Field Trip Report 2017-2018

SEG Student Chapter TU Bergakademie Freiberg

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Field Trip 1 (10.30.2017)

Sn-W-Li greisen of Altenberg and Zinnwald-Cinovec

Guide: Dr. Thomas Dittrich (Deutsche Lithium GmbH)
Participants: 12
Schedule: Start: 7.30 am
Stop 1 – Visitors mine “Vereinigt Zwitterfeld zu Zinnwald”
Stop 2 – Drilling sites of the exploration project
Stop 3 – Core Yard of the exploration project
Stop 4 – Altenberg Pinge (collapsed underground mine)
Stop 5 – Altenberg historical Sn processing facility and mining museum
End: 5.00 pm

The Sn-W-Li mineralization of the Erzgebirge was economically important since the Middle Ages and the last mine closed in 1990. Currently, the Deutsche Lithium AG and European Metals explore the lithium potential of the Zinnwald Greisen.

The greisen-type Zinnwald ore deposit is located in the eastern part of the Erzgebirge region, Saxony, Germany and extends into the Cinovec deposit in the Czech Republic. The Zinnwald granite constitutes one of small, highly evolved granitic intrusions, which are marked by prominent enrichment of incompatible elements. The Zinnwald granite intruded during the post-collisional stage of the late-Variscan (Permo-Carboniferous) magmatic evolution, ascending along deep-reaching fault zones into crystalline basement rocks and into the rhyolites of the Altenberg-Teplice caldera. The granite stock at Zinnwald is ovoid in shape with dimensions of 3 x 1 km. It is regarded as highly altered albite granite which intruded the volcanic pile of the Teplice rhyolite. The deposit itself is characterised by flat dipping, sheet-like greisen ore bodies and veins in the apical part and of the Zinnwald granite stock. The greisen bodies predominantly consist of quartz, Li-Rb-Cs-bearing mica (named zinnwaldite), topaz, fluorite and accessory cassiterite and wolframite.

The participants had the chance to see the historic mining methods and processing plants of the tin-extraction in the local mining museum in Altenberg. In Zinnwald we visited the historic mine “Vereinigt Zwitterfeld zu Zinnwald“, guided by the former SEG Student Chapter Freiberg president Dr. Thomas Dittrich (Deutsche Lithium GmbH), who gave a detailed talk about the regional geology, ore formation and structural control of the mineralization process. The historic underground mine provided a unique chance to enter the deposit walk along the endo- and exo-contacts of a greisen body within the granite. Furthermore, the students get an exclusive look on greisen alteration and typical greisen minerals (e.g. cassiterite, wolframite, zinnwaldite and pycnite). Finally, Thomas Dittrich introduced the students to the exploration campaign of the Deutsche Lithium GmbH and demonstrated the drilling methods at the drilling site.
Fig.1: Sn-W-Li greisen of Altenberg and Zinnwald-Cinovec.

A) Introduction to historic mining methods.

B) Graded contact of the granite (left) to the greisen body (left).

C) Pegmatoide vein of zinnwaldite and quartz.

D) Typical greisen mineralization comprising quartz-pycnite-zinnwaldite-cassiterite.

E) Thomas Dittrich showing greisen mineralization in the drill core.

F) Field trip group at the drill site.
Field Trip 2 (03.08.2018)

Deformation Pattern of the Pöhla Hämmerlein Polymetallic Skarn Deposit

Guide: Dr. Uwe Kroner (Dept. of Tectonophysics)
Participants: 18 (16 SC members)
Schedule: Start: 10.00 am
Stop 1 – Pöhla Hämmerlein underground visitor mine
End: 2.00 pm

The deposits of Hämmerlein Sn deposit is a good example for the various types of possibly granite-related and hydrothermally controlled Sn-(W)-polymetallic deposits. The orebody was discovered and experimentally mined from the late 1960s with vast mining drives left open, till closure for mining after reunification of Germany in 1990. Currently the Saxore Bergbau GmbH explores the deposit.

The Sn-U ore field Pöhla-Tellerhäuser is situated in the Western Erzgebirge. The deposit is located at the intersection of the Fichtelgebirge-Erzgebirge anticline and the Gera-Jáchymov fault zone. The orebody is built up by an almost strata-bounded skarn-type tin mineralization local overprinted by hydrothermal veintype uranium mineralization. The local geology is dominated by Cambro-Ordovician schists. They contain layers of different skarn-effected metacarbonatic rocks, gneisses, amphibolites, quartzitic and carbon-rich schists. The metamorphic rocks are underlain by the granite ridge of the Eibenstock-Karlsbad massif. The granite intrusion likely led to contactmetamorphic and metasomatic processes inside the country rocks.

