CONSENT OF QUALIFIED PERSONS

To: British Columbia Securities Commission
Alberta Securities Commission
Ontario Securities Commission

I, Vadim Galkine, P.Geo., do hereby consent to the public filing of the technical report entitled: *"Technical Report for Richmond Minerals Inc. on the Oberzeiring Polymetallic Property, Zeiring Polymetallic Mining District, Styria, Austria,"* dated January 10, 2020 with an effective date of November 7,2019 (the "Technical Report") by Richmond Minerals Inc. (the "Issuer"), with the TSX Venture Exchange under its applicable policies and forms in connection with the purchase of mineral claim units located in Austria, as announced in a news release by the Issuer on November 7, 2019, and such news release fairly and accurately represents the information in the Technical Report that supports the disclosure set out in such press release, and I acknowledge that the Technical Report will become part of the Issuer's public record.

Dated this 10th day of January, 2020.

"Vadim Galkine"

Vadim Galkine

TECHNICAL REPORT FOR

RICHMOND MINERALS INC.

ON THE OBERZEIRING POLIMETALLIC PROPERTY,
ZEIRING POLYMETALLIC MINING DISTRICT STYRIA, AUSTRIA

NI43-101 REPORT

Prepared By:

Vadim Galkine, P Geo, Ph D

January 10, 2020

Table of Contents

Item 1: Summary

This technical report was prepared by Dr. Vadim Galkine (the "**Author**") for Richmond Minerals Inc. to evaluate the exploration potential of the Oberzeiring Polymetallic Property, Austria. This report provides details of land tenure, a summary of historical exploration and development work, and descriptions and analyses of geology, geophysics and assay data. Recommendations for further exploration work are also provided.

According to a letter of understanding ("**Letter of Understanding**") between Richmond Minerals Inc. (the "**Purchaser**") and Silbermine Zeiring GmbH as a subsidiary of Aurex Biomining AG (the "**Vendor**") whereby the Purchaser and the Vendor enter into a definitive purchase agreement (the "**Purchase Agreement**") allowing the Purchaser to acquire a 100% interest in a contiguous group of 99 mining (as set out in the Appendix) claim units referred to the Oberzeiring Polymetallic Property (the "**Property**") located in Styria region of Austria (the "**Proposed Transaction**"). The execution of the definitive agreement shall take place on or before November 18, 2019 (the "**Termination Date**") unless the parties otherwise agree ("**Letter of Understanding**" can be found in the Appendix).

The historical mining district of Zeiring with the overlaying SMZ-held concessions is located in Upper Styria (Steiermark), part of the Styrian Province of Austria.

The Ober-Zeiring historical mining district is divided into four areas:

- The West Field (Franzisci, Wiener and Grazer Adits)
- The Central or Middle Field, located underneath and slightly to the North of Ober-Zeiring (Pier Mine workings)
- The North-East Field – Johannes base tunnel, Klinger-, Taubenkropf and many other workings and underground stopes
- The South Field – Matthias Baue, Purgstallofen adits, Zugthal, Haberer Berg

Treffenthaler adit and the areas "A" to "G" with the historically most active area "D" (Klum Creek or Bunker area), belong to Unter-Zeiring – "Katzling Zone".

At the Zeiring Mining District there are up to eight mineralized vein structures in the Mining Fields of Ober-Zeiring (the West-, the Middle- and the NE-Field) and there are the deposits of Unter-Zeiring and the Katzling Zone reaching all the way to the Mur River Valley. The deposits are emplaced along trends of structural weakness, mostly close to N-S to NE-SW striking and steeply dipping fault and shear zones, that have split the mineralization-bearing formation, the Bretstein Marble into fault blocks that were shifted in steps northward, from E to W.

The host rock, the Bretstein Marble is the lowest and most prominent rock layer of the Bretstein Formation, an Early Paleozoic crystalline sequence of the Wölz Mica Schist Unit belonging to the East Alpine Crystalline Complex. The Marble's top is sealed off by layers of mica schist, which prevented the mineral solutions from ascending further up the formation composed of various kinds of mica schist and calcareous mica schist to calc schist, which normally are not mineralized. The thick layer of the Bretstein Marble also has been affected by an intricate system of Karst-type caves created during the last Ice Age, when aggressive waters flowing at the bottom of mighty glaciers and underground dissolved the carbonate rocks forming cave tunnels and large cave rooms, many parallel to the mineralyzed vein structures. They, too, followed the zones of weakness in the marble, and many of them were used as passage ways and/or as areas for stoping and as depositories for waste and backfill material by the old miners.

The main tectonic structure of the area is the deep-seated NW-SE striking Graben-type Fault system of the Pöls River Valley, a valley carved out by a large glacier along the fault lines.

The mineral emplacement of mainly three types of happened in several cycles of mineralization: The initial one was the metasomatic replacement of the marble by Iron-carbonates followed by hydrothermal veins with poly-metallic Lead-Silver mineralization, by a new phase of Siderite, of Silver–carrying sulfides, of metasomatic Barite and finally of veins of Marcasite.

Silver mining in the area began first to the South of Oberzeiring in the Zugtal (Zug Valley), on Haberer Berg, around Purgstallofen and Oberwinden, and further South, closer to the Mur Valley, at “In der Scheiben”. Gradually the mining operations moved north to the Lead-Silver veins of the Ober-Zeiring “Erzberg” and into the underground underneath the town of Ober-Zeiring. By the 13th Century Silver mining at Ober-Zeiring was so successful that the town was allowed to open its own mint of well- sought-after Zeiring Silver coins, while up to ten smelters were processing the Silver-bearing rocks. In the midst of this booming production miners in the mine underneath the town, the Pier Mine hit by accident an underground water source in 1361, which flooded the mine so fast that, it is said, 1400 miners drowned. From this catastrophic moment on the Zeiring Silver production declined steadily. Soon the mine closed, and repeated attempts to drain the mine failed due to unfit technologies. Mining of Silver lasted to about 1700 on a small scale. In the 1950s that an engineer R. HIRN, who had acquired the mining rights over the NE Field Mines of Ober-Zeiring and had cleared cave ins and collapsed mine installations, began to exploit Barite from the mine, a mineral that had been regarded as waste for the longest time. After investing a fortune HIRN’s small operation took off and produced about 6700t of anomalousBarite until 1964, when he had to close down operation for lack of working capital.

Silbermine Zeiring GmbH has conducted geophysical surveys, combined with soil and rock geochemical surveys, and with surface and underground reconnaissance. Important targets are veins of Marcasite exposed underground in the NE Field Mine and indicated further to the North by geophysics. Samples of this vein are said to have shown interesting values of Gold. There are also reports about mineralization microscopic research, which found that the Zeiring Silver contains Gold. Another target for SMZ’s exploration was the potential of Barite.

The study of the existing and available technical exsaminations and scientific publications, mine maps, technical reports and expert statements and detailed descriptions of the Zeiring Silver Mining District in general and especially the Ober-Zeiring area’s West-, Middle- and NE Field for this report draws the following conclusions:

- Apart from the many studies concentrating mainly on the underground, the whole district is under-explored by modern geophysical and geochemical surveys and drilling.
- The mineralization potential of the historical mines of Ober-Zeiring, especially the one in the flooded Pier Mine, is definitely not exhausted. At the time of the catastrophe ten smelters produced Silver and Ober-Zeiring’s mint was in full production. Furthermore, the mine’s owners and even Austrian Emperors wouldn’t have made any of the repeated attempts to drain the flooded mine, with the re-start of Silver production in mind, if its sudden decline in 1361 – the year of the flooding - had been caused by exhaustion of the available mineralized material.
- The Pier Mine needs to be drained to re-access the poly-metallic Silver stockpiles, evaluate the situation and make them available for exploitation. anomalous
- The whole area needs to be covered by modern geophysical surveys followed by core drilling of selected targets and geochemistry.

The Author conducted a site visit at the Oberzeiring Property on September 11, 2019, and spent approximately 8 hours at the Oberzeiring Property visiting and sampling the available outcrop, visiting the entrance to the old mine, and visiting and sampling the underground workings of the old mine.

The following recommendations for further exploration and development of the property have been made:

- Completing detailed Structural Analysis of the Satellite and other available aerial images of the Oberzeiring Property to develop a better understanding of relationship between structural deformation and mineralization.
- Re-visiting, re-sampling and assaying the dumps (ICP MS Finish, with additional testing for rare earth elements). It is also quite possible that many mine dumps were not mapped, or properly mapped due to abundant forest and difficult terrain of the property. Modern satellite images may be very helpful in doing the mapping. The end-goal of such exercise would be calculation of some kind of the "Dump Resource Estimate" which may potentially become an important part of the Property development.
- Compilation of the known geophysical data on a new base map
- Systematic geochemical areal soil survey on a grid with at least 100m interval should be conducted over the areas covered by geophysical survey.
- Seven IP-pole-dipole sections, recommended by OCZLON (2004, 2006), should be added during the further work in order to determine the precise location of potential drill targets
- Research and test by diamond drilling the structures indicated by geophysical surveys 2004 and 2006 (OCZLON) in the area to NE of the NE Field mines, NE of Hoanzl and SW of Möderbrugg, and other targets in the Katzling Zone. The drilling results should feed a proper re-interpretation of the available geophysical data.
- Additional ground magnetic surveying of the property to obtain information on the structural setting and geology - IP / resistivity and ground EM (VLF or a loop method) surveys over the areas where there are mine galleries (old mine works).

The exploration program is recommended to be conducted in two phases (see *Item 26: Recommendations* for details), the phase 2 being contingent on phase 1 results.
The minimum cost to prepare, initiate and conduct the phase 1 and 2 of the recommended program is approximately estimated at CAD 1,045,000.

Item 2: Introduction

In accordance to a letter of understanding ("**Letter of Understanding**") between Richmond Minerals Inc. (the "**Purchaser**") and Silbermine Zeiring GmbH, a subsidiary of Aurex Biomining AG (the "**Vendor**") whereby the Purchaser and the Vendor have entered into a definitive purchase agreement (the "**Purchase Agreement**") allowing the Purchaser to acquire a 100% interest in a contiguous group of 99 mining (as set out in the Appendix) claim units referred to the Oberzeirng Polymetallic Property (the "**Property**") located in Styria region of Austria (the "**Proposed Transaction**"). The execution of the Purchase Agreement shall take place on or before November 18, 2019 unless the parties otherwise agree.
This technical report was prepared by Dr. Vadim Galkine (the "**Author**") for Richmond Minerals Inc. to evaluate the exploration potential of the Oberzeiring Property, Austria. This report provides details of land tenure, a summary of historical exploration and development work, and descriptions and analyses of geology, geophysics and assay data. Recommendations for further exploration work are also provided.

Richmond Minerals Inc. management commissioned Vadim Galkine in September 2019 to prepare an independent report that conforms to NI 43-101 standards. Terms of engagement were outlined in discussions with representatives of Richmond Minerals Inc. Mr. Vadim Galkine, Ph.D, Dr. Sci, P Geo authored and is responsible for the contents of this report.

In preparing this report, the Author has reviewed geological and assessment reports, maps, and miscellaneous technical papers provided by the Silbermine Zeiring GmbH. The Author also reviewed geological reports, maps, and miscellaneous technical papers available from the Geological Survey of Austria and the Mining Cadastre of Austria. The conclusions and recommendations of the Author are based on thorough review of general geology and effective exploration techniques employed in the region. Cost estimates provided for recommended work programs are based on a general knowledge of current costs, as experienced by the Author on other exploration projects within the last few years.

The Zeiring Mining District, once an important center of metal production (Ag, Cu, Pb, Au, Fe), has received frequently repeated attention by geologists and mining engineers, but despite many promising reports the area's good potential remaines underexplored by modern technology.

The Silbermine Zeiring GmbH (the "SMZ") is a private "limited" Austrian company devoted to the exploration of the historical Mining District of Zeiring, Styria with the goal to re-activate once very profitable mine production from a wide variety of polymetallic deposits: Ag, Pb, Au, Zn, Cu, Fe, Ba and potentially others such as Gallium and Germanium and/or metals yet to be defined. The company was founded in 1988 and is registered in the County „Company Registry" of Leoben, Styria; it has registry number "FN 79596 d". As an exploration/exploitation oriented company its activities are ruled and controlled by the Austrian Federal "Mineralrohstoff" Gesetz (MINROG), the federal law regulating the mineral industry of Austria.

Over time SMZ has acquired the exploration licenses ("Freischürfe") covering the historical mining area of Unterzeiring and beginning in Jan. 1st, 2005 large parts of the mining/prospective area of Oberzeiring – Möderbrugg, Unterzeiring and the range on the western side of the Pöls Valley between Oberzeiring – Winden – Katzling – Pöls, and the Katzling Zone. The acquisition of exploration licenses covering the anomalousprospective gold district of Pusterwald - Goldriegel to the North of Zeiring followed during 2008 – 2009 (Fig. 1). Since the acquisition of these licenses the management of the company has conducted exploration and research programs with surveys of geochemistry, geophysics and geology over historical mine areas, including core drilling and reconnaissance inside the vast underground mine buildings of the district. The report describes the details and the results of these exploration programs.

