# Geology for Austria

Geological Survey of Austria

BMWF
Austrian Federal Ministry of Science and Research


Minerals (above left) and a raised relief globe (below) are displayed in the foyer of the Geological Survey of Austria. Water samples (above right) are analysed in the geochemical laboratory.

# Geology is …

Geology is everywhere. Our everyday life is linked to geology in many ways. How we perceive geology varies as much as the many aspects of this science which deals with the origin and structure of the Earth.

Rocks, minerals and fossils are research objects of the geological sciences and their manifold disciplines such as petrology, mineralogy or palaeontology. Rocks convey the feeling of continuity even though they often have a dramatic history as seen from a geological point of view. Crystals shine like magic, fossils are witnesses of evolution and show step by step how life evolved.

A wide variety of rocks, ores and minerals form the basis of our civilization. Our day-to-day environment is mostly made of geological material. We live in stone houses, the steel of the cars we drive comes from ores, the plastic casing of our mobile phones is made of oil, we add salt to our soup and hope that all these resources – just like the water we drink – will never be depleted.

In Austria, the highest mountain, Großglockner, reaching 3,798 m above sea level, and the deepest borehole, Zistersdorf ÜT2a, reaching 8,553 m below ground, are geological benchmarks. In the "land of mountains" geology is of special significance. Important chapters of geological history were written in the Alps where the beauty of the landscape is closely related to natural hazards. Geology as a science has depth, it is literally a fundamental science.

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The stone table in the inner courtyard (above left) originates from the Viennese World Exhibition of 1873. Director Peter Seifert (above right) and his team have all rocks under control (below).
The mosaic "Richness Earth" by Christian Ludwig Attersee decorates the foyer (left page).

←← Stilts support the new building of the Geological Survey as designed by architect Stefan Hübner.

# The Geological Survey of Austria

The Geological Survey of Austria (GBA) is the largest geoscientific research centre in Austria. It is often called the geological conscience of the country. The legal mandate is clearly defined. The task of GBA is to study and document the geology of the country systematically, continuously and overall.

With its expertise and the systematic production of geological maps GBA provides the basis for a number of societal needs. Main activities at GBA therefore are geological mapping, the study of mineral resources, the discussion of all types of geological hazards and investigations for the sustainable supply of drinking water.

Geophysical measurements from the air and on the ground, geochemical analyses and absolute or relative age dating of rocks, complement the work of mapping geologists as well as of economic geologists, engineering and hydrogeologists.

In Austria, the combination of all these geoscientific disciplines and methods is unique and reason for the competence of GBA, as in fact for any other national geological survey.

GBA's library, archives and collections store knowledge and objects from around the world. Numerous books, maps and other objects date back to the time before GBA's founding as the Imperial Geological Institute in 1849.

GBA is a founding member of EuroGeoSurveys (EGS), the umbrella organisation of all European geological surveys. GBA participates in many international projects and cooperations, even beyond Europe's borders.

# To inform

The reading room of the largest geoscientific library of Austria is open to anybody interested in scientific studies.

# To inform

GBA's mandate to serve the government as the centre for information and advice in the field of geosciences is written into the law (FOG § 18). Furthermore, the website provides access to data and information anywhere and anytime. GBA's geological maps are available as images and through web services, scientific journals can be downloaded in portable document format (pdf). The website offers applied geological map services as well as information on mineral resources and mass movements.

The largest geoscientific library in Austria keeps over 350,000 items including more than 46,000 geological maps from all over the world, available to anyone interested in geological research. International library networks combined with geoscientific know-how provide answers to specific problems. Archives dating back as far as the 19th century and modern data bases complement the sources of information.

GBA's employees have gained specialised experience with strong regional context over decades. At the same time, steady contacts with experts in Austria and abroad keep the knowledge at a high international level. This becomes evident through numerous publications in German and English speaking journals, oral presentations, posters and the leading of field trips.

**To analyse**


Different scientific questions necessitate specific treatments of samples (above right) ranging from the clean-lab (above left) to making thin sections (middle) and to the washing of loose rocks (below).
Measurements of the X-ray diffractometer are visualised in charts and interpreted in terms of clay mineral association (left page).

← ← In the clean-lab minerals are chemically prepared for the determination of absolute age.

# To analyse

Water, clay, sand, gravel, limestone, marble, sandstone, granite or gneiss – only the exact determination of material composition (geochemistry) permits the interpretation in terms of formation, origin or usage.

Well documented sampling and specimen preparation precede any chemical analysis. The first steps of preparation include cutting stones with diamond blades, crushing samples using a jaw crusher or washing clay and marl.

