# Opasraportti

# Geosciences (2016 - 2017)

**OULU MINING SCHOOL**

**THE DEGREE PROGRAMME IN GEOSCIENCES**

The geosciences include all branches of science that study the structure, composition, evolution and dynamics of the planet Earth and its natural mineral and energy resources. The social significance of geoscientific research has increased recently due to many factors, including the growing world population and the expanding global economy, resulting in an increasing demand for new raw materials and, at the same time, the enhanced awareness of the significance of environmental protection, mitigation of natural and anthropogenic hazards and sustainable development of the society.

The main aim of geoscientific research is to understand the Earth's ancient and current geological processes and related factors affecting the well-being of humankind. Geologists and geophysicists study different geological processes operating within and on the Earth, such as magmatism, metamorphism, deformation, erosion and sedimentation, and geological formations which are and were generated by these processes. Earth materials are constantly processed and recycled by physical, chemical and biological processes of our dynamic planet and anthropogenic activities, which provides investigators with many challenging questions.

Fundamental research focusing on the origin and evolution of the bedrock and its sedimentary cover provides a scientific basis for the research of renewable and non-renewable natural resources. Environmental research and environmental monitoring has recently attracted much attention along with the more traditional research fields such as mineral exploration and geological mapping. Also, the interest in the environment and natural resources of Arctic areas is currently strongly growing.

**The degree programme in Geosciences** is the other of the two degree programmes in Oulu Mining School. The other one is the degree programme in Mining Technology and Mineral Processing. The aim of the degree programme in Geosciences is to provide students with the competence to work as experts in different fields of geosciences in the public and private sector. It guides them to understand the action of geological processes and the mechanisms of formation of different geological formations. Teaching helps to develop skills that are needed in mineral exploration, mapping and exploitation of natural resources and also in their protection. More and more geological and geophysical information is needed in environmental planning and research and solution of environmental problems. The research field is multidisciplinary and therefore useful minor subjects include Chemistry, Physics, Geography, Biology, Mathematics, Information Sciences, Process, Water and Environmental Technology, economic subjects and especially Mining Technology and Mineral Processing.

Field and laboratory training and summer work form an important component of geological and geophysical education, complementing theoretical studies. Among the general learning outcomes are various communicational and problem solving skills. Other typical competences in the field are: 1) adoption of four-dimensional time-spatial visualisation skills in understanding processes that deform rocks, 2) capability to integrate versatile information obtained from the field or laboratory, and skills to synthesise and perform modelling, 3) ability to acquire diverse and comprehensive information on currently operating environmental processes, and 4) ability of develop a profound understanding on the needs of the society to exploit and protect natural resources. Internationalisation is a self-evident part of the training and future work relations, as the boundaries of geological formations do not follow those between countries or linguistic regions. The education thus creates good possibilities for the graduated student to move abroad either to continue his/her studies at other universities or work for international exploration and mining companies.

In Oulu Mining School, teaching and research of geosciences is distributed amongst the following four main subjects:

Geology and Mineralogy
Quaternary Geology

Geochemistry
Geophysics

**Geology and Mineralogy** is the study of the solid Earth, the materials which it is made of, including minerals, rocks and geological formations, and the physical, chemical and biological processes responsible for their generation. *Mineralogy* focuses on the structure, composition, occurrence and utilisation of minerals and forms the foundation to geological research. *Regional Geology* deals with general characteristics of a given area and the evolution of the bedrock. Using field studies and geochronological tools, geologists determine and date the time sequences of events in the *Earth's history*, from the beginning to the present time. In *igneous petrology*, the focus is on understanding the nature and origin of rocks crystallised from molten rock or magma, while *sedimentary and metamorphic petrology* deal with the nature and origin of sedimentary and metamorphic rocks, respectively. *Structural Geology* is the study of mechanical deformation of the bedrock and the resultant three-dimensional structural forms. An important branch of Geology and Mineralogy is Economic *Geology* dealing with the characteristics and genesis of different ore deposits, mineral exploration and the principles of mining business. Metals and minerals are essential for the sustainable development of the society, and their geological occurrence and exploitation have been chosen as one of the key topics in our department.

In Quaternary Geology, the focus is on the surface of the Earth's crust, which largely comprises different types of sediments. These were mainly formed during the youngest geological time period of the Earth's history, the Quaternary period, explaining the name given to this field of research. The sub-fields of Quaternary Geology include *Physical Geology* and, especially in Finland, its branch dealing with *Glacial Geology*, and *Historical Geology*, *Palaeontology* and many other fields (e.g., *Mineral Prospecting, Hydrogeology, Environmental Geology* and *Peat Geology*). The aim of *Historical Geology* is to unravel the chronology of geological events, age relations of different geological formations and the evolution of life and climate on Earth. *PhysicalSedimentology* is the study of sediments, their characteristics and depositional environments, and geomorphological landforms which they form. This is an economically important sub-field, because the information is used, for example in mineral exploration, environmental and regional planning, groundwater research, agricultural and forestry research and study of peat resources.

Geochemistry is the study of the source and fate of chemical species in natural environments, using chemical analysis of minerals, rocks, soils and waters. One of the aims is to describe and quantify the processes that control the recycling of elements and isotopes in nature. The main applications are geochemical exploration, environmental studies, and determining the age and genesis of different rock types. There are several subfields in Geochemistry. In *Isotope Geochemistry*, radiogenic and stable isotopes are analysed in order to perform age determinations and make inferences on the mechanisms and conditions of rock formations or other research targets. In *Environmental Geochemistry*, geochemists investigate natural and anthropological chemical changes in the environment. *Geochemical Exploration* utilises geochemical properties of the bedrock and its Quaternary cover with the aim to discover new mineral deposits.

**Geophysics** is a natural science that involves the study of the physical structure and physical properties of the Earth and its surrounding space environment, and related physical processes. At the Oulu University, teaching and research in Geophysics are focused on A *pplied Geophysics*, with emphasis on the use of geophysical methods in exploration, mapping and management of natural resources and in environmental and engineering studies. In the life cycle of a mine, Geophysics plays an important role in all stages: before opening the mine in mineral exploration and resource assessment, during active mining operations in exploration for additional resources and environmental monitoring, and after the closure of the mine, in environmental monitoring and mapping of potentially contaminated areas.

Students graduated as **geologists** from geosciences have been employed by public sector organisations, such as the Geological Survey of Finland, Finland's environmental administration, ELY Centres (Centres for Economic Development, Transport and the Environment) and universities. In the private sector, significant employers are domestic and foreign exploration companies, mining industry, and companies providing environmental consulting and construction services. The main duties of geologists in these organisations are research and the mapping of bedrock and Quaternary deposits, studying ore deposit formation processes, carrying out mineral exploration projects and inventories of sediment and peat resources, groundwater investigations, and various environmental research and administrative tasks.

Experts of Applied Geophysics are employed by domestic and foreign companies for research and instrumental development related to exploration and exploitation of geological raw materials (groundwater, dimension stones, mineral deposits, minerals, oil). Geophysicists also apply their skills in various construction projects and environmental studies to identify potential environmental and anthropogenic hazards. **Geophysicists can** work as researchers in various research institutes such as universities, the Geological Survey of Finland, Finnish Meteorological Institute, Finnish Environmental Institute, and geophysical observatories.

**Major subjects, structure of the degrees and lines of specialisation**

In the degree programme of geosciences, it is possible to obtain a lower university degree, Bachelor's degree (B. Sc.), in Geosciences amounting to 180 credits. After the Bachelor's degree, students have the possibility to continue to study for a higher university degree, the Master's degree (M.Sc.), which can be done in three major subjects: Geology and Mineralogy, Quaternary Geology, and Geophysics. The Master's degree consists of a total of 120 credits of intermediate- and advanced-level studies. The amount of advanced studies in the chosen major subject must be at least 60 credits including the 30 credits of the Master's thesis. The post-graduate degrees are the Licentiate of Philosophy degree and the Doctor of Philosophy degree, of which the latter can be obtained without the former.

The basic and intermediate level studies of Geophysics can be done in the degree programme of Physics. After completing a BSc degree in Physics with a sufficient amount of courses in Geophysics and Geology, students can apply for transfer to Oulu Mining School for studying Applied Geophysics as their major subject.

Students can graduate from the degree programme of Geosciences via three lines of specialisation:

- Master of Science degree in Geology and Mineralogy with specialisation in Economic Geology
- Master of Science degree in Quaternary Geology
- Master of Science degree in Geophysics with specialisation in Applied Geophysics

It is recommended that the decision on the major subject is made during the second year and not later than during the third year. The choice is not binding, as the line of specialisation can be changed within the degree programme still later through bridging studies. Differing from Geology and Mineralogy and Quaternary Geology, admission to the Geophysics Master's studies in Oulu Mining School takes place after a Bachelor degree in Physics and a minor subject entity of 25 ECTS credits in Geophysics in the degree programme of Physics have been completed.

In addition to the degreel programme described above, Oulu Mining School offers students the International Master´s Programme in Economic Geology. For these students, Geology and Mineralogy is the major subject. All courses in the programme are given in English.

The emphasis of the advanced-level teaching in Geology and Mineralogy is on courses which lead to specialisation in **Economic Geology**. The goal is that after obtaining a M.Sc. degree, students are sufficiently competent to cope with duties requiring detailed knowledge of the bedrock and its resources. The prime purpose of the education is to meet the need for experts in mineral exploration and mining industry. An important aspect of the teaching is to make students familiar with the occurrence, characteristics and genesis of different metallic ore deposits. Other topics include the evolution of the Finnish bedrock, isotope geochemistry, applied geophysics, geometallurgy, GIS applications, and geochemistry of mining environment.

The M.Sc. degree programme in **Quaternary Geology** offers the student high level education to understand how geological processes operate in different sedimentary environments and what is the human impact on these natural processes today. The core issue in the Quaternary research and education is to understand glacial sedimentology and stratigraphy. This knowledge on the mechanisms that operate in natural sedimentary environments is vital, for example in mineral exploration and can also be utilised in many fields ranging from sustainable use of groundwater resources to various environmental issues such as climate change.

**In Applied Geophysics**, teaching and research are focused on using of geophysical methods in exploration and mapping of natural resources and in environmental and engineering studies. The teaching comprises a number of core courses, a selection of specialised courses and a final thesis project. The core courses provide the students with fundamental information about physical backgrounds of basic geophysical techniques and instrumentation essential for practicing applied geophysics. The specialised courses provide more detailed information about geophysical techniques applied, for examle, at different stages of the mine life circle. They prepare the students for choosing a thesis research area that best suits their interests. The thesis project involves the integration of theory with data derived from geophysical field observations obtained in cooperation with a suitable industrial, governmental or research partner.

Because the candidate-level teaching is given in the degree programme of Physics, course descriptions and requirements are available in the study guide of the degree programme of Physics, whereas the Master's level studies in Geophysics are described below together with the studies in Geology and Mineralogy, Quaternary Geology and Geochemistry.

**General aspects of the studies**

The education in geosciences is given in the form of lecture courses, practical exercises, seminars, workshops and field courses. Students sketch a preliminary PSP in the first autumn during their orientation studies and will design a more precise PSP for the entire study period later on. Persons who help in detailed questions related to each subject

are: Eero Hanski in Geology and Mineralogy and Geochemistry, Tiina Eskola in Quaternary Geology, and Kari Moisio in Geophysics.

The geosciences courses are divided into basic studies (code P), intermediate studies (code A) and advanced studies (code S). In addition, language studies and orientation studies (code Y) are part of the curriculum. The geologic education begins with basic studies in geosciences, which are completed during the first academic year. During the first spring semester it is possible to conduct the first compulsory intermediate-level studies. It is advised to start compulsory minor subject studies for the B.Sc. degree as early as possible, especially a basic chemistry course, which is recommended to be taken during the first autumn semester.

Geology students study for a joint Bachelor's degree in Geosciences, but they can already prepare themselves for the future decision on their line of specialisation by choosing Geology and Mineralogy or Quaternary Geology as one of their minor subjects in their B.Sc. degree. Other minor subjects are also needed to widen students' possibilities to carry out duties in their future work life. Appropriate minor courses include those given in Chemistry, Information Processing Science, Geophysics, Physics, Mathematics, Geography, Economics and technical sciences. The Bachelor level studies described below concern geology students. Corresponding studies for future geophysics students are described in the study guide of the degree programme of Physics.

**BACHELOR'S DEGREE IN GEOSCIENCES (B.Sc.), 180 ECTS credits**

The Bachelor's degree in geology, which is normally completed within three years, constitutes the following studies:

- General studies, 8 credits
- Basic studies in geology, 36 credits
- Compulsory intermediate-level courses in geosciences, 43 credits
- Bachelor's thesis and maturity test, 9 credits
- Optional intermediate courses in Geosciences
- Compulsory minor subject studies
- Optional minor subject studies

**COMPULSORY MINOR SUBJECT COURSES**

The Bachelor's degree in geology must contain at least one minor subject entity that is compiled from the optional intermediate-level studies in Geology and Mineralogy or Quaternary Geology.

**OPTIONAL MINOR SUBJECT COURSES**

For complementing the chosen major subject, students can select appropriate optional minor courses from the curriculum of Oulu Mining School or other faculties, preferably the Faculty of Science and the Faculty of Technology. Most recommendable are courses in Chemistry, Physics, Geophysics, Mathematics, Information Processing Science, Geography and Technology including Process technology, Mineral processing and Mining technology. Minor subject entities are determined by the curriculum of the respective degree programme. It is advised that students strengthen their skills in mathematics at least with the course 031010P Calculus I (5 credits) if any courses in minor subjects require such skills.

A Bachelor of Science degree can include basic- and intermediate-level studies in one minor subject (minimum 60 credits) or basic studies in two minors subjects (2 x $\geq$25 credits). It is important to note that if a student wants to choose Geology and Mineralogy as his/her major subject in the Master's studies, he/she needs to complete a 25-credit entity of optional intermediate-level studies in Geology and Mineralogy, analogously, a 25-credit entity of optional intermediate-level studies in Quaternary Geology, if a student wants to graduate as a Master of Science in Quaternary Geology. Corresponding minor subject entities in Geophysics can be done in the degree programme of Physics.

**BACHELOR'S THESIS (9 ECTS credits)**

The thesis is based on independent research of literature complemented with potential minor field work or laboratory work and is commonly done during the third study year after a sufficient amount of studies have been conducted for

the Bachelor's degree. Before starting the thesis, students must agree upon its details with a supervising professor or lecturer.

**MATURITY TEST**

After completing their Bachelor's thesis, students write an essay in their native language (Finnish or Swedish) on the topic of the thesis, to show a good command of the language and the topic of the thesis. If the student has got a special permission to use a language that is other than Finnish or Swedish in completing his/her studies, the Dean may allow the student to write the maturity test in the language that he/she used in his/her Bachelor thesis.

**Master of science degree (M.Sc.)**

**(B.Sc. + 120 ECTS credits)**

The degree of Master of Science is a higher university degree and can be obtained by complementing the Bachelor's degree with additional studies of at least 120 ECTS credits, which include a Master's thesis worth of 30 ECTS credits and a minimum amount of 25 ECTS credits of advanced courses in the major subject.

Minor subject studies should be selected in such a way that they support the major subject studies and the field of specialisation chosen in the Master's programme.

The major subject in the Master of Science degree is Geology and Mineralogy, Quaternary Geology, or Geophysics. The degrees are the following:

- Master of Science degree in Geology and Mineralogy, specialisation in Economic Geology
- Master of Science degree in Quaternary Geology (Quaternary Geology as the major subject)
- Master of Science degree in Geophysics with specialisation in Applied

Geophysics

Irrespective of the line of specialisation, the minimum extent of the required advanced-level studies in the major subject is 60 ECTS credits, which include the 30 ECTS credits of the Master's thesis. The maturity test has to be done also in the Master's degree and consists of an abstract of the Master's thesis written on a separate form.

As mentioned above, students majoring in Geology and Mineralogy are required to have completed at least 25 ECTS credits of optional intermediate-level studies in Geology and Mineralogy. For those students who have been accepted directly to the Master's programme, these studies need to be performed as bridging studies. Advanced-level studies in Geology and Mineralogy lead automatically to specialisation in Economic Geology. The topic of the Master's thesis is within the field of Geology and Mineralogy. In addition, it is required that the student has completed at least a total of 10 ECTS credits of studies in Mineral processing and Mining technology.

Students majoring in Quaternary Geology must have completed a minimum of ECTS 25 credits of optional intermediate-level studies in Quaternary Geology. For those students who have been accepted directly to the Master' s programme, these studies need to be performed as bridging studies. The topic of the Master's thesis must be compatible with the major subject.

Students who major in Geophysics are required completion of a Bachelor of Science degree in Physics and a minimum of 25 ECTS credits of basic- and intermediate level courses in Geophysics (see the description of the Physics degree programme). If not included in the Bachelor' degree, these Geophysics studies need to be done as bridging studies. The topic of the Master's thesis must be within the field of Geophysics.

**MASTER'S THESIS (30 ECTS credits)**

The Master's thesis is prepared during the last (5th) study year. It is a research assignment with a workload corresponding to 30 ECTS credits. The thesis is based on student's own field or laboratory studies and, in many cases, these studies are closely related to student's summer work. Before starting the Master's project, the subject and other details are agreed with the supervising professor or lecturer.

**OTHER STUDIES**

300002M Advanced information skills, 1 credit

(recommended to all students working on their Master's thesis)

**POSTGRADUATE STUDIES**

Having completed his/her Master of Science degree, a student will be able proceed to pursue the Licentiate of Philosophy degree or the Doctor of Philosophy degree in Geology and Mineralogy, Quaternary Geology or Geophysics, provided that he/she has obtained his/her Master's degree with good rates (at least 60% of the maximum, 3/5, for both the courses and the Master's thesis), and his/her research plan has been accepted. The research plan for the Licentiate of Philosophy degree is accepted by the educational board of the geosciences degree programme, while that for the Doctor of Philosophy degree is accepted by the University of Oulu Graduate School (UniOGS).

The Licentiate degree consists of the Licentiate thesis (90 credits) and additional advanced- or intermediate-level studies of at least 35 credits, including the Licentiate examination (9 credits). The requirements for the Doctoral degree are the same with the exception that the Licentiate thesis is replaced with the doctoral dissertation. For more information on the doctoral studies, see the website of the Oulu Graduate School (http://www.oulu.fi/tutkijakoulu/).

**POSTGRADUATE COURSES**

Postgraduate courses can contain applicable intermediate- and advanced-level courses in the major subject or other relevant subjects and special courses organised by the UniOGS, of which some are mandatory. In addition, the faculty can grant credits from teaching duties (provided a certain amount pedagogical studies have been passed), participation in scientific meetings and research visits.

**Geosciences AS A MINOR SUBJECT**

Students of other degree programmes can complete a minor subject entity in geosciences consisting of 15, 25 or 60 ECTS credits. A minor course entity of 15 ECTS credits can also be done in Geology and Mineralogy, Quaternary Geology or Geochemistry. It needs to be noted that the number of participants in some cases (especially in field courses) is limited.

Detailed descriptions of each course can be found in WebOodi (https://weboodi.oulu.fi/oodi/).

**Examinations and grading**

An examination is organised within two weeks after the end of each lecture course. After that students can participate in two additional examinations for each course. Registration to an examination is regarded as participation. Commonly the retake exams are held in connection with joint university exams.Students must register for these examinations using WebOodi latest at 12.00 on the Monday preceding the exam. Summer examinations of the faculty are organised in June and August and the dates are announced separately during the late spring term. Registration for the summer examinations should be done in May.

A numerical scale 0-5 in whole numbers is used in assessing a completed course, with 0 = fail, 1 = sufficient, 2 = satisfactory, 3 = good, 4 = very good and 5 = excellent. In some courses, verbal grading Pass or Fail is applied. For study courses consisting of several subunits, the grade is the weighted average of all subunits. Evaluation of the Master's thesis is based on the same scale 0-5, and the grade of the thesis is not considered when determining the average grade of the advanced studies.

# Tutkintorakenteet

## Economic Geology, Master´s Programme

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

### International Master´s Programme in Economic Geology, major subject Geology and Mineralogy (vähintään 120 op)

Completion of the Master's degree requires that the student has completed at least 70 credits of advanced studies in his/her major subject, including a 30-credit Master's thesis and related maturity test and a minimum of 40 credits of advanced-level courses in the major subjects. Below is a list of courses in Geology and Mineralogy for your selection.