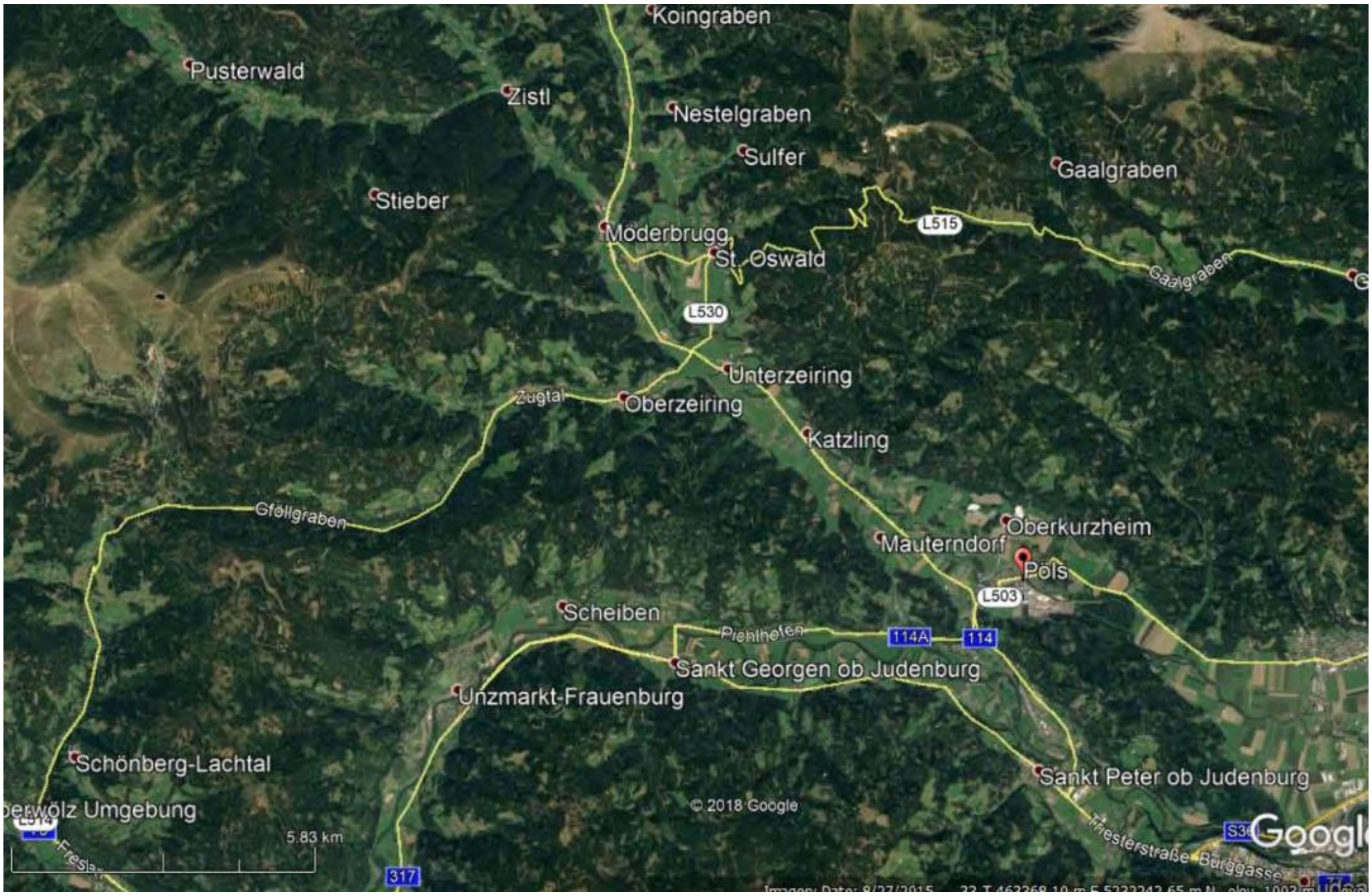

Figure 1: Fig. 1: Road Map of the Judenburg – Mur Valley – Pöls – Ober-Zeiring - Möderbrugg – Pusterwald Area of Styria

This technical report shall serve as a basis and guide for the development of a project data base and the design of well-focused short-, mid- and long-term work programs to better assist the continued exploration and development work and bring the district back to an economically viable production.

This report only covers the Zeiring – Möderbrugg Concession (“Freischurfgebiet”) of the two areas held by SMZ.
A major source of the information is represented by the in-house (unpublished, compiled for SMZ in 2012) “PRELIMINARY TECHNICAL REPORT and DATA COMPILATION for the ZEIRING POLYMETALLIC PRECIOUS METAL MINING DISTRICT” written by Dr Hans R. Klob (HRK International GeoConsulting Services). In turn, in Dr.Klob’s own words, a “rich and unique source for data related to the historical polymetallic Silver Mine of the Ober-Zeiring area was made available for this report’s research by Dr. A. SCHEDL, the Custodian of the Austrian Mining Archive at the Geological Survey of Austria in Vienna and by the Library of the Montan University in Leoben”.
The types of information and data ranged from historical to recent geological maps, historical and present day mine plans and a wide array of reports and publications, some of them going back to the 14th– 15th Century. Most of the data and reports used by Dr.Klob were in German language. For Dr. Klobb, a native Austrian, there were no language barriers in using and translating the materials to English. The Author (Dr. Galkine) of this report used various professional translating software and had the help of the native German language speakers (such as Thomas Brunner, Chairman/CEO of Aurex Biomining AG) when clarification of the official documents and other publications was needed.
Several attempts have been made in the past to project the amount of mineable minerals on Oberzeiring property. However, there existed no drill or other systematic sampling assays to support such extrapolations.

Researchers used only very general information about observed or projected thicknesses and lengths of the veins, rare sample assays, amounts of dump material etc. In QP opinion, these projections by no means can be considered as ***historical resource estimates***. They just demonstrate the unceasing attention and interest of geologists and miners to the area mineral potential under the circumstances when the main part of the historical mines is under water.

The Author conducted a site visit at the Oberzeiring Property on September 11, 2019, and spent approximately 8 hours at the Oberzeiring Property visiting and sampling the available outcrop, visiting the entrance to the old mine, and visiting and sampling the underground workings of the old mine which nowadays serves as a tourist and schooling attraction (Schaubergwerk Museum Oberzeiring). The author is of the opinion that the scientific technical information about the Veronneau Property presented in this report can be considered current as there has been no material change since the site inspection.

Item 3: Reliance on Other Experts

This report represents the professional opinion of Vadim Galkine, Ph.D, Dr. Sci, P.Geo. This document has been prepared based on a scope of work agreed with the Client and is subject to inherent limitations considering the scope of work, the methodology, and procedures used. This document is meant to be read as a whole, and portions thereof should not be read or relied upon unless in the context of the whole.

The QP has seen the registration of the Licenses with Federal Ministry of Sustainability and Tourism of Austria which states (translated in English; the original copy in German can be found in the Appendix I): "The application of SILBERMINE ZEIRING GmbH of 26 July 2018 will extend the **validity** of the eligibility for … (another SMZ's property)… **and for 99 free judgments with the designations 1/04 (1) to 31/04 (31} or 83/04 (1) to 150/04 (68) by 5 years, that is until December 31, 2023** "(highlighted by the Author). The QP is relying on this document with respect to the ownership and good standing of these licenses under the section of this technical report entitled "Property Description and Location".

In the preparation of this report, the author has relied on information provided by Richmond Minerals Inc. and Silbermine Zeiring GmbH, as well as published historical information obtained through the open source web accessible data.

The author has reviewed a number of historical reports that were prepared by various consultants working for Silbermine Zeiring GmbH. Those reports outlined various aspects of the exploration programs dealing with drilling/sampling methods, assaying protocols, density determinations, geologic interpretations, historical production, and discussions on amount of mineable mineralization.

The Author has made every attempt to accurately describe and convey the information contained in these sources, however he cannot guarantee the accuracy, validity or completeness of the data. Therefore, the Author relies on the accuracy presented to him in the sources used to prepare this report.

The reader should note that due to the vintage of the historical data, it has not been possible for the author to fully validate the information contained therein. However, the author's personal examination of the Property supports the substantive qualitative inferences of the historical data as an indication of prospectivity of the Oberzeiring Property.

The author has relied on the following key reports:

1. Dr. Hans R. Klob (2012). Preliminary Technical Report and Data Compilation for the Zeiring Polymetallic Precious Metal Mining District (Parts I-III), HRK International GeoConsulting Services San Francisco, California, July 2012, for Silbermine Zeiring GmbH Vienna, Austria
2. Dr. Martin S. Oczlon (2004). REPORT On Geophysical and Geochemical Exploration near the Medieval Silver Mining Area Oberzeiring, Steiermark, Österreich, November 2004, Geology and Minerals Consulting, Geophysical Consulting Company
3. Dr. Martin S. Oczlon (2004). REPORT On Geophysical and Geochemical Exploration in the Ancient Katzling Silver Mining Area, Steiermark, Austria, November 2004
4. Dr. Rainier Arndt (2006). Synopsis and Re-Interpretation Of Geophysical Data For the Exploratory Work at the Oberzeiringer Erzberg / Prospect Möderbrugg, Dr. R ARNDT, Certified Expert Witness for Geophysics at the Civil Court of Vienna, especially for: Engineeringgeophysics, Environmental geophysics, Exploration
5. Dr R.M. Vielreicher. Bericht zur Silber (Ag) & Gold (Au) Exploration in den Freischurfgebieten, Oberzeiring / Katzling; Silbermine Zeiring GmbH, September,2012 (English translation made by Dr. V. Galkine, the Author of the current report).

Item 4: Property Description and Location

SILBERMINE ZEIRING GmbH is a company established Under Austrian commercial law, duly registered in the company registry of the Republic of Austria since January 3^{rd,} 1989 under registry number FN 79596d. As an exploration/exploitation oriented company its activities are ruled and controlled by the Austrian Federal "Mineralrohstoff" Gesetz (MINROG), the federal law regulating the mineral industry of Austria.

Aurex Biomining AG, registered in the commercial registry of St. Gallen, Switzerland, registry number 320.3.059.072-4, established in Wattwil, Switzerland, is 100% shareholder of SILBERMINE ZEIRING GmbH.

The permits cover an area of more than 3,000 hectares and are located near the town of Oberzeiring in the province of Styria, approximately 80 kilometers north of Graz, Austria.

SILBERMINE ZEIRING GmbH is holder of the licences and has the full and exclusive right to perform mining explorations in the area of 99 exploration permits. Such title is legal, valid and binding in relation to the present owner and any other persons with outstanding interests including the diverse owners of the surface rights.

According to the registration of the Permits with Federal Ministry of Sustainability and Tourism of Austria which states (translated in English, the original copy in German can be found in the Appendix I): "The application of SILBERMINE ZEIRING GmbH of 26 July 2018 will extend the **validity** of the eligibility for … (another SMZ's property)… **and for 99 free judgments with the designations 1/04 (1) to 31/04 (31) or 83/04 (1) to 150/04 (68) by 5 years, that is until December 31, 2023** " (Table 1).

The annual ministry fees, 8.72 EUR for each of our 99 + 48 exploration permits/claims, total 1,281.84 EUR have been duly paid till December 31, 2019. The next annual ministry fees for 2020 have to be paid till April 2020.

To the QP knowledge, there are no royalties obligations, back-in rights, payments, or other agreements and encumbrances attached to these permits.

There are no known environmental liabilities to which the property is subject.

For the best of QP's knowledge there are no other significant factors and risks that may affect access, title, or the right or ability to perform work on the property.

Location

The historical mining district of Zeiring with the overlaying SMZ-held concessions is located in Upper Styria (Steiermark), part of the Styrian Province of Austria (Fig. 2).

Figure 2: Schematic Map of Austria - Location (Ober)-Zeiring, Styria (from SMZ Website: "silbermine.at")

The Zeiring Concession

The Zeiring Concession ("Freischurfgebiet") is an assemblage of overlapping licenses ("Freischürfe") chosen by the applicant/holder to cover the areas of interest. A license is a circle with a diameter of 850m (Fig. 3). The licenses authorize the holder to explore for metallic and other mineral raw materials defined by the Austrian "Mineral-Rohstoff Gesetz" (MINROG), the law which regulates exploration and mining activities in Austria. Licenses are issued for a period of five years. They can be renewed as long as the holder has carried out a work program approved by the Austrian Mining Department ("Montanbehörde"), part of the Austrian Federal Ministry of Economy and Labor.

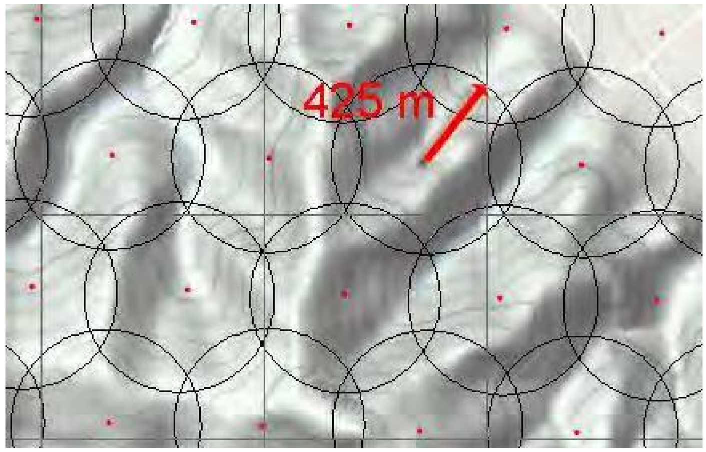

Figure 3: License Definition in Austria

The Concession area (“Freischurfgebiet”) of SMZ covers the following historical mining areas (“Fields”) (Fig.3):

- Ober-Zeiring – Möderbrugg: the West-, Middle-, NE- and South-Field with its underground Ag, Au, Cu, Pb, Zn, Fe and Barite mines (Fig. 3); the area of Oberzeiring has been extended more recently northward to include the areas near Möderbrugg,
- The mining areas of Unter-Zeiring and the Katzling Zone (Fig. 3 and 4), and
- The area to the W of the Katzling Zone and N of the Mur Valley from Pöls in the E to Scheiben in the W

According to the registration of the Permits with Federal Ministry of Sustainability and Tourism of Austria which states (translated in English, the original copy in German can be found in the Appendix I): “The application of SILBERMINE ZEIRING GmbH of 26 July 2018 will extend the **validity** of the eligibility for … (another SMZ’s property)… **and for 99 free judgments with the designations 1/04 (1) to 31/04 (31) or 83/04 (1) to 150/04 (68) by 5 years, that is until December 31, 2023** ” (Table 1).

