The mineralogical collections of the TU Bergakademie Freiberg

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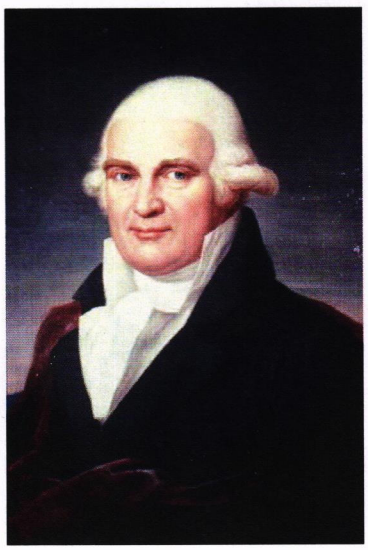
Three mineralogical exhibits can be found in the centre of the university and mountain town of Freiberg, each complementing the other. Along with the Mineralogical Institute, the Abraham-Gottlob-Werner building houses one of the oldest and largest mineralogical collections in the world, built up under scientific criteria. Although it was only opened in 2008 in Freudenstein Castle, the terra mineralia exhibit has become much more popular, having already been visited by over 500,000 guests. The mineralogical world tour on which you can embark in the terra mineralia exhibit will be expanded in October 2012 by yet another building block – a mineralogical journey through Germany in the 'Krüger Haus', also located in the castle square.

On the history of the mineralogical collections

After the Seven Years' War, the flatlining Saxon economy was in need of a kick-start. The commissary general of mountain troops F. A. v. Heynitz (1725-1802) and the chief mining officer F. W. v. Oppel (1720-1796) convinced Prince Xavier to create an independent educational establishment to educate experts in mining and metallurgy. So as to be able to educate the students as practically as possible, Heynitz and Oppel, the founders of the Bergakademie mining college, combined their private collections into a 'cabinet of specimens' which was situated in Oppel's home. The former education building now houses the administration of the TU Bergakademie Freiberg in Akademiestrasse. J. F. W. T. v. Charpentier (1738-1805) expanded this initial collection into a suite and minerals collection. A few years later, the Saxon mining office initiated the 'storage of marketable minerals' at the Bergakademie. It lasted until 1956 and was mainly designed to supply the collection with new material from Germany and abroad. Its first administrator, C. H. Lommer (1735-1787) acted at the same time as the steward of the Bergakademie's collection of specimens, which was already open to the public at set times. When Lommer left office in 1772, J. F. Scheuchler (1740-1791) took over his tasks and carried them out until the functions were taken over by A. G. Werner (1749-1817) in 1775.



Abraham Gottlieb Werner (1749-1817).

Werner taught the subjects of mineralogy, geology, palaeontology, preparation, mining machine operation and ironworking. Werner paid the collection little attention. While he was still a student in Leipzig in 1774, he already published his first book entitled 'Von den äußeren Kennzeichen der Fossilien' ('on the exterior features of fossils'), which was the first mineral identification book in the world. With this book he also developed a mineral classification scheme which categorised minerals based on their properties. As a visual aid for his lectures and as a basis for his scientific work, he built up a private collection over his many years of work, which he sold to the Bergakademie in 1814 for 40,000 thaler. By taking over this significant collection which even today consists of approximately 10,000 specimens, the mineralogical collection in particular was given a great development stimulus. It is one of the most valuable historical collections in the entire TU Bergakademie. Werner's intensive collecting plus his meticulous identification and description of the material were the basis of his scientific success. He himself wrote the original descriptions of 12 new minerals. Wernerite, named after him, is a new variety of mineral belonging to the scapolite group. His collections were of great significance to the teaching work of Abraham Gottlob Werner. By directly viewing the materials, he was able to teach the students in an extraordinarily practical fashion. He also provided original ideas on how best to subdivide geoscientific collections. For example, he built up a systematic mineral collection and a geological collection so as to best be able to use the collections for his various lectures. After Werner's death, the chair was split into two professorships. The collections were adapted to the new chairs, causing two separate collections to develop from then on; the mineralogical and geological partial collections. More and more chairs were created in later years, causing both of these main fields to be constantly divided in order to optimise them for their purpose of serving to help educate the students. The 'university town' was built in the fifth decade of the 20th century and with this, the geologists received in the Humboldt building their own department building and exhibition areas for the collections. This meant that the mineralogical and geological collections were finally physically separated.

