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Field Trip

DMG Deutsche Mineralogische Gesellschaft

DFG

The Western Harz Mountains Vein Deposits
- Economic Geology and History of Mining Operations especially in Sankt Andreasberg district

(by Wilfried Ließmann)

The Western Harz Mountains enclose two important ore vein regions the Oberharz district round Clausthal-Zellerfeld in NW and the orefield of Sankt Andreasberg in the east. Both belong to the most famous Pb-Zn-Ag mining districts of Europe.
Since the middle age or earlier argentiferous lead ore, copper ore and later zinc ore and barite have been mined. First mining activities started in the eleventh and continued until the late fourteenth century.
This early intense near-surface mining led to the discovery of all important vein systems.
Systematic exploitation which lasted until 1992, dates back to the early 16th century. After the founding of seven mining towns ("freie Bergstädte") in the first half of the 16th century the Upper Harz mountains became one of the first entirely industrialized regions of Europe. Within a few decades after its resumption, mining became an economic success. Private investment and state allowances resulted in an increase of production of mainly silver for mint purposes until the early 19th century. The economic crisis in 1817 resulted in the abandonment of numerous mines. Nevertheless, the total ore production increased owing to the discovery of the Bad Grund deposit (Silbernaal fault system) which became the most important ore deposit of the Upper Harz area. With the exception of the mines in Bad Grund and Lautenthal, all other mines in the Upper Harz area were closed in 1930 (shaft Kaiser Wilhelm II /Clausthal) as a consequence of the decrease in metal prices following the world-wide economic crisis. The closure of the Bad Grund mine in 1992 terminated the long tradition of ore mining in the Upper Harz Mountains.
Altogether the crude ore production is estimated at 36.9 mio. mt out of what 1 910 000 mt lead, 1.463.000 mt zinc and slightly over 5000 mt silver were recovered. Almost half of the silver (2.240 mt) has been exploited in the Bad Grund deposit.
The Sankt Andreasberg orefield in the Middle Harz mountains has yielded only a fraction of the metal output of the Oberharz district. The results of a 400 years mining period are somewhat about 350 mt silver, 12500 mt lead and 2500 mt copper.
Because of its remarkable wealth of rare minerals and nice crystals e.g. calcite, silver sulphosalts and zeolites, it has become well known to the scientific world. Documented mining activities are dated back to 1487. Discoveries of rich silver ores in 1520 led to the founding of the town Sankt Andreaberg, where up to 116 mines were running. At the beginning of the 30-years war (1618) all mining activities stopped mainly because of problems with the water. It went through a time of revival at the end of the 17th century, with new drainage gallery (Grünhirscher Stollen, 1692) and a better water management (Rehberger Graben, Oderteich). Economic and technical problems during the second half of the 18th century conducted to the closing of the most mines. Later attempts to recover new resources in this region failed to be successful Only the Samson mine, which reached a depth of 810 m below surface, was in the middle of the 19th century one of the world`s deepest mines, produced until 1910.
Near by in the area of Bad Lauterberg barite veins are of economic interest. Since 1838 about 15 veins have been worked on different scales. The Wolkenhügel barite mine north of Bad Lauterberg was until 2007 the last operating mine in the Harz Mountains. Altogether more than 5.5 million t barit of high quality have been exploited.

The silver deposit of Sankt Andreasberg

The former mining town ("Bergstadt") and today national park community St. Andreasberg (now part of Braunlage) lies in the middle Harz Mountains about 600 m above the sea level. After closing the mines in 1910, forestry work, woodcraft and tourism (in particular winter sport) became the most important sources of income. Today there are about 1400 inhabitants.

The heritage of 500 years of mining activities is next to the nature an important factor for the attraction of tourists. Their are the mining museum & technical monument "*Grube Samson*", the visitors mines of the "*Lehrbergwerk Grube Roter Bär*" and the old arrangements of water supply from the early 18th century (Oderteich, Rehberger Graben).

In 2010 the "*Upper Harz Mountains water management system*" became UNESCO world heritage. The vicinity of Sankt Andreasberg forms an important part of this extensive culture monument.

The famous silver mining district of St. Andreasberg is located in a horst-like wedge, bounded to the north and south by two big fault-systems ("Neufanger" and "Edelleuter" fault), with its open end facing east. Within this block, 20 not very sized veins (on an average of less than 1 m thick) of different strike directions are prevalent.

Main differences to the Upper Harz area are dip direction, amount of displacement and thickness of veins. The veins in the St. Andreasberg district dip steeply to the N and NE. The mineralization is established up to a depth of more than 800 m.

Complicated fault tectonics during the mineralization, frequent changes of vein behaviour as a consequence of host rock variations as well as high variability in mineral content made mining operations difficult. Wilke (1952) distinguished four cycles of deformation and stages of mineralization.

- Prestage of mineralization: Low-grade ore, oxide-carbonate stage.
- Second Cycle: Main stage of mineralization: galena, sphalerite, chalcopyrite and tetrahedrite of major importance.
- Third Cycle: Reactivation of older fractures; reopening of veins; displacement along shear zones; formation of silver rich ore shoots, nickel-cobalt-arsenides, native arsenic and antimony, called "*noble calcite generation*"
- Fourth Cycle: remobilization of calcite and deposition of rich silver ores; development of the youngest faults with minor vertical movement.

Mineable ore concentrations were found in the footwalls of intersections between veins and thick cataclastic zones (e.g. "Silberburger Ruschel"), the latter obviously acting as an impermeable barrier for the hydrothermal solutions. Country rocks of the veins are middle devonian slates, marly shales, sandstones and spilitic rocks (diabase with pillow structures), mostly within the granite contact aureole of the Brocken-pluton.