**Advanced major studies, min. 70 ects.**

A325603: Geology and Mineralogy, advanced studies, 60 - 85 op
- *engl*
  - 772632S: Regional ore geology of Fennoscandia, 5 op
  - 772687S: Gold deposits, 5 op
  - 772667S: Seminar in ore geology, 5 op
  - 774636S: Geochemistry of Mining Environment, 5 op
  - 772658S: Special issues in geology and mineralogy, 1 - 9 op
  - 772615S: Literature study, 5 op
  - 773615S: Studia Generalia -lectures, 2 op
  - 772690S: Studies in other universities and colleges, 0 op
  - 772695S: Magmatic ore deposits, 5 op
  - 772692S: Hydrothermal ore deposits, 5 op
  - 772693S: Sedimentary ore deposits, 5 op
  - 772675S: Geophysics in economic geology, 5 op
  - 772628S: Layered intrusions and their ore deposits, 5 op
  - 772608S: Mining geology, 3 op
  - 772694S: Geometallurgy and mineral processing, 5 op
  - 772640S: Excursion, 5 op
  - 772613S: Bedrock geology of Finland, 6 op
  - 774637S: Isotope geochemistry for economic geologists, 6 op
  - 772684S: GIS applications, 5 op
  - 772666S: Master's thesis, 30 op
  - 770690S: Maturity test, 0 op

**Other optional studies**

# M.Sc., Geosciences

Tutkintorakenteen tila: archived

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

## Master of Science in geology and mineralogy, specialization in economic geology (vähintään 120 op)

Completion of the Master's degree requires that the student has completed at least 60 credits of advanced studies in his/her major subject, including a 30-credit Master's thesis and related maturity test and a minimum of 30 credits of advanced-level courses in the major subjects. Below is alist of courses in Geology and Mineralogy for your selection. In addiotion it is required that 10 credits of cources in mining engineering and mineral processing are included (e.g., 493300A Basics of Mineral Processing, 492300A Rock Mechanics). Choose the other studies in such a way that they support your field of specialisation.

In addition, it is required that an entity of at least 25 ECTS credits of intermediate-level courses has been completed.

**Advanced major studies, min. 60 ects.**

A325603: Geology and Mineralogy, advanced studies, 60 - 85 op
- *engl*
  - 772632S: Regional ore geology of Fennoscandia, 5 op
  - 772687S: Gold deposits, 5 op
  - 772667S: Seminar in ore geology, 5 op
  - 774636S: Geochemistry of Mining Environment, 5 op
  - 772658S: Special issues in geology and mineralogy, 1 - 9 op
  - 772615S: Literature study, 5 op
  - 773615S: Studia Generalia -lectures, 2 op
  - 772690S: Studies in other universities and colleges, 0 op
  - 772695S: Magmatic ore deposits, 5 op
  - 772692S: Hydrothermal ore deposits, 5 op
  - 772693S: Sedimentary ore deposits, 5 op
  - 772675S: Geophysics in economic geology, 5 op
  - 772628S: Layered intrusions and their ore deposits, 5 op
  - 772608S: Mining geology, 3 op
  - 772694S: Geometallurgy and mineral processing, 5 op
  - 772640S: Excursion, 5 op
  - 772613S: Bedrock geology of Finland, 6 op
  - 774637S: Isotope geochemistry for economic geologists, 6 op
  - 772684S: GIS applications, 5 op
  - 772666S: Master's thesis, 30 op
  - 770690S: Maturity test, 0 op

772685S: Work practice II, 4 op

**Optional studies in geosciences**

## Master of Science in quaternary geology (vähintään 120 op)

Completion of the master's degree requires that the student has completed at least 60 credits of advanced studies in his/her major subject, including a 30-credit Master's thesis and related maturity test and a minimum of 30 credits of major subject courses. Below is a list of courses in Quaternary Geology for your selection. Choose the other studies in such a way that they support your field of specialization. In addition, it is required that an entity of at least 25 ECTS credits of intermediate-level courses in quaternary geology has been completed.

**Advanced-level courses in Quaternary Geology**

A326103: Surficial Geology, advanced studies, 60 op

*engl*

773616S: Aerial photo interpretation in surficial geology, 5 op
773641S: Surficial geology in ore exploration, advanced course 1, 5 op
773646S: Advanced field techniques, 3 op
773613S: Literature essay, 5 op
773607S: Literature study, 5 op
773608S: Special questions in Quaternary geology, 5 op
773619S: Quaternary geology seminar II, 5 op
773673S: Environmental geology and geophysicfield course, 3 op
773679S: Studies in other universities, 0 op
773615S: Studia Generalia -lectures, 2 op
773650S: Biostratigraphy: Pollen and spores, 5 op
773654S: Biostratigraphy: Diatoms, 5 op
773627S: Global environmental and climate change during the Cenozoic, 5 op
773601S: Glacial Geology II, 5 op
773655S: Sedimentology, 5 op
773657S: Pro gradu thesis, 30 op
770690S: Maturity test, 0 op

**Optional studies**

**Other optional studies**

## Master of science in geophysics (vähintään 120 op)

Completion of the Master's degree requires that the student has completed at least 60 credits of advanced studies in his/her major subject, including a 30-credit Master's thesis and related maturity test, and other studies amounting to a minimum of 60 credits. Below is a list of courses in Geophysics for your selection, divided into compulsory and elective courses. Choose the other studies in such a way that they support your field of specialization. Including opitonal advanced-level courses as much as possible in Geophysics. In addition, it is required that an entity of at least 25 ECTS credits of the following intermediate-level courses has been completed in the candidate stage or are completed during the Master's studies as bridge studies: Compulsory: 762104P Introduction to solid Earth Geophysics, 762306A Hydrology in geosciences, 762305A Geophysical research methods of rock and soil, 762107P Introduction to global environmental geophysics; Optional: 762108P GIS and spatial data 1, 762322A Geomagnetism, 762321A Seismology and the structure of the Earth.

**Compulsory advanced-level studies, major subject**

762608S: Airborne geophysics, 5 op
772684S: GIS applications, 5 op
762612S: Gravimetric and magnetic methods, 5 op
762681S: M.Sc. work (thesis and seminar), 30 op
762679S: Maturity test, 0 op
762618S: Mining geophysics, 5 op
762610S: Physical properties of rocks, 5 op
762636S: Seismic soundings, 6 op

**Optional advanced-level studies, major subject**

H325508: Optional advanced-level courses in Geophysics, 0 - 60 op

*Electives*

762645S: Field course in bedrock mapping and applied geophysics, 3 op
762661S: An advanced level course from another Finnish university, 0 op
762663S: An advanced level course from another university abroad, 0 op
762684S: Excursion, 2 op
772675S: Geophysics in economic geology, 5 op
762620S: Computers in geophysics, 3 op
762662S: Special courses in geophysics, 0 op
762624S: Electrical research methods of rock and soil, 5 op
762616S: Ground Penetrating Radar Sounding, 5 op
762630S: Modelling of electromagnetic fields, 5 op
762611S: Theory of electromagnetic methods, 5 op

762646S: Field course in environmental geology and applied geophysics, 3 op

**Optional studies**

# Geosciences, Bachelor in Science

Tutkintorakenteen tila: archived

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

## Bachelor of Sciences in geosciences (180 ECTS credits)

The Bachelor of Science degree in geology is a joint degree for all geology students. It includes 96 credits of obligatory major subject studies, which are divided into basic studies (36 cr), intermediate-level studies (43 cr), and the Bachelor thesis (9 cr) and related maturity test. It is recommended that during the Bachelor studies, the student takes a sufficient amount of intermediate-level courses in his/her future major subject to ensure that courses needed as pre-requirements for the Master`s studies are done.

**OBLIGATORY GENERAL STUDIES**

902002Y: English 1 (Reading for Academic Purposes), 2 op
902004Y: English 2 (Scientific Communication), 2 op
030005P: Information Skills, 1 op
770001Y: Orientation course for new students, 1 op
901055Y: Second Official Language (Swedish), Oral Skills (OMS), 1 op
901054Y: Second Official Language (Swedish), Written Skills (OMS), 1 op

**BASIC STUDIES IN GEOSCIENCES**

771102P: Basic course in mineralogy, 6 op
762108P: GIS and spatial data 1, 5 op
771113P: Introduction to Geology I, 5 op
771114P: Introduction to Geology II, 5 op
771116P: Introduction to Quaternary deposits of Finland and their resources, 5 op
771115P: Introduction to bedrock geology of Finland and ore geology, 5 op
762104P: Introduction to solid earth geophysics, 5 op

**OBLIGATORY INTERMEDIATE STUDIES IN GEOSCIENCES**

774301A: A Basic Course in Geochemistry, 6 op
771303A: Bachelor of Science thesis, 9 op
773344A: Basics of glacial geology, 5 op
773346A: Environmental geology, 5 op
762305A: Geophysical research methods of rock and soil, 6 op
770390A: Maturity test, 0 op
772339A: Optical mineralogy, 6 op
772386A: Ore Geology and Society, 5 op
773317A: Physical Sedimentology, 5 op
773343A: Quaternary Geology Seminar I, 5 op
772337A: Seminar in geology and mineralogy I, 5 op

**Minor studies**

780117P: General and Inorganic Chemistry A, 5 op

Select 25 credits from the Geology and mineralogy module or Quaternary geology module depending on which subject you choose as a minor subject. The degree can also contain other minor subject entities, for example, in chemistry, physics, mathematics, geography and combined entity of studies of natural sciences.

If the Geology and mineralogy module is chosen as a minor subject, other optional studies can include subject entities in  Quaternary geology, geochemistry and mining engineering and mineral processing.

If the Quaternary geology module is chosen as a minor subject, other optional studies can include subject entities in  Geology and mineralogy, geochemistry and mining engineering and mineral processing.

A325604: Geology and Mineralogy Minor, 25 op
*E2*
772334A: Bedrock mapping, 3 op
772344A: Sedimentary Petrology, 5 op
772335A: Introduction to ore mineralogy, 5 op
772310A: General mineralogy, 5 op
772316A: Structural geology, 5 op
772341A: Igneous Petrology, 7 op
772345A: Metamorphic Petrology, 6 op
771304A: Practical training, 4 - 5 op

771304A: Practical training, 4 - 5 op
A326104: Surficial Geology Minor, 25 op
*E1*
773324A: Field mapping of Quaternary deposits, 5 op
773306A: Quaternary Geology of Finland, 5 op
762306A: Hydrology in geosciences, 6 op
773322A: Surficial geology in ore exploration, 5 op
773300A: Quaternary Stratigraphy, 5 op
773347A: Technical properties of sediments I, 5 op
773348A: Technical properties of sediments II, 5 op

774304A: Analytical methods in geochemistry, 5 op
774329A: Introduction to Environmental Geochemistry, 5 op

762103P: Introduction to geophysics, 2 op
762107P: Introduction to global environmental geophysics, 5 op
802360A: Introduction to inverse problems, 4 op
762104P: Introduction to solid earth geophysics, 5 op
762321A: Seismology and the structure of the earth, 5 op

### Other studies

Other optional studies can include courses, supporting the degree, that are not part of the major and minor subject entities.

# Opintojaksojen kuvaukset

## Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

### A325603: Geology and Mineralogy, advanced studies, 60 - 85 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Study module
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

*engl*

**772632S: Regional ore geology of Fennoscandia, 5 op**

**Voimassaolo:** 01.08.2010 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

After the course students should have an understanding of the occurrence and petrogenesis of the most important ore deposits in Fennoscandia, and their main analogues in a global context. Students will thus have gained an improved capability to contribute to mineral exploration in Finland.

**Contents:**

Factors that control temporal and spatial distribution of ores, with particular focus on Finnish and Fennoscandian ore deposits, including the Finnish VMS (Pyhäsalmi, Outokumpu), chromite (Kemi), PGE (Portimo, Penikat, Konttijärvi), vanadium (Mustavaara, Koitelainen), Fe (Kolari district, Otanmäki), gold (Suurikuusikko, Pahtavaara, Pampalo), and Ni deposits (Kevitsa, Talvivaara, Vammala-Kotalahti belt), the Swedish Kiruna and Skelefteå districts, the Pechenga deposit of Russia, and the Norwegian Fe-Ti deposits.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, handspecimen examination

**Target group:**

Masters students and PhD students in geology.

**Prerequisites and co-requisites:**

Ore Geology (772385A), Igneous Petrology (772341A), Metamorphic Petrology (772345A), Introduction to Ore Mineralogy (772335A).

**Recommended optional programme components:**

Other courses of the International Master programme.

**Recommended or required reading:**

Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia **.** Geological Survey of Finland, Special Paper 53. 401 p., Maier, W., O'Brien, H., Lahtinen, R. (Eds.) (2015) Ore Deposits of Finland. Elsevier.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

**772687S: Gold deposits, 5 op**

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The students know the distribution of the major gold deposits in Finland and elsewhere, they comprehend the main models of ore formation, and can formulate criteria relevant in exploration for the various types of gold deposits.

**Contents:**

Distribution and petrogenesis of gold deposits globally.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30h, microscopy exercises

**Target group:**

Masters students and PhD students in geology.

**Prerequisites and co-requisites:**

Ore geology (772385A), Ore Mineralogy (772335A).

**Recommended or required reading:**

Hedenquist JW et al. (2005) Economic Geology 100 $^{th}$ Anniversary volume, Society of Economic Geologists, 1136 p. Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53. 401 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772667S: Seminar in ore geology, 5 op

**Voimassaolo:** 01.08.2010 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The course will enhance students' ability to construct and deliver a scientific presentation and deepen their knowledge on different ore types. Students will be able to summarize the geology and petrogenesis of selected ore deposits and present these data to a specialist audience.

**Contents:**

Students write a 20-page paper on a subject in the field of ore geology. The paper is presented in a seminar meeting with someone acting as an opponent. Each student acts as an opponent to a paper in their turn.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Independent literature studies, oral presentations by students,seminars c. 20 h.

**Target group:**

Masters and PhD students.

**Prerequisites and co-requisites:**

Bachelor,s degree.

**Recommended or required reading:**

Journal papers and Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53. 401 p
The availability of the literature can be checked from " this link".

**Assessment methods and criteria:**

Oral presentation and acting as an opponent.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

### 774636S: Geochemistry of Mining Environment, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

After completing the course, students can describe and assess environmental problems associated with metal mining. They are familiar with the chemical and mineralogical phenomena related to acid mine drainage and know how to test the acid-producing or -neutralizing capacity of rock types.

**Contents:**

Oxidation of sulphidic ores, formation of secondary minerals, water chemistry in mining environment, acid neutralisation capacity of rocks waste and its determination, factors involved in acid mining drainage (AMD) and its mitigation.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

28 h lectures

**Target group:**

Master's students in geology and mineralogy and other students interested in environmental issues.

**Prerequisites and co-requisites:**

Basic course in geochemistry (774301A), also recommended Introduction to Environmental Geochemistry (774329A).

**Recommended or required reading:**

Articles (informed separately) from the following books: Jambor, J. L., Blowes, D. W., Ritchie, A. I. M. (Eds.) (2003) Environmental Aspects of Mine Wastes, Mineralogical Association of Canada, Short Course Series, Vol. 31, 430 s., Plumlee, G.S., Logsdon, M.J. (Eds.) (1999) The Environmental Geochemistry of Mineral Deposits. Reviews in Economic Geology, Vol. 6A., Blowes et al. (2014) The Geochemistry of Acid Mine Drainage, Treatise in Geochemistry, Vol. 9.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination/essay
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

**772658S: Special issues in geology and mineralogy, 1 - 9 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

5 credits.

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The objective of the course is to provide the students with knowledge on the current developments in a special topic in geology and mineralogy. The students will have gained a deeper understanding of specific aspects of the subject.

**Contents:**

A course on a current topic given by a staff member or outside lecturer. Topics include economic geology, petrology, and mineralogy

**Mode of delivery:**

Face to face teaching

**Learning activities and teaching methods:**

30 h lectures and 10 h practical work consisting of examination of rock samples, maps or working with digital data.

**Target group:**

Masters and PhD students in geology

**Prerequisites and co-requisites:**

Bachelor in geology

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

1-5/fail

**Person responsible:**

W. Maier

**Working life cooperation:**

No

### 772615S: Literature study, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

Students acquire deep knowledge on a particular geology and mineralogy topic.

**Contents:**

Independent literature search and writing of an essay on a given theme.

**Mode of delivery:**

Independent work and personal tuition.

**Target group:**

Master's students

**Prerequisites and co-requisites:**

Bachelor's degree

**Recommended optional programme components:**

Will be informed separately.

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Report
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass /fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

### 773615S: Studia Generalia -lectures, 2 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

2 credits

**Language of instruction:**

Finnish/English

**Timing:**

4th or 5th study year

**Learning outcomes:**

Students will acquire information on the current duties and special fields of geologists working in different sectors of the society and they will learn to gather the most essential points from lectures.

**Contents:**

Students attend lectures given by external visitors having different types of careers as geologists.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Attendance of at least four lectures.

**Target group:**

All intermediate- and advanced-level geology students.

**Recommended or required reading:**

Material presented during lectures.

**Assessment methods and criteria:**

Circa 2-page reports on each lecture.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Holger Paulick

**Working life cooperation:**

No

### 772690S: Studies in other universities and colleges, 0 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

Course dependent.

**Contents:**

Courses taken in international exchange programs (Erasmus, Nordplus) or courses taken in other Finnish universities.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**

Professors

### 772695S: Magmatic ore deposits, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Shenghong Yang
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

After completion of the course students should have knowledge of the occurrence of the most important magmatic ore deposits, including PGE- Ni-Cu, Cr, V-Ti, apatite, and diamond deposits. Students are familiar with the geology, and can comprehend the petrogenesis, of the main Finnish and global magmatic mineral deposits, including the deposits at Kemi (Cr), Portimo and Penikat (PGE), and Kevitsa (Ni-Cu-PGE), Mustavaara (Fe-Ti-V) and Otanmäki (Fe-Ti-V) as well as global deposits including the Bushveld (PGE, Cr, V), Pechenga (Ni), Monchegorsk (PGE), Noril'sk (Ni-Cu-PGE), Sudbury (Ni-Cu-PGE), Kambalda (Ni), Jinchuan (Ni-Cu-PGE) and Panzhihua (Fe-Ti-V). Students will thus have gained an improved capability to contribute to exploration for magmatic ore deposits in Finland.

**Contents:**

Global distribution, geology and petrogenesis of magmatic ore deposits.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, hand-specimen examination, microscopy sessions, exploration modelling.

**Target group:**

Masters students and PhD students in geology.

**Prerequisites and co-requisites:**

Igneous Petrology (772341A).

**Recommended optional programme components:**

Other courses in the International Master's course.

**Recommended or required reading:**

Li C and Ripley EM (2011) Magmatic Ni-Cu and PGE deposits: geology, geochemistry, and genesis. Reviews in Economic Geology, vol. 17, Society of Economic Geologists; Hedenquist JW et al. (2005) Economic Geology 100 $^{th}$ Anniversary volume, Society of Economic Geologists, 1136 p.

**Assessment methods and criteria:**

Examination

**Grading:**

5-1/fail

**Person responsible:**

Sheng-Hong Yang

**Working life cooperation:**

No

### 772692S: Hydrothermal ore deposits, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

**ECTS Credits:**

5 cr

**Language of instruction:**

English

**Timing:**

4$^{th}$ or 5$^{th}$ year

**Learning outcomes:**

4th or 5th year Students have a knowledge of the distribution of the main hydrothermal ore deposits in Finland, including the Finnish VMS belt, the Kolari Fe-Au skarn deposits, Talvivaara Ni deposit, and Suurikuusikko Au deposit, as well as the most important hydrothermal ore deposits globally, e.g. the porphyry Cu-Mo deposits of the Cordillera, orogenic gold deposits of the Yilgarn craton, Carlin-type gold deposits, MVT deposits.

**Contents:**

Global distribution and petro-genesis of hydrothermal ore deposits.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, hand-specimen examination and microscopy exercises 6 h

**Target group:**

Master's students and PhD students in geology

**Prerequisites and co-requisites:**

Igneous Petrology (772341A), Metamorphic petrology (772345A)

**Recommended optional programme components:**

Other courses in the International Master programme

**Recommended or required reading:**

Hedenquist JW et al. (2005) Economic Geoogy 100th Anniversary volume, Society of Economic Geologists, 1136 p.
Mineralium Deposita, Vol. 46, Nr. 5–6 (A thematic issue on the Geological setting and genesis of VMS deposits)
Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53. 401 p.

**Assessment methods and criteria:**

Examination

**Grading:**

5–1/fail

**Person responsible:**

Holger Paulick

**Working life cooperation:**

no

### 772693S: Sedimentary ore deposits, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

### 772675S: Geophysics in economic geology, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Elena Kozlovskaya
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The students comprehend the main techniques used in exploration geophysics and have become familiar with a number of casa studies. They should be able to interpret basic geophysical data and their importance in target evaluation.

**Contents:**

Geophysical methods in exploration and their use in exploration targeting.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures, data interpretation exercises.

**Target group:**

Master's students and PhD students in geology.

**Prerequisites and co-requisites:**

Bachelor's degree.

**Recommended or required reading:**

Reynolds, J.M. (2011) An Introduction to Applied and Environmental Geophysics, Wiley-Blackwell
Everett M.E. (2013) Near-Surface Applied Geophysics. Cambridge University Press.
Kearey, P., Brooks, M., Hill, I. (2002) An Introduction to Geophysical Exploration. Blackwell Science.
Geophysical methods, in: Moon et al. (2009) Introduction to Mineral Exploration, Blackwell
The availability of the literature can be checked from " this link".