Table 1 list and provide the geographic Coordinates of SMZ’s “Freischürfe” in Concessions Ober-Zeiring – Möderbrugg, Unter-Zeiring and the Katzling Zone (the western ridge of the Pöls valley from “Matthias Baue” in the North to mining areas “A” to “G” near Mauterndorf – Pöls). The coordinates in the Table 1 are given in Austrian Gauss-Kruger Meridian 31 System, and the permits are shown in the Fig. 4, the outline can be seen in Fig.5

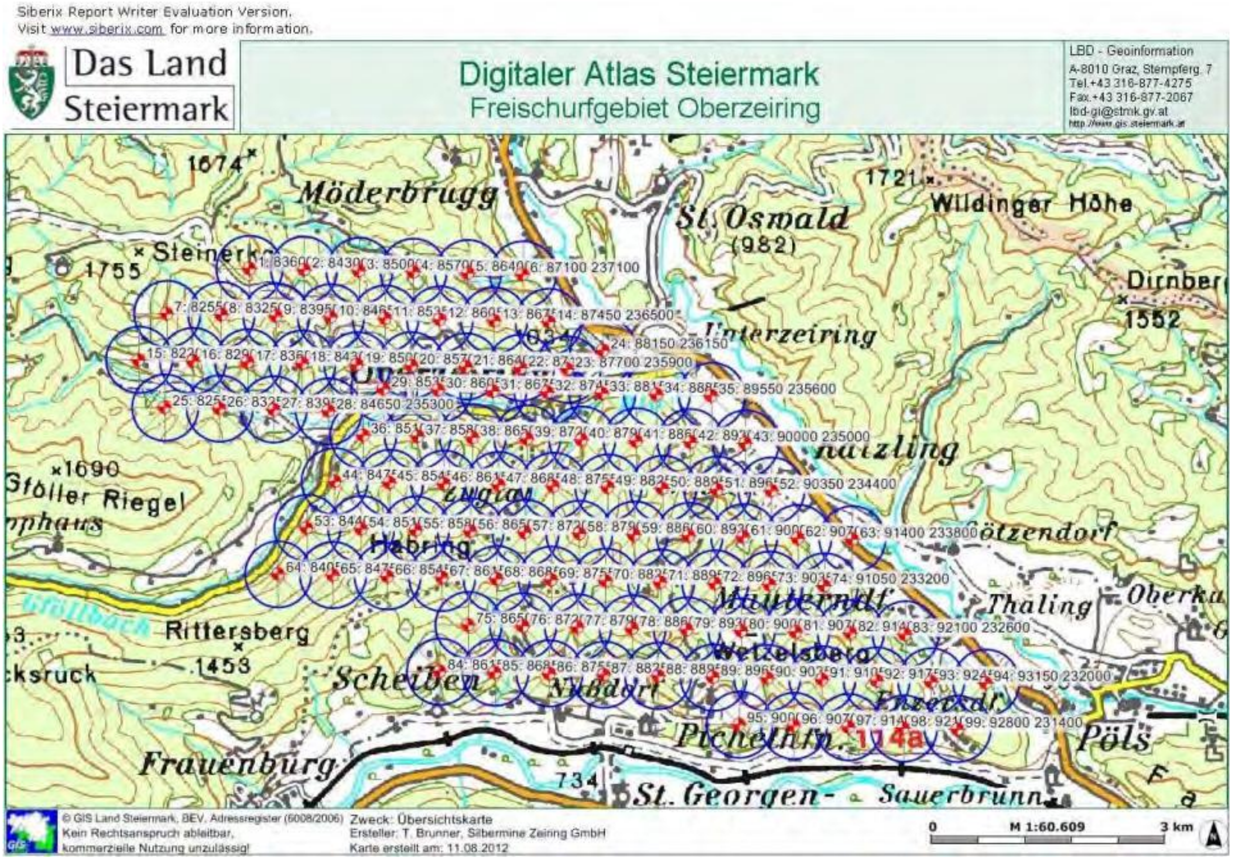

Figure 4: SMZ Concession area ("Freischurfgebiet") at Ober-Zeiring – Möderbrugg, and Unter-Zeiring – Katzling Zone

Bezeichnung Sample #	Bezugs-meridian	Koordinaten in Metern y	x	Katastralgemeinde Cadastral Communit
	Austrian Gauss-Krüger Meridian 31 System			
1/04 (1)	M 31	+ 83 600,00	+ 5 237 100,00	Möderbrugg, Oberzeiring
2/04 (2)	M 31	+ 84 300,00	+ 5 237 100,00	Möderbrugg, Oberzeiring
3/04 (3)	M 31	+ 85 000,00	+ 5 237 100,00	Möderbrugg
4/04 (4)	M 31	+ 85 700,00	+ 5 237 100,00	Möderbrugg
5/04 (5)	M 31	+ 86 400,00	+ 5 237 100,00	Möderbrugg
6/04 (6)	M 31	+ 87 100,00	+ 5 237 100,00	Möderbrugg
7/04 (7)	M 31	+ 82 550,00	+ 5 236 500,00	Oberzeiring
8/04 (8)	M 31	+ 83 250,00	+ 5 236 500,00	Oberzeiring
9/04 (9)	M 31	+ 83 950,00	+ 5 236 500,00	Oberzeiring, Möderbrugg
10/04 (10)	M 31	+ 84 650,00	+ 5 236 500,00	Oberzeiring, Möderbrugg
11/04 (11)	M 31	+ 85 350,00	+ 5 236 500,00	Oberzeiring, Möderbrugg
12/04 (12)	M 31	+ 86 050,00	+ 5 236 500,00	Möderbrugg, Oberzeiring
13/04 (13)	M 31	+ 86 750,00	+ 5 236 500,00	Möderbrugg, Oberzeiring
14/04 (14)	M 31	+ 87 450,00	+5 236 500,00	Möderbrugg, Oberzeiring
15/04 (15)	M 31	+ 82 200,00	+ 5 235 900,00	Oberzeiring
16/04 (16)	M 31	+ 82 900,00	+ 5 235 900,00	Oberzeiring
17/04 (17)	M 31	+ 83 600,00	+ 5 235 900,00	Oberzeiring
18/04 (18)	M 31	+ 84 300,00	+ 5 235 900,00	Oberzeiring
19/04 (19)	M 31	+ 85 000,00	+ 5 235 900,00	Oberzeiring
20/04 (20)	M 31	+ 85 700,00	+ 5 235 900,00	Oberzeiring
21/04 (21)	M 31	+ 86 400,00	+ 5 235 900,00	Oberzeiring, Möderbrugg
22/04 (22)	M 31	+ 87 100,00	+ 5 235 900,00	Oberzeiring, Möderbrugg
23/04 (23)	M 31	+ 87 700,00	+ 5 235 900,00	Oberzeiring, Möderbrugg
24/04 (24)	M 31	+ 88 150,00	+ 5 236 150,00	Oberzeiring, Möderbrugg
25/04 (25)	M 31	+ 82 550,00	+ 5 235 300,00	Oberzeiring
26/04 (26)	M 31	+ 83 250,00	+ 5 235 300,00	Oberzeiring
27/04 (27)	M 31	+ 83 950,00	+ 5 235 300,00	Oberzeiring
28/04 (28)	M 31	+ 84 650,00	+ 5 235 300,00	Oberzeiring
29/04 (29)	M 31	+ 85 350,00	+ 5 235 600,00	Oberzeiring
30/04 (30	M 31	+ 86 050,00	+ 5 235 600,00	Oberzeiring
31/04 (31)	M 31	+ 86 750,00	+ 5 235 600,00	Oberzeiring

Tab. 1: SMZ Exploration Permits ("Freischürfe") # 1 to 31, valid 5 Years to Dec. 31, 2023 – Ober-Zeiring-

Möderbrugg

Bezeichnung	Bezugs-meridian	Koordinaten in Metern y	x	Katastralgemeinden
83/04 (1)	M31	+ 87 450,00	5 235 600,00	Oberzeiring
84/04 (2)	M31	+ 88 150,00	5 235 600,00	Oberzeiring
85/04 (3)	M31	+ 88 850,00	5 235 600,00	Unterzeiring, Oberzeiring
86/04 (4)	M31	+ 89 550,00	5 235 600,00	Unterzeiring
87/04 (5)	M31	+ 85 100,00	5 235 000,00	Oberzeiring
88/04 (6)	M31	+ 85 800,00	5 235 000,00	Oberzeiring
89/04 (7)	M31	+ 86 500,00	5 235 000,00	Oberzeiring
90/04 (8)	M31	+ 87 200,00	5 235 000,00	Oberzeiring
91/04 (9)	M31	+ 87 900,00	5 235 000,00	Oberzeiring
92/04 (10)	M31	+ 88 600,00	5 235 000,00	Oberzeiring, Unterzeiring
93/04 (11)	M31	+ 89 300,00	5 235 000,00	Unterzeiring
94/04 (12)	M31	+ 90 000,00	5 235 000,00	Unterzeiring
95/04 (13)	M31	+ 84 750,00	5 234 400,00	Oberzeiring
96/04 (14)	M31	+ 85 450,00	5 234 400,00	Oberzeiring
97/04 (15)	M31	+ 86 150,00	5 234 400,00	Oberzeiring
98/04 (16)	M31	+ 86 850,00	5 234 400,00	Oberzeiring
99/04 (17)	M31	+ 87 550,00	5 234 400,00	Oberzeiring
100/04 (18)	M31	+ 88 250,00	5 234 400,00	Oberzeiring, Unterzeiring
101/04 (19)	M31	+ 88 950,00	5 234 400,00	Unterzeiring
102/04 (20)	M31	+ 89 650,00	5 234 400,00	Unterzeiring
103/04 (21)	M31	+ 90 350,00	5 234 400,00	Unterzeiring
104/04 (22)	M31	+ 84 400,00	5 233 800,00	Oberzeiring
105/04 (23)	M31	+ 85 100,00	5 233 800,00	Oberzeiring
106/04 (24)	M31	+ 85 800,00	5 233 800,00	Oberzeiring
107/04 (25)	M31	+ 86 500,00	5 233 800,00	Oberzeiring, Scheiben, Pichelhofen
108/04 (26)	M31	+ 87 200,00	5 233 800,00	Oberzeiring, Scheiben, Pichelhofen
109/04 (27)	M31	+ 87 900,00	5 233 800,00	Oberzeiring, Unterzeiring
110/04 (28)	M31	+ 88 600,00	5 233 800,00	Unterzeiring, Oberzeiring
111/04 (29)	M31	+ 89 300,00	5 233 800,00	Unterzeiring
112/04 (30)	M31	+ 90 000,00	5 233 800,00	Unterzeiring
113/04 (31)	M31	+ 90 700,00	5 233 800,00	Unterzeiring, Oberkurzheim
114/04 (32)	M31	+ 91 400,00	5 233 800,00	Unterzeiring, Oberkurzheim
115/04 (33)	M31	+ 84 050,00	5 233 200,00	Oberzeiring, Scheiben (P)
116/04 (34)	M31	+ 84 750,00	5 233 200,00	Oberzeiring, Scheiben (P)
117/04 (35)	M31	+ 85 450,00	5 233 200,00	Scheiben, Oberzeiring

Tab. 1: SMZ Exploration Permits ("Freischürfe") # 83 to 117, valid 5 Years until Dec. 31, 2023 – Ober-& Unter-

Zeiring

Bezeichnung	Bezugs-meridian	Koordinaten in Metern y	x	Katastralgemeinden
118/04 (36)	M31	+ 86 150,00	5 233 200,00	Scheiben, Oberzeiring
119/04 (37)	M31	+ 86 850,00	5 233 200,00	Scheiben, Oberzeiring
120/04 (38)	M31	+ 87 550,00	5 233 200,00	Scheiben, Oberzeiring
121/04 (39)	M31	+ 88 250,00	5 233 200,00	Pichelhofen, Oberzeiring, Unterzeiring
122/04 (40)	M31	+ 88 950,00	5 233 200,00	Pichelhofen, Unterzeiring
123/04 (41)	M31	+ 89 650,00	5 233 200,00	Unterzeiring, Pichelhofen
124/04 (42)	M31	+ 90 350,00	5 233 200,00	Unterzeiring, Pichelhofen
125/04 (43)	M31	+ 91 050,00	5 233 200,00	Unterzeiring
126/04 (44)	M31	+ 86 500,00	5 232 600,00	Scheiben
127/04 (45)	M31	+ 87 200,00	5 232 600,00	Scheiben
128/04 (46)	M31	+ 87 900,00	5 232 600,00	Scheiben
129/04 (47)	M31	+ 88 600,00	5 232 600,00	Pichelhofen
130/04 (48)	M31	+ 89 300,00	5 232 600,00	Pichelhofen, Unterzeiring
131/04 (49)	M31	+ 90 000,00	5 232 600,00	Pichelhofen, Unterzeiring
132/04 (50)	M31	+ 90 700,00	5 232 600,00	Unterzeiring, Pichelhofen
133/04 (51)	M31	+ 91 400,00	5 232 600,00	Unterzeiring
134/04 (52)	M31	+ 92 100,00	5 232 600,00	Unterzeiring, Oberkurzheim
135/04 (53)	M31	+ 86 150,00	5 232 000,00	Scheiben
136/04 (54)	M31	+ 86 850,00	5 232 000,00	Scheiben
137/04 (55)	M31	+ 87 550,00	5 232 000,00	Scheiben
138/04 (56)	M31	+ 88 250,00	5 232 000,00	Scheiben, Pichelhofen
139/04 (57)	M31	+ 88 950,00	5 232 000,00	Scheiben, Pichelhofen
140/04 (58)	M31	+ 89 650,00	5 232 000,00	Pichelhofen
141/04 (59)	M31	+ 90 350,00	5 232 000,00	Pichelhofen, Unterzeiring
Bezeichnung	Bezugs-meridian	Koordinaten in Metern y	x	Katastralgemeinden
142/04 (60)	M31	+ 91 050,00	5 232 000,00	Pichelhofen, Unterzeiring
143/04 (61)	M31	+ 91 750,00	5 232 000,00	Unterzeiring
144/04 (62)	M31	+ 92 450,00	5 232 000,00	Unterzeiring, Pöls
145/04 (63)	M31	+ 93 150,00	5 232 000,00	Pöls
146/04 (64)	M31	+ 90 000,00	5 231 400,00	Pichelhofen
147/04 (65)	M31	+ 90 700,00	5 231 400,00	Pichelhofen
148/04 (66)	M31	+ 91 400,00	5 231 400,00	Pöls, Pichelhofen, Unterzeiring
149/04 (67)	M31	+ 92 100,00	5 231 400,00	Unterzeiring, Pöls
150/04 (68)	M31	+ 92 800,00	5 231 400,00	Pöls, Unterzeiring

Tab. 1: SMZ Exploration Permits # 118 - 150, valid 5 Yrs to Dec. 31, 2023 – Unter-Zeiring-Katzling Zone

We must note that in Gauss-Kruger system for the Easting value, the letter Y is often used and for the high value the letter X is used. It is often quite confusing for unprepared readers.

The Author converted the local coordinates into more familiar WGS 84 Utm Zone 33N system; the resulted map is shown in the Fig. 6.