The deposit is famous for its richness in minerals, more than 200 species are described. The particular drusy veins delivered a lot of nice crystals of calcite in a great diversity of crystallographic shapes (144 simple forms and 391 combinations are known!), different members of the zeolite group (apophyllite , harmotom, stilbite) and rare silver minerals (pyrargyrite, dyscrasite, stephanite, polybasite, argentopyrite a.o.).

The most famous mineral of St. Andreasberg is samsonite ($Ag_3MnSb_2S_6$), discovered in 1908 on the Samson mine 550 m below the surface by Berginspektor H. Werner. St. Andreasberg is the single place in the world, where the mineral is found in

crystals up to 3 cm. On the whole there are only 80 small specimens of this extreme rare silver mineral in the collections world wide.
In former times the unusually diverse mineralization was generally explained by the close proximity to the granite complex of the Brocken. Assuming a genetic relationship with the granite intrusion of Variscan age (295 +- 3 Ma K/Ar) may be assigned to the mineralization. Recent isotopic age constraints however, indicate that the hydrothermal activities took place in the transition period from Jurassic to Cretaceous. Adularia from the St. Andreasberg vein system e.g. shows an K-Ar age of 136 +- 3 Ma, which coincide well with other results and demonstrate that most of the vein mineralizations are of mesozoic age.

The Samson Silver Mine
An international historic mechanical engineering landmark & world heritage
Today the 1521 opened Samson mine is mining museum and one of the most important technical monuments of the Harz region.
The unique ensemble of surface buildings from the early 19th century with the open inclined shaft, two big waterwheels and the famous man-engine can be visited. It is the single old shaft plant in the Harz mountains which is complete preserved and still in function as an underground electrical power plant. The inclined shaft reached its final depth of 780 m in 1849 and was at that time one of the deepest in the world.
There is an original reversible waterwheel (Kehrrad) with rope drums and braking device. It dates from 1824 has a diameter of 9 m and was used to lift and let down the wooden tons (Treibkunst). Secondly there is the man-engine (Fahrkunst) of 1837 with a 12-m waterwheel (Kunstrad) for the transport of the miners. The working depth that time was more than 600 m, later extended to 800 m. It is the last one in the world which is still in use!
The man-engine was invented in the Upper Harz Mountains (Zellerfeld) in 1833 by L. DÖRELL. Instead of wooden beams the man-engine in the Samson mine got rods of two stout iron-wire ropes and was prototype for a second generation of the engine. The wire hoisting rope was an invention of the mining councillor W.A.J. ALBERT at Clausthal in 1834.
The mine had 42 levels. The 1890 installed drilling with compressed air let the output of the mine increase to 10.000 mt / year. To use the now mainly hauled poor ores it was necessary to build a new separation plant (Erzwäsche). Because of the low metal contents, sinking silver prices and high hoisting costs the mine worked more and more with deficit. After turn off the pumps in 1910 water filled the workings up to the main drainage gallery (Sieberstollen). Since 1912 two electric power plants, 130 m and 190 m below the surface produce clan regenerative electricity (6,25 mio. kWh/year). Therefor the more than 300 years old water management system is still in function. The staff of the energy company today use the man-engine to control the underground plants.
In the former separation house (Pochwerk) visitors find an exhibition of nice minerals, several mining models, old tools, plans and historic photographs. Stairs up in the shaft house there is since 2001 a canary museum ("*Harzer Roller Kanarien Museum*") – the only one in the world. This type of birds came first by immigrated miners form Tyrol to the Harz Mountains in 1730. During the crisis of the mining industry in the 19th century the breeding of this birds got a significant economic importance. In 1883 about 350 families in St. Andreasberg breeded canaries. Yearly up to 150000 birds were exported e.g. to North and South America or Australia.

The "Lehrbergwerk Grube Roter Bär"

Nowadays in the Valley east of the town ("Bärener Tal") there is still an active mine but not for the producing of metals or getting minerals, but for practical historic research work and instruction.

This private institution exists since 1988. Its objects are research, preservation and documentation of the underground mines and other evidences of 500 years mining history in the famous St. Andreasberg district. It was founded by scientists and students of the Technical University Clausthal and other interested people around. Today the active working group ("Arbeitsgruppe Bergbau") has about 30 members; the local historical association ("*St. Andreasberger Verein für Geschichte e.V*.") has 200 members and carries on the **Lehrbergwerk**.

During the last 24 years in more than 100.000 voluntary and honorary done working hours the miners were succeded in reopening of 7 old mines, which represented workings from the early 16th to the early 20th century for mining archeological studies. All this activities are financed by contribution and gifts, without earning public money.

To the surface plant around the pit yard belong changing house, office, locksmith`s workshop, smithy magazine, compressor station and material stock.

By contracts with the owner of the mining property now a days the working group has the permission to explore the whole eastern part of the district ("Auswendiger Grubenzug", Beerberg). There is a potential of more than 34 km of old galleries and drifts! Because of the very competent rock and the thin width of different veins, most of them are intact and safe but filled with waste or collapsed near the surface.

Partly the reopened workings can be visited by specialists and also other interested people.

The Roter Bär Mine

The former iron mine Roter Bär (in production 1810-1866, exploration activities 1920-1929) became in 1931 the first visitor`s mine in the Harz mountains, but during the second world war it was closed and used as air-raid shelter. In 1990 it was reopened for visitors and is also used for practical exercises in geology for students of different universities.

