information Systems	4	7.5	VO Spatial Data in Earth Sciences UE Analysis of Spatial Data in Earth Sciences	1 2	2 3

Module 12			**Elective Module 11**		
VU Introduction to Soil Mechanics	2	4	VU Introduction to Soil Mechanics VU Engineering Geology	1 1	1.5 1.5
VU Introduction to Rock Mechanics	2	3.5	VU Introduction to Rock Mechanics	1	2
Module 13			**Elective Module 12**		
VO Geophysics	3	6	VU Applied Geophysics	2	3.5
UE Geophysics	1	1.5	EU Geophysical Terrain Exercise	1	1.5
Module 14			**Elective Module 16**		
VO Experimental Petrology UE Experimental Petrology	3 1	6 1.5	VO Materials at High Pressures UE Materials at High Pressures	2 2	3 2
Module 15			**Elective Module 15 and 30**		
VO Theoretical Petrology	2	4	VU Theoretical Petrology (EM15) VU Selected Chapters of Geological Research	1 2	2 3
VO Geothermobarometry	2	3.5	VU Geothermobarometry (EM15) VU Kinetics (EM15) SE Selected Chapters of Geological Research (EM30)	1 1 1	1.5 1.5 2
Module 16			**Elective Module 22**		
VO Crystallography	3	6	VO Crystallographic Diffraction Methods	3	6
UE Crystallography	1	1.5	PR Practical Course – Diffraction Methods	2	1.5
Modul 17			**Elective Module 14 and 32**		
VO Silicates	3	6	VO Silicates (EM14) VU Gemstones (EM32) VU Environmental Mineralogy (EM32)	2 1 1	3 1.5 1.5
VO Non-Silicates	1	1.5	VO Non-Silicates	1	2
Module 18			**Elective Module 20**		
VO Applied Mineralogy	3	6	VU Metal Ore Deposits and Industrial Minerals	3	4
UE Applied Mineralogy	1	1.5	VU Metals and Alloys	1	1

Modul 19			**Elective Module 19**		
VO Inorganic Materials	3	6	VO Material Science Mineralogy	3	6
UE Inorganic Materials	1	1.5	EX Material Science Mineralogy	1	1.5
Module 20			**Elective Module 9 or 18**		
VO Radiogenic Isotopes	2	4.5	VO Concepts of Isotope Geochemistry and Geochronology UE or VU Selected Topics	1 1	1.5 2
VU Stable Isotopes	2	3	VO Concepts of the Geochemistry of Stable Isotopes	1	1.5
Module 21			**Elective Module 13 and 34**		
VO Analytical Techniques (2) UE Analytical Techniques (2)	2 2	6 1.5	VU Thermal Analysis (EM 13) VU X-ray Fluorescence Analysis (EM 13) VU IR-Spectroscopy (EM34) VU Raman-Spectroscopy (EM34) UE Projektarbeit Mineralspektroskopie (WM34)	1 1 1 1 1	1 1 1.5 1.5 2
Module 22			**Elective Module 36**		
VO Basics of Global Change and Risk Research	2	3.5	Individual Choice of Specialisation	-	3.5
SE Aspects of Man-Environment-Relationships	2	4	Individual Choice of Specialisation	-	4
Module 23			**Elective Module 36**		
VO Basic Research on Mountain Regions	2	3.5	Individual Choice of Specialisation	-	3.5
VO Comparative Geography of Mountain Regions	2	4	Individual Choice of Specialisation	-	4
Module 24			**Elective Module 36**		
VO Physical Glaciology	2	3.5	Individual Choice of Specialisation	-	3.5
VO Physical Climatology	2	4	Individual Choice of Specialisation	-	4
Module 25			**Elective Module 36**		
VO Gender Aspects in Spatial Planning	2	4	Individual Choice of Specialisation	2	4
UE Gender Aspects in Regional Development and Planning	2	3.5	Individual Choice of Specialisation	2	3.5

Appendix 2: Recognition acc. to §78 par. 1 Universities Act 2002

Acc. to §78 par. 1 Universities Act 2002, the successfully passed examinations within the scope of the Master's Programme in Earth Sciences at the University of Innsbruck (curriculum published in the University of Innsbruck Bulletin of 25 May 2021, Issue 70, No. 791) listed below are recognised as equal for the Master's Programme in Material and Nano Sciences at the University of Innsbruck (curriculum published on 28 June 2019, Issue 66, No. 580) as follows:

Positively evaluated exams			**Recognised as:**		
Master's Programme in Earth Sciences 2021	**h**	**ECTS -Credits**	**Master's Programme in Material and Nano Science 2019**	**h**	**ECTS -Credits**
Elective Module 13			**Elective Module 3**		
VU Thermal Analysis	1	1	VU Thermo Analysis for Material and Nano Science	1	1
VU X-ray Fluorescence Analysis	1	1	VU X-ray Fluorescence Analysis for Material and Nano Science	1	1
Elective Module 16			**Elective Module 4**		
VO Materials at High Pressures (Experimental Petrology)	2	3	VO Materials at High Pressures (Experimental Petrology)	2	3
UE Materials at High Pressures	2	2	UE Materials at High Pressures	2	2
Elective Module 19			**Compulsory Module 2**		
VO Material Science Mineralogy	3	6	VO Inorganic Materials	3	6
Elective Module 20			**Elective Module 12**		
Metal Ore Deposits and Industrial Minerals	3	4	VO Mineral Raw and High-Performance Materials for Materials and Nano Science	3	4
VU Metals and Alloys	1	1	UE Mineral Raw and High-Performance Materials for Materials and Nano Science	1	1
Elective Module 22			**Compulsory Module 4**		
VO Crystallographic Diffraction Methods	3	6	VO Crystallographic Diffraction Methods	3	6
PR Practical Course – Diffraction Methods	2	1.5	PR Lab Practice n Diffraction Methods	2	1.5
Elective Module 28			**Elective Module 13**		
VU Methods for Powder Diffraction	2	2.5	VU Methods of Powder Diffraction	2	2.5
VU Selected Chapters of Structural Research	2	2.5	VU Selected Chapters of Structural Research	2	2.5

Elective Module 31			**Elective Module 14**		
VU Mineral Physics	2	2.5	VU Crystal Physics	2	2.5
VU Thermodynamic Process-Modelling	2	2.5	VU Thermodynamic Modelling	2	2.5
Elective Module 34			**Elective Module 3**		
VU IR-Spectroscopy	1	1.5	VU IR-Spectroscopy for Materials and Nano Science	1	1.5
VU Raman-Spectroscopy	1	1.5	VU Raman-Spectroscopy for Material and Nano Science	1	1.5