Today, in addition to the actual mineralogical collections, five more geoscientific partial collections are accommodated: the Petrological and Ore Deposit Collections in the Mineralogical Institute and the Paleontological and Stratigraphical Collections in the Geological Institute. The Collection of Fuel Geology was transferred in recent years and can now be found on the site of the 'Reiche Zeche' ('rich pit') training and research mine. These will each be introduced after the developments after the death of Werner.

In 1817, C. F. C. Mohs (1773-1839), as the professor of mineralogy, also assumed responsibility for the development of the collection. His fundamental work in mineral identification was in creating the abrasive hardness scale consisting of 10 levels.

Carl Friedrich Christian Mohs (1773-1839).

Johann Friedrich August Breithaupt (1791-1873).

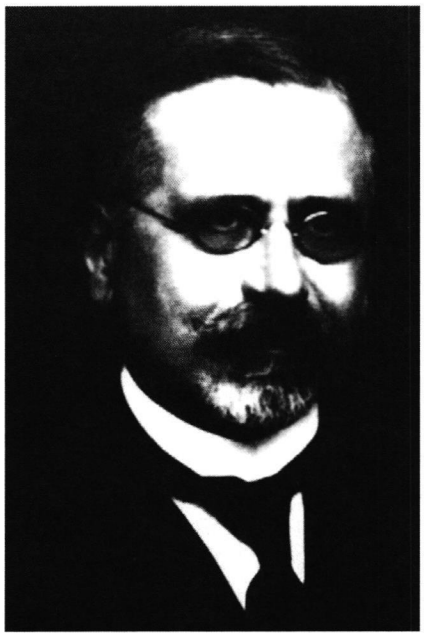
For 40 years from 1826, F. A. Breithaupt (1791-1873) managed the mineralogical education of miners and metalworkers at the Bergakademie. Alongside his numerous scientific works, he oversaw the collection as a steward. His interest lay in expanding the collection and the resulting new acquisitions originated both from his own collections during excursions and from purchases and gifts. When classifying the specimens, he wrote out the tags himself, many of which are still traceable today. His successful scientific work (roughly 500 publications) is recorded by 45 original descriptions. Breithaupt's most significant work, 'Die Paragenese der Mineralien' ('mineral paragenesis'), is an important contribution to the establishment of education in ore deposits. In 1840, in recognition of the merits of Breithaupt, a newly discovered nickel antimonide mineral was named breithauptite.

Albin Julius Weisbach (1833-1901).

In 1866, A. J. Weisbach (1833-1901) became the professor of mineralogy. As the steward of the collection, he examined the mineralogical composition of every specimen until the end of his office in 1900. He broke away from the Linnaean taxonomy and worked with the internationally recognised mineral nomenclature for the first time. Weisbach reprocessed and

reorganised the collection, which worthily concluded in his publishing the 'Tabellen zur Bestimmung der Mineralien' ('tables for the identification of minerals'). Eleven original descriptions of minerals can be traced back to him. One important mineral of these eleven is argyrodite, in which C. Winkler discovered germanium. The 'find of the decade' of the 'Weißer Hirsch' mine in Schneeberg in 1871 is worthy of mention in this regard. Weisbach identified five new secondary uranium minerals in this mine.

At the transition into the 20th century, by which time the collection had grown to around 30,000 specimens and new accommodation was urgently required for it, Freiberg was seen as the centre of geosciences.



Friedrich Ludwig Wilhelm Kolbeck (1860-1943).

When appointed professor of mineralogy and blowpipe docimacy in 1901, F. L. W. Kolbeck (1869-1943) assumed the office of steward of the collection. Together with R. Beck (1858-1919), the professor of geology, ore deposits and petrification and future vice chancellor, he prompted the Saxon government to construct a new mineralogical and geological institute which was dedicated in 1916. Thanks to Kolbeck, the relocation into the newly constructed building went off smoothly and with no losses. He built up various special collections in order to support the education of the students. A mineral discovered in the Sadisdorf copper mine was named kolbeckite in his honour. Before teaching recommenced at the Bergakademie after the Second World War, the collection was restored to its old location after being transferred to Freudenstein Castle. With the creation of the post of custodian in 1952, for the first time F. Leutwein created a group of employees dedicated solely to the collections. In the period that followed, the custodian of the collection worked very closely with the chair of mineralogy. In this way, a great international system of exchange was created during the term of H.-J. Rösler in order to overcome the stagnation in the state of completion of the collection caused by the period of National Socialism and to create a basis for continuous development.