Workable was a metasomatic ironore, bound to a middledevonian sequence of small limestone lenses in a black slate. The old workings extend to more than 400 m flat under the valley. Near the surface the primary sideritic ores are weathered to claylike limonitic material. In former time the hand sorted material has an content of 35-40 % Fe.

The small mine owned by private persons („Eigenlehner"), 3-4 men and a few boys produced yearly about 50-60 t ore. This was melted at the fiscalic Königshütte near Lauterberg. Because of some manganese content the ore had a good quality and was delighted for making steel for mining tools. The plant produced also wire for the first ironmade hoisting cables, ("Albertseil", first investigated in Clausthal 1834). The mining activity ended in 1866 with annexation of the kingdom hannover by prussia.

In the 1920th the Ilseder Hütte company (Groß-Bülten near Peine) started an exploration program and opened the old workings. For 10 years up to 42 miners were employed to drift 4 km new galleries on two levels. All activities finished with the world economic crisis, without finding workable reserves.

The abandoned workings became the first visitors mine in the Harz Mountains, opened in 1931 by the local historic association. After the second world war the Samson mine became mining museum (1951) and the unused Roter Bär mine felt into disrepair.

Since 1990 the mine is opened for guests which live to see the underground as authentic as possible, all mining work life and conserved in original state.

The Wennsglückt Mine

Today the former Wennsglückt silver mine lies in the centre of the historic investigations. The mining activities on that vein started probably in the early 16th century and finished 1928. The mine lies directly in the neighbourhood of the Roter Bär. The steep dipping vein has a width of 0,3-0,6 m, is mineralized with galena, chalcopyrite, tetrahedrite locally also nickel-cobalt arsenides mixed with quartz, argillic loam and altered rock.

By mining the vein structure is proved ca. 500 m in direction of the strike and max. 350 m to the depth.

In the upper parts, which are accessible again since 1992, there is an excellent developed gossan (oxidation zone, "Eiserner Hut") with lots of supergene minerals (malachite, pyromorphite, mimetesite, cerussite).

400 years of historical mining can be divided in six different periods, started probably in the middle of the 16th century and ended for the present at the begin of the 30-years war (1620). In this first period the mining reached a depth of 40 m under the bottom of the valley. In the following main period (1691 – 1756) the mine was called Wennsglückt and was carried by a company ("Gewerkschaft").

To raise the water an underground waterwheel was installed in an 50 m deep inside shaft ("inwendiger Kunstschacht") to move mechanical pumps.

In 1705 the mine got an inclined mainshaft ("Tagesschacht") and 1714 a reversible waterwheel (Kehrrad). In 1723 the mine had a staff of 12 men, an earned the first time profit, but only for a short episode.

In 1729 the Grünhirscher Stollen, at that time the main drainage adit, reached the mine in 110 m depth and lightened the drainage.

In the depth only silver poor low-grade ore was found and increasing running expenses brought the company into debts. So the state took possession of the mine, which was at least 294 m deep, when the last operations were stopped. The economic results of the second period were small: only 135 kg silver, 1370 Centner copper and a few hundred Centner lead were the total metal production.

1790 – 1812 the shaft was reopened and used as main drainage shaft for the eastern part of the district Financed by the state extended underground exploration were carried out.

In 1804 the deepest drainage gallery ("Sieberstollen", at all 12 km long) reached the Wennsglückt shaft 170 m below the surface and made the dewatering easier. The mine used one reversible waterwheel (Kehrrad) and two wheels for the pumps (Kunsträder). The main shaft got a final depth of 356 m. The Wennsglückter – and the Jacobsglücker vein in the neighbourhood were explored on the 8th and the 10th level. The expected discovery of rich ore shoots failed, only small amount of silver poor lead ore were mined. In 1812 all attempts below the Sieberstollen level finished. The shaft was abandoned and later refilled.

The Andreasberger Hoffnung Mine (Beerberger Stollen)

The forests of the Beerberg are rich in relicts of the ancient mining activities. There are outcrops of the veins, holes ("Pingen"), dumps, defiles and rests of the former water management system. For tourism a special hiking path („*Geologisch-bergbauhistorischer Wanderweg*") with 42 yellow infotables to the mining history is etablished.

About 1520 the first highgrade silver ores were found at the Beerberg, which trigger a big silver rush („große Berggeschrei“).
The old workings were finally 1820 -1850 investigated by a 500 m long gallery (Beerberger Stollen), which portal lies in the Wäschegrund.
At last 1867–1912 (with gaps) the private mining company **Andreasberger Hoffnung** tried to find ores, and used this gallery for the haulage. It reached three main vein structures, with the St. Jacobsglücker vein as the most important one. But the residual mining activities ended without any success.
In 2004 the working group opened the refilled entrance and used the Beerberger Stollen as access to the very old workings in the centre of this mount. Very exciting are the openings in the mines **Claus Friedrich**, **Neues Glück Auf** (late 18th century), **Weinstock** and **St. Georg** (16th and early 17th century). Here very old openings formed by fire setting were excavated. Other workings in the underground which can be visited ate the **St. Annen Galery** and the **Jacobsglücker Galery** with different outcrops of the hyddothermal mineralization.