The field trip was linked to our short course on “Tectonics and Mineral Deposits” and focused on the role of tectonic process on the control of the ore formation. In addition, the general genesis of skarns and their economic mineralization were discussed. Initially, the regional metamorphic, orogenic and igneous events were introduced to the students. Subsequently different localities of the underground mine were visited, comprising different types of deformation and mineralization. Main topics were the analyses of local brittle-ductile deformation and a potential structural control on the mineralization process. Moreover, the mineralogy of the ore, skarn and alteration zone were interpreted. Finally, the group discussed the genesis deposit according the structural and mineralogical observations.

The previous short course was about tectonic settings of different mineral deposit types, structural control on fluid migration and regional geology and of the Sn deposits of the Erzgebirge. The field trip provided an opportunity for the students to apply their new knowledge in the field.
**Fig. 2:** Deformation Pattern of the Pöhla Hämmerlein Polymetallic Skarn Deposit.

A) Lectures of the short course “Tectonics and Mineral Deposits”.

B) Field trip group at the entrance of the visitor mine.

C) Uwe Kroner giving an introduction to the tectonic evolution of the region.

D) Discussion about brittle-ductile deformation within the skarn.

E) Sulfide mineralization within the magnetite skarn.

F) Massive sphalerite vein within the skarn.
Field Trip 3 (04.30. – 05.05.2018)

Harz Field Trip (Ore Deposits and industrial minerals of Central Germany)

Guides: Dr. Wilfried Ließmann (TU Clausthal), Dr. Jürgen Kopp, Dipl.-Ing. Jürgen Wesiger, Dominique Dostal (European Salt Company), several local guides

Participants: Participants: 17 (10 SC members, 3 students from Saint Petersburg Mining University)

Schedule:
- 04.30.2018 – Teufelsmauer Weddersleben, introduction to reginal geology
- 05.01.2018 – Rammelsberg underground mine, Ag-Cu-Pb SHMS deposit, Grube Samson underground mine, Pb-Zn-Ag vein-type deposit
- 05.02.2018 – Mineralogical Collection TU Clausthal
- 05.03.2018 – Kohnstein and Niedersachswerfen gypsum / anhydrite quarries, Lange Wand Kupferschiefer SSC outcrop
- 05.04.2018 – Group 1: Röhringschacht, Kupferschiefer SSC deposit, Group 2: Bernburg halite mine (European Salt Company, K+S)
- 05.05.2018 – Hydrothermal Mn and sedimentary Fe deposits in the Ilfeld district

The Harz is low mountain chain and covers an area of around 2000 km² in the middle of Germany. It was formed in the course of the variscan orogeny and later uplifted in single several blocks by tectonic movements since Cenozoic time. Geologically the Harz is highly diverse. Mining in that area lasts for about 3000 years but most of the mining activities ceased in the later 20th century. During the Middle Ages to the 19th the Harz district was a major mining and smelting industry center in Germany. Former mining activities focused on e.g. Ag, Pb, Zn, Cu. In modern times just industry minerals like barite, gypsum and salt are extracted in the Harz and adjacent areas. During the field trip, the students accessed many geological sites, which familiarized them with the regional geology, tectonics, diverse mineral occurrences, ore formation and different mineralization styles in the Harz area. Due to the visit of historic and active mines, the students got an insight to the historic and modern mining and smelting industry. Therefore, the students got hey get familiar with ancient and modern mining and processing methods.

30.04.2018 – Teufelsmauer Weddersleben, introduction to reginal geology

Drive to the Harz region and meeting at the Teufelsmauer. A German national geotope. There a short introduction to the regional geology of the Harz region was given to the participants. Later on, arrival at the holiday park in Hahnenklee for stay overnight.

01.05.2018 – Rammelsberg underground mine, Ag-Cu-Pb SHMS deposit, Grube Samson underground mine, Pb-Zn-Ag vein-type deposit

Visit of the UNESCO world heritage site of the Rammelsberg Bergwerk. A former Pb-Zn-Cu-Ag mine operating from the 10th century to 1988. After a 3.5 h guided tour through the
Rammelsberg we’re heading to the Grube Samson a former silver mine. Where also a guided tour was executed.