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Elena Kozlovskaya

**Working life cooperation:**

No

**Other information:**

-

**772628S: Layered intrusions and their ore deposits, 5 op**

**Voimassaolo:** 01.08.2009 -

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Shenghong Yang
**Opintokohteen kielet:** English

**ECTS Credits:**

5 cr

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

By the end of this course students should have an understanding of the origin of igneous layering, the processes that control the generation and emplacement of the magmas, and the formation of the ore deposits associated with layered intrusions. Students will be able to compare layered igneous bodies to the world's main layered intrusions (notably Bushveld Complex, Great Dyke, Stillwater Complex, Skaergaard Monchegorsk, and Panzhihua) in terms of stratigraphy, petrogenesis and mineralization potential. In particular, students will be able to assess the economic potential of Finnish layered intrusions.

**Contents:**

Layered intrusions in space and time, mineralogy, petrology, stratigraphy and ore-forming processes in layered intrusions. Examination of rock textures and mineralogy under the microscope and exploration modeling.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures, 12 h exercises

**Target group:**

Masters students and PhD students in geology

**Prerequisites and co-requisites:**

Igneous petrology, Ore geology. Other courses in International Master programme

**Recommended or required reading:**

Cawthorn, R.G. (1996) Layered Intrusions. Elsevier, 531 p.,
Charlier, B., Namur, O., Latypov, R., Tegner, C. (2015) Layered Intrusions. Springer, 748 p

**Assessment methods and criteria:**

Examination

**Grading:**

5–1/fail

**Person responsible:**

Sheng-Hong Yang

**Working life cooperation:**

no

**772608S: Mining geology, 3 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay772608S Mining geology (OPEN UNI) 3.0 op

Ei opintojaksokuvauksia.

### 772694S: Geometallurgy and mineral processing, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Pertti Lamberg

**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

Upon completion of the course students should be able to: 1) Describe the principles of different areas of Geometallurgy (ore geology, process mineralogy, minerals processing, modeling and simulation) and how they are linked in a geometallurgical concept. 2) Use different research and analytical methods of importance for Geometallurgy and interpret the results. 3) Evaluate, analyze and interpret the geometallurgical data in a quantitative way. 4) Design a geometallurgical sampling, analysis and research campaign. 5) Design a geometallurgical program.

**Contents:**

The course will introduce main parts of the Geometallurgy: 1) ore geology, 2) process mineralogy and 3) minerals processing. The focus is in process mineralogy, mineral processing and in assimilating the geo-metallurgical concept. Exercises, assignments and seminars concentrate on practical aspects of Geometallurgy needed in mining industry.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures and PC classes with assignments 33 h.

**Target group:**

geology majors, minor subject students. Prerequisites and co-requisites: Ore geology (772385A), Introduction to Ore mineralogy (772335A).

**Prerequisites and co-requisites:**

Ore geology (772385A), Ore microscopy (772335A).

**Recommended optional programme components:**

ü Petruk, W. (2000) Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.
ü Wills, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.
ü Becker et al. (2016) Process Mineralogy, JKMRC Monograph Series in Mining and Mineral Processing: No. 6, ISBN: 978-1-74272-171-2

**Recommended or required reading:**

Petruk, W. (2000). Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.
Will, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Laboratory classes, Geometallurgical investigations (for the seminar) and the seminars are compulsory. Seminars, the investigation and the opposition are each awarded points based on the attained level. Assignments and reports must be delivered in time or there will be an automatic deduction of points. The total points production determines the grand grade of the course, and it is given on the scale Fail-1-5.
. For grade 1, the student must be able to describe different parts and procedures of Geometallurgy and to conduct a routine geometallurgical analysis.
. For grade 2, the student must be able to collect geometallurgical data and perform an analysis with interpretation.
. For grade 3 the student must be able to evaluate and interpret geometallurgical data provided by different analytical and research techniques and to report the results.
. For grade 4, the student must be able to design geometallurgical campaign, interpret the result and establish a geometallurgical program.
. For grade 5, the student must be able to apply the acquired skills to a new geometallurgical case, interpret, report and present the results and to defend the conclusions.

**Grading:**

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

**Person responsible:**

Jussi Liipo

**Working life cooperation:**

No

### 772640S: Excursion, 5 op

**Voimassaolo:** 01.08.2010 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The objective is to widen the student's field experience. Through exposure to novel geologic environments, students will have learnt to appreciate the diversity of geologic processes and environments on Earth.

**Contents:**

Introduction to Finnish or foreign geological field targets. Excursions typically last 1-2 weeks and consist of visits to field outcrops, as well as discussion of exposed structures and rocks. Past excursions went to Finland, Spain, South Africa, Norway and Iceland.

**Mode of delivery:**

Face to face in field or mine.

**Learning activities and teaching methods:**

Pre-excursion seminar, field techniques, excursion.

**Target group:**

Master students and PhD students in geology.

**Recommended or required reading:**

Other reading will be informed separately depending on excursion destination.

**Assessment methods and criteria:**

Pre-excursion seminar, field protocol.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772613S: Bedrock geology of Finland, 6 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

### 774637S: Isotope geochemistry for economic geologists, 6 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

### 772684S: GIS applications, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Moisio, Kari Juhani
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4 th or 5 th year, spring

**Learning outcomes:**

After the course, students can utilise the possibilities of the geographic information system in geological research and specific methods of spatial data analyses.

**Contents:**

This course focuses more on the capabilities of the GIS-software and the possibilities they offer in presenting and analyzing spatial data in practical exercises.

**Mode of delivery:**

Face to face teaching and exercises.

**Learning activities and teaching methods:**

Lectures and practicals totalling 30 h, plus independent study. Course is passed by returning exercise reports

**Target group:**

Students of Oulu Mining School and Faculties of science and technology etc

**Prerequisites and co-requisites:**

Course GIS and spatial data 1 or equivalent, basics of GIS

**Recommended optional programme components:**

Exercise materials

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Assessment is based on the evaluation of the written reports of exercises

**Grading:**

Numerical grading scale 0 – 5, where 0 = fail

**Person responsible:**

Kari Moisio

**Working life cooperation:**

No

**Other information:**

-

**772666S: Master's thesis, 30 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Diploma thesis

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

35 credits

**Language of instruction:**

Finnish, English

**Timing:**

5th year

**Learning outcomes:**

Upon completing a Master’s thesis, students will gain advanced understanding on a subject belonging economic geology or geology and mineralogy in generally. They will be able to use and apply pertinent

research methods and theoretical knowledge of their research field, make independent inferences from their observations and measurements, and utilise effectively scientific literature.

**Mode of delivery:**

Students carry out a personal research project, which is normally based field and/or laboratory work, and they write a Master's thesis (pro gradu) on the results. The topic of the thesis is agreed with the supervisor from the department and with other potential internal or external supervisors. Personal guidance is given by the supervisor(s) during the research and writing stage. The official reviewers of the thesis are decided by the chair of the educational programme board of the department after the proposal of the professor of the discipline and the thesis is accepted and rated by the educational programme board.

**Target group:**

All Master's level geoscience students.

**Prerequisites and co-requisites:**

Sufficient amount of intermediate- and advanced-level courses to enable the student to start independent research work.

**Recommended or required reading:**

Reading is decided separately in each case.

**Assessment methods and criteria:**

Thesis
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Professors, lecturers

**Working life cooperation:**

Yes (commonly)

### 770690S: Maturity test, 0 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

0 credits

**Language of instruction:**

Finnish or English

**Timing:**

5th year

**Learning outcomes:**

The student can write an informative abstract on his/her M.Sc. thesis.

**Contents:**

The student describes and analyses the material, research methods, and results of his/her M.Sc. thesis.

**Mode of delivery:**

Independent work

**Learning activities and teaching methods:**

Independent work

**Target group:**

Compulsory for all M.Sc. students in geosciences.

**Prerequisites and co-requisites:**

Written after the completion of the Master's thesis.

**Recommended optional programme components:**

No alternative course units.

**Recommended or required reading:**

No special reading (material of the M.Sc. thesis).

**Assessment methods and criteria:**

One-page abstract, which is written on a special form provided by the faculty.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Supervisor of the Master's thesis.

**Working life cooperation:**

No work practise.

## A325603: Geology and Mineralogy, advanced studies, 60 - 85 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Study module
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

*engl*

### 772632S: Regional ore geology of Fennoscandia, 5 op

**Voimassaolo:** 01.08.2010 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

After the course students should have an understanding of the occurrence and petrogenesis of the most important ore deposits in Fennoscandia, and their main analogues in a global context. Students will thus have gained an improved capability to contribute to mineral exploration in Finland.

**Contents:**

Factors that control temporal and spatial distribution of ores, with particular focus on Finnish and Fennoscandian ore deposits, including the Finnish VMS (Pyhäsalmi, Outokumpu), chromite (Kemi), PGE

(Portimo, Penikat, Konttijärvi), vanadium (Mustavaara, Koitelainen), Fe (Kolari district, Otanmäki), gold (Suurikuusikko, Pahtavaara, Pampalo), and Ni deposits (Kevitsa, Talvivaara, Vammala-Kotalahti belt), the Swedish Kiruna and Skelefteå districts, the Pechenga deposit of Russia, and the Norwegian Fe-Ti deposits.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, handspecimen examination

**Target group:**

Masters students and PhD students in geology.

**Prerequisites and co-requisites:**

Ore Geology (772385A), Igneous Petrology (772341A), Metamorphic Petrology (772345A), Introduction to Ore Mineralogy (772335A).

**Recommended optional programme components:**

Other courses of the International Master programme.

**Recommended or required reading:**

Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia **.** Geological Survey of Finland, Special Paper 53. 401 p., Maier, W., O'Brien, H., Lahtinen, R. (Eds.) (2015) Ore Deposits of Finland. Elsevier.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772687S: Gold deposits, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The students know the distribution of the major gold deposits in Finland and elsewhere, they comprehend the main models of ore formation, and can formulate criteria relevant in exploration for the various types of gold deposits.

**Contents:**

Distribution and petrogenesis of gold deposits globally.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30h, microscopy exercises

**Target group:**

Masters students and PhD students in geology.

**Prerequisites and co-requisites:**

Ore geology (772385A), Ore Mineralogy (772335A).

**Recommended or required reading:**

Hedenquist JW et al. (2005) Economic Geology 100 th Anniversary volume, Society of Economic Geologists, 1136 p. Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53. 401 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772667S: Seminar in ore geology, 5 op

**Voimassaolo:** 01.08.2010 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The course will enhance students' ability to construct and deliver a scientific presentation and deepen their knowledge on different ore types. Students will be able to summarize the geology and petrogenesis of selected ore deposits and present these data to a specialist audience.

**Contents:**

Students write a 20-page paper on a subject in the field of ore geology. The paper is presented in a seminar meeting with someone acting as an opponent. Each student acts as an opponent to a paper in their turn.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Independent literature studies, oral presentations by students,seminars c. 20 h.

**Target group:**

Masters and PhD students.

**Prerequisites and co-requisites:**

Bachelor,s degree.

**Recommended or required reading:**

Journal papers and Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53. 401 p
The availability of the literature can be checked from " this link".

**Assessment methods and criteria:**

Oral presentation and acting as an opponent.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

### 774636S: Geochemistry of Mining Environment, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

After completing the course, students can describe and assess environmental problems associated with metal mining. They are familiar with the chemical and mineralogical phenomena related to acid mine drainage and know how to test the acid-producing or -neutralizing capacity of rock types.

**Contents:**

Oxidation of sulphidic ores, formation of secondary minerals, water chemistry in mining environment, acid neutralisation capacity of rocks waste and its determination, factors involved in acid mining drainage (AMD) and its mitigation.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

28 h lectures

**Target group:**

Master's students in geology and mineralogy and other students interested in environmental issues.

**Prerequisites and co-requisites:**

Basic course in geochemistry (774301A), also recommended Introduction to Environmental Geochemistry (774329A).

**Recommended or required reading:**

Articles (informed separately) from the following books: Jambor, J. L., Blowes, D. W., Ritchie, A. I. M. (Eds.) (2003) Environmental Aspects of Mine Wastes, Mineralogical Association of Canada, Short Course Series, Vol. 31, 430 s., Plumlee, G.S., Logsdon, M.J. (Eds.) (1999) The Environmental Geochemistry of

Mineral Deposits. Reviews in Economic Geology, Vol. 6A., Blowes et al. (2014) The Geochemistry of Acid Mine Drainage, Treatise in Geochemistry, Vol. 9.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination/essay
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

### 772658S: Special issues in geology and mineralogy, 1 - 9 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

5 credits.

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The objective of the course is to provide the students with knowledge on the current developments in a special topic in geology and mineralogy. The students will have gained a deeper understanding of specific aspects of the subject.

**Contents:**

A course on a current topic given by a staff member or outside lecturer. Topics include economic geology, petrology, and mineralogy

**Mode of delivery:**

Face to face teaching

**Learning activities and teaching methods:**

30 h lectures and 10 h practical work consisting of examination of rock samples, maps or working with digital data.

**Target group:**

Masters and PhD students in geology

**Prerequisites and co-requisites:**

Bachelor in geology

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

1-5/fail

**Person responsible:**

W. Maier

**Working life cooperation:**

No

### 772615S: Literature study, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

Students acquire deep knowledge on a particular geology and mineralogy topic.

**Contents:**

Independent literature search and writing of an essay on a given theme.

**Mode of delivery:**

Independent work and personal tuition.

**Target group:**

Master's students

**Prerequisites and co-requisites:**

Bachelor's degree

**Recommended optional programme components:**

Will be informed separately.

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Report
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass /fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

### 773615S: Studia Generalia -lectures, 2 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

2 credits

**Language of instruction:**

Finnish/English

**Timing:**

4th or 5th study year

**Learning outcomes:**

Students will acquire information on the current duties and special fields of geologists working in different sectors of the society and they will learn to gather the most essential points from lectures.

**Contents:**

Students attend lectures given by external visitors having different types of careers as geologists.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Attendance of at least four lectures.

**Target group:**

All intermediate- and advanced-level geology students.

**Recommended or required reading:**

Material presented during lectures.

**Assessment methods and criteria:**

Circa 2-page reports on each lecture.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Holger Paulick

**Working life cooperation:**

No

### 772690S: Studies in other universities and colleges, 0 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

Course dependent.

**Contents:**

Courses taken in international exchange programs (Erasmus, Nordplus) or courses taken in other Finnish universities.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**

Professors

**772695S: Magmatic ore deposits, 5 op**

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Shenghong Yang
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

After completion of the course students should have knowledge of the occurrence of the most important magmatic ore deposits, including PGE- Ni-Cu, Cr, V-Ti, apatite, and diamond deposits. Students are familiar with the geology, and can comprehend the petrogenesis, of the main Finnish and global magmatic mineral deposits, including the deposits at Kemi (Cr), Portimo and Penikat (PGE), and Kevitsa (Ni-Cu-PGE), Mustavaara (Fe-Ti-V) and Otanmäki (Fe-Ti-V) as well as global deposits including the Bushveld (PGE, Cr, V), Pechenga (Ni), Monchegorsk (PGE), Noril'sk (Ni-Cu-PGE), Sudbury (Ni-Cu-PGE), Kambalda (Ni), Jinchuan (Ni-Cu-PGE) and Panzhihua (Fe-Ti-V). Students will thus have gained an improved capability to contribute to exploration for magmatic ore deposits in Finland.

**Contents:**

Global distribution, geology and petrogenesis of magmatic ore deposits.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, hand-specimen examination, microscopy sessions, exploration modelling.

**Target group:**

Masters students and PhD students in geology.

**Prerequisites and co-requisites:**

Igneous Petrology (772341A).

**Recommended optional programme components:**

Other courses in the International Master's course.

**Recommended or required reading:**

Li C and Ripley EM (2011) Magmatic Ni-Cu and PGE deposits: geology, geochemistry, and genesis. Reviews in Economic Geology, vol. 17, Society of Economic Geologists; Hedenquist JW et al. (2005) Economic Geology 100 $^{th}$ Anniversary volume, Society of Economic Geologists, 1136 p.

**Assessment methods and criteria:**

Examination

**Grading:**

5-1/fail

**Person responsible:**

Sheng-Hong Yang

**Working life cooperation:**

No

**772692S: Hydrothermal ore deposits, 5 op**

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

**ECTS Credits:**

5 cr

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

4th or 5th year Students have a knowledge of the distribution of the main hydrothermal ore deposits in Finland, including the Finnish VMS belt, the Kolari Fe-Au skarn deposits, Talvivaara Ni deposit, and Suurikuusikko Au deposit, as well as the most important hydrothermal ore deposits globally, e.g. the porphyry Cu-Mo deposits of the Cordillera, orogenic gold deposits of the Yilgarn craton, Carlin-type gold deposits, MVT deposits.

**Contents:**

Global distribution and petro-genesis of hydrothermal ore deposits.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, hand-specimen examination and microscopy exercises 6 h

**Target group:**

Master's students and PhD students in geology

**Prerequisites and co-requisites:**

Igneous Petrology (772341A), Metamorphic petrology (772345A)

**Recommended optional programme components:**

Other courses in the International Master programme

**Recommended or required reading:**

Hedenquist JW et al. (2005) Economic Geoogy 100th Anniversary volume, Society of Economic Geologists, 1136 p.
Mineralium Deposita, Vol. 46, Nr. 5–6 (A thematic issue on the Geological setting and genesis of VMS deposits)
Eilu P (Ed.) (2012) Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53. 401 p.

**Assessment methods and criteria:**

Examination

**Grading:**

5–1/fail

**Person responsible:**

Holger Paulick

**Working life cooperation:**

no

### 772693S: Sedimentary ore deposits, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

### 772675S: Geophysics in economic geology, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Elena Kozlovskaya
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The students comprehend the main techniques used in exploration geophysics and have become familiar with a number of casa studies. They should be able to interpret basic geophysical data and their importance in target evaluation.

**Contents:**

Geophysical methods in exploration and their use in exploration targeting.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures, data interpretation exercises.

**Target group:**

Master's students and PhD students in geology.

**Prerequisites and co-requisites:**

Bachelor's degree.

**Recommended or required reading:**

Reynolds, J.M. (2011) An Introduction to Applied and Environmental Geophysics, Wiley-Blackwell
Everett M.E. (2013) Near-Surface Applied Geophysics. Cambridge University Press.
Kearey, P., Brooks, M., Hill, I. (2002) An Introduction to Geophysical Exploration. Blackwell Science.
Geophysical methods, in: Moon et al. (2009) Introduction to Mineral Exploration, Blackwell

The availability of the literature can be checked from " this link".

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Elena Kozlovskaya

**Working life cooperation:**

No

**Other information:**

-

### 772628S: Layered intrusions and their ore deposits, 5 op

**Voimassaolo:** 01.08.2009 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Shenghong Yang
**Opintokohteen kielet:** English

**ECTS Credits:**

5 cr

**Language of instruction:**

English

**Timing:**

$4^{th}$ or $5^{th}$ year

**Learning outcomes:**

By the end of this course students should have an understanding of the origin of igneous layering, the processes that control the generation and emplacement of the magmas, and the formation of the ore deposits associated with layered intrusions. Students will be able to compare layered igneous bodies to the world's main layered intrusions (notably Bushveld Complex, Great Dyke, Stillwater Complex, Skaergaard Monchegorsk, and Panzhihua) in terms of stratigraphy, petrogenesis and mineralization potential. In particular, students will be able to assess the economic potential of Finnish layered intrusions.

**Contents:**

Layered intrusions in space and time, mineralogy, petrology, stratigraphy and ore-forming processes in layered intrusions. Examination of rock textures and mineralogy under the microscope and exploration modeling.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures, 12 h exercises

**Target group:**

Masters students and PhD students in geology

**Prerequisites and co-requisites:**

Igneous petrology, Ore geology. Other courses in International Master programme

**Recommended or required reading:**

Cawthorn, R.G. (1996) Layered Intrusions. Elsevier, 531 p.,
Charlier, B., Namur, O., Latypov, R., Tegner, C. (2015) Layered Intrusions. Springer, 748 p

**Assessment methods and criteria:**

Examination

**Grading:**

5–1/fail

**Person responsible:**

Sheng-Hong Yang

**Working life cooperation:**

no

### 772608S: Mining geology, 3 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** Finnish
**Leikkaavuudet:**

ay772608S Mining geology (OPEN UNI) 3.0 op

Ei opintojaksokuvauksia.

### 772694S: Geometallurgy and mineral processing, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Pertti Lamberg
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

Upon completion of the course students should be able to: 1) Describe the principles of different areas of Geometallurgy (ore geology, process mineralogy, minerals processing, modeling and simulation) and how they are linked in a geometallurgical concept. 2) Use different research and analytical methods of importance for Geometallurgy and interpret the results. 3) Evaluate, analyze and interpret the geometallurgical data in a quantitative way. 4) Design a geometallurgical sampling, analysis and research campaign. 5) Design a geometallurgical program.