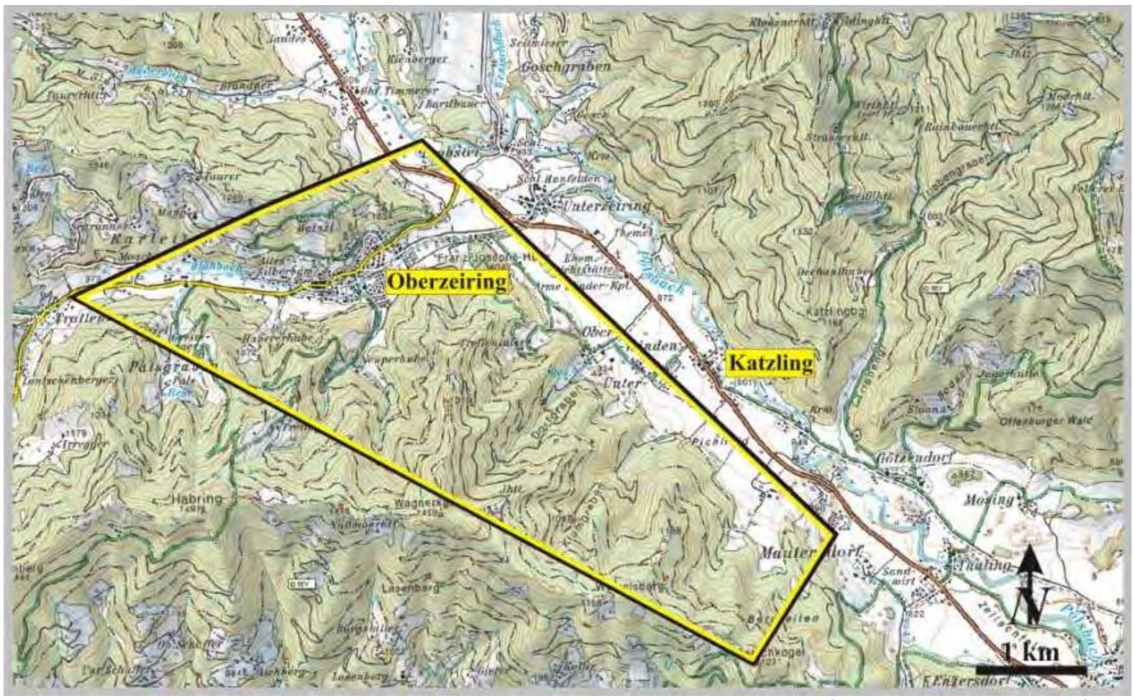

Figure 5: Contours of the SMZ Concession's Area of Zeiring and the Katzling Zone (from: VIELREICHER, 2012)

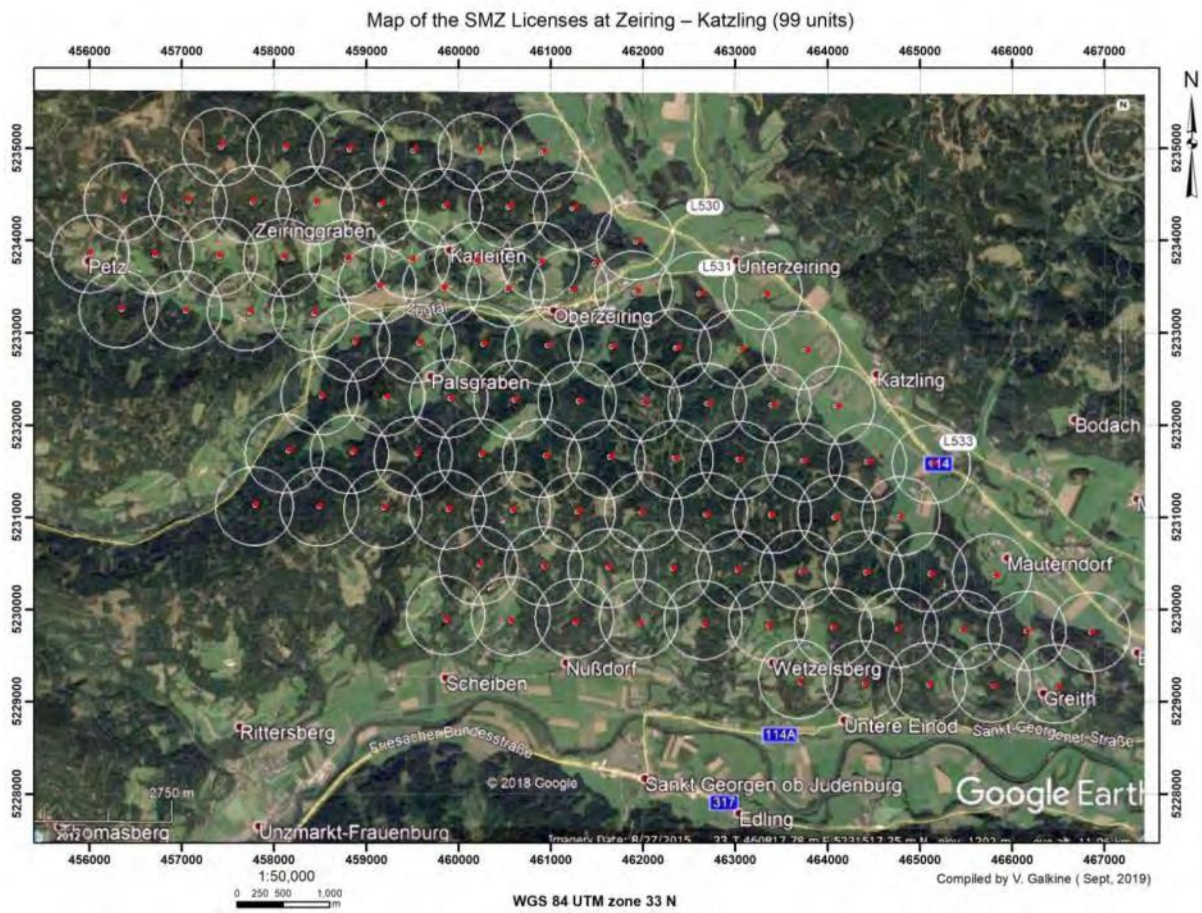

Figure 6: Oberzeiring licenses in WGS 84 Utm Zone 33N system

The Zeiring Mining Areas

The Ober-Zeiring mining district is divided into four areas (Fig. 7):

- The West Field (Franzisci, Wiener and Grazer Adits)
- The Central or Middle Field, located underneath and slightly to the North of Ober-Zeiring (Pier Mine workings)
- The North-East Field – Johannes base tunnel, Klinger-, Taubenkropf and many other workings and underground stopes
- The South Field – Matthias Baue, Purgstallofen adits, Zugthal, Haberer Berg
- Treffenthaler adit and the areas “A” to “G” with the historically most active area “D” (Klum Creek or Bunker area), belong to Unter-Zeiring – “Katzling Zone”.

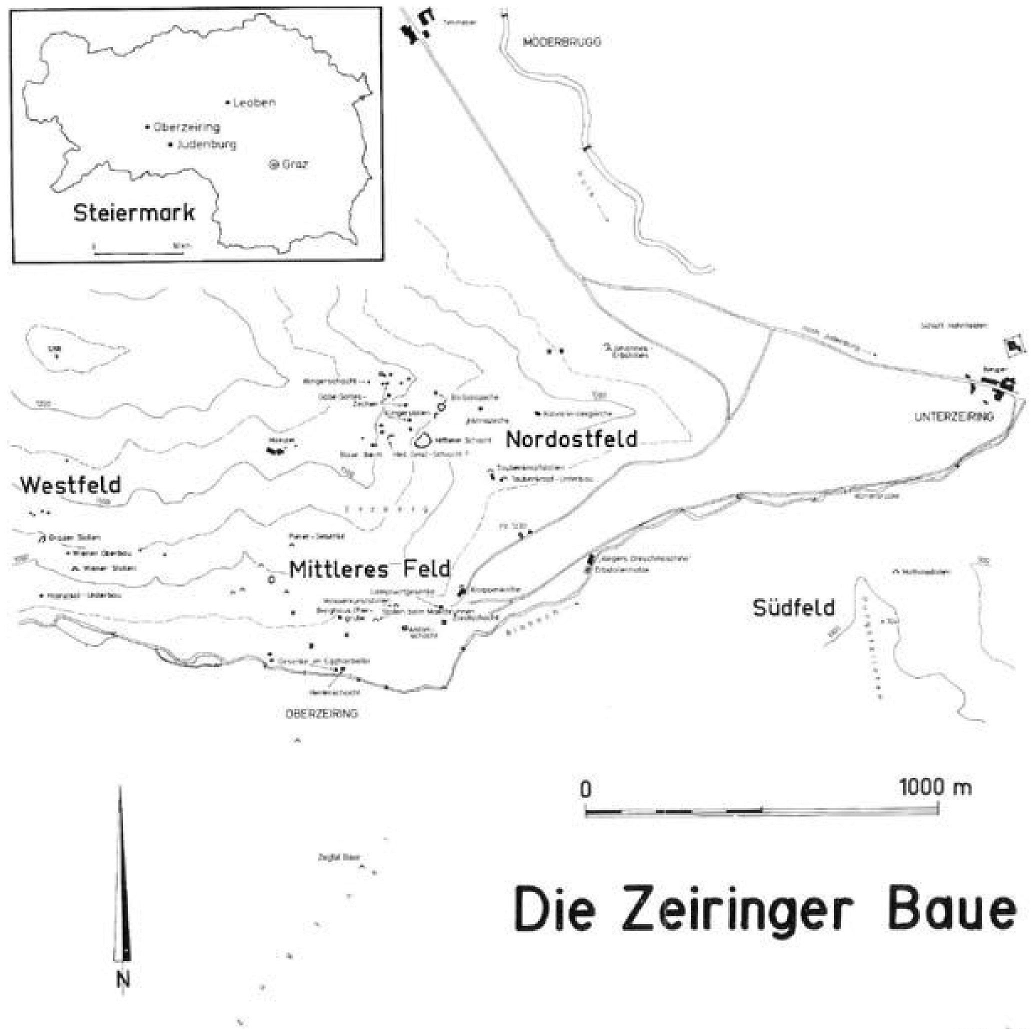

Figure 7: The four Mining Fields of the Ober-Zeiring Silver Mine: 1. W Feld, 2. Mittleres Feld, 3. NE Feld, 4. S Feld (from: HADITSCH, 1967)

The West Field

The West Field (Fig. 8) is located on the North side of the Blabach (Bla Creek) valley, West of the town of Oberzeiring. There are three main access tunnels:

- The lowest, the Franzisci (base) tunnel at an ASL of about 965m has a length of about 350m
- The Wiener Stollen (Adit) at about 1015m ASL, and
- The Grazer Stollen at about 1040m ASL.

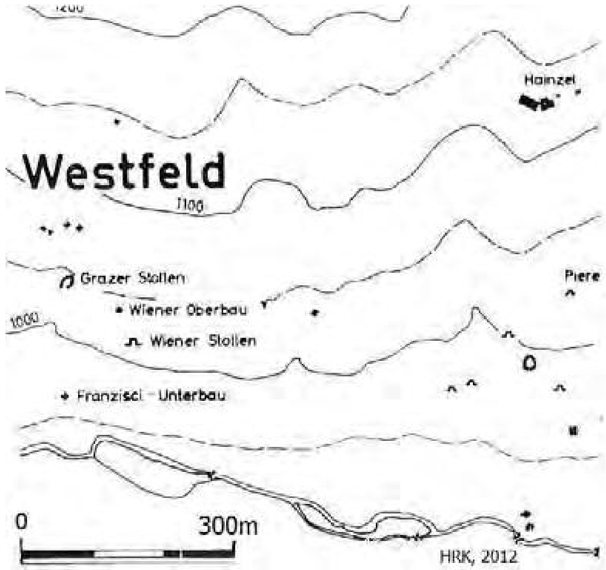

Figure 8: Topographic Map Detail of the "Westfeld" with Mine Center (Extract from map of Fig. 7)

Figure 9: Topographic Map Detail of the "Westfeld"Mine Projection of Historical Underground Workings

The mine building, its plan view provided in Fig. 9, is rather small compared to the mining centers further to the E. The mine building has a predominantly N-S orientation. The base tunnel - the Franzisci Unterbau - is SSW to NNE oriented. The Wiener Oberbau (upper stope is at about 1035m ASL or 70m above the base tunnel.

The Middle Field

The "Mittel-Feld" (Fig. 10) is located in the center of the district, E of the West Field. Its extensive mine building – the Pier Mine – is right underneath and extending slightly to the North and South of the town of Ober-Zeiring (Fig. 10). Many mine shafts, often in the middle of the town, inactive over centuries have been closed and/or buried over time. For centuries the Middle Field also has been the Center of the area's Silver Mining Industry. Most of the mine workings, a complicated system of tunnels, drifts, crosscuts, raises, shafts and various extensive stopes (Fig.11), extend to the North of Bla Creek and well below the valley bottom. Only a small western portion of the mine's over ten centuries old mine building has been mapped properly (Fig. 11) and recorded between 1620 and 1743 and again in 1922 by SETZ and in 1952 (NEUBAUER).

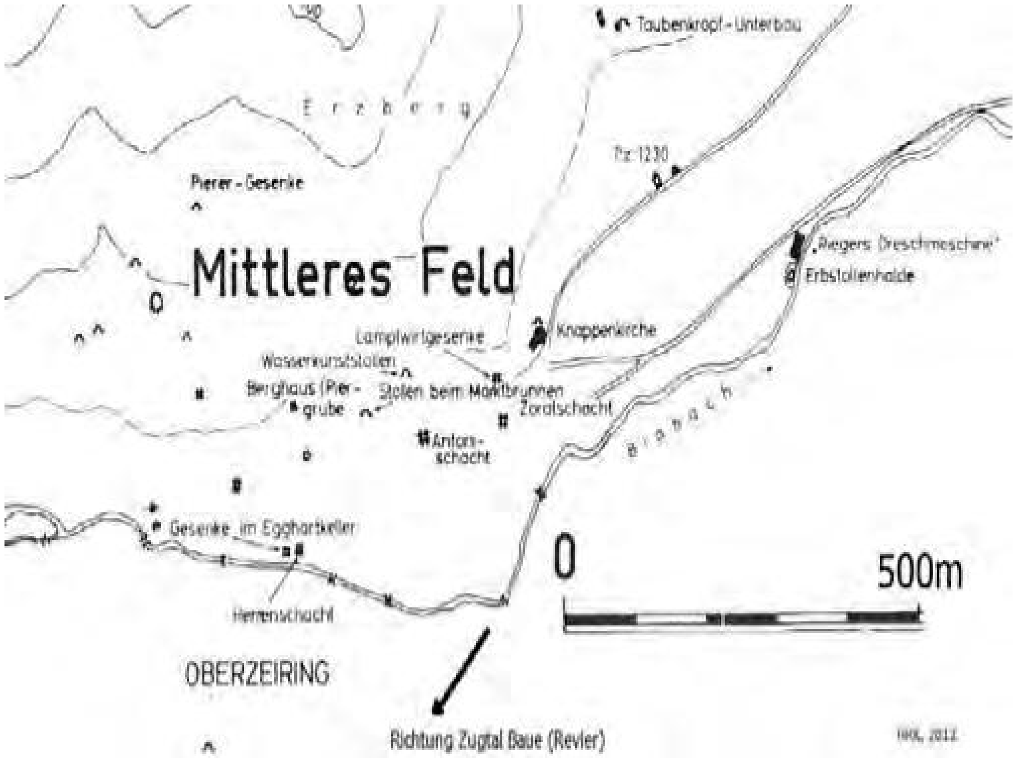

Figure 10: Topographic Map Detail of the "Mittleres Feld" Pier Mine mining Center – (Extract from map of Fig. 7)