From 2004, events in Freiburg began to follow in quick succession. After collecting for over 60 years, Dr Erika Pohl-Ströher, originally from the Saxon Vogtland region and now living in Switzerland, decided to make her collection of tens of thousands of specimens available to a wider audience. The collection built up over decades was not to be cast to the winds one day by traders, but rather the wish was to keep it as united as possible and display it prestigiously

to the public in a museum or exhibition. Therefore, with a total of over 35 million euros in subsidies from the European Union, the federal government and the Free State of Saxony combined with Freiberg's own resources, the ailing Freudenstein Castle was transformed into a treasure chest over the next four years. A modern exhibition concept, developed by employees of the TU together with the architectural firm AFF in Berlin, it was designed to appeal above all to young people and to arouse interest in issues of natural science.

Alongside this large project, in 2007 the Krüger Foundation began to restore the former district offices directly in front of the gates of Freudenstein Castle, intending to create a geoscientific exhibition to complement terra mineralia that would allow visitors to embark on a mineralogical journey through Germany. To realise this idea, the 'Mineralogische Sammlung Deutschland' ('mineralogical collection of Germany') foundation was created in 2008 by the then rector of the TU Bergakademie and future Saxon finance minister Professor Georg Unland. This foundation became a nucleus for a national German collection. Here, minerals of scientific, historical or aesthetic significance and geoscientifically relevant exhibits are collected with the aim of securing and preserving mineralogical assets whilst using them for research and teaching work at the same time.

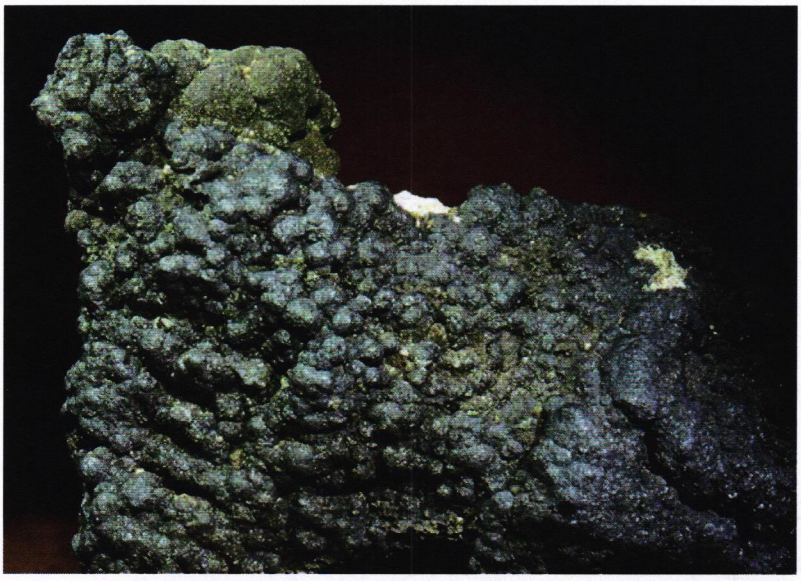
Abraham-Gottlieb-Werner-Building.
Photo: Andreas Massanek.

A journey through the world of the mineral classification

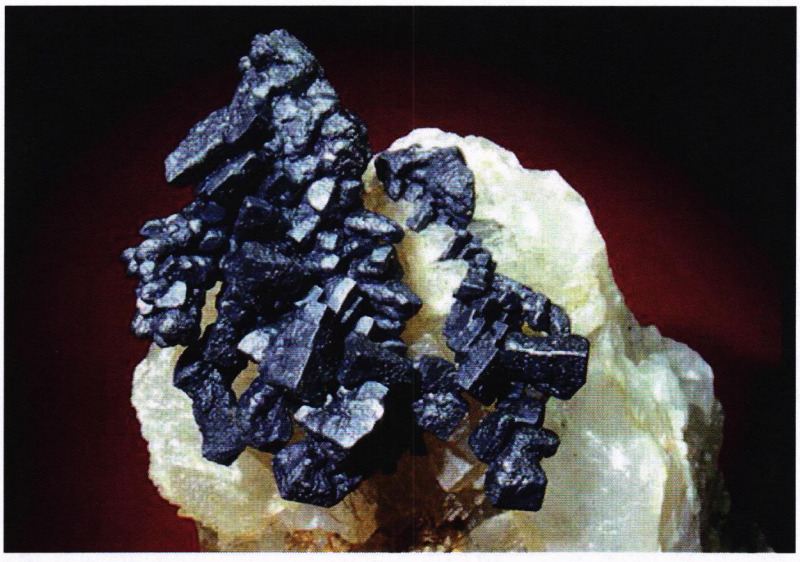
The exhibition in the large room in the Abraham-Gottlob-Werner building is based on the mineralogical classification scheme and was also adapted to the TU Bergakademie Freiberg using the 'special mineralogy' lecturing concept. This classification scheme takes the crystallochemical data, chemical bonds and geochemical and genetic relationships of the minerals into consideration and in doing so represents a combination of the Strunz and Kostov classification schemes.