**Contents:**

The course will introduce main parts of the Geometallurgy: 1) ore geology, 2) process mineralogy and 3) minerals processing. The focus is in process mineralogy, mineral processing and in assimilating the geo-metallurgical concept. Exercises, assignments and seminars concentrate on practical aspects of Geometallurgy needed in mining industry.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures and PC classes with assignments 33 h.

**Target group:**

geology majors, minor subject students. Prerequisites and co-requisites: Ore geology (772385A), Introduction to Ore mineralogy (772335A).

**Prerequisites and co-requisites:**

Ore geology (772385A), Ore microscopy (772335A).

**Recommended optional programme components:**

ü Petruk, W. (2000) Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.
ü Wills, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.
ü Becker et al. (2016) Process Mineralogy, JKMRC Monograph Series in Mining and Mineral Processing: No. 6, ISBN: 978-1-74272-171-2

**Recommended or required reading:**

Petruk, W. (2000). Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.
Will, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Laboratory classes, Geometallurgical investigations (for the seminar) and the seminars are compulsory. Seminars, the investigation and the opposition are each awarded points based on the attained level. Assignments and reports must be delivered in time or there will be an automatic deduction of points. The total points production determines the grand grade of the course, and it is given on the scale Fail-1-5.
. For grade 1, the student must be able to describe different parts and procedures of Geometallurgy and to conduct a routine geometallurgical analysis.
. For grade 2, the student must be able to collect geometallurgical data and perform an analysis with interpretation.
. For grade 3 the student must be able to evaluate and interpret geometallurgical data provided by different analytical and research techniques and to report the results.
. For grade 4, the student must be able to design geometallurgical campaign, interpret the result and establish a geometallurgical program.
. For grade 5, the student must be able to apply the acquired skills to a new geometallurgical case, interpret, report and present the results and to defend the conclusions.

**Grading:**

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

**Person responsible:**

Jussi Liipo

**Working life cooperation:**

No

### 772640S: Excursion, 5 op

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The objective is to widen the student's field experience. Through exposure to novel geologic environments, students will have learnt to appreciate the diversity of geologic processes and environments on Earth.

**Contents:**

Introduction to Finnish or foreign geological field targets. Excursions typically last 1-2 weeks and consist of visits to field outcrops, as well as discussion of exposed structures and rocks. Past excursions went to Finland, Spain, South Africa, Norway and Iceland.

**Mode of delivery:**

Face to face in field or mine.

**Learning activities and teaching methods:**

Pre-excursion seminar, field techniques, excursion.

**Target group:**

Master students and PhD students in geology.

**Recommended or required reading:**

Other reading will be informed separately depending on excursion destination.

**Assessment methods and criteria:**

Pre-excursion seminar, field protocol.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772613S: Bedrock geology of Finland, 6 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

### 774637S: Isotope geochemistry for economic geologists, 6 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

**772684S: GIS applications, 5 op**

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Moisio, Kari Juhani
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4 th or 5 th year, spring

**Learning outcomes:**

After the course, students can utilise the possibilities of the geographic information system in geological research and specific methods of spatial data analyses.

**Contents:**

This course focuses more on the capabilities of the GIS-software and the possibilities they offer in presenting and analyzing spatial data in practical exercises.

**Mode of delivery:**

Face to face teaching and exercises.

**Learning activities and teaching methods:**

Lectures and practicals totalling 30 h, plus independent study. Course is passed by returning exercise reports

**Target group:**

Students of Oulu Mining School and Faculties of science and technology etc

**Prerequisites and co-requisites:**

Course GIS and spatial data 1 or equivalent, basics of GIS

**Recommended optional programme components:**

Exercise materials

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Assessment is based on the evaluation of the written reports of exercises

**Grading:**

Numerical grading scale 0 – 5, where 0 = fail

**Person responsible:**

Kari Moisio

**Working life cooperation:**

No

**Other information:**

-

**772666S: Master's thesis, 30 op**

**Opiskelumuoto:** Advanced Studies
**Laji:** Diploma thesis
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

35 credits

**Language of instruction:**

Finnish, English

**Timing:**

5th year

**Learning outcomes:**

Upon completing a Master’s thesis, students will gain advanced understanding on a subject belonging economic geology or geology and mineralogy in generally. They will be able to use and apply pertinent research methods and theoretical knowledge of their research field, make independent inferences from their observations and measurements, and utilise effectively scientific literature.

**Mode of delivery:**

Students carry out a personal research project, which is normally based field and/or laboratory work, and they write a Master’s thesis (pro gradu) on the results. The topic of the thesis is agreed with the supervisor from the department and with other potential internal or external supervisors. Personal guidance is given by the supervisor(s) during the research and writing stage. The official reviewers of the thesis are decided by the chair of the educational programme board of the department after the proposal of the professor of the discipline and the thesis is accepted and rated by the educational programme board.

**Target group:**

All Master's level geoscience students.

**Prerequisites and co-requisites:**

Sufficient amount of intermediate- and advanced-level courses to enable the student to start independent research work.

**Recommended or required reading:**

Reading is decided separately in each case.

**Assessment methods and criteria:**

Thesis
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Professors, lecturers

**Working life cooperation:**

Yes (commonly)

**770690S: Maturity test, 0 op**

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

0 credits

**Language of instruction:**

Finnish or English

**Timing:**

5th year

**Learning outcomes:**

The student can write an informative abstract on his/her M.Sc. thesis.

**Contents:**

The student describes and analyses the material, research methods, and results of his/her M.Sc. thesis.

**Mode of delivery:**

Independent work

**Learning activities and teaching methods:**

Independent work

**Target group:**

Compulsory for all M.Sc. students in geosciences.

**Prerequisites and co-requisites:**

Written after the completion of the Master's thesis.

**Recommended optional programme components:**

No alternative course units.

**Recommended or required reading:**

No special reading (material of the M.Sc. thesis).

**Assessment methods and criteria:**

One-page abstract, which is written on a special form provided by the faculty.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Supervisor of the Master's thesis.

**Working life cooperation:**

No work practise.

## 772685S: Work practice II, 4 op

**Voimassaolo:** 01.01.2013 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Practical training
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

## A326103: Surficial Geology, advanced studies, 60 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Study module
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

*engl*

**773616S: Aerial photo interpretation in surficial geology, 5 op**

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th year

**Learning outcomes:**

Upon completion of the course, students should be able to identify and interpret basic landforms from air photographs.

**Contents:**

Basics of air photograph interpretation; identification of landforms from air photographs and topographical maps; mapping based on air photograph interpretation and the necessary field research. Students compile a map of a small area.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

20 h lectures, 30 h exercises

**Target group:**

Master's level geoscience students.

**Prerequisites and co-requisites:**

Quaternary geology of Finland (773306A), Basics of glacial geology (773303A).

**Assessment methods and criteria:**

Pre-examination, exercises and written examination.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka and Tiina Eskola

**Working life cooperation:**

No

**Other information:**

Obligatory in Master of Science degree in Quaternary geology.

**773641S: Surficial geology in ore exploration, advanced course 1, 5 op**

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course, students have gained knowledge of the mode of occurrence of elements in surficial deposits, research methods of heavy minerals and their use in ore exploration.

**Contents:**

Mode of occurrence of elements in surficial deposits; research methods of occurrence of elements; using partial extraction methods; separating different fractions from a sample; heavy mineral prospecting; mineral determinations and analysis; defining mechanisms of dispersion.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures

**Target group:**

Master's level geoscience students.

**Prerequisites and co-requisites:**

Surficial geology in ore exploration (73322A).

**Recommended or required reading:**

McClenaghan, M., Bobrowsky, P.T., Hall, G.E.M. & Cook, S.J. (2001) Drift Exploration in Glaciated Terrain, Geological Society Special Publication N:o 185, 350 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773646S: Advanced field techniques, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

3 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course the student will be able to use a range of field techniques required in Quaternary Geology research projects (e.g. aerial image, sedimentological, drilling, ground penetrating techniques).

**Contents:**

Field course comprises planning and implemetation of geological methods to collect geological data (sedimentological, geomorphological and geophysical data) from a preselected field area.

**Mode of delivery:**

Face to face in class and field.

**Learning activities and teaching methods:**

Field course, 40 h teaching and exercise in the field.

**Target group:**

Advanced-level geology students.

**Prerequisites and co-requisites:**

Bachelor of Science degree.

**Assessment methods and criteria:**

Participation in the field course.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773613S: Literature essay, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Students search for relevant literature on given topic and write an essay with proper reference procedure.

**Contents:**

Student searches literature on the given topic and writes an essay.

**Mode of delivery:**

Independent working

**Learning activities and teaching methods:**

Reading literature and writing an essay.

**Target group:**

Master's level geoscience students.

**Prerequisites and co-requisites:**

Introduction to geology II (771114P), Quaternary geology of Finland (773306A), Basics of glacial geology (773344A).

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Writing an essay
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773607S: Literature study, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Students acquire deep knowledge on a particular surficial geology topic.

**Contents:**

Independent literature search and construction of a report on a given theme.

**Mode of delivery:**

Independent work.

**Learning activities and teaching methods:**

Essay writing.

**Target group:**

Advanced-level students in Quaternary geology.

**Prerequisites and co-requisites:**

Introduction to geology II (771114P), Quaternary geology of Finland (773306A), Basics of glacial geology (773344A).

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Essay
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773608S: Special questions in Quaternary geology, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course, the student will be able to critically asses and analyze recent research results of the chosen topic lectured.

**Contents:**

Guest lecture course on recent advances in Quaternary Geology.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures

**Target group:**

Master's level Quaternary geology students.

**Prerequisites and co-requisites:**

Bachelor of Science degree.

**Recommended or required reading:**

Announced separately.

**Assessment methods and criteria:**

Attending lectures and written examination.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773619S: Quaternary geology seminar II, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

The objective is to enhance students' ability to construct and give a scientific presentation on a subject of their field.

**Contents:**

Students prepare and give an oral presentation (about 30 minutes) on a subject that has required independent work and judgement. Each participant acts once as an opponent. Active class participation required.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Seminar

**Target group:**

Master's students in Quaternary geology.

**Prerequisites and co-requisites:**

Introduction to Geology II (771114P), Quaternary geology of Finland (773306A), Basics of glacial geology (773344A).

**Recommended or required reading:**

Will be informed separately.

**Assessment methods and criteria:**

Oral presentation and acting as an opponent and an essay.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773673S: Environmental geology and geophysicfield course, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

3 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

After conducted the course student can well-founded choose and specify which kind geophysical measurements must be used in different surficial environments.

**Contents:**

Course gives basic knowledge and skills for studying Quaternary landforms, their consistency, ground water questions and environmental issues with geological and geophysical methods.

**Mode of delivery:**

Face to face in the field.

**Learning activities and teaching methods:**

8 h lectures, 32 h exercises in the field.

**Target group:**

Students majoring in Quaternary geology.

**Prerequisites and co-requisites:**

Introduction to Geology II (771114P), Quaternary geology of Finland (773306A), Basics of glacial geology (773344A).

**Recommended or required reading:**

Material delivered during the course.

**Assessment methods and criteria:**

Attending lectures and written report.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Kari Moisio, Juha Pekka Lunkka

**Working life cooperation:**

No

### 773679S: Studies in other universities, 0 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

Varies depending on the original course.

**Learning outcomes:**

Dependend on the course.

**Contents:**

Courses taken in international exchange programmes (Erasmus, Nordplus) or courses taken in other Finnish universities.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**

Professor responsible of the subject in question.

### 773615S: Studia Generalia -lectures, 2 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

2 credits

**Language of instruction:**

Finnish/English

**Timing:**

4th or 5th study year

**Learning outcomes:**

Students will acquire information on the current duties and special fields of geologists working in different sectors of the society and they will learn to gather the most essential points from lectures.

**Contents:**

Students attend lectures given by external visitors having different types of careers as geologists.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Attendance of at least four lectures.

**Target group:**

All intermediate- and advanced-level geology students.

**Recommended or required reading:**

Material presented during lectures.

**Assessment methods and criteria:**

Circa 2-page reports on each lecture.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Holger Paulick

**Working life cooperation:**

No

### 773650S: Biostratigraphy: Pollen and spores, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Tiina Eskola
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course, students should be able to prepare pollen samples in the laboratory and identify the most common pollen types and spores in Finland.

**Contents:**

Theory of the pollen analysis and laboratory methods, the most common pollen and spore types, manufacturing preparations, sediment analysis.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 20 h/ exercises 38 h/ independent work 40 h.

**Target group:**

The course unit is aimed primarily at major subject students.

**Prerequisites and co-requisites:**

Introduction to Geology II (771114P).

**Recommended or required reading:**

Handouts and Bennett, K.D. & Willis, K.J. (2001) Pollen. In: Smol, J.P., Birks, H.J.B., Last, W.M. (Eds.). Tracking Environmental Change Using Lake Sediments. Volume 3: Terrestrial, Algal, and Siliceous Indicators. Kluwer, Dordrecht, The Netherlands, pp. 5 - 32. Berglund, B. (Ed.) (1988) Handbook of Holocene Palaeoecology and Palaeohydrology. Wiley & Sons, p. 455-484.

**Assessment methods and criteria:**

Students participate actively in teaching, written report and an examination.

**Grading:**

Pass/fail

**Person responsible:**

Tiina Eskola

**Working life cooperation:**

No

### 773654S: Biostratigraphy: Diatoms, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Tiina Eskola
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course, students should be able to prepare diatom samples in the laboratory and identify some of the most general diatoms in Finland.

**Contents:**

Theory of the diatom analysis and laboratory methods, the most general diatom genera and species, manufacturing preparations, sediment analysis.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 22 h/ exercises 42 h/ independent work 30 h.

**Target group:**

The course unit is aimed primarily at major subject students.

**Prerequisites and co-requisites:**

Basic studies in geosciences.

**Recommended or required reading:**

Handouts and Battarbee, R.W., Jones, V.J., Flower, R.J., Cameron, N.g., Bennion, H., Varvalho, L., Juggins, S. (2001) Diatoms. In: Smol, J.P., Birks, H.J.B., Last, W.M. (Eds.). Tracking Environmental Change Using Lake Sediments. Volume 3: Terrestrial, Algal, and Siliceous Indicators. Kluwer, Dordrecht, The Netherlands, pp. 155 - 202. Berglund, B. (Ed.) (1988) Handbook of Holocene Palaeoecology and Palaeohydrology. Wiley & Sons., p. 527-570. Forsström, L. (1999) Piikuoriset levät. Opintomoniste, Oulun yliopisto Geotieteiden laitos, 104 p.

**Assessment methods and criteria:**

Students participate actively in teaching, written report.

**Grading:**

Pass/fail

**Person responsible:**

Tiina Eskola

**Working life cooperation:**

No

### 773627S: Global environmental and climate change during the Cenozoic, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** English, Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course the student will be able to explain the mechanisms behind the natural climate and environmental change and relate that to the ongoing changes in climate and environment.

**Contents:**

Mechanisms and rates of environmental and climate change during the past 100 million. The course introduces, for example the influence of orbital cycles, tectonics, ocean currents and ice sheets on the environmental and climate change during the deep past.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

24 h lectures

**Target group:**

Advanced-level geology students.

**Prerequisites and co-requisites:**

No

**Recommended optional programme components:**

No

**Recommended or required reading:**

Lunkka, J.P. (2008) Maapallon ilmastohistoria. Gaudeamus, Helsinki University Press, 286 s.

**Assessment methods and criteria:**

Attending lectures and written examination.

**Grading:**

5-2/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773601S: Glacial Geology II, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course the student will be able to explain the physical properties of glaciers and the genesis of glacial sediments and glacial landforms.

**Contents:**

Dynamics and hydrology of glaciers; erosion and sedimentation processes in glacial environment; basics of glaciology; subglacial, englacial and supraglacial processes. Origin of different glacigenic sediments and landforms and modelling of paleoice sheets.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

26 h lectures

**Target group:**

Geology students

**Prerequisites and co-requisites:**

Bachelor of Science degree

**Recommended or required reading:**

Handouts given during lectures and applicable parts of Benn, D.I. & Evans, D.J.A. (1988) Glaciers & Glaciation, 734 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773655S: Sedimentology, 5 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Kari Strand
**Opintokohteen kielet:** Finnish, English

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish (optionally English)

**Timing:**

4th or 5th study year

**Learning outcomes:**

Upon completion of the course, the student will be able to explain how different sediment beds and sediment associations are related to different sedimentary environments. The student will also be able link individual observations to various sedimentary processes and their products and explain the fundamental concepts used in sequence stratigraphy.

**Contents:**

The topics that are introduced in the course are: sedimentary environments their processes and products, basin analysis and sequence stratigraphy.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures

**Target group:**

Advanced-level geology students.

**Prerequisites and co-requisites:**

Bachelor of Science degree

**Recommended or required reading:**

Applicable parts of Reading, H.G. (1996) Sedimentary Environments. Blackwell Science Ltd. 688 s. and Coe, A.L. (2005) The Sedimentary Record of Sea-level Change. Cambridge University Press. 287 p. Lecture notes.

**Assessment methods and criteria:**

Examination

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773657S: Pro gradu thesis, 30 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Diploma thesis
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

35 credits

**Language of instruction:**

Finnish/English

**Timing:**

5th study year

**Learning outcomes:**

Upon completing their Master's thesis, students will gain advanced understanding on a subject belonging to two of the four specializations: Quaternary geology and geoenvironment. They will be able to use and apply pertinent research methods and theoretical knowledge of their research field, make independent inferences from their observations and measurements, and utilize effectively scientific literature.

**Contents:**

Independent research and literature study and production of scientific text.

**Mode of delivery:**

Personal supervision.

**Learning activities and teaching methods:**

Students carry out a personal research project, which is normally based field and/or laboratory work, and they write a Master's thesis (pro gradu) on the results. The topic of the thesis is agreed with the supervisor from the department and with other potential internal or external supervisors. Personal guidance is given by the supervisor(s) during the research and writing stage.

**Target group:**

Advanced-level geology students.

**Prerequisites and co-requisites:**

A sufficient amount of intermediate- and advanced-level courses has to be done to enable the student to start independent research work

**Recommended or required reading:**

Is decided separately in each case.

**Assessment methods and criteria:**

Thesis
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Professors and lecturers

**Working life cooperation:**

Yes (commonly)

### 770690S: Maturity test, 0 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

0 credits

**Language of instruction:**

Finnish or English

**Timing:**

5th year

**Learning outcomes:**

The student can write an informative abstract on his/her M.Sc. thesis.

**Contents:**

The student describes and analyses the material, research methods, and results of his/her M.Sc. thesis.

**Mode of delivery:**

Independent work

**Learning activities and teaching methods:**

Independent work

**Target group:**

Compulsory for all M.Sc. students in geosciences.

**Prerequisites and co-requisites:**

Written after the completion of the Master's thesis.

**Recommended optional programme components:**

No alternative course units.

**Recommended or required reading:**

No special reading (material of the M.Sc. thesis).

**Assessment methods and criteria:**

One-page abstract, which is written on a special form provided by the faculty.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Supervisor of the Master's thesis.

**Working life cooperation:**

No work practise.

## 762608S: Airborne geophysics, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** English, Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish (optionally English)
**Timing:**
2nd or 3rd spring term
**Learning outcomes:**
After completion the student identifies the special characteristics of airborne geophysical measurements, and knows how to process and interpret airborne geophysical data in various different ways.
**Contents:**
The course provides basic knowledge on airborne geophysical investigation methods. The course focuses on the airborne geophysical mapping made by the Geological Survey of Finland. The course considers the theoretical principles of the magnetic, electromagnetic and radiometric measurements, practical measurement arrangements, auxiliary measurements, navigation and positioning, data processing and interpretation and the special characteristics of magnetic and electromagnetic anomalies. Modelling and interpretation software are used in computer exercises to emphasise the lectures.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Lectures and demonstrations 30 h, independent study 100 h
**Target group:**
Primarily for the students of the degree programme in Oulu Mining School. Compulsory for geophysics students in M. Sc studies.
**Prerequisites and co-requisites:**
No specific prerequisites.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Lecture notes and Peltoniemi, M. (1998) Aerogeofysikaaliset menetelmät.
**Assessment methods and criteria:**
Examination
**Grading:**
5-1/fail
**Person responsible:**
Toivo Korja
**Working life cooperation:**
No work practice.
**Other information:**
https://wiki.oulu.fi/display/762332A/

## 772684S: GIS applications, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits
**Language of instruction:**
English
**Timing:**
4 th or 5 th year, spring
**Learning outcomes:**
After the course, students can utilise the possibilities of the geographic information system in geological research and specific methods of spatial data analyses.
**Contents:**
This course focuses more on the capabilities of the GIS-software and the possibilities they offer in presenting and analyzing spatial data in practical exercises.
**Mode of delivery:**
Face to face teaching and exercises.
**Learning activities and teaching methods:**
Lectures and practicals totalling 30 h, plus independent study. Course is passed by returning exercise reports
**Target group:**
Students of Oulu Mining School and Faculties of science and technology etc
**Prerequisites and co-requisites:**
Course GIS and spatial data 1 or equivalent, basics of GIS
**Recommended optional programme components:**
Exercise materials
**Recommended or required reading:**
Will be informed separately.
**Assessment methods and criteria:**
Assessment is based on the evaluation of the written reports of exercises

**Grading:**
Numerical grading scale 0 – 5, where 0 = fail
**Person responsible:**
Kari Moisio
**Working life cooperation:**
No
**Other information:**
-

## 762612S: Gravimetric and magnetic methods, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Elena Kozlovskaya

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish or English
**Timing:**
4th or 5th study year
**Learning outcomes:**
After completion the student identifies the special characteristics of geophysical gravimetric and magnetic methods, recognizes anomalies of various sources, and knows how to apply data processing and interpretation methods to example data.
**Contents:**
Because the variations of density and magnetization create changes in Earth's gravity and magnetic field, the measurements of these fields can be used in geological bedrock mapping and mineral exploration. The course provides knowledge about the geophysical gravity and magnetic field measurements including physical and theoretical background, practical measurement arrangement, data processing and principles of interpretation. Modelling and interpretation software are used in computer exercises to study the generation of gravity and magnetic anomalies of various kinds.