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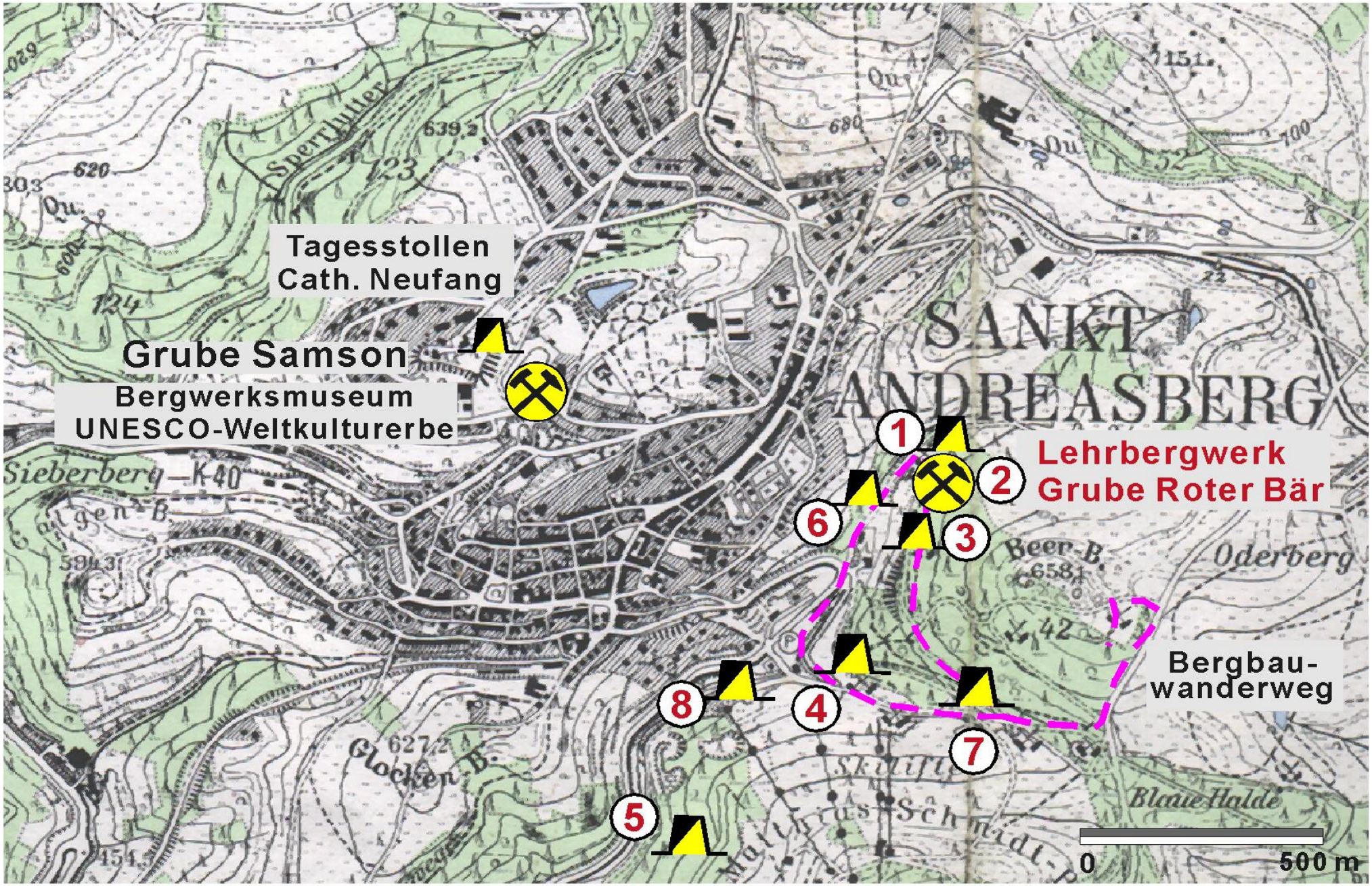

Betriebspunkte des Lehrbergwerks Grube Roter Bär: 1 Tagesstollen Roter Bär; 2 Grube Wennsglückt - Tagesstollen Unverhofftes Glück; 3 Sankt Annen Stollen; 4 Beerberger Stollen; 5 St. Andreasbergs Glück ; 6 Verlegte Silberburg (Versuchsstollen); 7 St. Jürgen (St. Georg) Stollen; 8 St. Johannes Stollen

Roter Bär educational mine in Sankt Andreasberg

This excursion includes a visit to the polymetallic silver deposit in St. Andreasberg, which is part of the Mittelharz vein area, was mined from 1520 to 1910 and is still world-famous today due to its complex mineralogy.
The Roter Bär educational mine, which has been run on a voluntary basis for research purposes by the mining working group since 1988, allows visitors to familiarise themselves with old mines and study underground outcrops.
The 'Roter Bär' is an old ironstone mine from the early 19th century, which was later operated again as an exploratory mine. From 1920 to 1928, the Ilseder Hütte company drove approx. 4 km of exploration workings in search of sulphide veins and sank a blind shaft. Today, approx. 800 m of drifts can be travelled. Metasomatically formed limonite ore bound to Devonian limestone was mined.
The geological inventory includes outcrops of brown ironstone lenses in Middle Devonian clay shale and limestone layers; clay shale altered hydrothermally to clay (so-called 'white rock') with mineralisation of garnet and nontronite (rare pistachio-green clay mineral); accessory rocks are hornfels and calc-silicate rocks in the contact zone of the nearby Brocken granite; quartz-calcite veins and pronounced ruschel zones can also be observed.

Due to the variety of underground geological outcrops, this mine is particularly suitable for the training of geoscientists, who can also carry out mapping exercises here.
In the Wennsglückt mine, which has been developed to a depth of 130 metres, the oxidation zone of a silver vein can be viewed.
Sturdy hiking boots and robust clothing are required (the temperature in the mountain is approx. 7-8°C). If available, bring a helmet and a lamp (preferably a headlamp). If not, this equipment can be provided by the Roter Bär training mine in St. Andreasberg.