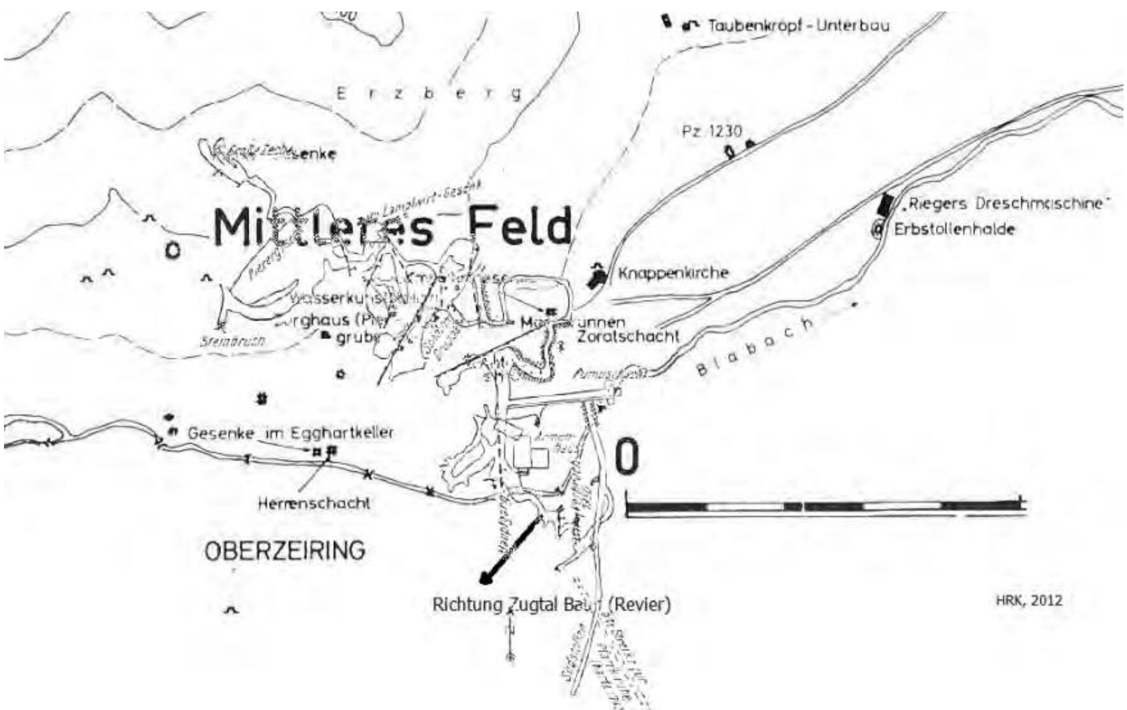

Figure 11: Topographic Map Detail of the "Mittleres Feld" with Projection of Historical Underground Pier Mine

Vertically it extends from the water level of the flooded mine workings at about 880m upwards to workings and stopes between 950m and/or an estimated 1050m at the S end of the mine. No production or other data and/or mine maps exist from the time before the flooding.

Flooding affected the part below the 880m level after a water invasion accident around 1361, which killed a reported 1400 miners. It is an important fact that the influx of water did not originate from the Bla Creek (around 900m ASL) but from waters contained and/or flowing through Karst-type caverns in the mineralization bearing marble.

The North-East Field

The North-East mining Field (Fig. 12, Fig. 13) is located to the NNE – NE of the Middle Field and the town of Oberzeiring. Its extension W-E is about 1km, N-S about 600-700m. The lowest part of the mine building is the Portal to the Johannes Base Tunnel, located at an altitude between 920 and 930m ASL at the base of the western slopes of the Pöls River valley, NW of Unter-Zeiring. The Johannes Base Tunnel ("Erbstollen") extends from its portal in WSW direction over 650 to 700m (Fig. 13) and reaches the eastern-most stoped area after about 40-45m. From there on the Johannes Stollen leads to the different stoped mining centers through cross cuts and raises in southerly direction. It was reopened by HIRN in the 1950s to study and gain access to Barite bearing bodies left behind by Silver, Lead and Iron mining. Mining of Barite took place from 1959 to 1965.

Cross-cut ("Querschlag") 1 connects Johannes Base Tunnel with the stopes of the Franzens Zechen I, II and III. Via a raise and drift to the SW it connects to the "Weite Zeche" and the Taubenkropf Base Tunnel (its portal at about 960m ASL).

Cross-cut 2, also in southerly direction, connects with Taubenkropf Mine workings and the Weite Zeche stopes. About 100m to the South from the turn-off point it connects with a system of drifts and raises to the Neue Zeche, the Barbara Zeche and the "1958" Zeche, where Barite was mined until 1965.

Cross-cut 3 turns off Johannes Base Tunnel in SW direction. It connects to the stoping centers of Gabe Gottes Zeche, Veronika and other Zechen (stopes), extending vertically over several mine and production levels and located in the center of the NE Field mine building. Continuing further to the SW and then along drifts to the NW a multitude of stopes, the Gamsgebirgszeche, the Erikazeche. Sigridzeche, Goisernbau, Leozeche, Theresienzeche and furthest to the North finally Klingerbau can be reached. With the mine portal at about1070m ASL, Klingerbau is one of the highest mine levels of the NE Field Mine building.

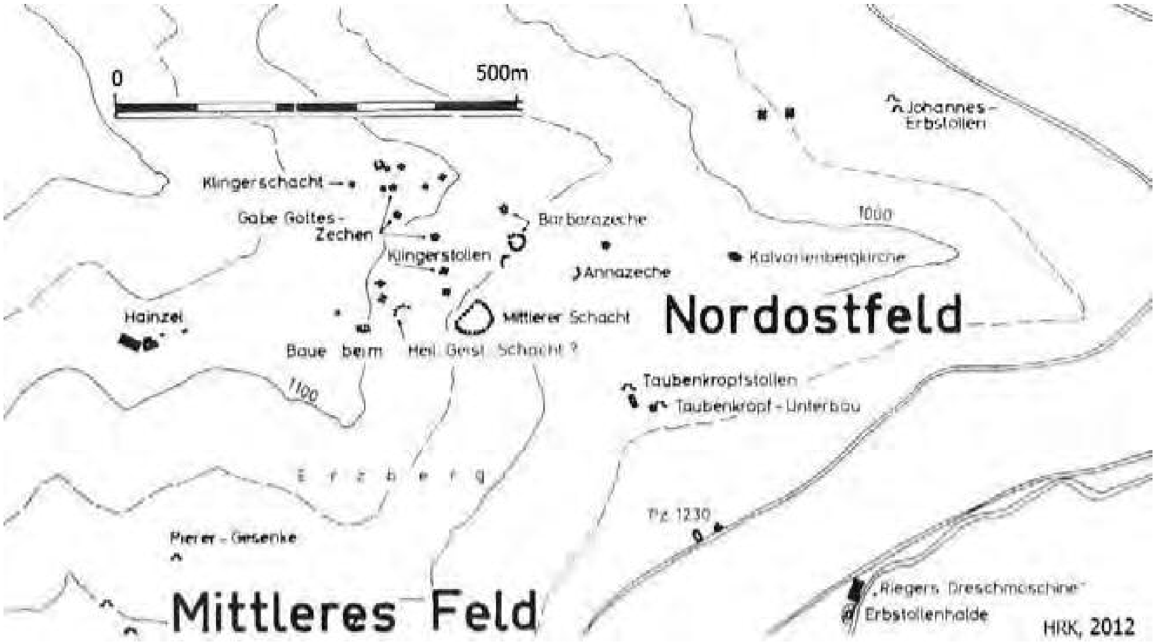

Figure 12: Topographic Map Detail of the "Nordost (NE) Feld" Mine Center – (Extract from map of Fig. 7)

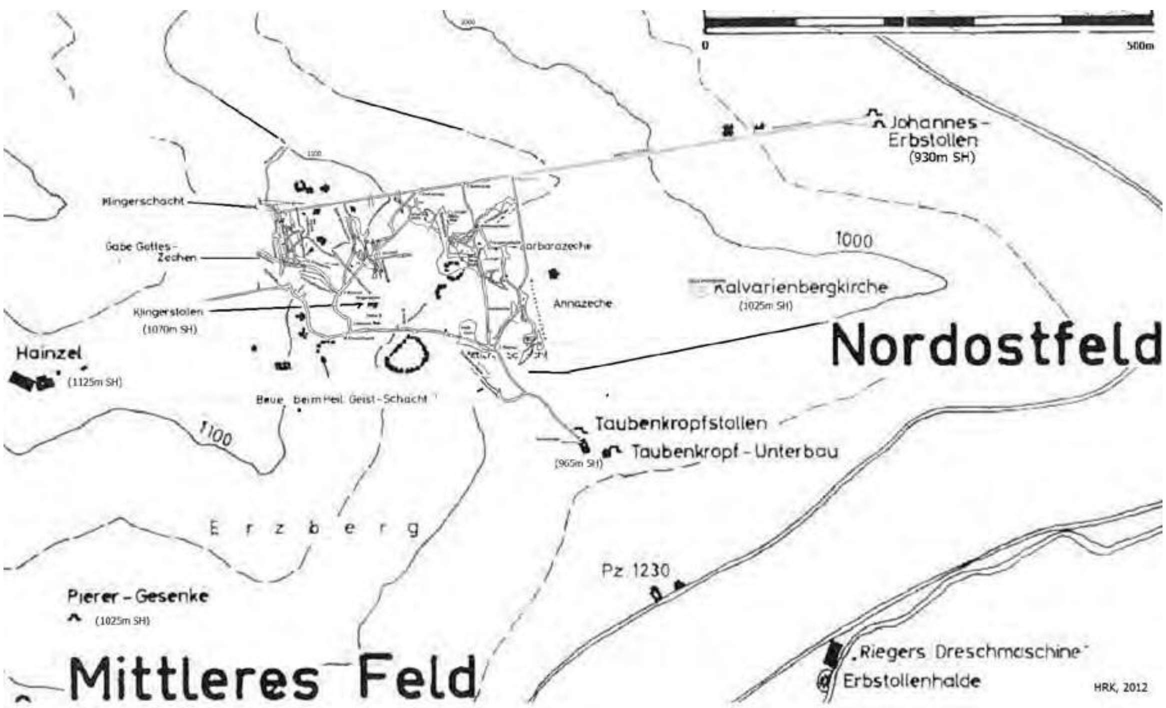

Figure 13: Topographic Map Detail of the "NE Feld" Mine Center – Projection of Historical Underground Workings

The South Field and the Mining Area of the "Katzling Zone"

The original Ober-Zeiring South Field mining area and attached Katzling Zone to the SW are – in contrast to the three other mining centers – characterized more by a multitude of small centers of mines and adits. It covers an area located S of Ober-Zeiring and the Blabach valley, from the Zugthal and "Haberer" mines in the West to its main, but small and at least in part still accessible mine, the Matthias Baue (Fig. 14). One once important mining center called Purgstallofen is geographically located between Zugthal and Matthias Baue. Historic research by BRACHER (1970) points out that it was this area, where mining activities started long before they spread out to the North to Ober-Zeiring and its "Erzberg".

Continuing from the "South Field" the concession's SE area, the "Katzling Zone", spreads out to the SE over the ridge and slopes of the western Pöls River valley. The zone extends from the area of the confluence of Blabach and Pöls River East of Ober-Zeiring (at Unter-Zeiring) to the SE beyond the settlements of Winden, Katzling, Pichl and Mauterndorf to Pöls.

The northwestern-most mining structures in the South Field are collapsed adits in the Zug Valley ("Zugthal") West of Purgstallofen (Fig. 14) located in the NE of the South Field. Further East are is the Matthias Baue and adit as the most prominent mine (Fig. 14). The "Katzling Zone" of historical mining activities and centers begins to the SE of Matthias Baue. The altitude of the individual adits is from a few 10m above the Pöls Valley bottom (around 880-900m ASL) to about 1050m ASL. From NW (the Matthias Baue) to SE there are the historical mines, the Treffenthaler Adit (near the farm house Treffenthaler) and further to the SE the historical mine centers "A" to "G" (Fig. 15). Of these areas area "D", also known under the name of "Klum Baue" or "Bunker Hill Baue", shows the highest number of known adits (Fig. 16).

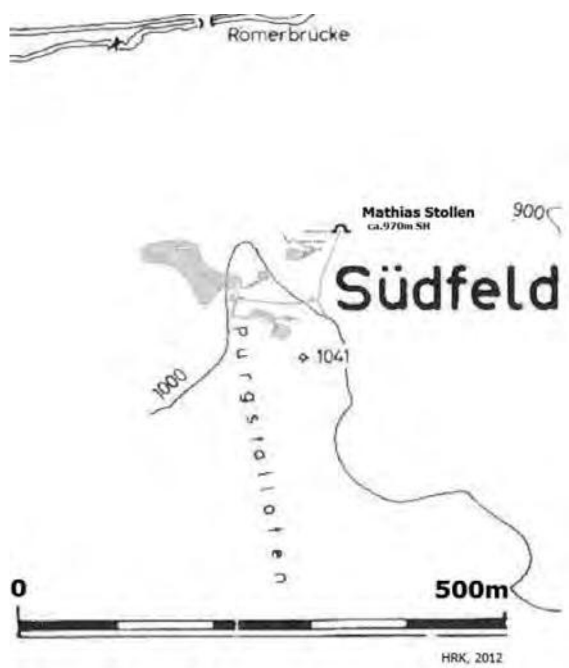

Figure 14: Topographic Map Detail of the "Süd Feld" Mine Center - "Purgstallofen" and Matthias Adits

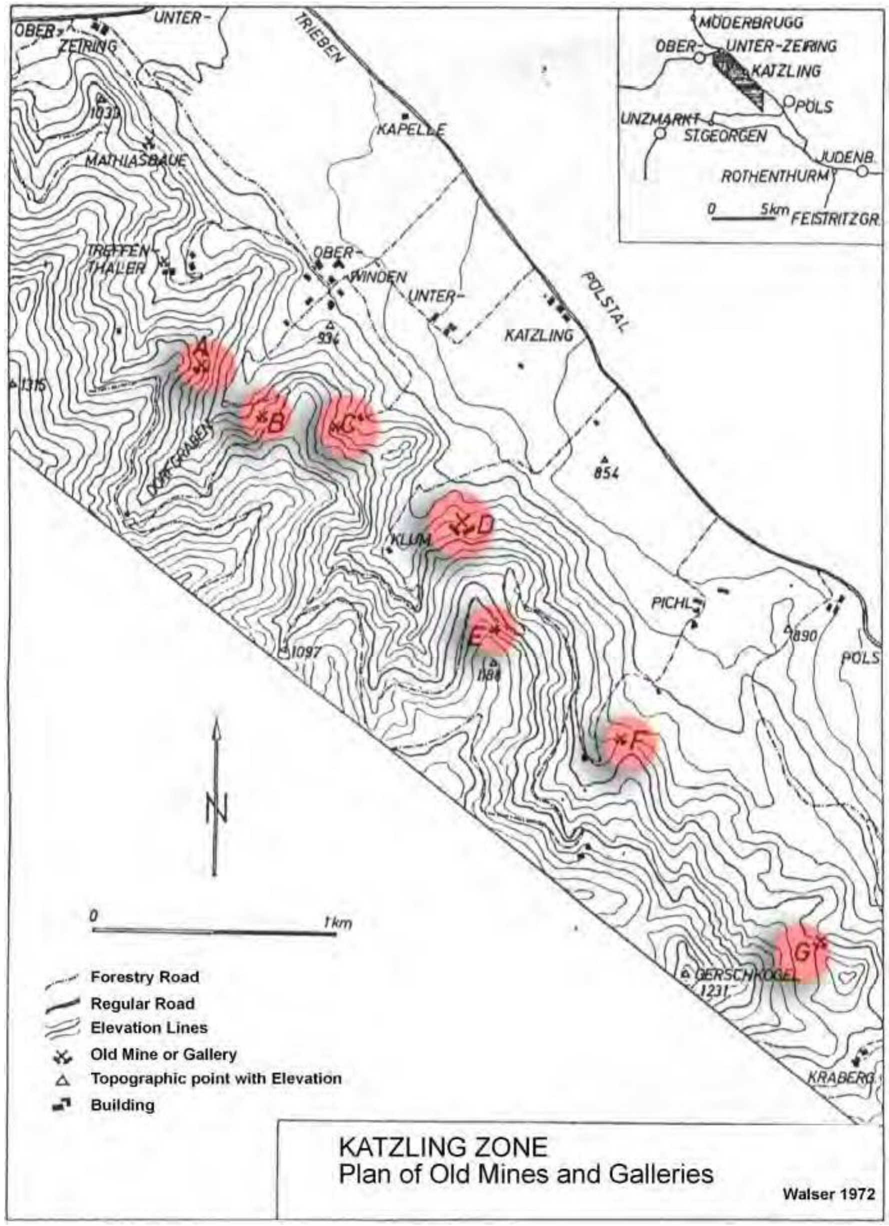

Figure 15: Topographic Map: Katzling Zone from Matthias and Treffenthaler Adits to Mining Centers "A" – "G"