**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Lectures 20 h and 20 h demonstrations and practical work, self-study 93 h.
**Target group:**
MSc students of geophysics. Also for the other students of the University of Oulu.
**Prerequisites and co-requisites:**
No specific prerequisites.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Lecture notes, selected articles from geophysical journals and Blakely, R.J. (1995) Potential theory on gravity and magnetic applications.
**Assessment methods and criteria:**
Examination and approved report.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Elena Kozlovskaya
**Working life cooperation:**
No work practise.

## 762681S: M.Sc. work (thesis and seminar), 30 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Diploma thesis

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
35 credits
**Language of instruction:**
Finnish or English
**Timing:**
5th study year
**Learning outcomes:**
The student can define and describe the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results. Finally the student can give a seminar talk based on his/her thesis.
**Contents:**
The student must demonstrate ability to scientific thinking, to define a research problem, choose the research methods and be able to use to methods to solve the problem. In addition the student must show adequate familiarity with the literature related to the subject of thesis and skills in scientific writing. The subject must be chosen with the professor of geophysics.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Writing a thesis, giving a seminar talk, and participating in the seminars during one term. Self-study 933 h.
**Target group:**
Compulsory for students of geophysics in the M.Sc. degree.
**Prerequisites and co-requisites:**
No specific prerequisites.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Selected case by case.
**Assessment methods and criteria:**
Thesis, seminar talk.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**
5-1/fail
**Person responsible:**
N.N.
**Working life cooperation:**
No work practise
**Other information:**
https://wiki.oulu.fi/display/762681S/

## 762679S: Maturity test, 0 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
0 credits
**Language of instruction:**
Finnish or English
**Timing:**
5th study year
**Learning outcomes:**
The student can independently produce text from the research field of his/her thesis using the language of the thesis (762681S).
**Contents:**
If a student has written a maturity test for his/her Bachelor degree, showing a good command of Finnish or Swedish, the maturity test for the M.Sc. degree is an abstract of his/her Master's thesis, written as regulated by the faculty.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Independent work
**Target group:**
Compulsory for Master of Science in geophysics.
**Prerequisites and co-requisites:**
Written after the completion of the Master's thesis.
**Recommended optional programme components:**
No alternative course units.
**Recommended or required reading:**
No reading
**Assessment methods and criteria:**
The test event
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
N.N.
**Working life cooperation:**
No work practise

## 762618S: Mining geophysics, 5 op

**Voimassaolo:** 01.08.2016 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**ECTS Credits:**
5 cr
**Language of instruction:**
Finnish or english
**Timing:**
4th - 5th year
**Learning outcomes:**
The students got familiar with geophysical methods and instrumentation used to solve practical problems arising at all stages of mine life circle.
**Contents:**
The course is intended for geophysicists, geologist and mining and rock mechanics engineers working at mines. The basic techniques of applied geophysics are introduced and explained with application to problems of exploration, development, planning, operation, closure and reclamation of open and underground mines. For each method, principles, instrumentation, field procedures, interpretation and case histories are discussed. The students get familiar with the geophysical instrumentation used in specific mining environment. A part of the course is introduction to mining seismology and the modern methods and techniques used to monitor and study seismicity and rock bursts in underground mines.
**Mode of delivery:**
facte to face
**Target group:**
Geophysics, geology, mineral processing and mining engineering students

**Prerequisites and co-requisites:**
No alternative course units or course units that should be completed simultaneously.

**Recommended optional programme components:**
Basic courses in geology, geophysics, mineral prosessing.

**Assessment methods and criteria:**
Continuous assessment (home work), final exam
**Grading:**
1-5/Fail
**Person responsible:**
Elena Kozlovskaya
**Working life cooperation:**
no

## 762610S: Physical properties of rocks, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** Finnish, English

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
4th or 5th study year for students in geophysics.
**Learning outcomes:**
Upon the completion of the course, a student
- can define the position, role and significance of petrophysics (rock property analysis) in geophysical and geological research
- can explain the physical properties of major rocks and rock forming minerals and their mutual dependence
- can describe how the temperature and pressure affect the physical properties of rocks

- can relate the structure of the rocks with the physical properties of the rocks
- can use petrophysical data in the geological interpretation of geophysical models
- is able to measure the major petrophysical properties of rock samples

**Contents:**
Physical properties of rocks and minerals including density, magnetic, elastic, electric, thermal and radiometric properties, their mutual dependence and behaviour as a function of temperature and pressure. In practical exercises the students will e.g. carry out rock property analysis for a given set of samples using the facilities at the faculty.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Lectures 30 h, exercises 14 h, homework exercise, self-study 116 h.
**Target group:**
Compulsory for M.Sc. students in geophysics and recommended for those who work with the geological interpretation of geophysical models.

**Prerequisites and co-requisites:**
It is recommended that the course Geophysical research methods of rock and soil (762305A) has been attended. Courses of basics of geology (mineralogy, petrology) are also essential.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Lecture notes. Handouts. Schön, J.H. (1998) Physical Properties of Rocks, Volume 18: Fundamentals and principles of petrophysics (Handbook of geophysical exploration: Seismic exploration).
**Assessment methods and criteria:**
Examination (form to be selected during the course) and completion of the report on homework exercise.
**Grading:**
5-1/fail
**Person responsible:**
Toivo Korja
**Working life cooperation:**
No work practice.
**Other information:**
https://wiki.oulu.fi/display/762607S/

## 762636S: Seismic soundings, 6 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
6 credits
**Language of instruction:**
Finnish (optionally English)
**Timing:**
4th or 5th study year
**Learning outcomes:**
After this course student knows how to apply and use seismic methods to investigate soil and bedrock structure. Student can explain theoretical background, limitations and error sources of the seismic methods. Student knows how use seismic equipment in the field, measure seismic data, interpretate and analyze measured data and he can also create a summary of the measurement.
**Contents:**
This course gives basic knowledge required for seismic refraction-, reflection soundings and surface wave studies and their interpretation. Contents of the course; Physical principles and theory of the seismic soundings, interpretation, seismic tomography, mining seismology and seismic monitoring, processing and measurement in practice. Case histories. Independent work includes refraction or reflection seismic sounding in the field.
**Mode of delivery:**
Face to face

**Learning activities and teaching methods:**
Lectures 30 h, exercises 15 h, an independent exercise, self-study 115 h.
**Target group:**
Optional for students of Geophysics. Recommend for everyone interested in shallow seismic soundings especially for groundwater investigations.
**Prerequisites and co-requisites:**
No specific prerequisites.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Lecture notes. Selected parts: Burger, H.R. (2006) Introduction to Applied Geophysics: Exploring the Shallow Subsurface; Sjögren, B. (1984) Shallow refraction seismics; Palmer, D. (1986) Refraction seismics; Al-Sadi, H.N. (1982) Seismic exploration.
**Assessment methods and criteria:**
One written examination and accepted report of an independent exercise.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Kari Moisio
**Working life cooperation:**
No work practise.
**Other information:**
https://wiki.oulu.fi/display/762636S/

## H325508: Optional advanced-level courses in Geophysics, 0 - 60 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Study module
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

*Electives*

### 762645S: Field course in bedrock mapping and applied geophysics, 3 op

**Voimassaolo:** 01.08.2009 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**
3 credits
**Language of instruction:**
Finnish
**Timing:**
4th or 5th study year
**Learning outcomes:**
After completion the student know how to make field measurements related to geological mapping and know better the requirements of data processing, interpretation, and reporting.

**Contents:**

The course introduces the students of geophysics with geological bedrock mapping and gives the students of geology practical information about the methods of applied geophysics. The geophysical methods include magnetic, electrical, electromagnetic profiling. The course starts with four days of field work, after which the student groups process and interpret the collected geological and geophysical data themselves and report their results.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

32 h field work, 20 h processing and interpretation of measured data, approved written report, 28 h self-study.

**Target group:**

Compulsory in MSc studies of geophysics.

**Prerequisites and co-requisites:**

Geophysical research methods of rock and soil (762305A) (earlier 762302A or 762102P).

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Peltoniemi, M. (1988) Maa- ja kallioperän geofysikaaliset tutkimusmenetelmät.

**Assessment methods and criteria:**

Participation and approved written report.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No work practise.

**Other information:**

https://wiki.oulu.fi/display/762645S/

### 762661S: An advanced level course from another Finnish university, 0 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

Variable credits

**Contents:**

Courses taken at other Finnish universities.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**

N.N.

### 762663S: An advanced level course from another university abroad, 0 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

Variable credits, depending of the course.

**Contents:**

Courses taken in international exchange programs (Erasmus, Nordplus, etc.) for example in universities abroad.

**Assessment methods and criteria:**

Depend of the course.
Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**

Professors and lecturers.

### 762684S: Excursion, 2 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Korja, Toivo Johannes

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

2 credits

**Language of instruction:**

Finnish

**Timing:**

2th to 5th year. Arranged on demand.

**Learning outcomes:**

After the excursion, a student can list some of the employers in the field of geosciences and the work done there. After the excursion, the student can list the role of geophysicist in companies and other organizations and analyze the skills and knowledge needed to successfully complete the work of a geophysicist. After the excursion, the student can create a generalized profile of a geophysicist working in a company or in other organization.

**Contents:**

The students at their final stage of studies make a guided excursion and visit companies and research institutions applying geophysical techniques.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Two to three days long excursion arranged by teachers. After the excursion participants write a common report or prepare a poster.
Participation in the excursion and completion of the report.

**Target group:**

M.Sc. students in geophysics.

**Prerequisites and co-requisites:**

No specific prerequisites.

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

The list of stops is delivered to students prior to excursion. Based on the list, students collect information on the stops in advance as well as collect the material delivered in stops.

**Assessment methods and criteria:**

Participation in the excursion and the completion of a written report/poster prepared together by all participants.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Toivo Korja

**Working life cooperation:**

No work practise.

**Other information:**

Travel costs and major part of accommodation costs are covered by the section of geophysics. Participants cover other costs (e.g. meals).
https://wiki.oulu.fi/display/762684S/

### 772675S: Geophysics in economic geology, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Elena Kozlovskaya
**Opintokohteen kielet:** English

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

4th or 5th year

**Learning outcomes:**

The students comprehend the main techniques used in exploration geophysics and have become familiar with a number of casa studies. They should be able to interpret basic geophysical data and their importance in target evaluation.

**Contents:**

Geophysical methods in exploration and their use in exploration targeting.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures, data interpretation exercises.

**Target group:**

Master's students and PhD students in geology.

**Prerequisites and co-requisites:**

Bachelor's degree.

**Recommended or required reading:**

Reynolds, J.M. (2011) An Introduction to Applied and Environmental Geophysics, Wiley-Blackwell
Everett M.E. (2013) Near-Surface Applied Geophysics. Cambridge University Press.
Kearey, P., Brooks, M., Hill, I. (2002) An Introduction to Geophysical Exploration. Blackwell Science.
Geophysical methods, in: Moon et al. (2009) Introduction to Mineral Exploration, Blackwell
The availability of the literature can be checked from " this link".

**Assessment methods and criteria:**

Examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Elena Kozlovskaya

**Working life cooperation:**

No

**Other information:**

-

## 762620S: Computers in geophysics, 3 op

**Voimassaolo:** 01.08.2009 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

3 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

After completion the student can make a computer program that does file I/O and data handling and numerical computations related to geophysics.

**Contents:**

The solution of geophysical problems often requires writing own computer programs. The course applies Fortran programming language to solve some geophysical problems and tasks such as reading from file, formatted writing, numerical computations and data visualization. The course consists of practical computer exercises and compulsory tasks related to them.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h exercises, approved tasks, self-study 50 h

**Target group:**

Primarily for the students of the degree programme in geosciences and physics. Also for the other students of the University of Oulu.

**Prerequisites and co-requisites:**

Prior knowledge on computer programming (e.g. 763114P, 763315A or 763616S).

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Excercise material and Haataja J., Rahola J. & Ruokolainen J. (1998) Fortran 90/95 and Press W.H., Flannery B.P., Teukolsky S.A & Vetterling W.T. (1988) Numerical recipes in Fortran.
Course material availability can be checked here.

**Assessment methods and criteria:**

Participation and approved project work.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No work practise

**Other information:**

https://wiki.oulu.fi/display/762620S/

### 762662S: Special courses in geophysics, 0 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish
**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

1-9 credits

**Language of instruction:**

Usually English.

**Contents:**

Credit points according to the course. Lectures given by visiting scientists. Contents and assessment will be negotiated with the professor in advance. These courses are usually held in English and they will cover topical issues of current geophysical research.

**Learning activities and teaching methods:**

According to the course.

**Target group:**

Optional for students of geophysics.

**Recommended or required reading:**

According to the course.

**Assessment methods and criteria:**

Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**

N.N.

### 762624S: Electrical research methods of rock and soil, 5 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

3rd - 5th study year

**Learning outcomes:**

After passing the course the student can explain the theoretical basics and use of electric methods based on the DC theory, can use in practice the measuring instruments of different electric methods and is able to analyse and interpret measured data in near-surface geophysical surveys.

**Contents:**

The course familiarizes students with the electric methods based on direct current theory in surveying the near-surface earth. Electric methods in surveying the earth. Electric properties of rocks and sediments. Electrical resistivity methods. Self-potential method. Charged-body potential (mise-à-la-masse) method. Induced polarization method. Multiple electrode measurements. Electric surveying in boreholes. Interpretation. About software for interpretation. Case studies.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, an independent exercise (field measurement and its interpretation), self-study 103 h.

**Target group:**

Optional for M.Sc students of geophysics.

**Prerequisites and co-requisites:**

Geophysical research methods of rock and soil (762305A) (earlier 762302A or 762102P).

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Lecture notes and lecture material. Parts of the following: Telford, W.M., Geldart, T.M. & Sheriff, R.E. (1990) Applied geophysics; Zhdanov, M.S. & Keller, G.V. (1994) The geoelectrical methods in geophysical exploration; Reynolds, J.M. (2011) An introduction to applied and environmental geophysics (2nd ed.); Sharma, P.V. (1997) Environmental and engineering geophysics.
Course material availability can be checked here.

**Assessment methods and criteria:**

One written examination and accepted report of an independent exercise.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No work practise.

**Other information:**

https://wiki.oulu.fi/display/762624S/

### 762616S: Ground Penetrating Radar Sounding, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

After completion the student identifies the special characteristics of GPR soundings and can process and interpret GPR data using modern computer software.

**Contents:**

Ground penetrating radar (GPR) is a high frequency (20-2000 MHz) electromagnetic research instrument that is widely used in surficial and environmental geology and geotechnical and geophysical investigations. The course provides students with the basic knowledge and skills on GPR as a geophysical investigation method. The course deals with theoretical background, practical measurement arrangements, data processing, presentation and analysis. The course includes exercises, where basic mathematics and data processing are introduced, and a compulsory practical work, where the students process and interpret GPR data from their own measurements.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 20 h and 20 h demonstrations and practical work, self-study 93 h.

**Target group:**

MSc students of geophysics, students of surficial and environmental geology, and students of water resources and environmental engineering. Also for the other students of the University of Oulu.

**Prerequisites and co-requisites:**

No specific prerequisites.

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Lecture notes, selected articles from geophysical journals and Jol, H.M (Ed.) (2009) Ground penetrating radar theory and applications.

**Assessment methods and criteria:**

Examination and approved report.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Kari Moisio

**Working life cooperation:**

No work practise.

**Other information:**

https://wiki.oulu.fi/display/762616S/

**762630S: Modelling of electromagnetic fields, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

After passing the course the student can justify and explain how to find out theoretical electromagnetic responses of the earth model either by electromagnetic scale modelling or by analytical solution or by numerical modelling. The student can use different numerical methods and is able to apply them in solving electromagnetic field equations.

**Contents:**

To familiarize students with methods in getting the theoretical anomalies for one- or multidimensional earth structures. Electromagnetic fields: field equations, boundary conditions. Layered model. Multidimensional model: physical modelling, integral equation method, transmission surface analogy, finite-difference method, finite-element method. Thin sheet approximation. Solving the set of linear equations. On the errors.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 30 h, demonstrations 10 h, an independent work, self-study 93 h

**Target group:**

Optional for students of geophysics in the M.Sc. degree.

**Prerequisites and co-requisites:**

No specific prerequisites.

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Lecture notes and lecture material. Selected papers. Parts of the following: Nabighian, M. N. (ed.) (1988) Electromagnetic methods in applied geophysics, Volume 1, Theory, p. 313-363 ja 365-441.
Course material availability can be checked here.

**Assessment methods and criteria:**

A final examination and an independent exercise work.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No work practise

**Other information:**

https://wiki.oulu.fi/display/762630S/

**762611S: Theory of electromagnetic methods, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

English (or Finnish depending on participants and lecturer)

**Timing:**

4th or 5th study year

**Learning outcomes:**

After completion the student knows how to link electromagnetic theory with its many applications, identifies the basic characteristics of the most common geophysical electromagnetic methods and the anomalies of various geological targets and knows how to interpret data visually and computationally.

**Contents:**

Electromagnetic (EM) measurements are used to provide information about the subsurface variations of electrical conductivity that can be used in geological mapping of soil and bedrock, environmental studies and mineral exploration. The course provides knowledge on the theory and applications of the geophysical EM methods including electromagnetic induction, quasi-static approximation, attenuation of the fields, time and frequency domain measurements, electric and magnetic dipole source in free-space, conductive whole space, above layered earth, and near two- and three-dimensional targets. In addition the various electromagnetic systems for near-surface investigations, their responses and anomalies and the effect of conductive host medium and overburden layer and data interpretation are studied. Modelling and interpretation software are used in computer exercises to emphasize the lectures.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

Lectures 20 h, demonstrations 20 h and practical work, self-study 93 h

**Target group:**

MSc students of geophysics. Also for the other students of the University of Oulu.

**Prerequisites and co-requisites:**

No specific prerequisites.

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Lecture notes and Ward, S.H. & Hohmann, G.W. (1988) Electromagnetic theory for geophysical applications; Frischknecht, F.C., Labson, V.F., Spies, B.R. & Anderson, W.L. (1991) Profiling methods using small sources; Spies, B.R. & Frischknecht, F.C. (1991) Electromagnetic sounding, In: Nabighian, M. N. (ed.) (1988 & 1991) Electromagnetic methods in applied geophysics. Volumes 1 and 2.
Course material availability can be checked here.

**Assessment methods and criteria:**

Examination and approved report.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No work practise.

**Other information:**

https://wiki.oulu.fi/display/762611S/

### 762646S: Field course in environmental geology and applied geophysics, 3 op

**Voimassaolo:** 01.08.2009 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

3 credits

**Language of instruction:**

Finnish

**Timing:**

4th or 5th study year

**Learning outcomes:**

After completion the student know how to make field measurements related to environmental research and know better the requirements of data processing, interpretation and reporting.

**Contents:**

The course introduces the students of geophysics with various geological problems and gives the students of geology practical information about the methods of applied geophysics. The geological problems include peat bog, esker, hummocky moraine, clay layers and thick overburden. The geophysical methods include ground penetrating radar method and seismic, electrical and electromagnetic soundings. The course starts with four days of field work, after which the student groups process and interpret the collected geological and geophysical data themselves and report their results.

**Mode of delivery:**

Face to face teaching. The course is arranged every two or three years.

**Learning activities and teaching methods:**

32 h field work, 20 h processing and interpretation of measured data, approved written report, self-study 28 h.

**Target group:**

Compulsory in MSc studies of geophysics.

**Prerequisites and co-requisites:**

Prior completion of course 762305A (earlier 762302A) Geophysical research methods of rock and soil.

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Peltoniemi, M. (1988) Maa- ja kallioperän geofysikaaliset tutkimusmenetelmät.