Mining for copper, iron and barite near Bad Lauterberg in the SW Harz region

On the subject:
The mostly flat Hercynian-striking veins (three main veins) of Bad Lauterberg carry quartz and barite (only locally also fluorite) as well as haematite and sulphide copper ore. Since the early modern period, iron and copper have formed the basis for extensive mining, which experienced its greatest heyday during the first half of the 18th century. When copper production became increasingly unprofitable despite major state subsidies, mining had to be discontinued in the 1820s. Extensive mining searches followed until 1869, but were ultimately unsuccessful. 20 larger mines yielded a total of 1620 tonnes of copper metal.
A copper smelter was built at the confluence of the two Lutter valleys in 1705, which produced high-quality copper until 1826. A mining water management system developed until 1820 comprised around 60 km of ditches, 5 reservoirs and 6 km of watercourses and water release tunnels.

With the operation of the Electoral-Hanoverian Königshütte, founded in 1733, the village developed into an important centre of iron production, supplying the Upper Harz towns and mines with iron goods. In addition to numerous small private mines in the neighbourhood and beyond, the fiscal Knollengrube mined high-quality red ironstone from 1820 to 1925. At the beginning of the 20th century, this mining district experienced a new boom thanks to rich barite deposits, which are among the most important in Europe. The mines operated by Deutsche Baryt Industrie (DBI), in particular the Hoher Trost (until 1979) and Wolkenhügel (until 2009) mines, produced a total of around 5 million tonnes of the ‘white gold’.

To the stop
The bus stops in the Luttertal valley north-west of Bad Lauterberg (Augenquelle car park). A short walk leads to the slag heaps of the Kupferrose mine (1688-1748), which was one of the richest in this area. Copper ores (primarily only chalcopyrite) were mined down to a depth of almost 300 metres in mesothermal quartz veins. The vein filling, which was up to 10 metres thick, consisted mainly of ‘sand quartz’ (‘chopped quartz’ formed as a result of hydrothermal displacement of older carbonates) and was deeply oxidized, so that copper carbonates (e.g. malachite) and copper oxides (cuprite, tenorite) were of great economic importance in the past. A speciality is hydrothermally formed anhydrite (mostly later plastered), which occurs here as a ‘gangue’.
An important technical monument is the head of the barrel-lined New Shaft of the Kupferrose mine (created around 1720), which is lined with anhydrite. There are several old wheel pits and relics of working trenches. The former Kupferrose pond (built in 1720, broken in 1808) in the valley of the Graden Lutter served as a power supply.

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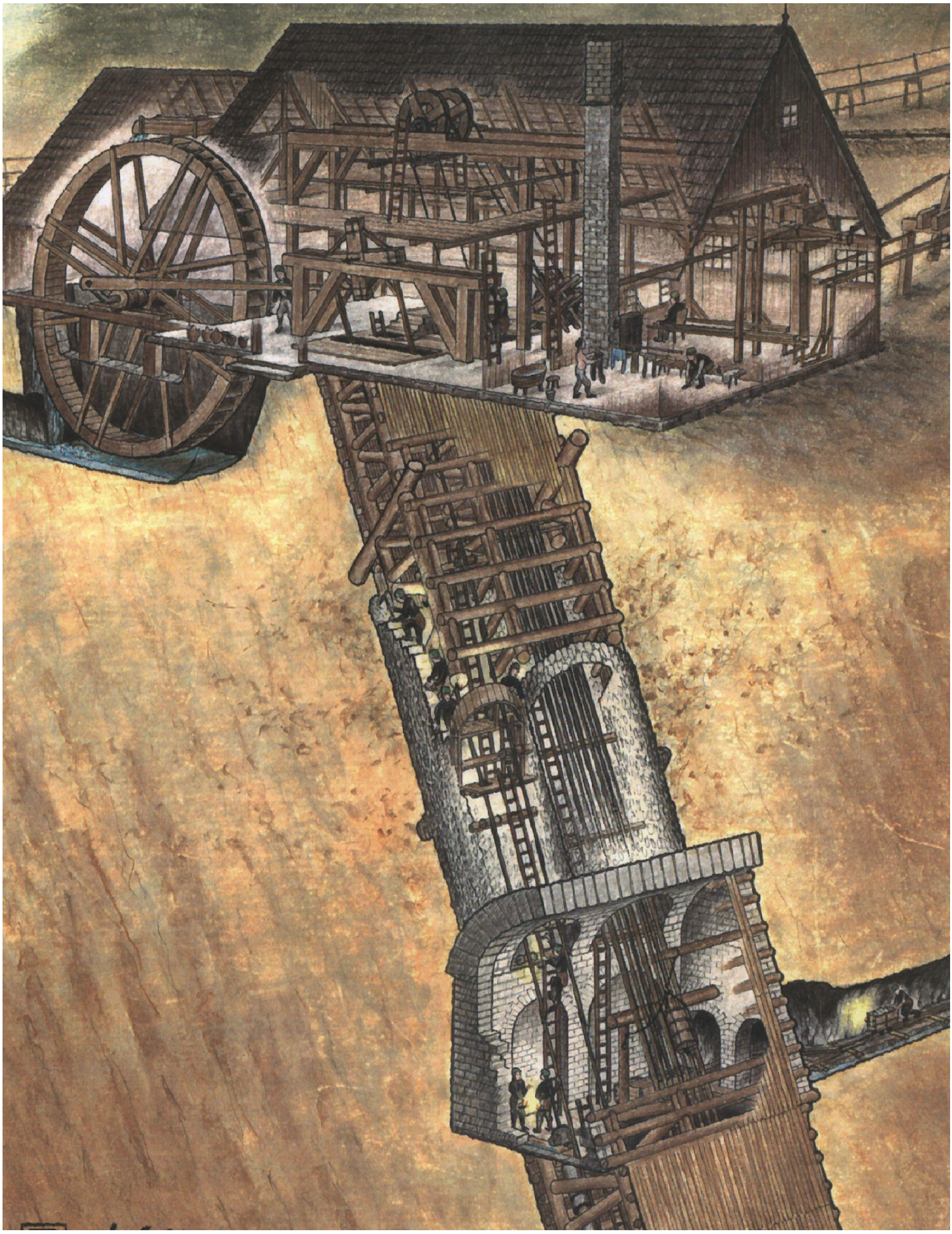
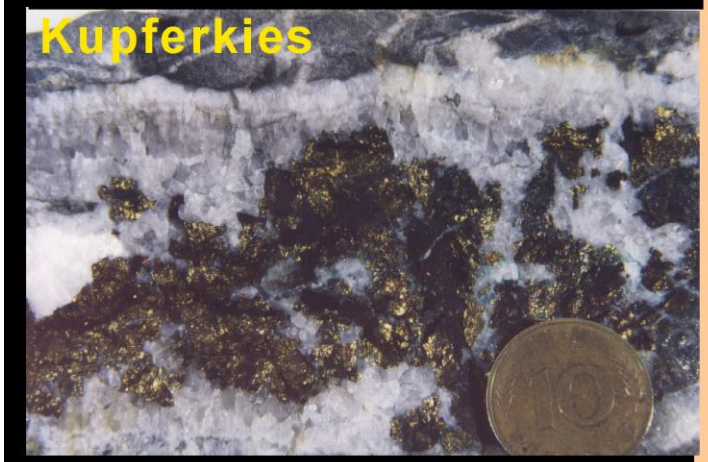