Thin section analysis, X-ray fluorescence, X-ray diffraction and scanning electron microscopy are some of the analytical techniques used routinely at GBA to determine the rock or mineral composition of a sample both qualitatively and quantitatively. Accuracy is the top priority in this process, not only in the clean lab where mineral concentrates are chemically treated before measuring their absolute age.

Analysis and expert knowledge for the interpretation of collected data are housed under the same roof at GBA. This constellation accommodates the necessary holistic approach to geoscientific problems.

# To map

Hammer and geological compass (above left) are the most important tools for geologists. Fossils (above right) are used for determining geological age and depositional environment of sedimentary rocks. All field observations are integrated in geological maps (below).
The accuracy and complexity of geological maps calls for multistage corrections during production (left page).

← ← The drilling truck of the Geological Survey is used for geological field work.

# To map

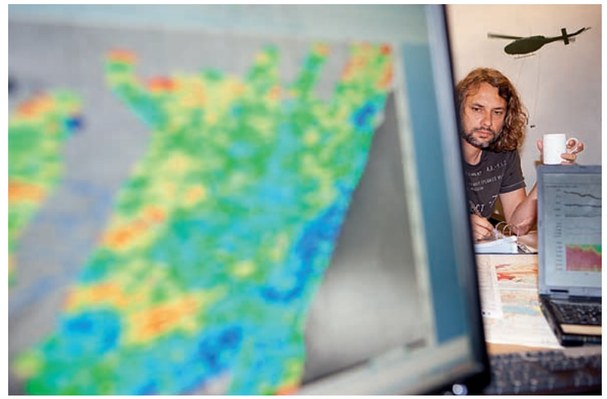
Geological maps form the most important basis for almost any geoscientific problem. The coloured display of the distribution of rock units on topographic maps accompanied by special symbols and line elements portray the orientation of these units in space. Information on rock age and composition together with the location of quarries and land slides complement the map.

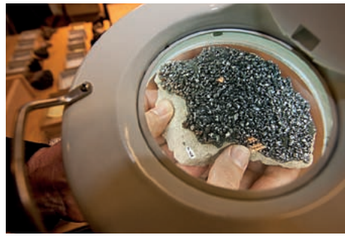
It all starts with mapping, i.e. detailed field investigation by geologists, be it in high mountains, dense forest or urban areas. The main tools of a field geologist are hammer and compass. GPS and handheld computers have been added recently. Vegetation and soil cover often obstruct the view onto underlying rocks. In this case, drilling by hand or by machines mounted on trucks allows inspection of the subsurface. Geophysical techniques can also help.

After completion of a manuscript map, cartographic processing is performed digitally. The overall goal is to present a maximum amount of information without limiting readability of the printed map.

GBA produces geological map sheets at the scales of 1:50,000 and 1:200,000 aiming to cover the entire territory of Austria. Regional, thematic or overview maps are also published.

## To evaluate





Aerogeophysical measurements (above left), minerals (above right) and areas of mass movement (below) are professionally evaluated. Geoelectric measurements give insight into the underground (left page).

←← A view of the clay mineral laboratory with samples and sample holders.

# To evaluate

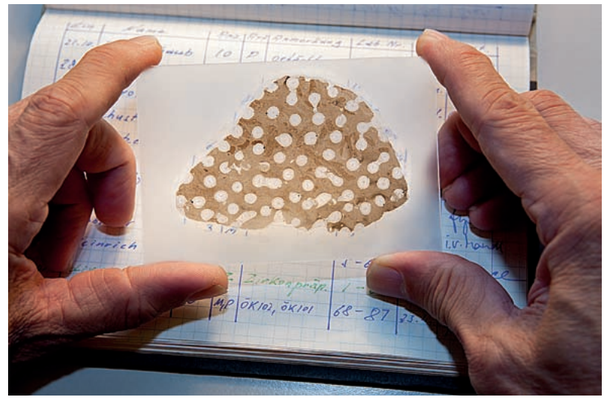
Economic geologists, hydrogeologists and engineering geologists represent the applied geosciences. Their task is to evaluate occurrences of raw materials or groundwater and to assess slope stability. GBA undertakes assessments of the geo-potential of a region in the overlapping fields of resource planning, environmental protection, land use or groundwater supply.

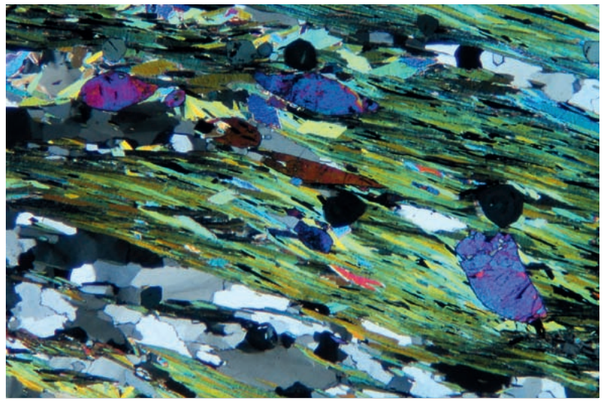
Beside ores and hydrocarbons, surficial deposits of mineral resources (construction materials and industrial minerals) play an important economic role. In Austria, the yearly consumption of sand, gravel, natural stone, limestone, clay and industrial minerals such as gypsum, salt or magnesite, exceeds 100 million tons.