**Assessment methods and criteria:**

Participation and approved written report.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

## 902002Y: English 1 (Reading for Academic Purposes), 2 op

**Voimassaolo:** 01.08.1995 -

**Opiskelumuoto:** Language and Communication Studies

**Laji:** Course

**Vastuuyksikkö:** Languages and Communication

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**Proficiency level:**
B2/C1 on the Common European Framework of Reference scale.
**Status:**
This course is mandatory for students of the following degree programmes:
**Faculty of Science**
•Biology
•Chemistry
•Mathematical Sciences
•Physics
**Oulu Mining School**
•Geosciences degree programme
**Faculty of Information Technology and Electrical Engineering**
•Department of Information Processing Science

Students in the Department of Geography take English 3.

Engineering students in the following programmes take their English courses in the Faculty of Technology:
Oulu Mining School:
• Mining Technology and Mineral Processing degree programme

Faculty of Information Technology and Electrical Engineering
•Department of Electrical Engineering
•Department of Communications Engineering
•Department of Computer Science and Engineering

Please consult the Faculty Study Guide to establish the language requirements for your own degree program.
**Required proficiency level:**
English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.
**ECTS Credits:**
2 ECTS credits (total work load 54 hours including classroom meetings.)
**Language of instruction:**
English
**Timing:**
Biology: 1st year spring term
Chemistry: 1st year autumn term
Geology: 1st year spring term
Information Processing Science: 1st year spring term
Mathematical Sciences (pedagogy): 1st year spring term
Mathematical Sciences: 2nd year autumn term
Physical Sciences: 1st year autumn term
**Learning outcomes:**
By the end of the course, you are expected to be able to

- have acquired effective vocabulary learning techniques
- be able to distinguish parts of words to infer meanings
- utilize your knowledge of text structure and cohesion markers to understand academic texts
- extract information and learn content from English readings in scientific and professional contexts

**Contents:**
The course will focus on reading strategies; these include recognizing how texts are organized, identifying key points in a text, and understanding words in context. Vocabulary work in the course will focus on a) academic vocabulary, as used in formal scientific writing, and b) using your knowledge of the meanings of parts of words (affixes) to infer meaning.
**Mode of delivery:**
Contact teaching
**Learning activities and teaching methods:**

The scope of the course is 2 op (54 hours student workload).
**Target group:**
1st year students of Biology, Chemistry, Geology, Information Processing Science, Physics, and Mathematics (pedagogy); 2nd year students of Mathematics
**Prerequisites and co-requisites:**
-
**Recommended optional programme components:**
Students are also required to take 902004Y Scientific Communication, which is taken AFTER completion of this course.
**Recommended or required reading:**
Photocopies will be provided by the teacher and/or required texts will be accessible online or from the university library.
**Assessment methods and criteria:**
Student work is monitored by continuous assessment. You are required to participate regularly and actively in all contact teaching provided, and successfully complete all required coursework. There will be three monthly tests on material covered so far.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/Fail
**Person responsible:**
Karen Niskanen
**Working life cooperation:**
-
**Other information:**
N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by the Faculty of Science.

## 902004Y: English 2 (Scientific Communication), 2 op

**Voimassaolo:** 01.08.1995 -

**Opiskelumuoto:** Language and Communication Studies

**Laji:** Course

**Vastuuyksikkö:** Languages and Communication

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**Leikkaavuudet:**

| | | |
|---|---|---|
| ay902004Y | English 2 (Scientific Communication) (OPEN UNI) | 2.0 op |

**Proficiency level:**
B2/C1 on the CEFR scales
**Status:**
This course is mandatory for all 2nd year students (except **geographers**) who will have English as their foreign language in their B.Sc. degree. This includes the students who were exempted from ‘Reading for Academic Purposes'(902002Y). Please consult the faculty study guide to establish the language requirements on your own degree programme.
**Required proficiency level:**
Students taking this course must have had English as the A1 or A2 language at school or the equivalent English skills should have been acquired otherwise. The course 'Reading for Academic Purposes' (902002Y) is a pre-requisite, unless exempted.
**ECTS Credits:**
**The student workload is** 53 hrs work/ 2 ECTS credits.
**Language of instruction:**
English
**Timing:**
Biology: 2nd year autumn term
Chemistry: 2nd year spring term
Geology: 2nd year spring term
Information Processing Science : 2nd year autumn term
Mathematics: 2nd year spring term
Physics: 2nd year autumn term
**Learning outcomes:**

By the end of the course, you are expected:

1. to have demonstrated your use of appropriate strategies and techniques for communicating effectively in English in an academic context.
2. to have demonstrated the ability to prepare and present scientific subjects to your classmates, using appropriate field-related vocabulary.

**Contents:**
Skills in listening, speaking, and presenting academic topics are practised in the classroom, where there is an emphasis on working in pairs and small groups. Homework tasks include online lecture listening and reading, preparation for classroom discussions and written work to support the classroom learning.
**Mode of delivery:**
Contact teaching
**Learning activities and teaching methods:**
Contact teaching 28 hours, homework 28 hours
**Target group:**
2nd year students of Biology, Chemistry, Geology, Information Processing Science, Mathematics, Physics
**Prerequisites and co-requisites:**
-
**Recommended optional programme components:**
Also required: 902002Y Reading for Academic Purposes Englannin kieli 1
**Recommended or required reading:**
Course materials will be provided by the teacher.
**Assessment methods and criteria:**
Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass / fail.
**Person responsible:**
Karen Niskanen
**Working life cooperation:**
-
**Other information:**
**-**

## 030005P: Information Skills, 1 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Technology

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Sassali, Jani Henrik, Ursula Heinikoski

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 030004P | Introduction to Information Retrieval | 0.0 op |

**ECTS Credits:**
1 ECTS credit
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd year
**Learning outcomes:**
Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.
**Contents:**
Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.
**Mode of delivery:**
Blended teaching: classroom training, web-based learning material and exercises in Optima environment, a final assignment on a topic of the student’s own choice

**Learning activities and teaching methods:**
Training sessions 8h, group working 7h, self-study 12h
**Target group:**
Compulsory for all students of the Faculty of Technology, the Faculty of Information Technology and Electrical Engineering and the Faculty of Architecture. In the Faculty of Science compulsory for students of biology, physics, geosciences, chemistry and geography. Optional for students of biochemistry and mathematics.
**Prerequisites and co-requisites:**
-
**Recommended optional programme components:**
-
**Recommended or required reading:**
Web learning material https://wiki.oulu.fi/display/030005P.
**Assessment methods and criteria:**
Passing the course requires participation in the training sessions and successful completion of the course assignments.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
pass/fail
**Person responsible:**
Science and Technology Library Tellus, tellustieto (at) oulu.fi
**Working life cooperation:**
-
**Other information:**
-

## 770001Y: Orientation course for new students, 1 op

**Opiskelumuoto:** General Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
1 credit
**Language of instruction:**
Finnish
**Timing:**
1st year autumn
**Learning outcomes:**
Students are familiar with the university environment and practical issues of their studies and are able find appropriate of advice if needed.
**Contents:**
Students are tutored to the study system of the university and given information on the contents and goals of the degree programme of the Geosciences.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
15 to 18 h of tutoring
**Target group:**
1st year students
**Assessment methods and criteria:**
Participation in team tutoring.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
N.N.
**Working life cooperation:**
No.

## 901055Y: Second Official Language (Swedish), Oral Skills (OMS), 1 op

**Voimassaolo:** 01.08.2014 -
**Opiskelumuoto:** Language and Communication Studies
**Laji:** Course
**Vastuuyksikkö:** Languages and Communication
**Opintokohteen kielet:** Swedish

## 901054Y: Second Official Language (Swedish), Written Skills (OMS), 1 op

**Voimassaolo:** 01.08.2014 -
**Opiskelumuoto:** Language and Communication Studies
**Laji:** Course
**Vastuuyksikkö:** Languages and Communication
**Opintokohteen kielet:** Swedish

## 771102P: Basic course in mineralogy, 6 op

**Opiskelumuoto:** Basic Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Pekka Tuisku
**Opintokohteen kielet:** Finnish

**ECTS Credits:**
6 credits
**Language of instruction:**
Finnish
**Timing:**
1st year autumn
**Learning outcomes:**
Students obtain a basic knowledge on mineralogy.
**Contents:**
Crystal, crystal systems, mineral, rocks. Formation of minerals in geological processes, chemical and physical properties of minerals, occurrence and utilization.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
20 h lectures, 16 h exercises. Excersises are compulsory.
**Target group:**
1st year geosciences students.
**Prerequisites and co-requisites:**
No
**Recommended optional programme components:**
-
**Recommended or required reading:**
Risto Piispanen ja Pekka Tuisku (2005) Mineralogian perusteet. http://cc.oulu.fi/~petuisku/Mineralogia/MinPer.htm
**Assessment methods and criteria:**
Examination, compulsory exercises
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
1-5/fail
**Person responsible:**
Pekka Tuisku, Jukka Pekka Ranta
**Working life cooperation:**

No
**Other information:**
-

## 762108P: GIS and spatial data 1, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2 nd or 3 rd autumn (continues to spring semester)
**Learning outcomes:**
After completion the student collects the basics of spatial data and geographical information systems (GIS) including especially the most important coordinate systems, map projections, Finnish map coordinates and satellite positioning, and knows how to visualise spatial data in various different ways.
**Contents:**
Geoscientific observations and measurements are always tied to spatial location of the data. The course provides basic information about the presentation and handling of spatially dependent geoscientific data and geographic information systems (GIS). The course considers the basics of spatial data, coordinate systems, map projections and map coordinates, satellite positioning, processing and visualisation of spatial data. Computer exercises demonstrate preparation and visualisation of geoscientific data in practice.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Lectures and exercises totalling 40 h plus independent study.
**Target group:**
Students of Oulu Mining School, and the Faculties of Science and Technology. Obligatory to geosciences students in B.Sc. degree.
**Prerequisites and co-requisites:**
No specific prerequisites.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Lecture notes and Löytönen, M., Toivonen, T. & Kankaanrinta, I., (Eds.) 2003: Globus GIS.
**Assessment methods and criteria:**
Examination and computer test.
**Grading:**
5-1/fail
**Person responsible:**
Kari Moisio
**Working life cooperation:**
No work practise.
**Other information:**
Course website

## 771113P: Introduction to Geology I, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay771113P Introduction to Geology I (OPEN UNI) 5.0 op

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
1st year autumn
**Learning outcomes:**
Stdents have an understanding of the basic concepts of the Earth, from its composition and internal *structure* to the geological *processes* that has led to its evolution the present Earth as part of the solar system. They can tell how endogenic processes in the mantle and crust produce magmas and how magmas produce different igneous rock type upon emplacement below and on the Earth's surface. Students are able to recognise and classify common igneous rocks based on their mineral composition and are familiar with common metamorphic rocks and know the metamorphic facies concepts. They can relate deformation and metamorphism of the rocks to plate tectonic processes.

**Contents:**
Evolution of the Earth as part of the solar system, structure and composition of the Earth. Classification of igneous rocks, magmatism, origin and crystallisation of magmas, volcanism, metamorphism and formation of metamorphic rocks, plate tectonics and deformation structures.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
36 h lectures, 6 h exercises
**Target group:**
1st year geoscience students. The course is a good minor subject course for others.
**Prerequisites and co-requisites:**
Basic course in mineralogy (771102P) is parallel to this course.
**Recommended optional programme components:**
This course is intended as an introduction to the scope and methods of igneous and metamorphic petrology.
**Recommended or required reading:**
Martti Lehtinen, Pekka Nurminen and Tapani Rämö (1998) Suomen kallioperä – 3000 vuosimiljoonaa. Suomen Geologinen Seura, Gummerus Jyväskylä, ISBN 952-90-9260-1, Chapters 2-3. John Grotzinger & Thomas H. Jordan (2010 or 2014) Understanding Earth, 6 $^{th}$ or 7 $^{th}$ edition, Chapters 1-4, 6-7, 9-10, 12.
**Assessment methods and criteria:**
Written examination and identification test of rock types.
**Grading:**
5-1/fail
**Person responsible:**
Eero Hanski
**Working life cooperation:**
No

## 771114P: Introduction to Geology II, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits

**Language of instruction:**
Finnish
**Timing:**
1st year autumn
**Learning outcomes:**
Upon completion of the course, students should have acquired basic knowledge on the concepts and processes of surficial geology. Students should also be able to identify basic sediment types and soils.
**Contents:**
Basic concepts of surficial physical geology, weathering, erosion, sedimentation, and sediment types, soils and geological processes forming sedimentary deposits.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
16 h lectures, 8 h exercises
**Target group:**
1st year Geoscience students. The course ia s good minor subject course for others.
**Prerequisites and co-requisites:**
-
**Recommended optional programme components:**
-
**Recommended or required reading:**
Handouts and John Grotzinger & Thomas H. Jordan (2010 or 2014) Understanding Earth, 6 th or 7 th edition, Chapters 5, 8, 15-21.
**Assessment methods and criteria:**
Obligatory exercises and written examination.
**Grading:**
5-1/fail
**Person responsible:**
Juha Pekka Lunkka and Tiina Eskola
**Working life cooperation:**
No

## 771116P: Introduction to Quaternary deposits of Finland and their resources, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
1st year spring
**Learning outcomes:**
Students can describe the main features and raw material resources of the Finnish Quaternary deposits.
**Contents:**
Main features and raw material resources of the Finnish Quaternary deposits and their origin.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
22 h lectures. In addition, a one-day field trip is organized in May for major subject students.
**Target group:**
1st year geoscience students.
**Prerequisites and co-requisites:**
Introduction to Geology II (771114P) or equivalent knowledge.
**Recommended or required reading:**
Veli-Pekka Salonen, Matti Eronen, Matti Saarnisto (2002) Käytännön maaperägeologia, 236 p.

**Assessment methods and criteria:**
Written examination.
**Grading:**
5-1/fail
**Person responsible:**
Juha Pekka Lunkka
**Working life cooperation:**
No

## 771115P: Introduction to bedrock geology of Finland and ore geology, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
1st year spring
**Learning outcomes:**
Students can describe and recognise the main geological unist of the Finnish bedrock and nane them based on their stratigraphic position and age relations. They can connect the major geological units to the main stages of the plate tectonic evolution. Students are familiar with most common ore types and industrial minerals occurring in the bedrock and the principal processes leading to their formation and how they are explored.
**Contents:**
Lithostratigraphical units, the Archaean and Palaeoproterozoic bedrock of Finland and younger rock formations. Mineral resources, their classification and origin, exploration methods.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
24 h lectures. In addition, a one-day field trip is organized in May for major subject students.
**Target group:**
Major and minor subject students starting studies in geology.
**Prerequisites and co-requisites:**
Basic course in mineralogy (771102P), Introduction to Geology I (771113P), Introduction to Geology II (771114P) or equivalent knowledge.
**Recommended or required reading:**
Material given during the lectures and Lehtinen, M., Nurmi, P., Rämö, T. (1998) Suomen kallioperä – 3000 vuosimiljoonaa. Suomen Geologinen Seura, Gummerus Jyväskylä, ISBN 952-90-9260-1, p. 94-324 (available on webpages of Suomen Geologisen Seura). Parts of Craig, J.R., Vaughan, D.J. & Skinner, B.J. (1996) Resources of the Earth - Origin, Use, and Environmental Impact. Prentice Hall, 472 p.
**Assessment methods and criteria:**
Written examination.
**Grading:**
5-1/fail
**Person responsible:**
Eero Hanski
**Working life cooperation:**
No

## 762104P: Introduction to solid earth geophysics, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani, Elena Kozlovskaya

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish or English
**Timing:**
1st year autumn, every year.
**Learning outcomes:**
Upon the completion of the course, a student
- can describe the position and role of geophysics in the field of the Earth system sciences
- can list major unsolved global research problems in the Earth system sciences
- can describe the structure of the Earth and its neighbouring environment in space (spheres), their internal geophysical properties and the interactions between different spheres
- can describe large scale transfer (movement) of rock material inside the Earth and on its surface (convection, plate tectonics)
- can name major geophysical research methods.

**Contents:**
An overview of geophysics: physics of geosphere, hydrosphere, atmosphere and magnetosphere. Solid Earth geophysics and Earth Sciences. Properties, structure and dynamics of the Earth. Geophysical methods used to explore the interior of the Earth. Earth as a planet: shape, size, rotation, revolution. Gravity: Earth's gravity field, geoid, gravimetry, isostasy, tides. Deformation and rheology. Seismology: seismic waves and the internal structure of the Earth. Seismics: refraction and reflection profiling. Earth as a magnet: geomagnetic field, spatial and temporal variations, Earth-Sun interaction, space weather, palaeomagnetism. Thermal, electrical and radioactive properties of the Earth. Dynamic Earth: plate tectonics, internal dynamics.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
30 h lectures, 10 h exercises, 93 h independent study.
**Target group:**
Course is compulsory for geoscience students (geophysics, geology). Also for the other students of the University of Oulu.
**Prerequisites and co-requisites:**
No specific prerequisites. The course substitutes previous courses 762103P Introduction to Geophysics (2 cr) and 762192P Solid Earth Geophysics (3 cr).
**Recommended optional programme components:**
Parallel courses Introduction to geology I (771113P), Introduction to geology II (771114P).

**Recommended or required reading:**
Material given during the lectures and U., Borén, E., Hjelt, S.-E., Karjalainen, T. and Sirviö, J. (2004) Geofysiikka, Tunne maapallosi. WSOY, 191 p. Additional recommended reading: Musset, A.E. and Aftab Khan, M. (2000) Looking into the Earth: An Introduction to Geological Geophysics. Cambridge University Press, 470 p. and Lowrie, W. (1997) Fundamentals of Geophysics. Cambridge University Press, 354 p.
**Assessment methods and criteria:**
Examination.
B.Sc. students in physics can complete the course 762103P Johdatus geofysiikkaan/Introduction to Geophysics (2 cr) in their curriculum by this course without exercises.
**Grading:**
5-1/fail
**Person responsible:**
Elena Kozlovskaya, Kari Moisio
**Working life cooperation:**
No
**Other information:**
Course website

## 774301A: A Basic Course in Geochemistry, 6 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
6 credits
**Language of instruction:**
Finnish
**Timing:**
1st spring
**Learning outcomes:**
Upon completion of this course, students will have a broad overview of the different fields of geochemistry and be able to relate the behavior of elements to different physico-chemical processes in nature. They will be able to convert geochemical data from one form to another (wt%, molar and cation proportions, milliequivalents), plot these data on different diagrams, and carry out simple mineral dissolution/precipitation and mass balance calculations.
**Contents:**
Geochemistry as a field of science; history of geochemistry; tasks and fields of geochemistry; origin and electron configuration of chemical elements; origins and structure of the Earth; meteorites; the geochemical classification of the elements; composition of earth's different spheres; geochemical differentiation; composition of magmas; dissolution and precipitation of minerals; pH-Eh-diagrams; introduction to isotope geochemistry.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
32 h lectures, 12 h exercises
**Target group:**
All students conducting basic courses in geosciences.
**Prerequisites and co-requisites:**
A basic course in chemistry.
**Recommended optional programme components:**
It is recommended that a basic course in chemistry (e.g. 780117P) has been taken during the previous fall semester.
**Recommended or required reading:**
Gill, Robin, Chemical Fundamentals of Geology, Chapman & Hall, London, 1996, 298 p. And Mason, B. & Moore, C. B.: Principles of Geochemistry, 4th Student Edition, J. Wiley, New York, 1982, p. 187-209.
The availability of the literature can be checked from this link.
**Assessment methods and criteria:**
Examination in both theory and calculations.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Eero Hanski
**Working life cooperation:**
No

## 771303A: Bachelor of Science thesis, 9 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
9 credits
**Language of instruction:**
Finnish/English
**Timing:**

3rd year
**Learning outcomes:**
Depending on the assignment, students will be able to conduct research work including hypothesis formulation, sampling and interpretation of data, and writing a report, or alternatively, they will be able to make a literature search of a given research topic and write a synthesis of previously published relevant studies.
**Contents:**
Individual research of literature, field work or laboratory work. Before starting the thesis, students must agree upon the details of the thesis with their professor or lecturer.
**Mode of delivery:**
Independent work and personal supervision.
**Learning activities and teaching methods:**
Literature study or small research project.
**Target group:**
All Bachelor level students.
**Prerequisites and co-requisites:**
Around two years of geosciences studies.
**Recommended or required reading:**
Selected separately for each student.
**Assessment methods and criteria:**
A 20-30 page thesis.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
Professors, lecturers
**Working life cooperation:**
Usually no.
**Other information:**
Before starting the thesis, students must agree upon the details of the thesis with their professor.

## 773344A: Basics of glacial geology, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd study year
**Learning outcomes:**
Upon completion of the course, students should have acquired basic knowledge of glaciogenic sediment types and of morphological landforms and can present theories of how glaciers are formed.