At present approximately 4,400 different types of mineral are known, around 3,100 of which are present in the collection. It is impossible to exhibit examples of all minerals. The selection covers the most important minerals from their most famous places of discovery around the

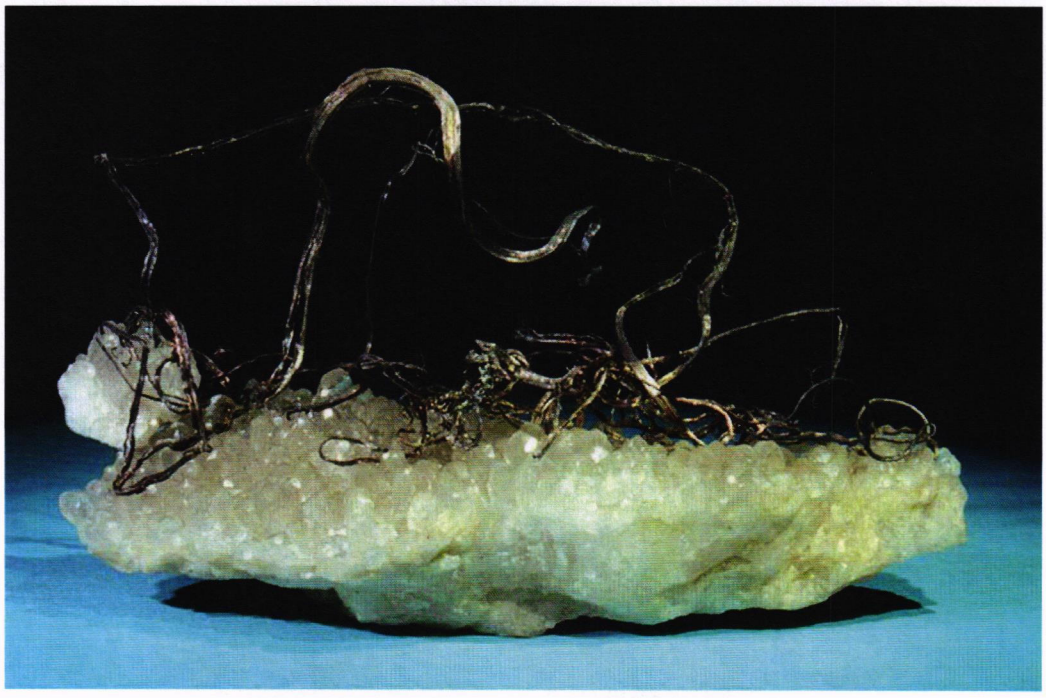
world which are visually appealing and which appear in common mineral assemblages. They are presented in 25 display cases. The collection features many authentic original descriptions of minerals, rare minerals and scientifically valuable, well-documented objects. For example, this includes the mineral argyrodite. It was discovered in 1885 in the Himmelsfürst mine in Brand-Erbisdorf and described by Professor Albin Weisbach. However, he had difficulty chemically characterising the mineral and therefore gave samples of it to the chemist Professor Clemens Winkler. During his analysis, Winkler discovered a new chemical element: germanium. Another mineral of great significance to the history of the Bergakademie is black sphalerite, also known as 'zinc blende'. Using a spectroscope, the Freiberg scientists Reich and Richter discovered within it the new element indium. The name was taken from the initial letters of the indigo colour of the spectral lines. This mineral classification scheme is complemented by particularly attractive large specimens on display in four columnar display cases. The popular subject of gemstones and jewellery stones is presented in 11 table-top display cases. It too is arranged based on the mineral classification scheme. The symmetry of the crystal forms and the related mineral classification principle are displayed in seven table-top display cases. Two table-top display cases are dedicated to the pseudomorphoses, i.e. mineral substances in the crystal forms of other minerals. The collection is rounded off by two additional display cases containing meteorites, tektites and impactite rocks.