**02.05.018 – Mineralogical Collection TU Clausthal**

Visit of the mineralogical collection Clausthal-Zellerfeld. Travel to the camping park in Neudorf im Harz for stay several days overnight. Later on, studying of old mining legacies of Fe-mining in the area of Neudorf.

**03.05.2018 – Kohnstein and Niedersachswerfen quarries, Lange Wand SSC outcrop**

In the morning visiting of a big gypsum quarry in Niedersachswerfen and of the Knauf gypsum company in Nordhausen. There examining of drill cores, visiting of the quarry and the processing facilities, lunch. In the afternoon visiting of the outcrop of the Kupferschiefer at the Langewand and also the visit of the former copper mine Langewand nearby where the kupferschiefer seam could be visited. Later on, visiting of more outcrops of the Kupferschiefer in the area of Harztor above ground.

**04.05.2018 – Röhringschacht, Kupferschiefer SSC deposit, Bernburg halite mine (ESCO, K+S)**

One group gone to the Esco salt company (K+S salt) in Bernburg. Visiting of a major Zechstein salt mine. There mine entering, guided tour underground and visiting of the above ground processing facilities, lunch. The other group visits a former Kupferschiefer mine in Wettelrode, SSC deposit.

**05.05.2018 – Hydrothermal Mn and sedimentary Fe mineralization in the Ilfeld district**

Intense mineralogic and geologic study of the Mn-Fe-Ilfeld district at the example of old mine dumps, -facilities, -remains, outcrops. In the afternoon visiting of a former gypsum quarry with an occurrence of Selenite.
Fig. 3: Harz field trip (Ore Deposits and industrial minerals of Central Germany)

A) Field trip group.

B) Introduction to the regional geology at the Teufelsmauer Weddersleben

C) Inside the Rammelsberg underground mine (Ag-Cu-Pb SHMS deposit),

D) Hydrothermal Mn and sedimentary Fe mineralization in the Ilfeld district

E) Quarry of Niedersachsenwerfen gypsum / anhydrite mine.

F) Drill cores of the Niedersachsenwerfen gypsum / anhydrite deposit.
Fig.4: Harz field trip (Ore Deposits and industrial minerals of Central Germany)

A) Field trip group at the entrance of the Röhringschacht visitor mine, (Kupferschiefer SSC deposit).

B) Kupferschiefer SSC mineralization.

C) Field trip group in the Bernburg halite mine (ESCO, K+S).
Field Trip 4 (06.24.2018)

Bicycle Tour around Freiberg

Participants: 8 (5 SC Members)
Schedule:

- Start: 9.30 am
- Stop 1 – Wasserturmstraße (Freiberg): place of first Ag-ore discovery in 1168
- Stop 2 – Alte Elisabeth (Freiberg): historic ventilation shaft
- Stop 3 – Davidschacht and Erzwäsche (Freiberg): historic drawing shaft and processing plant
- Stop 4 – Reiche Zeche: research underground mine of the TU Bergakademie Freiberg
- Stop 5 – Davidschacht dump (Freiberg): determining polymetallic Pb-Zn-Ag minerals of the “kb-Formation” (galena, sphalerite, pyrite, arsenopyrite; gangue: quartz)
- Stop 6 – Ludwigsschacht dump (Freiberg): determining of polymetallic Pb-Zn-Ag minerals of the “fba-Formation” (galena, sphalerite, pyrite; gangue: fluorite, barite, quartz)
- Stop 7 – Alter und Tiefer Fürstenstolln (Halsbrücke): historic adits and water management of the Freiberg district
- Stop 8 – St. Lorenz Gegentrum (dump, Halsbrücke): ore and gangue minerals (barite, fluorite)
- Stop 9 – Herders Ruhe (Freiberg): Monument of August von Herder, one of the most important miners of Freiberg

End: 4.30 pm

The Freiberg mining district is located in the Freiberg metamorphic core complex, comprising gneisses and schists, and ca. 1100 silver-base metal veins are evident in the total area. The Polymetallic Pb-Zn-Ag vein-type deposit is characterized by two principal types of late Variscan polymetallic vein-type mineralization: Quartz-bearing As–Zn–Cu–Pb–Ag–Bi–Sb polymetallic sulphide association and (2) Carbonate- or quartz-bearing Ag–Sb polymetallic sulphide association. The ore forming processes are associated with regional extensional tectonic events during the Carboniferous and Perm. Lamprophyric dykes, which intruded during the extension, are considered to the metal and fluid source of the mineralization. Later remobilization concentrated the metals in veins.