The task of hydrogeologists is to study underground flow paths of water through rocks (aquifers). Especially shallow groundwater bodies and karst water systems are relevant. Deep water resources of drinking water quality are significant for emergency water supply. Not only flow paths but quality and temperature of groundwater (thermal water) become increasingly important. Geothermal heat has great potential as a future source of renewable energy.

In an alpine country like Austria, the expertise of engineering geologists is needed to assess mass movements which are a common phenomenon due to relief, climate and rock properties. Engineering geologists together with geophysicists and other experts collect and evaluate evidence for mass movements. Based on conceptual models, hazard susceptibility maps are produced.

# To research







Thin sections of rocks (above left) are examined using special microscopes (above right). Under polarised light, the thin section of a mica schist from the Hohe Tauern region displays a multitude of colours (middle). Cross sections of shells of marine protozoa as seen in a thin section (below).
The scanning electron microscope magnifies minuscule fossils for the display on computer screens (left page).

←← Correct interpretation of diverse microscopical observations requires a lot of experience.

# To research

Looking through a microscope is a typical activity of many geoscientists as minuscule details reveal the history of rocks. Microfossils or even smaller nannofossils represent the remains of animal or plant organisms. Micropalaeontologists use them for dating the relative age and former sedimentary environment of rocks. Information on water depth, salinity or climate at the time of deposition can thus be gained.

Crystalline geologists study thin sections of rocks under special microscopes. Polarised light makes minerals appear in certain colours. The determined mineral association allows to infer pressure and temperature conditions in the Earth's interior at the time of rock formation.

Through meticulous research, time slices of the geological past can be modelled and put together to reconstruct Earth's history. Further topics of basic geological research include the position of former continents on the globe, the face of Austria before the formation of the Alps and glaciations during ice ages.

Research geologists naturally include neighbouring countries as geological units continue across borders. Discussion with colleagues, joint field trips and research lead to scientific publications which are presented at international conferences.

In the field of development of instruments and methods, GBA contributes significantly. Examples include optimising geophysical measurement systems and developing expert systems for the evaluation of mineral resources.

# To archive



Historical documents are kept in an office archive (above left and right).
The collections of the Geological Survey include fossils like Pontosaurus lesinensis (Kornhuber, 1873 – previous double page), Trachyceras armatum (Münster, 1841 – left page) as well as minerals and rocks samples (middle and below).

# To archive

Geoscientists, especially mineralogists and palaeontologists, are collectors with a scientific mission. Compared to laymen their motive is not the hunt for spectacular or big specimens but rather the responsibility to conserve pieces of evidence for future scientific work.

The best preserved and typical specimen of a previously unknown fossil is described and given a scientific name. These specimens (holotypes) together with comparable pieces (syntypes) are stored at the GBA. Other fossils, minerals and rocks which are the objects of illustrations in GBA publications are equally conserved. The data base now contains more than 18,000 of these ‘types’.

The archives at GBA include vast material collections of which the places of recovery often don’t exist any longer or have become inaccessible. Due to historic reasons, the majority of pieces originate from the former Austro-Hungarian monarchy. Exceptional specimens can be found in the minerals and fossils collections.

Beside the specimen collections, the GBA archives are stores of knowledge for resource geology, engineering and hydrogeology. Unique features of these archives are the continuity and density of information covering the entire country. A graphics collection holds images and photographs of geologists. An office archive reaches back to 1849 and contains all letters and correspondences from the founding day of the institute until today. Valuable documents record the history of the organisation as well as the history of geological research in Austria.

# Expertise

The Geological Survey of Austria fulfils a number of tasks focusing on geological mapping and surveying. The Survey is often called the "geological conscience" of Austria. Since its foundation in 1849 modern methods are used for answering questions concerning the geological underground.

Natural hazard analysis

Geogenic natural hazards

Raw materials

Alternative energies

Water

Engineering geology

Geothermal energy

Publications

Geophysics

Publishing Department

Geological maps

Cartography

IT

Geological mapping and surveying

Drinking water

Hydrogeology

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Thermal water

Collections

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Geochemistry

Rocks

Archive

Soil

Water

Mineral resources

Regional geopotential

Mineral resources plan

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