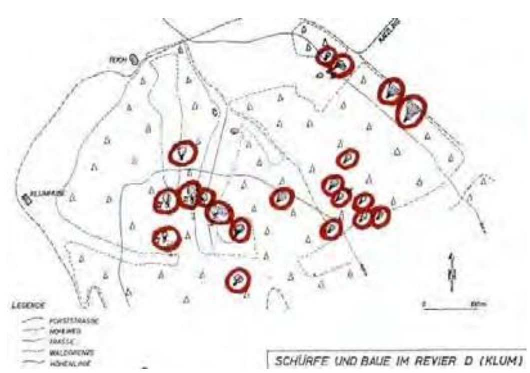

Figure 16: Map Detail for the Klum Valley Mining Center's many historical Adits and Mines (also Center "D")

Item 5_Accessibility, Climate, Local Resources, Infrastructure and Physiography

Regarding the infrastructure and road access to the area, it is well developed. One main Freeway (Autobahn) connects the area directly to Vienna at Judenburg. About 15km to the NE of Judenburg this freeway crosses another main traffic artery, the Graz – Salzburg "Pyhrn" Autobahn.

The Autobahn (Freeway) S36 is the direct link from Vienna to the town of Judenburg. By car it takes about 1hr 45 minutes, by train 2hr 30 min., a very pleasant ride. The road distance to Salzburg is about 150km and to Graz about 80km via the Pyhrn Autobahn which crosses the S36 about 20km to the North of Judenburg at St. Michael, connecting Graz to Salzburg.

From the town of Judenburg it is about 12km to Unter-Zeiring in north-westerly direction on a state highway up-river the Pöls Valley past Pöls, Mauterndorf, Pichl, Katzling and Winden. From there it is less than 2km on a paved country road to Ober-Zeiring, the center of the historical silver mining district (Fig. 17).

Figure 17: Road Map of the Area of Judenburg – Ober-Zeiring – Möderbrugg – Pusterwald (from: VIELREICHER, 2012)

Locally, within the concession and work area a dense network of utility and forestry roads allows for easy access to sites of old adits and mine portals. The majority of the mines and adits are located higher up the often steep hillsides, and most of them have collapsed and cannot be accessed any longer.

The mining town of Ober-Zeiring is located at around 930m ASL in the Blabach Valley. Blabach ("Bla-Creek") drains to the East and joins the larger Pöls River at Unter-Zeiring. The Pöls River drains in south-easterly direction past the villages of Winden, Katzling, Pichl, Mauterndorf and Pöls, about the southern limit of the SMZ holding. The Pöls has its confluence with the Mur River at the town of Judenburg. The shape of both valleys is typical for valleys carved out by glaciers during ice age, the time when also Karst-type caves were formed within the main marble layer, the host to the Zeiring polymetallic deposits.

The valley floors of Blabach and Pöls are mostly flat and used for agriculture. On each side the valleys are bounded by often rather steep slopes of mountains reaching up to 1200-1300m ASL. The mountain slopes are mostly covered by coniferous forest. A dense network of forestry roads allows for easy access of these areas by car (a 4x4 SUV is recommended).

The mining centers like the town of Ober-Zeiring, but also smaller settlements and farm houses still have maintained their original character with houses, churches and chapels dating back to the 13th and following Centuries. Ober-Zeiring itself is mentioned first in 1265.

The local population is occupied with farming and forestry, small businesses and tourism. One of the old mine tunnels located directly within the limits of Ober-Zeiring and preserved open is used as a "healing" site for Radon treatment of various respiratory illnesses, and problems with digestion and mobility of the limbs. The facility also offers a complete set of wellness and therapeutic treatments. An upper portion of the otherwise flooded old mine underneath the town of Ober-Zeiring has been converted into a Mining Museum.

The hydrographic drainage system of the Pöls Valley and its tributaries is one of the most important side valleys of the Mur River. Due to its NW – SE orientation it has an average wind velocity of 2 to 3m/sec and therefore fog appears rarely (less than 30 days/year) and winter temperatures are moderate. For an average of 80 days/year a northerly wind occurs.

With regards to precipitation occasional rain showers during the spring, summer and fall and snow showers in winter are typical for this area with rather little precipitation. In winter there is often not even sufficient precipitation to cover the ground with snow. The climatic averages from reading at the Ober-Zeiring weather station are as follows (from: CLIMATE REGIONS of STYRIA):

- Temperatures (average): January (-4.1°C), July (15.1°C), yearly average (5.9°C)
- Days with temperatures below freezing point: about 145 days/year
- Summer days about 25 days/year
- Precipitation: January (35mm), July (142mm), yearly average (1102mm).

Operating season on the property lasts year round. Parts of the exploration program such as ground geophysics and/or airborne geophysics can be conducted in winter. Geochemical survey/sampling, as well as diamond drilling can be comfortably conducted during late spring – early/middle fall. Structural Analysis of the Satellite images is independent of the seasonal conditions.

Item 6: History of Mining at Zeiring

The Zeiring Mining District, located in the Austrian province of Styria, dates back for over thousand years, possibly even to pre-Roman times. It produced mainly silver and lead but also has shown and produced gold, copper and zinc, iron sulfides (pyrite, marcasite) and iron carbonates (siderite, ankerite), and barite. Once a flourishing and very active and important production center for these metals/minerals the town had its own mining legislation and court, and the rare privilege to mint silver coins. A major disruption in the area's mining activities happened, when miners in the early 1360s accidentally hit water during their tunneling/stoping work and the main and major mining center – the Pier Mine - was flooded, drowning about 1400 miners working there at that moment. With this catastrophic event the very productive main deposits at Ober-Zeiring became inaccessible and lost until today. Pumping and draining the waters, technically, was not possible at the time. Later attempts usually were not carried through or inadequate and abandoned.

In every century thereafter futile trials, due to the lack of appropriate technology, to pump the water out of the mountain, were done in the hope to regain access to the deposits of silver. Emperor Maximilian I had built the Castle of Hahnfelden (Fig. 18), where he is said to have resided himself for three months around the year 1506, in order to supervise the reactivation of the silver-mine himself. Later the abbey of Admont, private entrepreneurs, and the state commission on mining under Empress Maria Theresa had tried reopening the mine , however without electricity and machines this could not be achieved.

Figure 18: The Castle of Hahnfelden built by Emperor Maximilian I.

Mining activities continued over centuries in the higher upper levels of the deposit(s) inside the four existing mining centers (“Abbau Felder”):

- The West Field,
- The Central or Middle Field,
- The NE Field and
- The South Field and

- The Katzling Zone.

Following the accident, mining activities were carried out usually by several mine owners and/or companies until the late 19th Century, when Siderite mining dominated the areas activities until 1885 (NEUPER's Iron Mining Comp.). In the 1950s the NE Field's mine was reactivated and produced barite over several years until 1965.

The Mining History of Zeiring is described and documented well and in great detail by HADITSCH (1967) in the FRIEDRICH Monography on Oberzeiring using mainly information derived from MILLER-HAUENFELS (1859), NEUBAUER (1952), OCHERBAUER (1957), ROLLE (1854), SCHMUT (1904), STEINER-WISCHENBART (1906), TREMEL (1953), TUNNER (1841) and many other published and unpublished records.

In his publication about local historical research on Silver Mining BRACHER (1970) reports that there is enough evidence that Silver Mining in the area began first to the South of Oberzeiring in the Zugtal (Zug Valley), on Haberer Berg, around Purgstallofen and Oberwinden, and further South, closer to the Mur Valley, at "In der Scheiben". Historical records show that the Zugthaler Mining District was already active before 1000, or over 100 years earlier than the start of mining from the Taubenkropf Mine North of Oberzeiring at around 1100.

An abbreviated form of Zeiring's History is given as follows:

- About 900: Settlement of Germans in the area of Pölstal (Pöls River Valley) with probable commencement of mining and/or continuation of earlier activities;
- 1200: Production from Taubenkropf Mine at 1000m ASL (NE Field) and Grazer and Wiener Grube (W Field);
- 1225: Beginning of Mining below the Pöls Valley floor at Pier Mine (Middle Field);
- 1284: Mining at Purgstallofen (southern Middle Field) documented;
- 1294: Purchase of a large part of the ownership of the seven active mines by the Admont Benedictine Monastery (after APFELBECK, 1920);
- 1336 – 1339: Implementation of Styrian Mining Code at Zeiring, later adopted by all European States;
- 1361 or 1365: Accidental flooding of Pier Mine (after APFELBECK, 1920: Flooding in 1272) with the "Karst"-type cavernous marbles as underground water source reduces the flourishing production especially of silver leadingto a closing down of the Oberzeiring mint – at the time of the flooding accident a total of seven mines and ten silver ore smelters along the Blabach Creek were active leaving behind huge dump piles of lead-slag reported by TUNNER in 1840 to amount to several hundred cubic meters. They were analyzed by the Mining Commission visiting the site in 1738: they found 60gram Silver per 100kg slag (APFELBECK, 1920).
- From 1395: Mining in the upper levels of the district. Repeated attempts over the next several centuries failed to drain the water and allow for a re-entry of the flooded lower mine portion;
- 1500 – 1507: Renewed and failed attempts of draining the flooded mine, initiated and supervised by Emperor Maximilian I himself;
- 1696: Begin of extraction of iron minerals (mainly siderite) left over after extraction of the Ag-Pb-Cu mineralized bodies;
- 1700 – 1868: Flourishing Iron (Siderite)-production;
- 1721: Documented mining activities at the Klinger Baue (mine) (NE Field);
- 1738 – 1770: Attempts to drain and to create access to the flooded lower portion of the mine through a base tunnel commencing at the topographically much lower Mur Valley to the East – first financed by the Emperor's Court and in the following by private mine owners were abandoned;
- 1783 – 1784: Second period of iron ore mining and construction of the Taubenkropf Base Tunnel (NE Field);

- 1810: Construction of the Franzisci Base Tunnel (West Field) and mining activities at the Purgstallofen area of Middle Field;
- 1828 – 1832: Renewed production of iron ores;
- 1839 – 1840: Discovery & production of Ag-bearing galena deposit at the Franzisci Mine (W Field);
- 1886: Termination of iron mining for economic reasons by NEUPER Family;
- 1910 - 1922: Intensive research and compilation of mining data by APFELBECK;
- 1922 – 1924: Attempt by a Mining Company newly established by H. SETZ to drain the flooded mine portion with modern pumps was abandoned due to lack of funding;
- 1953: Acquisition of exploration licenses covering the historical mining area of Zeiring by R. HIRN and reopening of the Johannes Base Tunnel, the Barbara Baue and the Taubenkropf Base Tunnel to map and study the old mine and its remaining Barite mineralization potential;
- 1959: Award of six Mining Concessions (“Grubenmaße”) to R. HIRN (the Schwerspatbergbau Oberzeiring GmbH, the predecessor of Silbermine Zeiring GmbH) by Austrian Mining Authority for the exploitation of mineral resources within the rehabilitated historical mine workings of Oberzeiring, followed by a short period of production of Barite (and Sphalerite with traces of Gallium) high grade mineralization (HIRN);
- Until 1965: Barite Production;
- Since 1990s: Exploration licenses are held by Silbermine Zeiring GmbH, successor of the Schwerspatbergbau Oberzeiring GmbH, an Austrian private company devoted to a well targeted exploration of the historical Mining District’s deposit(s) with the intent and goal to bring them back to an economically viable production.

Previous Exploration Work

Sampling and Geochemical Surveys

Samples of soils (soil surveys) and of rocks in outcrops, old mine dumps and underground have been analyzed usually for Silver, Gold and Base Metals over centuries. Numerous of these analytical results may be available in old recordings; however, exact sampling locations often are no longer available and/or accessible. Many samples taken from old mine dumps have been of interest by representing types, mineralogy and grades of mineralizationmined in the respective underground mines, but without access to the old stopes they only give indications for the local rock mineralogy. Most of the mines’ accesses still open in the 1950s-1970s and/or reopened during the 1950s are inaccessible again today.

Historical analytical results reported in various papers and documents dating back up to several centuries refer mostly to samples taken from inside the mines or from mine dumps:

One type of historical analytical reporting is about the Gold and Silver contents and varying ratios between the two PMs:

- Ratios vary between 1:10 to 1:200 Gold to Silver, which amounts to a Gold content in Silver between 0.5% and 9%. These numbers, however, do not exclude the fact that some mineralized bodies have not shown any Gold.

R. HIRN, owner of the Ober-Zeiring Barite Mine in the late 1950s to 1965, the predecessor company of Silberbergbau Zeiring GmbH received a sample taken from the NE Field. Analyzed, it showed:

• 114 g/t Au (or about 3.6 oz/t Au). Analysis of two other mineralized samples originating from the Klinger Stopes (NE Field) to the East of the country inn "Hoanzl" contained 80g/t and 60g/t Au. Anomalous Gold contents in Silver can be recognized by the Silver's yellowish tint under the ore microscope (APFELBECK, 1920).
KIRNBAUER (1968), Professor at the Leoben Montan-University, reports of an Ober-Zeiring rock sample:

- With a Silver content of 10% (or 100kg/t).

NEUBAUER (1952) reports a Silver content in Galena from the Franzisci Gallery of

- 1000g Ag/t. Older sources report a Silver content in galena from Zeiring of 4000g/t.