**Contents:**
A review to history of glacial research and its methods; theories of how glaciers are generated and factors that affect them; present-day glaciers and their research; how snow turns into ice; movement of ice; structures of glaciers; glacier types; facts and theories about the geological activities in glaciers and how glacial sediments, landforms and erosional features are formed; glaciofluvial, glaciolacustrine and glaciomarine sedimentation, glacial deposits in pre-pleistocene formations, causes of ice ages.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
26 h lectures
**Target group:**

2nd and 3rd year geoscience students.
**Prerequisites and co-requisites:**
Introduction to Geology II (771114P) or equivalent knowledge, Introduction to Quaternary deposits of Finland and their resources (771116P).
**Recommended or required reading:**
Bennet, M.R. & Glasser, N.F. (1996) Glacial Geology, Ice sheet and Landforms. Wiley. 364 p.
**Assessment methods and criteria:**
Written examination
**Grading:**
5-1/fail
**Person responsible:**
Juha Pekka Lunkka
**Working life cooperation:**
No

## 773346A: Environmental geology, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd study year
**Learning outcomes:**
Upon completion of the course, students should have acquired basic knowledge of concepts of environmental geology.
**Contents:**
Basic concepts of environmental geology, geological processes, landforms and risks related to geological processes, geological resources, and environmental geological aspects in planning the land use, environmental geochemistry.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
24 h lectures
**Target group:**
2nd and 3rd year geoscience students.
**Prerequisites and co-requisites:**
Introduction to Geology II (771114P) or equivalent knowledge.
**Recommended or required reading:**
Heikki Niini, Raimo Uusinoka, Risto Niinimäki (2007) Geologia ympäristötoiminnassa. Rakennusgeologinen yhdistys – Byggnadsgeologiska föreningen r.y., 354 p., Murck, B.W., Skinner, B.J. & Porter, S.C. (1996) Environmental Geology, John Wiley & Sons, 535 p.
**Assessment methods and criteria:**
Written examination
**Grading:**
5-1/fail
**Person responsible:**
Juha Pekka Lunkka
**Working life cooperation:**
No

## 762305A: Geophysical research methods of rock and soil, 6 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
6 credits
**Language of instruction:**
Finnish
**Timing:**
2nd spring
**Learning outcomes:**
After passing the course the student can explain on which the use of geophysical methods in studying rock and soil is based. The student can describe theoretical basics and the measuring techniques of the methods and is able to apply the methods in various important economical and civil tasks.
**Contents:**
The aim of the course is to learn the principles of applying different geophysical methods for various economical and civil tasks. Geophysical subjects in sediments and bedrock and basics for their exploration. Basics of petrophysical properties. Gravity methods, magnetic methods, resistivity methods, IP method, electromagnetic methods, radiometric methods and seismic methods: the physical principles, devices and the most important ways of using them in practice. Aerogeophysical methods. Borehole measurements. Geothermal research.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Lectures 40 h, practical exercises 20 h, field exercises 20 h plus independent study.
**Target group:**
Students of Oulu Mining School, and the Faculties of Science and Technology. Obligatory to geosciences stdents in B.Sc. degree and for geophysical students.
**Prerequisites and co-requisites:**
No particular pre-requisites.
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Material given during lectures and Peltoniemi, M. (1988) Maa- ja kallioperän geofysikaaliset tutkimusmenetelmät and applicable parts of the following textbooks: Milsom, J. (1989) Field Geophysics; Telford, W.M., Geldart, T.M. & Sheriff, R.E. (1990) Applied Geophysics; Kearey; P., Brooks, M. & Hill, I. (2002) An Introduction to Geophysical Exploration (3 rd edition); Parasnis, D.S. (1997) Principles of Applied Geophysics (5 th edition); Reynolds, J.M. (2011) An Introduction to Applied and Environmental Geophysics (2nd edition); Sharma, P.V.,(1997) Environmental and Engineering Geophysics.
**Assessment methods and criteria:**
Examination
**Grading:**
5-1/fail
**Person responsible:**
Kari Moisio, Elena Kozlovskaya
**Working life cooperation:**
No work practise.
**Other information:**
Course website

## 770390A: Maturity test, 0 op

**Voimassaolo:** 01.08.2008 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
0 credits
**Language of instruction:**
Finnish or Swedish (for international students English)
**Timing:**
3rd spring
**Learning outcomes:**
The student can independently produce scientific text using his/her mother tongue or English. The maturity test shows familiarity with the subjects of the Bachelor's thesis.
**Contents:**
Written test on the subject of the B.Sc. thesis.
**Mode of delivery:**
Independent preparation for the test.
**Learning activities and teaching methods:**
Independent work
**Target group:**
Compulsory in the B.Sc. degree to all geoscience students.
**Prerequisites and co-requisites:**
Written after the completion of the Bachelor's thesis (for international Master's students, after completion of the Master's thesis if not done at the Bachelor level).
**Recommended optional programme components:**
No alternative course units.
**Recommended or required reading:**
No reading
**Assessment methods and criteria:**
The test event. The length of the text is recommended to be one exam paper (four pages).
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
Supervisor of the Master's thesis.
**Working life cooperation:**
No work practise.

## 772339A: Optical mineralogy, 6 op

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Pekka Tuisku

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
6 credits
**Language of instruction:**
Finnish
**Timing:**
1st spring
**Learning outcomes:**
After the course students are able to identify most common minerals from thin sections under the microscope.
**Contents:**
The basics of crystal optics. Research of the properties of minerals, identifying minerals from thin sections, usage of stereographic projector and basics of the universal stage method.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
30 h lectures, 40 h exercises.
**Target group:**

1st year geoscience students.
**Prerequisites and co-requisites:**
Basic course in mineralogy (771102P).
**Recommended optional programme components:**
-
**Recommended or required reading:**
Wm. Revell Phillips (1971) Mineral Optics, p. 1-170; Risto Piispanen (1981) Kideoptiikka, osa I, Isotrooppisten aineiden kideoptiikka; Risto Piispanen and Pekka Tuisku (1996) Kideoptiikka, part II, anisotrooppisten aineiden kideoptiikka; Handbooks: Alexander and Horace Winchell (1967) Elements of Optical Mineralogy. Part II: Description of Minerals. 6th edition; W. E. Tröger (1971) Optische Bestimmung der gesteinbildenden Minerale. Teil 1, Bestimmungstabellen. 4 th revised edition; W. E. Tröger (1967) Optische Bestimmung der gesteinbildenden Minerale. Teil 2, Textband.
The availability of the literature can be checked from this link.
**Assessment methods and criteria:**
Written examination
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Pekka Tuisku
**Working life cooperation:**
No

## 772386A: Ore Geology and Society, 5 op

**Voimassaolo:** 01.08.2016 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**ECTS Credits:**
5 ECST
**Language of instruction:**
English
**Timing:**
2nd or 3rd year autumn semester
**Learning outcomes:**
Upon completion of the course, students should have a basic knowledge of the raw materials obtained by mining and their role in the modern society. Based on geological review of ore deposit types the dynamics of various commodity spaces will be examined with an emphasis on the dynamics of demand and supply fundamentals. Also, challenges to the mining industry with regard to social acceptance will be discussed.

**Contents:**
The ore-forming processes, gobla distribution of mineral resources, benefits and challenges of mining activities, discussion of economic, social and other constraints on exploration and mining.

**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Lectures and hand specimen examination, 30h lectures
**Target group:**
All Bachelor-level geoscience students
**Prerequisites and co-requisites:**
Basic studies in Geosciences
**Recommended or required reading:**
Arndt N., Kesler S., Ganino, C. (2015) Metals and Society - An introduction to Economic Geology, Springer, Second edition, 205 p.
Kesler, S., Simon, A. (2015) Mineral Resources, Economics and the Environment, Cambridge University Press, Second edition. 434 p.

**Assessment methods and criteria:**
Written examination
**Grading:**
1-5/fail
**Person responsible:**
Holger Paulick
**Working life cooperation:**
No

## 773317A: Physical Sedimentology, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Pertti Sarala

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd study year
**Learning outcomes:**
Upon completion the student should be able to recognize the main geological agents that control erosion and deposition in different sedimentary environments.
**Contents:**
The aim of the lecture course is to give geological and physical background of the exogenic processes that operate in terrestrial and marine sedimentary environments. The lecture course also introduces the basic methods and concepts used in physical sedimentology. The topics discusses are related to modern and ancient sedimentary environments and processes including themes such as weathering, soils and palaeosoils, mass movement mechanisms, water and ice flow dynamics, erosion and sedimentation processes and products.

**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
24 h lectures
**Target group:**
Geosciences and geography students (suites well as a minor subject course).

**Prerequisites and co-requisites:**
Introduction to Geology II (771114P) or equivalent knowledge, Introduction to Quaternary deposits of Finland and their resources (771116P).

**Recommended optional programme components:**
The course is a pre-requisite for other courses in the Quaternary Geology.
**Recommended or required reading:**
Press, F. & Siever, R. (1998) Understanding Earth. W.H. Freeman and Company, p. 134-161, p. 264-455 and material given during lectures.

The availability of the literature can be checked from this link.
**Assessment methods and criteria:**
Attending lectures and written examination.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Juha Pekka Lunkka
**Working life cooperation:**

No

## 773343A: Quaternary Geology Seminar I, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3 rd year
**Learning outcomes:**
Upon completion of the course, the student will be able to construct an essay on given scientific topic and give a scientific presentation on a subject of their field.
**Contents:**
The student prepares an essay and gives an oral presentation (about 30 minutes) on a subject that has required independent work. The student also acts once as an opponent. Active class participation required.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Seminar work (oral presentation and acting as an opponent) and independent preparation of an essay.
**Target group:**
Bachelor-level students.
**Prerequisites and co-requisites:**
The required pre-requisite is the completion of the following courses prior to enrolling for the course unit: Basic courses in Geology, Physical Sedimentologia (773317A) and the Basics of Glacial Geology (773344A).
**Recommended optional programme components:**
Corresponding seminar is organised for those who give a seminar presentation in Quaternary Geology (772337A). Either 772337A or 773343A is required.
**Recommended or required reading:**
Reading chosen separately for each student.
**Assessment methods and criteria:**
Seminar presentation and acting as an opponent and a short essay.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Juha Pekka Lunkka
**Working life cooperation:**
No
**Other information:**
Topic of the seminar presentation may be related to that of the Bachelor's thesis.

## 772337A: Seminar in geology and mineralogy I, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd year
**Learning outcomes:**
After the course, students' ability to construct and give a scientific presentation on a subject of their field has increased and their skills to write scientific text have improved.
**Contents:**
Students prepare and give an oral presentation (about 30 minutes) on a subject that has required independent work and judgement. Each participant acts once as an opponent.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
Preparing a seminar presentation and an essay.
**Target group:**
All geology students (geology and mineralogy).
**Prerequisites and co-requisites:**
Basic studies in geosciences.
**Recommended optional programme components:**
Corresponding seminar is organised for those who give a seminar presentation in Quaternary Geology (773343A). Either 772337A or 773343A is required.
**Recommended or required reading:**
Reading material depends on the chosen subjects and is informed upon starting the course/ or students are given the task to search for proper sources from the literature.
**Assessment methods and criteria:**
Seminar presentation and acting as an opponent and a short essay.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
Eero Hanski
**Working life cooperation:**
No
**Other information:**
Topic of the seminar presentation may be related to that of the Bachelor's thesis.

## 780117P: General and Inorganic Chemistry A, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Field of Chemistry

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 780120P | Basic Principles in Chemistry | 5.0 op |
| ay780117P | General and Inorganic Chemistry A (OPEN UNI) | 5.0 op |
| 780115P | General and Inorganic Chemistry II | 6.0 op |
| 780114P | General and Inorganic Chemistry I | 6.0 op |
| 780113P | Introduction to Chemistry | 12.0 op |
| 780101P | Introduction to Physical Chemistry | 7.0 op |
| 780102P | Introduction to Inorganic Chemistry | 5.0 op |
| 780109P | Basic Principles in Chemistry | 4.0 op |

**ECTS Credits:**
5 credits /134 hours of work
**Language of instruction:**

Finnish
**Timing:**
1st autumn
**Learning outcomes:**
After this course the student should understand basic concepts of chemistry as described in international general chemistry curriculum.
**Contents:**
Basic concepts of chemistry, chemical formula, chemical reaction, chemical equation, oxidation-reduction reactions, stoichiometry, gases, chemical equilibrium, acids and bases, additional aspects of acid-base equilibria, solubility and complex-ion equilibria.
**Mode of delivery:**
Face-to-face teaching
**Learning activities and teaching methods:**
32 hours of lectures and applications, 20 hours of exercises and 82 hours of self-study
**Target group:**
Biochemistry, Chemistry compulsory. In the entity of 25 credits (minor studies), compulsory. Physical sciences, Mathematical sciences, optional.
**Prerequisites and co-requisites:**
Upper secondary school chemistry
**Recommended optional programme components:**
The course is an independent entity and does not require additional studies carried out at the same time.
**Recommended or required reading:**
Petrucci, R.H., Herring, F.G., Madura, J.D. ja Bissonnette, C.: General Chemistry: Principles and Modern Applications, 10. edition (also 7., 8. and 9. edition), Pearson Canada Inc., Toronto, 2011. Chapters 1 – 6, 15 – 18.
**Assessment methods and criteria:**
Two intermediate examinations or one final examination. Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.
**Person responsible:**
N.N.
**Working life cooperation:**
No
**Other information:**
No

## A325604: Geology and Mineralogy Minor, 25 op

**Opiskelumuoto:** Basic Studies

**Laji:** Study module

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

*E2*

### 772334A: Bedrock mapping, 3 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

3 credits

**Language of instruction:**

Finnish, in field exercises potentially also English.

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

Upon completion the student should be able to:

- compile a bedrock map
- utilize different source materials in this work.

**Contents:**

Map materials and coordinate systems, methods of bedrock mapping and geological field work, supervised exercise to product a bedrock map.

**Mode of delivery:**

Face to face in the class and field.

**Learning activities and teaching methods:**

8 h lectures, field exercises and independent assignments 32 h.

**Target group:**

Bachelor-level geoscience students.

**Prerequisites and co-requisites:**

Basic studies in Geosciences.

**Recommended optional programme components:**

-

**Assessment methods and criteria:**

Participation in teaching in the field, construction of a geological map and its explanation.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772344A: Sedimentary Petrology, 5 op

**Voimassaolo:** 01.08.2011 -
**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Pekka Tuisku
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

During the course students will get familiar with the basic concepts of sedimentary rocks and develop a general understanding on their classification and processes of formation. They will know about the major

sedimentary structures, major depositional environments and their facies and stratigraphic characteristics and be able to interpret potential sources and transportation mechanisms of sediments based on their macroscopic and microscopic characteristics.

**Contents:**

Characteristics and classification of sedimentary rocks, their mode of occurrence and processes of formation. Identification of sedimentary rocks and their minerals using microscope.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

20 h lectures, 20 h microscope exercises.

**Target group:**

2nd or 3rd year geoscience students.

**Prerequisites and co-requisites:**

Optical mineralogy (772339A), Introduction to Geology II (771114P).

**Recommended optional programme components:**

-

**Recommended or required reading:**

Blatt and Tracy (2006) Petrology: Igneous, sedimentary and metamorphic, Freeman, 3rd edition.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Learning diary and written report or alternatively written examination.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Pekka Tuisku

**Working life cooperation:**

No

### 772335A: Introduction to ore mineralogy, 5 op

**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Eero Hanski
**Opintokohteen kielet:** English
**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**

5 credits

**Language of instruction:**

English

**Timing:**

2nd or 3rd year

**Learning outcomes:**

Students will obtain basic knowledge on ore minerals and their mode of occurrence, learn to recognize the most common ore minerals and textures under the ore microscope.

**Contents:**

Division and structure of ore minerals, composition and texture, phase diagrams and their applications. Ore microscope and how it is used, microscopic properties of ore minerals. Identify ore mineral and assemblages.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

14 h lectures, 21 h exercises

**Target group:**

Students specializing in geology and mineralogy.

**Prerequisites and co-requisites:**

Introduction to ore geology (771108P), Basic mineralogy (771102P) and Optical mineralogy (772339A).

**Recommended or required reading:**

Craig, J.P. & Vaughan, D.J. (1994) Ore Microscopy and Ore Petrography. Wiley & Sons, 2 nd ed. 434 p. Ramdohr, P.: The Ore Minerals and their Intergrowths, vol. 1 and 2. Pergamon Press, 1205 p. Spry P.G. & Gedlinski B.L. (1987) Tables for Determination of Common Opaque Minerals. Economic Geology Publishing Co. 52 p. Barnes H.L. (1997) Geochemistry of Hydrothermal Ore Deposits. John Wiley & Sons, Inc., New York, 3 rd ed. 992 p. Nesse W.D. (2012) Introduction to Mineralogy, Oxford University Press. 480 p. Pracejus B. (2008) The ore minerals under the microscope – An optical guide. Atlases in Geosciences 3, Elsevier, 875 p.

The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Examination, laboratory exercises.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Eero Hanski

**Working life cooperation:**

No

### 772310A: General mineralogy, 5 op

**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Pekka Tuisku
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

The student will deepen their basic knowledge of mineralogy.

**Contents:**

Research history and research methods of mineralogy. Classification of minerals, crystal chemical structures, chemical compositions, the most important properties and occurrence of minerals in rocks.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

26 h lectures

**Target group:**

2 nd and 3 rd year geosciences students.

**Prerequisites and co-requisites:**

Basic course in Mineralogy 771106P.

**Recommended or required reading:**

Wenk & Bulakh, Minerals: their Constitution and Origin, Cambridge University Press.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Pekka Tuisku, Jukka Pekka Ranta, Tiina Eskola

**Working life cooperation:**

No

### 772316A: Structural geology, 5 op

**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish or English

**Timing:**

2nd or 3rd year, autumn semester

**Learning outcomes:**

The student is able to analyze and describe deformation structures of the bedrock, and based on the result, he/she can evaluate the mechanisms of deformation and characteristics of the deformation processes.

**Contents:**

Development of structural geology and principles of the stress and strain theory, microscopic structural elements, fractures and fault structures, folding and fold structures, multiphase deformation and interference structures.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

24 h lectures, 85 h independent study.

**Target group:**

2nd and 3rd year geoscience students.

**Prerequisites and co-requisites:**

Basic studies in Geosciences.

**Recommended optional programme components:**

-

**Recommended or required reading:**

Material given during lectures and Haakon Fossen (2010) Structural Geology, Cambridge University Press, 480 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

N.N.

**Working life cooperation:**

No

### 772341A: Igneous Petrology, 7 op

**Voimassaolo:** 01.01.2009 -
**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Pekka Tuisku
**Opintokohteen kielet:** English

**ECTS Credits:**

7 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd year

**Learning outcomes:**

Students will be able to describe and classify the main types of igneous rocks in the field, and identify the main rock forming minerals and the textures of the rocks under the microscope. Students also are able to classify basic petrogenetic processes, including partial melting, crystallization, and contamination, and will be able to place igneous rocks into a broad geotectonic framework.

**Contents:**

The course provides an introduction to the main concepts of Igneous Petrology, including nomenclature, classification, processes of melting and crystallization, and identification of rocks and minerals under the microscope, as well as the distribution of igneous rocks in a global tectonic framework (mid-ocean ridges, subduction zones, continental rifts, oceanic island volcanism, continental anorogenic magmatism). The petrogenesis of the main types of igneous rocks (komatiites, basalts, andesites, dacites- rhyolites, granite family, gabbronorites, alkaline rocks) will be discussed.

**Mode of delivery:**

Face to face, independent microscope exercises.

**Learning activities and teaching methods:**

26 h lectures, 30 h microscope exercises.

**Target group:**

Bachelor-level geoscience students.

**Prerequisites and co-requisites:**

Optical mineralogy (772339A), Introduction to Geology I (771113P).

**Recommended optional programme components:**

Petrology of metamorphic rocks (772345A) and Petrology of sedimentary rocks (772344A).

**Recommended or required reading:**

Winter J.D. (2001) An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, 697 p. or Blatt and Tracy (2006) Petrology: Igneous, Sedimentary and Metamorphic, Freeman, 3 rd edition.

**Assessment methods and criteria:**

Learning diary and written report or alternatively written examination.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fall

**Person responsible:**

Pekka Tuisku

**Working life cooperation:**

No

### 772345A: Metamorphic Petrology, 6 op

**Voimassaolo:** 01.08.2011 - 31.07.2015
**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Pekka Tuisku
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

6 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

During the course students will get familiar with the basic concepts of metamorphic rocks and develop a general understanding on their classification and processes of formation. They will know about the major structures of metamorphic rocks and be able identify their minerals and textures based on macroscopic and microscopic characteristics. In addition they will be able to relate their mineralogical and textural observations to the processes that generate different kinds of metamorphic rocks.

**Contents:**

Metamorphism and factors that control it; metamorphic facies and their textures and occurrences. Identification of metamorphic rocks and their minerals using microscope.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

26 h lectures, 30 h microscope exercises.

**Target group:**

2nd or 3rd year geoscience students.

**Prerequisites and co-requisites:**

Optical mineralogy (772339A), Introduction to geology I (771113P).