Argyrodite,
Himmelsfürst Mine, Brand-Erbisdorf near Freiberg,
Saxony, Germany,
width 8 cm.
Photo: Andreas Massanek.

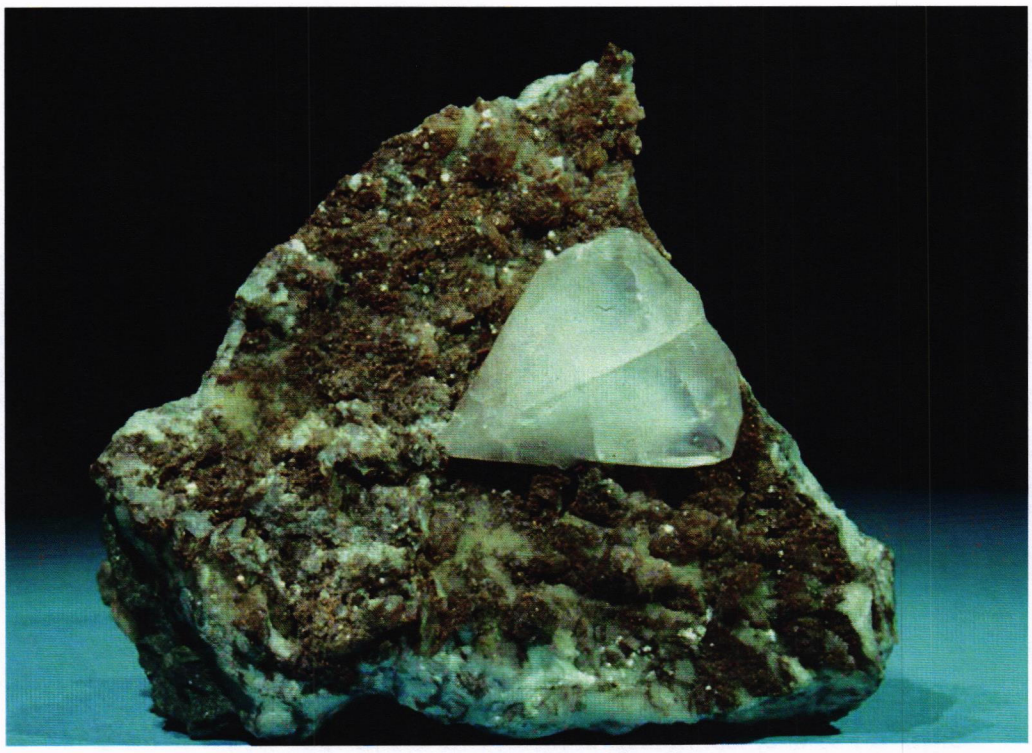


Argentite on calcite,
Himmelfahrt Mine, Freiberg,
Saxony, Germany,
width 6.5 cm.
Photo: Andreas Massanek.