Kupferkies


Hämatit


Schwerspat


Erz- & Minerallagerstätten
Zechsteinschichten (vorwiegend Dolomit)
Rhyolith / Rotliegendes (z.T. vulkanische Gänge)
Gefaltetes Grundgebirge (Grauwacke, Tonschiefer)
Störung, Erz- oder Mineralgang
Pb Blei-(Zink)-Silber-Erze
Cu Kupfererze
Fe Eisenerze
Ba Schwerspat (Baryt)
Fl Flussspat (Fluorit)
Wolkenhügeler Gangzug
Grube Wolkenhügel
Schadenbeeks-glücker Gang
Frische Lutter Gangzug
Knollen Gänge
Gr. Knollen
Hohe Troster Gangzug
Klingenthaler Gang
Krumme Lutter
Knollen-grube
Heiden-schnabel
Grube Hoher Trost
Grade Lutter
Mittel-berg
Sperrlutter
N
Herbstberg Gang
Kupferhütte
Gr. Kummel
Oder-stausee
Oder
Flußgruber Gang
Reinebornstal Gang
Kupferroser
Gr. Andreasbachtal
Scholben
Aufrichtigkeiter Gangzug
BAD LAUTERBERG
Königshütte
Maßstab
0 1 2 3 km
Wiesenbeker Teich

Hübichenstein near Bad Grund

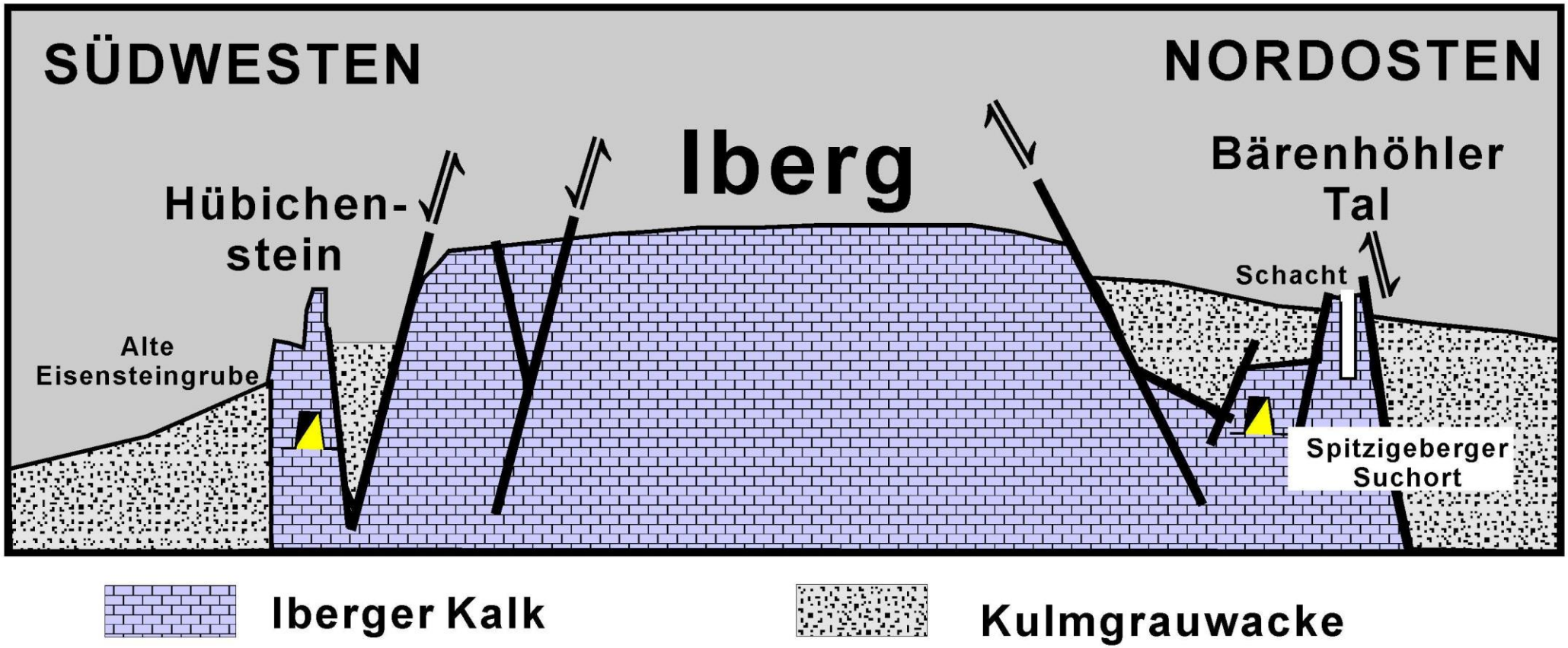
Iron ore and barite mineralisation in the Devonian reef limestone of the Iberg