**Recommended optional programme components:**

-

**Recommended or required reading:**

Blatt and Tracy, Petrology (2006): Igneous, sedimentary and metamorphic, Freeman, 3rd edition.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Learning diary and written report or alternatively written examination.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Pekka Tuisku

**Working life cooperation:**

No

## 771304A: Practical training, 4 - 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Practical training

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
4-5 credits
**Language of instruction:**
Finnish/English
**Timing:**
Commonly done as summer work during Bachelor's studies.
**Learning outcomes:**
Students will get familiar with geologists' duties in real-world situations and can assess the development of their own expertise during the training.
**Contents:**
Practical training accomplished under the guidance of a qualified geologist in Finland or abroad. Before the training, students must in advance agree upon the details of the field work with their professor, such as the work place, time, instructor and the supervisor.
**Mode of delivery:**
Participation in work life.
**Learning activities and teaching methods:**
A period of 1.5 to 3 month of practical work in a company or research institute, written report. For work exceeding 1.5 months 4 ECTS credits are granted and for the extending 2 months, 5 ECTS credits are granted.
**Target group:**
Obligatory to all geosciences students pursuing a Bachelor's degree.
**Assessment methods and criteria:**
A written report on the training work.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
Eero Hanski, Juha Pekka Lunkka
**Working life cooperation:**
Yes
**Other information:**
One practical work course belongs to the Bachelor's degree.

## 771304A: Practical training, 4 - 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Practical training

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
4-5 credits
**Language of instruction:**
Finnish/English
**Timing:**
Commonly done as summer work during Bachelor's studies.
**Learning outcomes:**
Students will get familiar with geologists' duties in real-world situations and can assess the development of their own expertise during the training.
**Contents:**
Practical training accomplished under the guidance of a qualified geologist in Finland or abroad. Before the training, students must in advance agree upon the details of the field work with their professor, such as the work place, time, instructor and the supervisor.
**Mode of delivery:**
Participation in work life.
**Learning activities and teaching methods:**
A period of 1.5 to 3 month of practical work in a company or research institute, written report. For work exceeding 1.5 months 4 ECTS credits are granted and for the extending 2 months, 5 ECTS credits are granted.
**Target group:**
Obligatory to all geosciences students pursuing a Bachelor's degree.
**Assessment methods and criteria:**
A written report on the training work.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Pass/fail
**Person responsible:**
Eero Hanski, Juha Pekka Lunkka
**Working life cooperation:**
Yes
**Other information:**
One practical work course belongs to the Bachelor's degree.

## A326104: Surficial Geology Minor, 25 op

**Opiskelumuoto:** Basic Studies

**Laji:** Study module

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

*E1*

### 773324A: Field mapping of Quaternary deposits, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Pekka Lunkka

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

Upon the completion of the course, the student will be able to produce a Quaternary geology map based on own field data.

**Contents:**

A field course introduces the techniques used in mapping of Quaternary deposits. In the field students are reconstructing a 1: 20 000 scale Quaternary map from a pre-selected mapping area.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures and exercises in the field.

**Target group:**

Bachelor-level geoscience students.

**Prerequisites and co-requisites:**

The required pre-requisite is the completion of the following courses prior to enrolling for the course unit: Basic courses in Geosciences, Physical Sedimentology (773317A), Basics of Glacial Geology (773344A) and Technical Properties of Sediments (773316A).

**Recommended optional programme components:**

No

**Recommended or required reading:**

No

**Assessment methods and criteria:**

Participation and quality of the map produced during the mapping course.
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Pass/fail

**Person responsible:**

Juha Pekka Lunkka, Tiina Eskola

**Working life cooperation:**

No

### 773306A: Quaternary Geology of Finland, 5 op

**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

Upon completion of the course, students should have acquired knowledge of the Finnish glacial landforms and deglaciation in Finland.

**Contents:**

The pre-Quaternary landform of Finland; thermomers and cryomers during Pleistocene period; Finnish glacial landforms and their regional division; occurrence of landforms and their combinations as seen in aerial photos; deglaciation; the highest shoreline and its meaning; water-laid deposits; eolian deposits; land uplift; evolutionary phases of lakes; evolution of organic environment.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures

**Target group:**

2nd or 3rd year geoscience students.

**Prerequisites and co-requisites:**

Introduction to Geology II (771114P) or equivalent knowledge, Introduction to Quaternary deposits of Finland and their resources (771116P).

**Recommended or required reading:**

Koivisto M. (2004): Jääkaudet, WSOY, Helsinki, 233 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 762306A: Hydrology in geosciences, 6 op

**Voimassaolo:** 01.08.2015 -
**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Juha Pekka Lunkka
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

6 credits

**Language of instruction:**

Finnish (It is possible to do the course in English, although all the lectures and exercises will be given in Finnish).

**Timing:**

2nd or 3rd spring term; given every year.

**Learning outcomes:**

Upon the completion of the course, a student
- can define the concept of a water cycle, can name the elements of the cycle, can identify their physical

basis and can estimate the magnitude of different components using the water balance equation
- can name and distinguish the principles of the methods used to observe evaporation, precipitation and runoff, and summarize their spatial and temporal variation in Finland
- can describe the behaviour of underground water in vadoze zone and aquifers and can define how the groundwater is formed and how it flows
- can identify different types of aquifers and can describe their relationship with structures of soil and bedrock
- owns basics of hydrogeology (groundwater geology)
- can name major geological and geophysical methods used in groundwater research and exploration

**Contents:**

Introduction to hydrology and hydrological processes in geosciences. Properties and behaviour of water in hydrosphere including hydrological cycle, its different components (evaporation, precipitation and runoff) and their relationship, observations and spatial and temporal variation of each hydrological component in Finland. The second part of the course introduces properties and behaviour of water underground including geohydrological and hydrogeophysical aspects of water and hydrogeology. This part of the course concentrates on the behaviour and properties of water in soil, superficial deposits and bedrock, particularly in Finland. Themes such as groundwater flow, aquifers, groundwater quality, geological and geophysical research methods in hydrogeology will also be introduced.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

40 h lectures, 20 h exercises, 100 h independent study.

**Target group:**

Course is compulsory for geoscience students (geophysics, geology). Also offers to the other students of the University of Oulu.

**Prerequisites and co-requisites:**

The following courses are required: Introduction to Solid Earth Geophysics (762104P); Physical Sedimentology (773317A); Introduction to Glacial Geology (773303A).

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously.

**Recommended or required reading:**

Handouts and lecture notes. Selected parts from: Hooli, J. & Sallanko, J., (1996) Hydrologian luentomoniste; Grundvatten, Teori & Tillämpning. Knutsson, G. & Morfeldt, C-O. (1993) Svensk Byggtjänst, 304 p. Maanalaiset vedet - pohjavesigeologian perusteet; Korkka-Niemi, K. & Salonen, V-P. (1996) Täydennyskoulutuskeskus. Turun yliopisto, 181 p. Mälkki, E. (1999) Pohjavesi ja pohjaveden ympäristö. Tammi, 304 p.

**Assessment methods and criteria:**

Examination

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka, Kari Moisio

**Working life cooperation:**

No work practice

**Other information:**

Course website

### 773322A: Surficial geology in ore exploration, 5 op

**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

Upon completion of the course, students should have a basic knowledge of the dispersal of ore boulders and how boulders and till geochemistry are utilised in ore exploration.

**Contents:**

This course provides practical skills for performing surficial geological ore prospecting in glaciated areas. Boulder prospecting; glacigenic and geochemical dispersion in different landforms; different modes of occurrence of element. Methods: digging, boring, grain analyses, separations and applications.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

30 h lectures

**Target group:**

2nd or 3rd study year students.

**Prerequisites and co-requisites:**

Introduction to Geology II (771114P), Quaternary Geology of Finland (773306A), Basics of glacial geology (773344A).

**Recommended or required reading:**

Kujansuu, R. ja Saarnisto, M. (eds.) (1990): Glacial Indicator Tracing, A.A. Balkema, 252 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773300A: Quaternary Stratigraphy, 5 op

**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 credits

**Language of instruction:**

Finnish

**Timing:**

2nd or 3rd study year

**Learning outcomes:**

Upon the completion of the course, the student will be able to explain the stratigraphical methods used in Quaternary Geology, to discuss stratigraphical issues using basic concepts of stratigraphy. The student will also be able to explain how environments and climate have changed during the Quaternary.

**Contents:**

The last period of the history of Earth is called the Quaternary. The course focuses on Quaternary history and stratigraphy of the Earth. The course consists of the following topics: basic concepts of stratigraphy including litho-, bio-, and chronostratigraphy, geochronology and other types of stratigraphical practices; stratigraphical methods; absolute and relative dating methods; marine and terrestrial sediments as stratigraphical archives; classical and modern stratigraphical models; climate change.

**Mode of delivery:**

Face to face

**Learning activities and teaching methods:**

26 h lectures

**Target group:**

Geoscience students, geography students (pursuing minor in geology).

**Prerequisites and co-requisites:**

Introduction to Geology II (771114P) or equivalent knowledge, Introduction to Quaternary deposits of Finland and their resources (771116P).

**Recommended or required reading:**

Ehlers, J. (1996) Quaternary and Glacial Geology, applicable parts;  Wiley & Sons, New York. Lowe, J.J. & Walker, M.J.C. (1997) Reconstructing Quaternary Environments, applicable parts; Longman, Hong Kong, 2nd edition.  Donner, J. (1995): The Quaternary History of Scandinavia. World and Regional Geology 7. Cambridge University Press, 200 p.
The availability of the literature can be checked from this link.

**Assessment methods and criteria:**

Written examination
Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

5-1/fail

**Person responsible:**

Juha Pekka Lunkka

**Working life cooperation:**

No

### 773347A: Technical properties of sediments I, 5 op

**Voimassaolo:** 01.08.2016 -
**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail
**Opintokohteen kielet:** Finnish

### 773348A: Technical properties of sediments II, 5 op

**Voimassaolo:** 01.08.2016 -
**Opiskelumuoto:** Intermediate Studies
**Laji:** Course
**Vastuuyksikkö:** Oulu Mining School
**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

## 774304A: Analytical methods in geochemistry, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd study year
**Learning outcomes:**
After the course students should know which kind of sample pretreatment and analysis methods are used for geological samples.
**Contents:**
Detection limits and errors in analysis, presentation of analytical results, sampling, sample pretreatment, sample digestion (melts, solutions), silicate analysis theories and practice of different instrumental methods (AAS, XRF, ICP-AES, ICP-MS, TIMS), a visit to a geochemical laboratory.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
24 h lectures, 6 h calculation exercises, visit to a laboratory.
**Target group:**
Bachelor- or Master-level geoscience students.
**Prerequisites and co-requisites:**
Basic course in geochemistry (774301A).
**Recommended or required reading:**
Gill, Robin (Ed.) (1997) Modern analytical geochemistry: an introduction to quantitative chemical analysis for earth, environmental and materials scientists, Harlow, Longman, 329 p. and Sawyer, Clair N., McCarty, Perry L., Parkin, Gene F. (2003) Chemistry for Environmental Engineering and Science, Boston, McGraw-Hill, p. 410-451.
The availability of the literature can be checked from this link.
**Assessment methods and criteria:**
Written examination or essay.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Eero Hanski
**Working life cooperation:**
No

## 774329A: Introduction to Environmental Geochemistry, 5 op

**Voimassaolo:** 01.01.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eero Hanski

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish
**Timing:**
2nd or 3rd study year
**Learning outcomes:**
The student will aquire knowledge of the physico-chemical processes and factors controlling the dispersion of elements in the surface environments. The will be able to carry out calculations related to hydrogeochemical processes such dissolution/precipitation, solubility of gases, absorption, and metal complex formation.
**Contents:**
Concepts of the environment and environmental geochemistry; solution, hydrolysis and redox reactions of minerals, sorption and related geochemical processes, topical environmental problems (acid rain, decrease of ozone, greenhouse phenomenon, heavy metal fallout) from the viewpoint of geochemistry; buffer systems of nature; heavy metals in environment; acid mine drainage.
**Mode of delivery:**
Face to face
**Learning activities and teaching methods:**
30 h lectures, 12 h computer exercises.
**Target group:**
2nd and 3rd year geoscience students.
**Prerequisites and co-requisites:**
Basic course in geochemistry (774301A)
**Recommended optional programme components:**
Advisable to have taken the course before the course Geochemistry of mining environment (774636S).
**Recommended or required reading:**
Sawyer, Clair N., McCarty, Perry L., Parkin, Gene F. (2003) Chemistry for Environmental Engineering and Science, Boston, McGraw-Hill, p. 1-397 and Alloway, B. J. (Ed.) (1995) Heavy Metals in Soils, London, Blackie Academic & Professional, p. 1-57.
The availability of the literature can be checked from this link.
**Assessment methods and criteria:**
Examination on theory and calculations as homework.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
5-1/fail
**Person responsible:**
Eero Hanski
**Working life cooperation:**
No

## 762103P: Introduction to geophysics, 2 op

**Voimassaolo:** 01.08.2009 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 762104P-01 | Introduction to solid earth geophysics (part 1): Introduction to geophysics | 0.0 op |

**ECTS Credits:**
2 credits
**Language of instruction:**
Finnish (It is possible to accomplish the course in English, although all the lectures will be given in Finnish).
**Timing:**
1. year, autumn fall
**Learning outcomes:**
Upon the completion of the course, a student
- can describe the structure of the Earth and its neighbouring environment in space (spheres), their internal geophysical properties and the interactions between different spheres

- can describe large scale transport (movement) of rock material inside the Earth and on its surface (convection, plate tectonics) and give physical and geological reasons for transport
- can describe the position and role of geophysics in the field of the Earth system sciences
- can list major unsolved global research problems in the Earth system sciences
- can name major geophysical research methods

**Contents:**
See 762104P
**Person responsible:**
Toivo Korja

## 762107P: Introduction to global environmental geophysics, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish, English
**Timing:**
2nd or 3rd spring
**Learning outcomes:**
After the course the student can define and explain the physical principles of global environmental issues and the use of geophysical methods in local environmental studies.
**Contents:**
An overview of the physical principles of global environmental issues and the use of geophysical methods in environmental case studies. The structure of the Earth and its geophysical processes: solid earth, oceans, atmosphere, glaciers, groundwater, nuclear waste disposal and natural disasters. Follow-up measurements of environment. Principles of modeling the environment: the Earth as a system. Climate change and its consequences.
**Mode of delivery:**
Face-to-face teaching, independent study
**Learning activities and teaching methods:**
Lectures and practicals
**Target group:**
The course is suitable for students of the Oulu Mining School, Faculty of Science and the Faculty of Technology Obligatory for students of geophysics in the B.Sc. degree.
**Prerequisites and co-requisites:**
No particular pre-requisites
**Recommended optional programme components:**
No alternative course units or course units that should be completed simultaneously.
**Recommended or required reading:**
Lecture notes and Kakkuri, J. & Hjelt, S.-E., 2000: Ympäristö ja geofysiikka and applicable parts of the following: Houghton, J., 2004: Global warming: The complete briefing (3rd ed.).
**Assessment methods and criteria:**
Different modes of approvement
**Grading:**
Numerical grading scale 0 – 5, where 0 = fail
**Person responsible:**
Elena Kozlovskaya, Kari Moisio
**Working life cooperation:**
No work placement period
**Other information:**
Course website

## 802360A: Introduction to inverse problems, 4 op

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Field of Mathematics

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Sari Lasanen

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
4 cr
**Language of instruction:**
Finnish. Alternatively, a book examination in English.
**Learning outcomes:**
Upon completion, the student will be able to

- recognise several inverse problems
- describe typical properties of inverse problems
- solve simple inverse problems with accurate and inaccurate data

**Contents:**

1. Examples of inverse problems and their typical properties
2. Well-posed and ill-posed problems
3. Least squares solutions
4. Tikhonov regularization
5. Statistical inverse problems

**Learning activities and teaching methods:**
Lectures 4x45 min / week. Exercises 2x45 min /week.
**Target group:**
Suitable for major and minor students.
**Prerequisites and co-requisites:**

- 802118P Linear Algebra I
- 802119P Linear Algebra II

Also recommended:

- 800322A Multidimensional Analysis (or Analysis II)
- 801396A Introduction to Probability Theory II
- 802352A Euclidian Topology
- 800345A Differential Equations I

**Assessment methods and criteria:**
Exam.
Read more about assessment criteria at the University of Oulu webpage.
**Other information:**
This course does not contain numerical programming tasks. Computer-aided computations are contained in a separate course
802362A Introduction to Computational Inverse Problems.

## 762104P: Introduction to solid earth geophysics, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Moisio, Kari Juhani, Elena Kozlovskaya

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits
**Language of instruction:**
Finnish or English
**Timing:**
1st year autumn, every year.

**Learning outcomes:**
Upon the completion of the course, a student
- can describe the position and role of geophysics in the field of the Earth system sciences
- can list major unsolved global research problems in the Earth system sciences
- can describe the structure of the Earth and its neighbouring environment in space (spheres), their internal geophysical properties and the interactions between different spheres
- can describe large scale transfer (movement) of rock material inside the Earth and on its surface (convection, plate tectonics)
- can name major geophysical research methods.

**Contents:**
An overview of geophysics: physics of geosphere, hydrosphere, atmosphere and magnetosphere. Solid Earth geophysics and Earth Sciences. Properties, structure and dynamics of the Earth. Geophysical methods used to explore the interior of the Earth. Earth as a planet: shape, size, rotation, revolution. Gravity: Earth's gravity field, geoid, gravimetry, isostasy, tides. Deformation and rheology. Seismology: seismic waves and the internal structure of the Earth. Seismics: refraction and reflection profiling. Earth as a magnet: geomagnetic field, spatial and temporal variations, Earth-Sun interaction, space weather, palaeomagnetism. Thermal, electrical and radioactive properties of the Earth. Dynamic Earth: plate tectonics, internal dynamics.

**Mode of delivery:**
Face to face

**Learning activities and teaching methods:**
30 h lectures, 10 h exercises, 93 h independent study.

**Target group:**
Course is compulsory for geoscience students (geophysics, geology). Also for the other students of the University of Oulu.

**Prerequisites and co-requisites:**
No specific prerequisites. The course substitutes previous courses 762103P Introduction to Geophysics (2 cr) and 762192P Solid Earth Geophysics (3 cr).

**Recommended optional programme components:**
Parallel courses Introduction to geology I (771113P), Introduction to geology II (771114P).

**Recommended or required reading:**
Material given during the lectures and U., Borén, E., Hjelt, S.-E., Karjalainen, T. and Sirviö, J. (2004) Geofysiikka, Tunne maapallosi. WSOY, 191 p. Additional recommended reading: Musset, A.E. and Aftab Khan, M. (2000) Looking into the Earth: An Introduction to Geological Geophysics. Cambridge University Press, 470 p. and Lowrie, W. (1997) Fundamentals of Geophysics. Cambridge University Press, 354 p.

**Assessment methods and criteria:**
Examination.
B.Sc. students in physics can complete the course 762103P Johdatus geofysiikkaan/Introduction to Geophysics (2 cr) in their curriculum by this course without exercises.

**Grading:**
5-1/fail

**Person responsible:**
Elena Kozlovskaya, Kari Moisio

**Working life cooperation:**
No

**Other information:**
Course website

## 762321A: Seismology and the structure of the earth, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Oulu Mining School

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5 credits

**Language of instruction:**
English

**Timing:**

3rd -5th year

**Learning outcomes:**

After this course student can explain the seismic wave phenomena, the wave propagation, and the difference and significance of different seismic waves related to the investigation of the Earth's structure. Student can define and explain basic theory and terminology behind seismic wave observations, analysis and interpretation. Student can analyze earthquake fault plane solutions and seismograms. Student can describe seismic methods used for investigating the Earth. He can define Earth's seismic structure, analyze results of seismic investigations and distinguish between different plate tectonic areas from seismic viewpoint.

**Contents:**

This course focuses in the fundamentals of the most important methods for investigating the Earth's deep structure, seismological and seismic methods. Course starts with some history of seismology, theory of wave motion, seismic waves, their propagation and properties. Seismic ray, raytracing and travel time inversion. Seismic registrations and the Earth's deep structure. Location and magnitudes of earthquakes and fault plane solution. The structure of crust, mantle and core in the light of seismic research. The relationship between seismology and plate tectonics and seismic soundings in the Finland and the Europe.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 30 h, exercises 15 h, self-study 88 h

**Target group:**

Optional for students of Geophysics. Recommend for everyone interested in understanding the principles of the most important method in studying the interior of earth.

**Prerequisites and co-requisites:**

No specific prerequisites

**Recommended optional programme components:**

No alternative course units or course units that should be completed simultaneously

**Recommended or required reading:**

Lecture notes. Selected parts: Stein, S. and Wysession, M., 2003: An introduction to seismology, earthquakes, and earth structure. Shearer, P.M., 1999: Introduction to seismology. Bolt, B.A., 1999: Inside the Earth. Evidence from earthquakes; Bullen, K.E. & Bolt, B.A., 1985: An introduction to the theory of seismology.

**Assessment methods and criteria:**

One written examination

Read more about assessment criteria at the University of Oulu webpage.

**Grading:**

Numerical grading scale 0 – 5, where 0 = fail

**Person responsible:**

Elena Kozlovskaya

**Working life cooperation:**

No work placement period