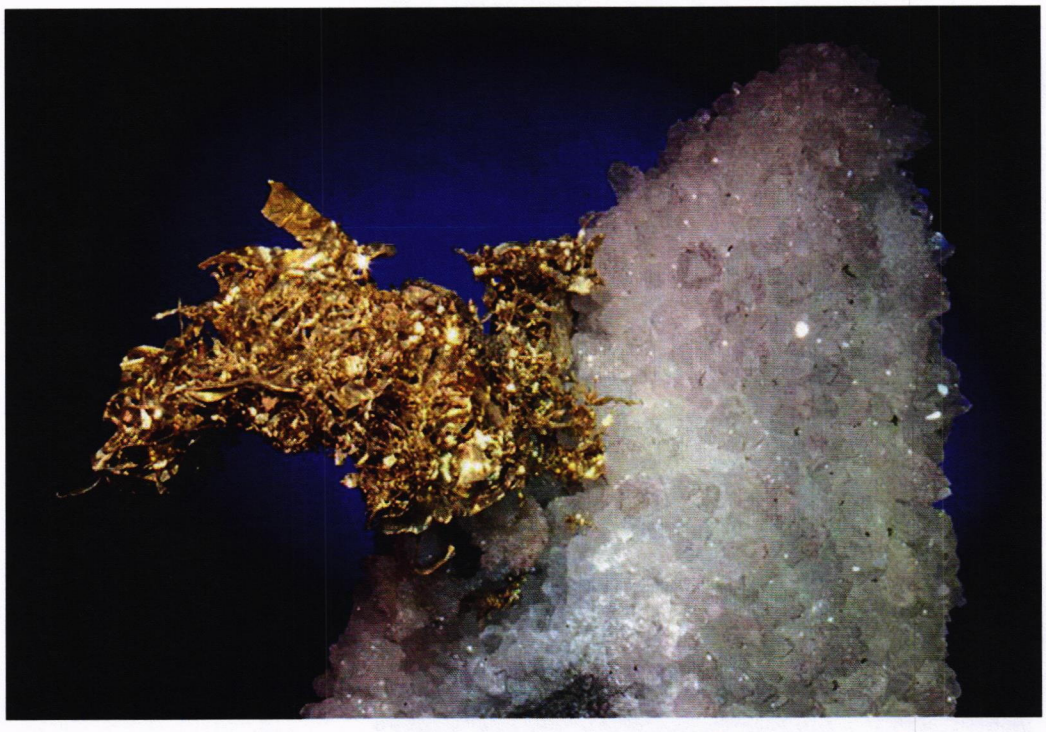


Silver on calcite, Himmelsfürst Mine, Brand-Erbisdorf near Freiberg, Saxony, Germany, 12x7 cm. Photo: Andreas Massanek.

Pitchblende,
Schneeberg, Erzgebirge Mts.,
Saxony, Germany, 9x12 cm.
Photo: Andreas Massanek.



Whewellite on dolomite, Schlema-Alberoda-Hartenstein, Erzgebirge Mts., Saxony, Germany, 6x5.5 cm. Photo: Andreas Massanek.



Gold on quartz, Botés near Zlatna, Alba, Romania, aggregate 4.5 cm. Photo: Andreas Massanek.

Proustite,
Shaft 207, Niederschlema,
Erzgebirge Mts., Saxony, Germany,
length of crystal 10 cm.
Photo: Andreas Massanek.

In the small exhibition room, the minerals are presented based on regional perspectives. When visitors come to Freiberg, they are right to expect the world-famous mineral deposits of Saxony, Thuringia and the Harz mountains to also have a special place in the exhibition. A total of 12 display cases with approximately 1500 specimens are dedicated to these regions. In these, the Ore Mountains, the Vogtland region and in particular the Freiberg deposit are given pride of place. This exhibition is supplemented by two display cases containing local varieties of quartz and minerals from the salt deposits. The contents of nine additional table-top display cases are dedicated to the following themes, some of which are only temporary:

- Whewellite, an organic mineral
- Mineral substances in humans, plants and animals
- Original descriptions of minerals
- Minerals from Saxon type localities
- Minerals from Lusatia
- Minerals from the Granulite Mountains in Saxony
- Amber
- Local jewellery and crafts

Alternating special exhibitions are shown in a central display case complex in the foyer of the geoscientific collections. Another important section is the presentation of Werner's teachings on the exterior features of minerals as a method of mineral identification. Another area displays a selection of the most interesting and beautiful new arrivals from recent years, totalling approximately 500 pieces. These are predominantly minerals from new deposits, special formations and entirely new minerals. The exhibition of the minerals acquired through exchanges, purchases and gifts is constantly updated.

Overall, the mineralogical collections house around 93,000 inventoried minerals and approximately 250,000 pieces in storage. Roughly 4,500 of these minerals are exhibited in the Werner building.

Schlossplatz-square, Krüger-Building (left) and Freudenstein castle (right).
Photo: Andreas Massanek.

A mineralogical world tour

Roughly 3,500 minerals are displayed in the terra mineralia exhibition in Freudenstein Castle, most of which originate from the Pohl-Ströher-Mineralienstiftung (mineral foundation). This comprehensive collection is arranged based on regional perspectives. In doing so, Dr Pohl-Ströher successfully attempted to compile as many known types of mineral from one deposit as possible and document the most varied appearances of a mineral in forms and colours. When acquiring the minerals, she paid particular attention to the quality and aesthetic formation of the specimens in order to give the collection great visual appeal. The collection grew in a time when the stewards responsible for the Freiberg collection were limited in their opportunities to acquire top international specimens. In the GDR era there were neither the travel opportunities to participate in significant mineral sales fairs, nor the financial resources to purchase comparative material. As a result, this private collection represents an excellent addition to the scientifically valuable geoscientific collections of the Freiberg alma mater.