The limestone deposit of the Iberg-Winterberg complex, which measures around 1 × 1.5 km, is a former coral reef that formed around 380 million years ago during the Devonian period. The limestone mining that has been carried out since 1938 (Winterberg open-cast mine of the FELS works) has provided valuable insights into the inner structure of this reef, which turned out to be a former atoll.
Scaffolding corals colonised a sill-like shallow area, possibly of volcanic origin, in what was then the Rheia Ocean, which once covered what is now Central Europe. During the Middle Devonian, this region was located south of the equator in the tropics. In symbiosis with a diverse marine fauna, the corals grew under relatively constant conditions over a period of around 10 million years. A gradual subsidence of the subsurface led to the formation of a body of very pure limestone, probably around 600 metres thick, surrounded by a ring of deposited reef rubble.

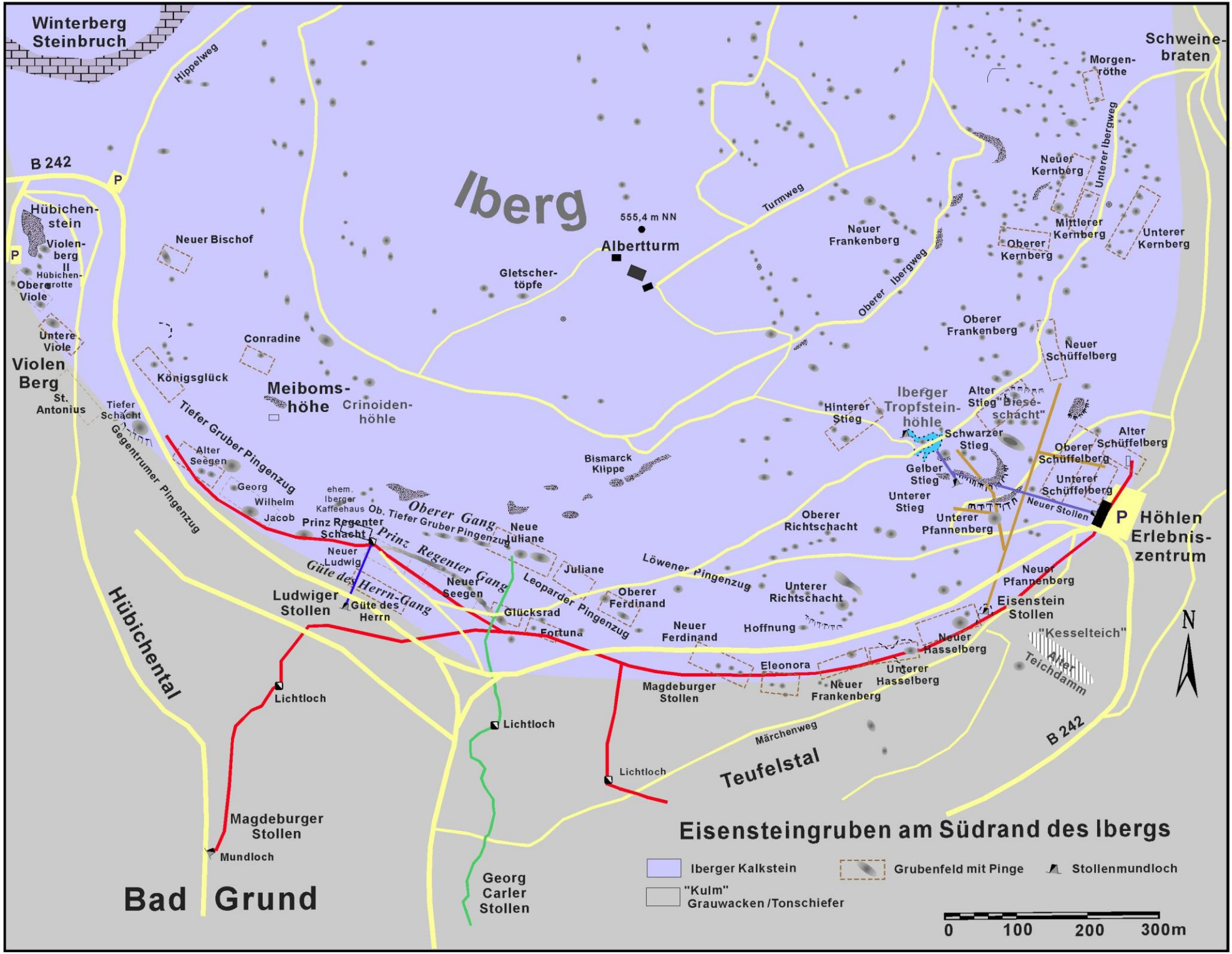
When the so-called Kellwasser event (approx. 373.5 million years ago) caused drastic climate changes and a lowering of the sea level, this had devastating effects on the marine ecosystem. The corals and almost all life in the reef died off. At times, the dead reef protruded from the sea as a ruin and began to karstify. During the Lower Carboniferous, coarse-grained sediments (sand and gravel) were brought in from the south-east in parallel with an ever-increasing subsidence of the earth's crust.
With the further subsidence of the sea floor, the dead reef was buried under thick deposits of Culmian greywacke and clay shales. The Variscan folding that progressed from south-east to north-west in the Upper Carboniferous led to the compression of the deeply submerged rock layers. While the surrounding shale and greywacke layers were folded, the massive limestone core resisted this tectonic stress and broke apart.