This field trip has become a regular event for all undergraduate students and new graduate economic geology students in Freiberg. The aim of this field trip is to inform the students about the geology and mineralogy of the polymetallic Pb-Zn-Ag vein deposit as well as the historical mining activities in the area of Freiberg. The more than 800 years of mining in the Erzgebirge is very important for the historical development of Freiberg and our university. Old mining remains such as shafts, dumps and processing plants are visible at many locations in and near the town. Some of these sites were the targets of our field trip. The understanding of ancient mining techniques are still important in modern times as artisanal miners apply similar methods. The several dumps in different areas of the deposit were a good opportunity to didactically introduce the students to the ore and gangue paragenesis as well as local distribution of the different polymetallic Pb-Zn-Ag vein systems.
Fig.5: Bicycle Tour around Freiberg.

A) Talk about the history of Freiberg and the first silver discovery.

B) On the way to the next spoil dump.

C) The Reiche Zeche shaft of the Himmelsfahrt mine.

D) Dump of the Reiche Zeche.

E) Dump of the David Shaft.

F) Field trip group at an old drainage adit.
Field Trip 5

Heavy Mineral Prospection in the Zellwald, Saxony

Guide: B.Sc. Jan Schulz-Isenbeck (SEG Student Chapter Freiberg)
Date: June 10 and August 31, 2017
Participants: 10 (8 SC members)
Schedule:
Start: 9:00 am
Stop 1 – Pitzschebach, Zellwald
End: 15.00 pm

Gold mineralization is not typical for the Erzgebirge, but small gold grains do accumulate in creeks throughout Saxony and especially during the first mining rush in the 11th century gold was panned at several places in the Erzgebirge.

The one-day field trip takes place in the Zellwald (Zell forest) about 20 km north of Freiberg. In a geological context, the Zellwald is located at the northern limb of the Erzgebirge and cuts the eastern border of the Saxonian granulite massif. The predominate lithologies of the area are phyllites, gneisses, meta-conglomerates and minor volume of basalts and gabbroic rocks. Several creeks occur in the area.

Our target is the Pitzschebach creek, which is the major stream in the morphological depression of the Zellwald. The students receive an introduction in panning techniques and the theory of placer formation. Based on the information the group samples different spots considering indicators in the stream and the sediments. This field trip provides a good opportunity for students to broaden their horizons and learn how to separate heavy minerals in the field. Due to the diverse lithologies of the area, the Pitzschebach creek hosts a huge variety of heavy minerals, which are analysed in the field or subsequently by stereomicroscopy.

Field Trip 6

Visit of the historic Freiberg Silver underground mine “Reiche Zeche”

Guide: Local guide
Date: October 2018
Participants: 15
Schedule:
Start: 10.00 am
Stop 1 – Visitor underground mine “Reiche Zeche”, Freiberg
End: 16.00 pm

The “Reiche Zeche” is a shaft of the historic underground silver mine “Himmelfahrt Fundgrube” within the Freiberg mining district, which comprises different hydrothermal
polymetallic veins of different ages. The base metal veins are linked to an intense branched network of faults and fractures. The crevices are crossing the FMD in order of two main shear systems characterized by an approximately equidistant spacing between them. For the opening of these fractures is associated with a late variscan and a postvariscan mineralisation phase. The late variscan cycle (320 to 280 Ma) comprises a minor Sn-W association and a major polymetallic sulphide mineralisation divided in a quartz-bearing (“kb” ore type) and a carbonate-bearing subdivision (“eb” ore type). As a subsidiary member of this cycle, a uranium-quartz-carbonate association (“uqk” ore type) occurs only in some veins. The “kb” - association, containing primarily Cu-, Zn-, Pb- and Fe- sulphides and intergrown with Ag-minerals, is the most important mineralisation of the deposit. A postvariscan mineralisation cycle dates over a wide timespan from the Triassic until the Tertiary era, resulting in the remobilization and concentration of Ag, e.g. the Bi-Co-Ni-Ag-association is one important association of this cycle which generated enriched ore accumulations through vein crossing other associations.

The historic underground mine is an outstanding opportunity to get an insight view of the Freiberg Pb-Zn-Ag and the historic mining activity. Furthermore, the field trip is perfect event to introduce the new M.Sc. and PhD students to the ore deposit geology of Freiberg.