In order to preserve the fascinating character of the collection, it was decided to present a mineralogical world tour in the terra mineralia exhibition. The minerals are displayed in four large rooms, divided into continents. These rooms are now split into Europe, Africa, America and Asia with Australia. Within these continent rooms, the minerals are arranged by country and place of discovery. There are of course focal points here, resulting for one from the available current offer of each market and for another from private interest. The partial collections from Romania, the territory of the former Soviet Union, Namibia, Morocco and South Africa, India, Brazil, Mexico, Peru, the USA and predominantly China are particularly noteworthy.

Rhodochrosite, Kalahari manganese fields, Northern Cape, South Africa, 9x5 cm.
Photo: Jörg Wittig, Dresden.

Dioptase, wulfenite, Tsumeb Mine, Otjikoto, Namibia, 9x7 cm.
Photo: Jörg Wittig, Dresden.

Topaz, Murzinka, Sverdlovsk,
Ural Mts., Russia,
length of crystal 2.5 cm.
Photo: Jörg Wittig, Dresden.

One of the greatest wishes of the founder was to use her initiated exhibition to interest young people over all others in the beauties of nature and the natural sciences. To do this, 'detours' from the mineralogical world tour were introduced, where the visitors embark on a tour of discovery and can learn more. The world tour begins on the observation platform. After an introductory film discussing the basics of mineralogy, such as the formation of the Earth and the identification and use of minerals, visitors have the opportunity to fly to 25 of the most famous mineral sources on jumbo screens with Google Earth. In another area, the significance of certain minerals and their uses in the production of high-tech materials is demonstrated. In the America room, visitors can take a trip 'into the light'. A wide range of minerals are subjected to UV radiation of various wavelengths in order to trigger luminescence. Just as Gulliver travelled into the land of giants and the land of dwarves, in the Asia room visitors can travel into different dimensions. This area has a special focus on fluorite. In a 'geode passage', visitors can experience how miners discover the hollows lined with these magnificent crystals underground. In a three-dimensional projection, visitors can walk from the outer surface of a fluorite crystal right into the crystal structure - in the true sense of the word: an accessible fluorite model allows visitors to experience the atomic dimensions. There is even more to discover from expeditions. Both experts and laypeople can use microscopes to embark on voyages of discovery. There is even a scanning electron microscope available for visitors to experience magnifications of over 1000 times. With prior notice, even the elementary compositions of visitors' own mineral discoveries can be examined. The expedition also allows school classes and other groups to attend courses on mineral or rock identification. The exterior properties of the minerals can be identified and photos can be taken. A small but excellent library and online computer are there to answer questions arising during the tour of the exhibition. New programmes are constantly being developed on specific topics which are then offered to school classes as an educational

supplement and which are designed to prompt parents and grandparents to visit the exhibition with their children during the holidays. The Europe room explains the formation of the minerals on metre-long illuminated panels on the fronts of the display cases. In particular, these use graphic depictions to present the areas where the minerals of interest to collectors form. Such areas include hydrothermal veins, alpino-type clefts, skarns and pegmatites. As part of a journey through time, the Africa room highlights that the significance and use of minerals have constantly changed over the course of human history in light of far-reaching discoveries and the development of society. In addition to this journey through time, the minerals in the Africa room are also arranged by the regions in which they were discovered. In five display cases, visitors can view the regions of discovery with the aid of relief maps. The tour is rounded off by a visit to the treasure room where large specimens, gemstones and meteorites are on display.

The mineralogical journey through Germany

This journey can be started from 06 October 2012 in the 'Krüger Haus' – Building directly adjacent to Freudenstein Castle. The idea of the terra mineralia exhibition was expanded upon here – the mineralogical world tour was supplemented by a mineralogical journey through Germany. The most interesting mineralogical regions of the country are presented on a total of three floors. These regions include the Erzgebirge Mountains and the Vogtland, the Thuringian Forest, the Harz mountains, the Rhoen Mountains, the Weserbergland and the Münsterland, the Ruhr region, the Sauerland, the Siegerland and the Westerwald, Lahntal, the Hunsrück Mountains, the Black Forest, the Upper Palatinate and the Fichtelgebirge Mountains.