As a result of the Harz folding, countless fissures and faults run through the limestone of the Iberg. Its southern boundary is formed by the Rosenhöfer Zug, which is part of the large Upper Harz vein system and is known locally as the ‘Prinz-Regent-Gang’. Some of these fissures opened up later as the uplift of the Harz progressed and served as ascent routes for hot, mineral-rich water (hydrothermal fluids), which left behind various mineral formations. The vein fillings consist mainly of iron ores (primarily siderite) and barite, in places also copper, lead and silver ores.
The slightly acidic, iron-rich solutions also reacted with the calcite of the reef limestone and partially transformed it into the iron carbonate siderite. Local dolomitisation of the rock also occurred.
When the limestone complex finally reached the earth's surface as a result of uplift and erosion, contact with oxygen-rich seepage water led to an extensive transformation of siderite into the hydrous iron oxide limonite (brown ironstone). The carbonic acid released in the process and dissolved in the water accelerated the progressive karstification of the Iberg. As a result, large cave systems up to 5 kilometres in length were formed near the iron ore bodies, which were often filled with a sediment of redeposited iron ore.
In order to access the coveted raw material, former miners used the natural caves - unique in the Harz Mountains. Thanks to the relatively high manganese content (5-6 % in the ‘Huterzen’), particularly high-quality steel could be produced from the Iberg

ironstone. Until the middle of the 19th century, the mining and smelting of ironstone characterised the mining industry in the Bad Grund and Gittelde area.
In old ironstone quarries and caves at the foot of the Hübichenstein, the hydrothermal-metasomatic mineralisation can be studied excellently. The primary siderite is almost completely transformed into goethite and is interspersed with younger barite (white, coarse-grained). Younger quartz veins can also be found on fissures and in druses.



Schematisches Profil des Ibergmassivs (nach Bode, 1911)


Winterberg Steinbruch
Hippelweg
B 242
P
Hübichen-stein
Violen-berg II
Hübichen-grotte
Obere Viole
Untere Viole
Violen Berg
St. Antonius
Tiefer Schacht
Tiefer Gruber Pingenzug
Gegentrumer Pingenzug
Alter Seegen
Georg
Wilhelm
Jacob
Prinz Regenter Schacht
Neuer Ludwig
Ludwiger Stollen
Hübichental
Lichtloch
Magdeburger Stollen
Mundloch
Bad Grund
Iberg
555,4 m NN
Albertturm
Gletscher-töpfe
Neuer Bischof
Conradine
Königsglück
Meiboms-höhe
Crinoiden-höhle
Bismarck Klippe
ehem. Iberger Kaffeehaus
Ob. Tiefer Gruber Pingenzug
Oberer Gang
Prinz Regenter Gang
Güte des Herrn-Gang
Güte des Herrn
Neue Juliane
Juliane
Neuer Seegen
Glücksrad
Fortuna
Leoparder Pingenzug
Oberer Ferdinand
Neuer Ferdinand
Hoffnung
Löwener Pingenzug
Oberer Richtschacht
Unterer Richtschacht
Eleonora
Magdeburger Stollen
Neuer Frankenberg
Unterer Hasselberg
Neuer Hasselberg
Neuer Pfannenberg
Eisenstein Stollen
Unterer Pfannenberg
Neuer Stollen
Unterer Stieg
Gelber Stieg
Schwarzer Stieg
Hinterer Stieg
Iberger Tropfstein-höhle
Alter Stieg
"Biese-schacht"
Oberer Frankenberg
Neuer Frankenberg
Turmweg
Oberer Ibergweg
Neuer Kernberg
Mittlerer Kernberg
Oberer Kernberg
Unterer Kernberg
Unterer Ibergweg
Morgen-röthe
Schweine-braten
Neuer Schüffelberg
Alter Schüffelberg
Oberer Schüffelberg
Unterer Schüffelberg
P Höhlen Erlebnis-zentrum
"Kesselteich"
Alter Teichdamm
Lichtloch
Lichtloch
Lichtloch
Märchenweg
Teufelstal
B 242
Georg Carler Stollen
N
Eisensteingruben am Südrand des Ibergs
Iberger Kalkstein
"Kulm" Grauwacken / Tonschiefer
Grubenfeld mit Pinge
Stollenmundloch
0
100
200
300m