A spectral analysis by SCHROLL (1957) of a Galena sample from the Franzisci Gallery showed

- 1000g/t Ag, 3000g/t Sb, 5g/t Bi, and 10g/t Sn. Spectral analysis of a Sphalerite sample showed 3g/t Silver, 1000g/t Cadmium, 50g/t Germanium, 300g/t Gallium and 10g/t Indium.

HIRN (1959), owner of the Schwerspatbergbau Ober-Zeiring GmbH, renamed Schwerspat Veredelungs-GmbH of Ober-Zeiring and after its transfer to the late owner, Mr. A. Langer, Silber Mine Zeiring GmbH (SMZ), reports of several assays of samples of Lead and Zinc high grade mineralization from the NE Feld mines submitted to the "Bleiberger Bergwerks-Union" (BBU):

- Galena high grade mineralization: 63.60% Pb/t and Sphalerite: 50.50% Zn/t (1)
- Galena high grade mineralization: 835kg Pb/t and 780 (g) fine Silver/t - Sphalerite: 65.60% Zn/t (2)
- Analysis of Gallium content of Sphalerite mineralized sample: 300g/t Gallium (2).

Recent geochemical data acquired by SMZ will be discussed in the "Item 9: Exploration" for the different selected prospects and other areas of research and of samples collected during geophysical surveys. Many of the samples – soil, rock chip samples from outcrops and samples from old mine dumps - taken and analyzed were part of the 2004 and 2006 (OCZLON) and other geophysical surveys of old mine centers and/or prospective zones. Their goal was to investigate and test, by means of geochemistry geophysical anomalies. Results are shown in the respective chapters.

Applied Geophysical Methods

THE AREA OF OBER-ZEIRING - MÖDERBRUGG

The earliest geophysical survey over the polymetallic mineralized bodies of Ober-Zeiring was conducted with electromagnetic instrumentation in 1924 and its results are summarized and superimposed on a topographic map (Fig. 19).

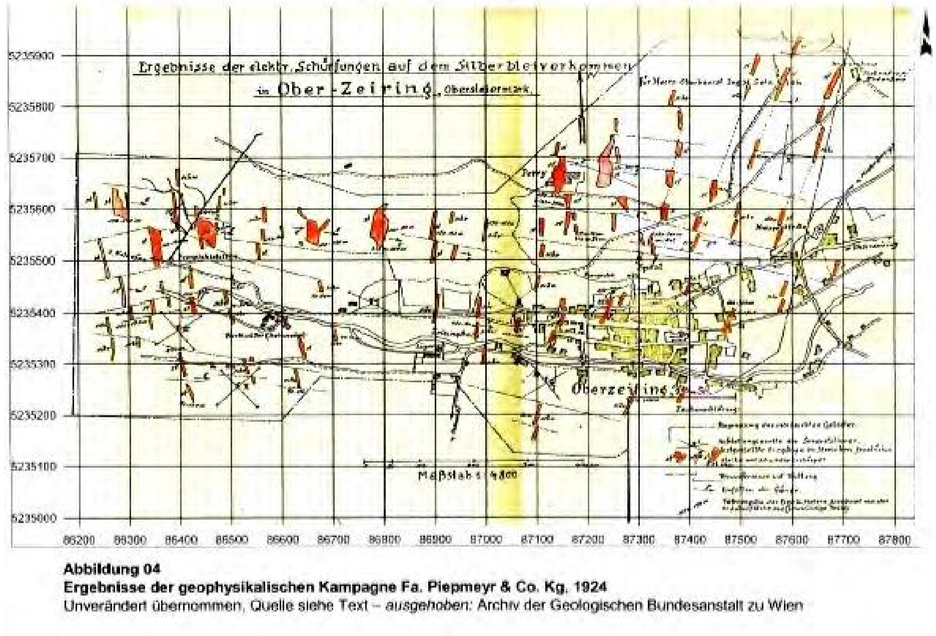

Figure 19: Results Geophysical Electro-magnetic Campaign of the PIEPMEYR & Co. KG. Company in 1924 in the area of the Polymetallic Ore Bodies of Ober-Zeiring showing identified anomalies (from ARNDT, 2006)

Projections of these recognized magneto-electric anomalies of 1924 onto the geological map of NEUBAUER (1952) (Fig. 20), onto the Ortho-photo of the area (Fig. 21) and the topographic map showing the four Ober-Zeiring Mining Centers (Fig. 22) was presented in ARNDT's report.

Figure 20: Projection of Electromagnetic Anomalies from 1924 Survey onto the Ober-Zeiring Mining Area's Geological Map (NEUBAUER, 1952), from ARNDT (2006)

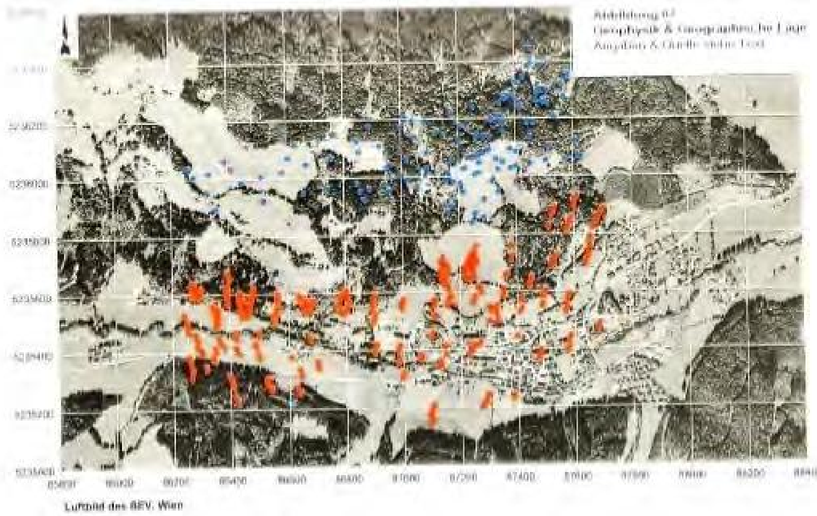

Figure 21: Projection of Electromagnetic Anomalies from 1924 Survey onto the Ober-Zeiring Mining Area’s Orthophoto, from ARNDT (2006)

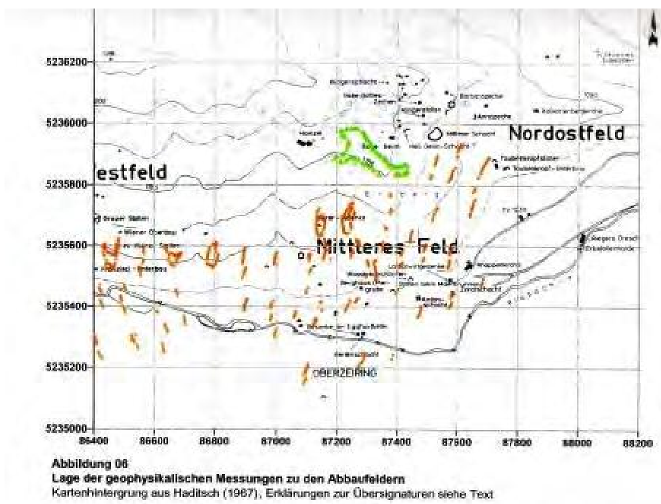

Figure 22: Projection of 1924 Electromagnetic Survey Anomalies onto Topographic Map of Ober-Zeiring Area’s Mining Centers presented by ARNDT (2006 – Fig. 06)

THE AREA OF SOUTH FIELD – “Katzling Zone”

The area spreads over a length of about 4 to 4.5 km along the NW – SE trending western ridge of the Pöls Valley down-river and to the SE of Ober-Zeiring. This area extends from the S end of the Oberzeiring South Field, the Matthias Baue, via Treffenthaler Gallery and historical mine centers “A” to “G” (Fig. 23). Despite its numerous historical mining sites in nine small Mining Centers the “Katzling Zone” has received little attention by active progressive exploration until SMZ acquired the concession covering the area. More recent research was done by NEUBAUER (1952) like Geological Mapping of Ober-Zeiring – Möderbrugg and the northern half of the Katzling Zone, and HADITSCH (1967). WALSER’s (1974) research work was concentrating on the “Katzling Zone”.

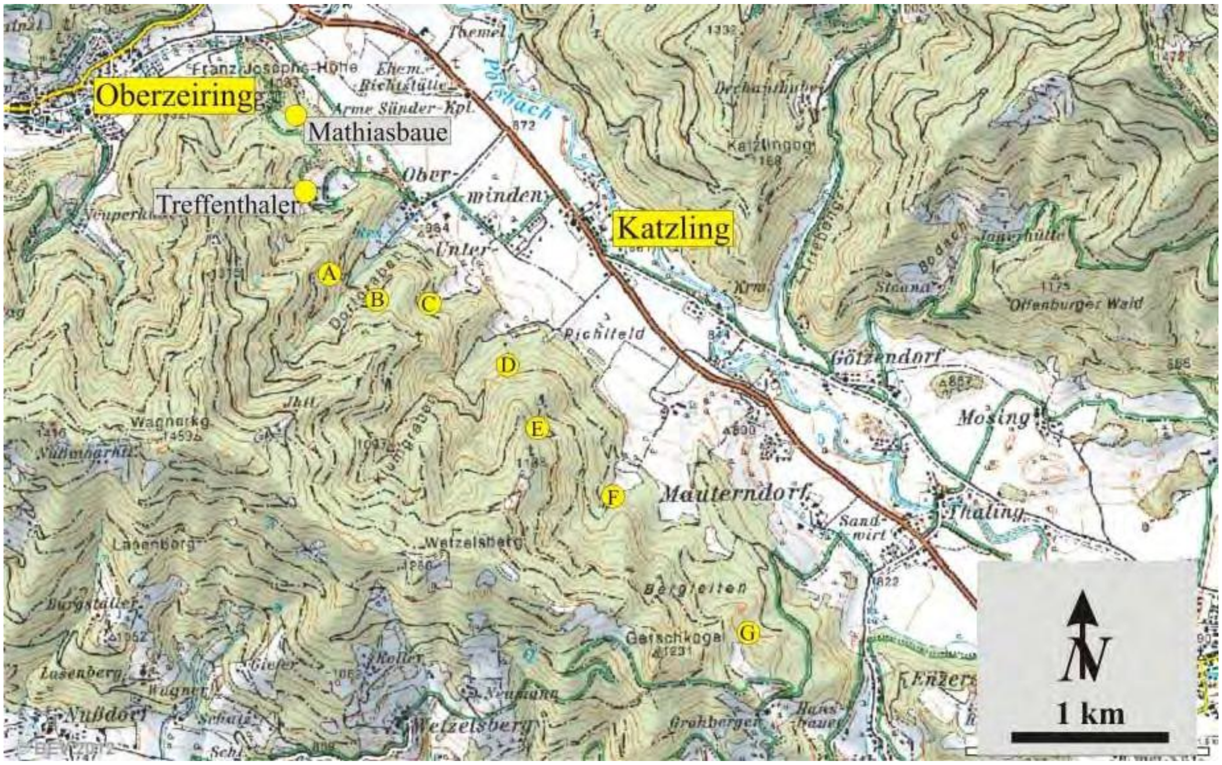

Figure 23: The Historical Mining Area between the Ober-Zeiring South Field and Mauterndorf-Pöls – The Katzling Zone –with Matthias Baue, Treffenthaler Gallery, and the Mining Centers A to G (from North to South) along the Western Mountain Ridge of the Pöls River Va

\Results from Core Drilling and Core Analysis

In a letter of January 15, 1924 to the Acetylene-Karbidverwertungs-GmbH, Vienna, SETZ (1924) reports about the Exploration and Mining activities at Ober-Zeiring during 1923. Next to pumping tests to examine ways to drain the mine the company had organized a Crealius core drill rig to explore for mineralized veins in the Bretstein marble below the water level at the Pier Mine. Following an invitation to Ober-Zeiring Prof. W. Petraschek of the Montan-University of Leoben advised the company on drilling locations. The one chosen for drilling the vertical hole from the surface was on a parcel behind the town's Hospital (Fig. 24) and about 25m E of "Water Point III" down in the mine, at 950m ASL.

PETRASCHEK had located the N-S striking vein with a dip of 45° E (SETZ, 1924) near the hospital, sheared into several blocks by a tectonic movement from the East, placing the mineralization-bearing block in the Pier Mine with the pump station (e.g. 1922-23 efforts were made to drain the water with a stationary pump, see Chapter 4.4.2.2 below) furthest of all to the East. The thrust fault blocks further to the West that were mined from the "Group of Shafts", from the "Pierer Winze" and the "Große Zeche" (Fig. 24) appear to be thrusted by about 25m each to the West.

Expectation was that the vein would maintain its 45° dip to the E till below the water level, so that it would be intercepted by the core hole at 90m drill depth (860m ASL). The final drill depth was at 124m (826m ASL) without intercepting the mineralized vein. Lower portions of the core, however showed thin bands of "Iron" and a lot of

Iron-oxide coloring indicating that the vein was in close vicinity of the drill hole. Signs of vertical shearing in the lower part of the core suggested a zone of thrusting there.

The lithological sequence of the core down-hole is described by SETZ (1924) as follows:

0 - 4m (950-946m ASL) Clayey Talus
4 - 20m (946-930m ASL) Mica schist
20 - 32m (930-918m ASL) Quartzitic schist intercalated with mica schist
32 - 40m (918-910m ASL) Mica schist
40 - 124m (910m - Bretstein Marble - 885m ASL, final depth of DH).

SETZ notes that during drilling below the water level there was a constant loss of the drilling water due to strong fracturing of the marble.

After completion of the surface DH the drill rig was transported into the Pier Mine between the pump chambers above the water level to drill an inclined core hole (Fig. 24) in the direction of the dip of the mineralized vein. By the time drilling of 15m core was completed the water level in the mine had risen by about one meter and had flooded the rig, which had to be taken out of the mine. It can be presumed that the 15m drill core was in marble, but no further information could be found in the archives except for a brief lithological core description (in the following).