The majority of the objects in the exhibition also originate from the Pohl-Ströhler-Mineralienstiftung mineral foundation. Some particularly impressive specimens in this collection are the minerals from the time of the Wismut mining company, a time when only relatively little material found its way into the museums and public collections in the former GDR. This includes spherical nickeline aggregates with a diameter of 8 cm, silver dendrites and honey-coloured barite from Pöhla; native bismuth, pyrargyrite and excellent skutterudite specimens from Schlema-Hartenstein and Alberoda, Aue. A large plate studded with wavellite from the Thuringian town of Ronneburg is of excellent quality. Wonderful pyromorphite from Bad Ems, excellent fluorite specimens from the Wölsendorf district, manganite from Ilfeld in the Harz mountains and minerals from the Black Forest, to name but a few. Another important source is mineral specimens from the 'Mineralogische Sammlung Deutschland' foundation. Through this foundation dedicated to minerals and geo-relevant objects, private collectors have taken advantage of the opportunity to actively participate in the organisation of the new exhibition. Of particular note are, for example, a deposit suite from the Dreislar barite mine from the collection of Professor Unland, superb large quartz specimens from the Black Forest from the Gulich collection, coelestine in the most varied forms and colours from the Rüdersdorf municipality in Berlin from the Kuhnke collection and pyrite specimens from Schleswig-Holstein, belonging to the Schröder family. Mr Einenkel, from Leipzig, donated gold-plated crystal models which he crafted himself. Other collectors and also museums have contributed to the success of the exhibition with their numerous loaned items.

The exhibition will be expanded by a room in the top floor at a later date, in which historical mineral identification devices will be on display. These were sourced from private collections and are on loan to the exhibition.

Baryte, Pöhla, Erzgebirge Mts., Saxony, Germany, 14x19 cm.
Photo: Hartmut Meyer, Lollar.

Manganite, Ilfeld, Harz Mts., Thuringia, Germany, width 10 cm.
Photo: Hartmut Meyer, Lollar.

Rhodochrosite,
Wolf Mine, Herdorf, Siegerland,
Rhineland-Palatinate, Germany,
9x6 cm.
Photo: Hartmut Meyer, Lollar.

Erythrite,
Daniel Mine, Schneeberg,
Erzgebirge Mts., Saxony,
Germany, length of crystals 3 cm.
Photo: Hartmut Meyer, Lollar.

Tasks and significance of the mineralogical collections

The mineralogical collections are part of the geoscientific collections which include the Petrological Collection, the Ore Deposit Collection, the Paleontological and Stratigraphical Collections and the Collection of Fuel Geology.

Since teaching began at the Bergakademie Freiberg, great value has been placed on the uniformity of theoretical and practical knowledge transfer. For this reason it is necessary to collect and provide suitable illustrative material as a teaching aid. Studies and research in the geoscientific disciplines require important basic knowledge of minerals, mineral ores, rocks and fossils, as well as their composition, properties and deposits. The value of each individual object to the collection, and therefore also to teaching and research, increases with the accuracy of the sample documentation. Alongside the general sample description, it mainly includes precise information on the place and date of discovery. Through this centuries-old tradition, significant geoscientific study collections have developed at the Bergakademie, consisting of a section on display and the scientific collection, collections in storage and a documentation archive. The practice and examination collections were separated from these and assigned to the chairs. The geoscientific collections in Freiberg are some of the most comprehensive comparable collections in the world.

Work in the geoscientific collections focuses on documenting and archiving the comprehensive documentation which finds its way into the collections through the comprehensive research work of the scientists and students. Search lists constantly in need of updating therefore represent the basis for the specific completion of the systematic collections. Added to this are the extrication of minerals, rocks and fossils from temporary exposures and targeted digs and sampling for current teaching and future research. The central task of university collections is to properly store this material with its source and processing data, and to make it available to scientific researchers and for student assignments. This gains all the more significance for geoscientific collections because the specimens were procured from often remote regions (Andes, Pamir, central Asia, Antarctica etc.) at a high cost or originate from temporary exposures, such as during motorway construction, which only become accessible once every hundred years. In this way, well-organised geoscientific collections become indispensible bases of current and future national and international research. Alongside this, material in the collection is subjected to modern qualitative tests in order that these collections develop into databases and sources of research material.

In the coming years, the collection data is expected to be entered into an internet-based database and thereby be indexed even more efficiently for scientific use. The exhibitions belonging to the partial collections primarily serve as teaching aids for graduate and postgraduate student education, but due to the wonderful exhibits, especially in terra mineralia and the Krüger Haus, they too are enjoying ever-increasing popularity with the public.
In this regard, the interest of the schools in our collections, which organise visits as educational supplements, mostly for the natural science disciplines, is remarkable. In leading the tours through the collections, the employees, also supported by committed students, are making a very important contribution to nurturing culture and education. The collections are also introduced in all their complexity and all partial collections in their specific details to interested members of the public, from both Germany and abroad, in presentations, publications and exhibitions.

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