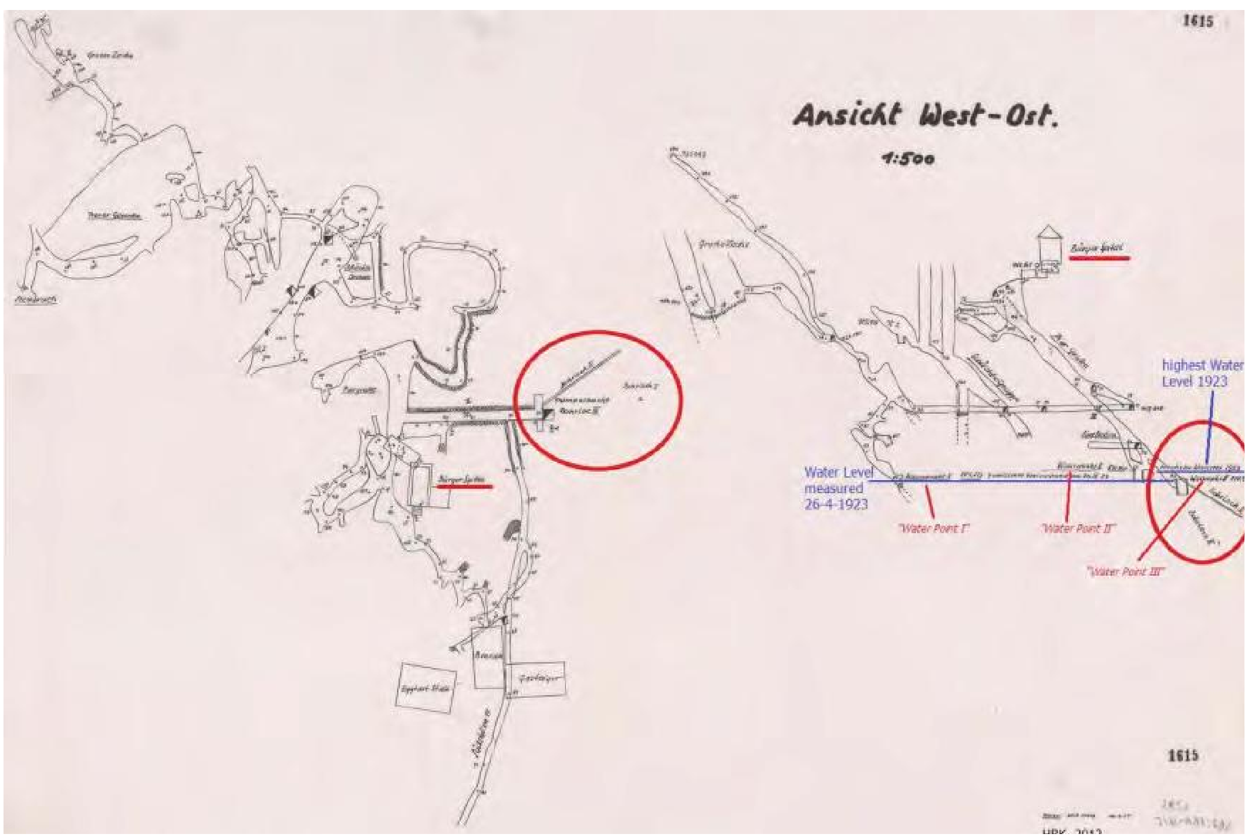

Figure 24: The Pier Mine in Map view and W-E Profile (from SETZ, 1924) with Mine Water Levels in 1923 & Drill Points, surface and underground

In a note regarding Ober-Zeiring attached to correspondence between the Exploration and Mining Ltd.

(“Schurf und Bergbau GmbH”) and the Austrian Geological Survey, dated 29th of March 1973, two core drill holes were reported drilled in the area of the Pier Mine in 1970, and two more in 1971 in the area of the Franzisci Mine (ARNDT, 2006).

The four core holes, planned for a drill depth of 200m each, were approved by the Austrian “Mining Authority” (Montanbehörde) during 1970. As core diameter “NQ” was chosen. The drill rig was an ATLAS COPCO 750.

Two core holes were positioned (Position I, Fig. 25 and Fig. 26) on the parcel Nr. 1116/1 in Ober-Zeiring to explore the Pier Grube (Middle Field):

- Drill hole I/1 was oriented 265° with an angle of 45° from the vertical. It reached a drill depth of 220m.
- Drill hole I/2 was inclined 75° (or 25° from the vertical), also oriented to 265°; it reached a drill depth of 199m.

The other twin core holes were positioned on parcel Nr. 1015, KG, Oberzeiring to explore the Franzisci Grube (West Field) (Position II, Fig. 27 and Fig. 28):

- Drill hole II/1a was oriented toward 77° E with an angle of 45° from the vertical. It only reached a drill depth of 27.80m, when the drilling equipment got stuck and had to be left behind.
- Drill hole II/1b, also directed 77° E but with an angle of 77° or 23° from the vertical reached a drill depth of 276m.

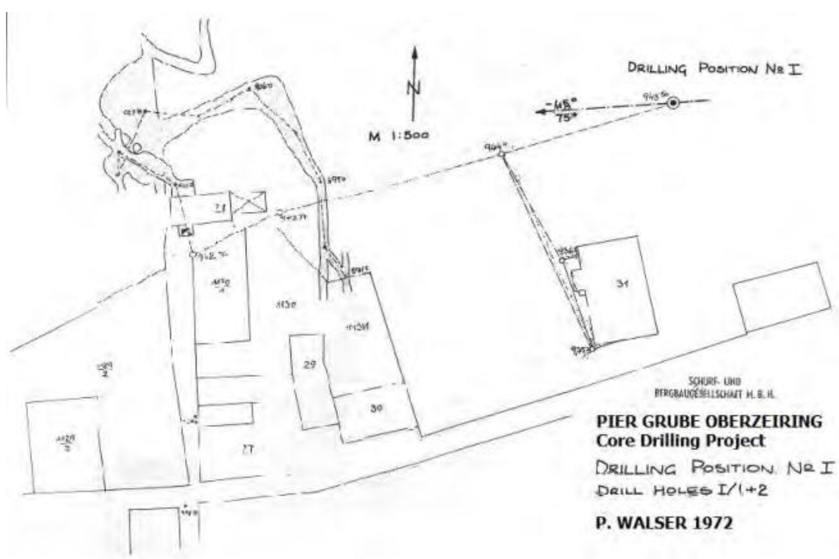

Figure 25: Position of directional Core Drill Holes A & B (I & II) to explore the Geology of the Pier Grube (Middle Field) in Ober-Zeiring (WALSER, 1972)

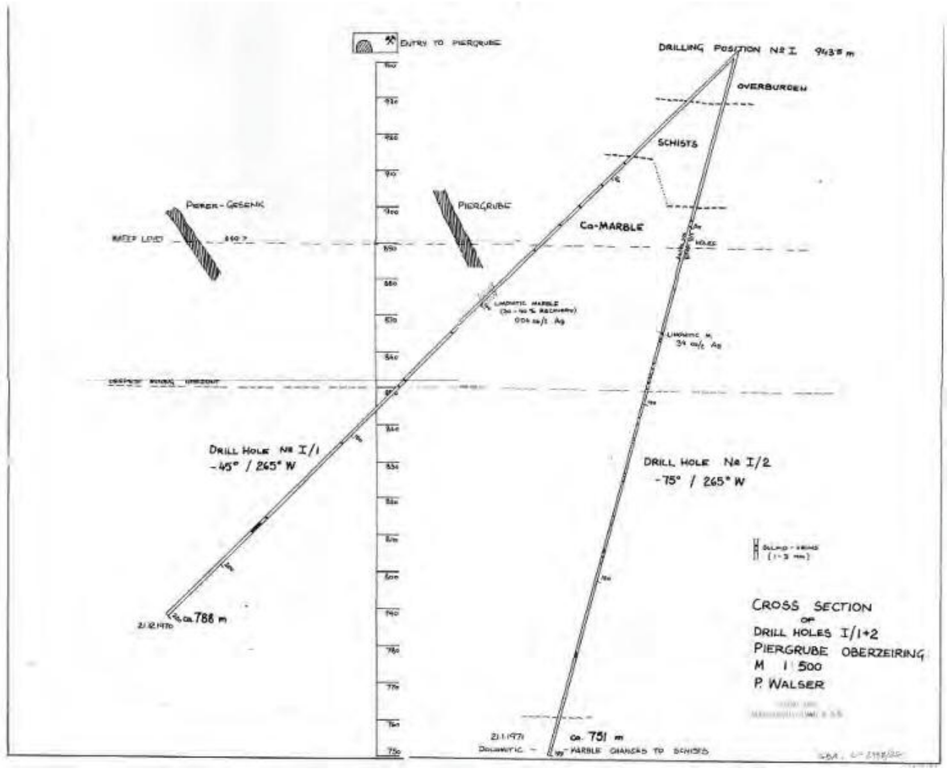

Figure 26: Core Drill Holes I/1 & I/2 Profiles – Position I, Pier Grube Location – (WALSER, 1972)

Drill Hole I/1 Profile: (Fig. 26) (Core depth in m): Overburden to about 20m – Schist to about 40m – 40m to 220m Marble - between 45m and 70m five intercepts of thin sulfide veins – about 95m – 103m brecciated limonitic Marble (30-40% core recovery): 0.04oz Ag (interpreted as correlating with Pier Mine Zone) – 115m one sulfide vein
– 125m 2 sulfide veins – 155m one sulfide vein – 170 to 180m group of closely spaced intercepted sulfide veins
– 220m drill depth or about 788m ASL end of DH.

Drill Hole I/2 Profile: (Fig. 26) Overburden to about 15m – Schist to about 40m – 40m to drill depth 199m Marble (the last about 20m transition from (dolomitic) Marble to Schist - 45 to 50m two thin sulfide veins – 52 to 65m several caverns intercepted – 70m one sulfide vein – 80 to 85 four sulfide veins: 3.4 oz/t Ag – 85 to 95m six sulfide veins – 105 to 145m 13 thin sulfide veins – at about 170m three sulfide veins closely spaced – 199m or about 751m ASL end of DH.

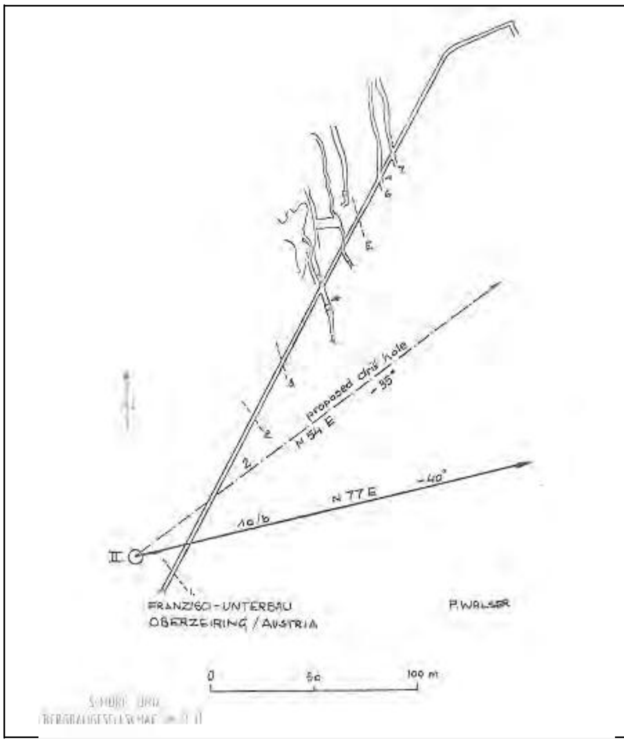

Figure 27: Position of two directional Core Drill Holes to osition II, explore the Geology of the Franzisci Grube, W Field

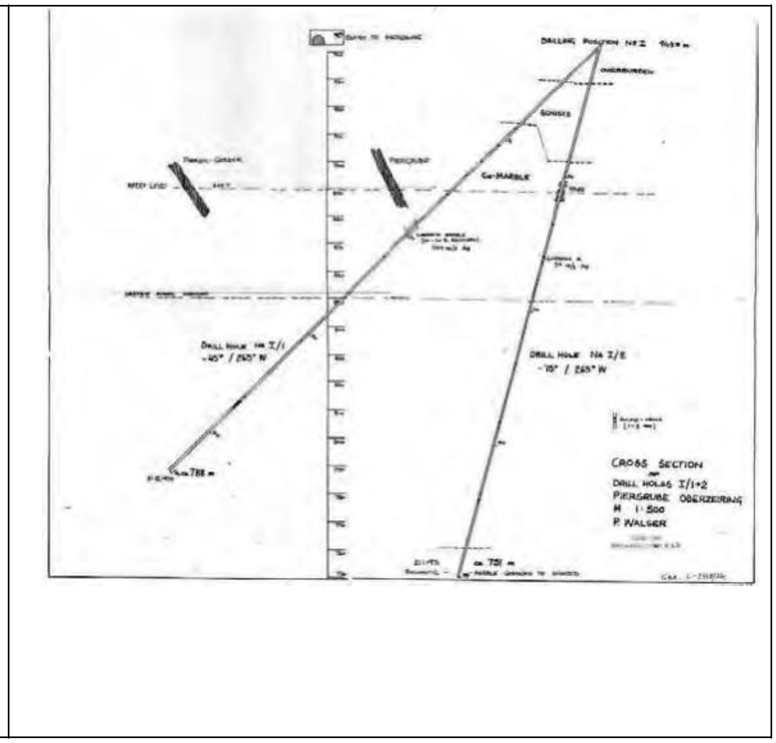

Figure 28: Core Drill Holes II/1a & II/1b Profile – Ober-Zeiring (WALSER, 1972)

Drill Hole II/1a: (Fig. 28) Between 5 to 10m Overburden – 10 to 27.80m (end depth of DH) Marble – about 15 to 18m limonitic marble – 20 to 25m Marble "dissociated" – at about 26m thin sulfide vein.

Drill Hole II/1b: (Fig. 28) To 10m depth Overburden – 10m to 276m (end depth of DH or 782m ASL) Marble – at 25m limonitized Marble – 25 – 28m Marble "dissociated" – about 27m thin sulfide vein – at about 103m several meters of brecciated Marble – followed to about 115m by 12 thin sulfide veins – at about 130m three thin sulfide veins – at about 175m zone of limonitized Marble – 215 to 130m intercept of five caverns – 275m one cavern – at 276m end of DH.

Since the four core drill holes had been financed by a private company, the data were kept confidential, and there were no other data available in the archives than the ones shown in Fig. 25 to Fig. 28.

Item 7_Geological Setting and Mineralization

Regional Geology

The Zeiring – Pusterwald Precious- and poly-metallic deposits geologically are a part of the zone of the "Austro-Alpine Crystalline Complex" (Fig. 29). It is a nappe originating from the Alpine orogenetic processes and it extends from West of Graz, Capital of Styria, westward over several hundred of kilometers.Its main lithologies are Ortho- and Para-gneiss, Micaschist and Amphibolite. The age of these rocks is spread over the time from Early to Late Paleozoic.

The map and the enlarged view window of Figure 29 show two main tectonic NNW to NE – SSE to SE striking fault deep- seated structures:

- The deep-seated Pölstal (Valley) Graben Fault and
- The Lavanttal Fault system, which has more or less the same strike direction as the Pölstal Fault and is located about 25 – 30km to the West.

The length of both fault systems along strike is between about 100 and over 150km. Deep seated as they both are they have been instrumental to the mineralization formation at Zeiring – Pusterwald (Pölstal Fault system) and at the Lavanttal (Lavanttal Fault system) by serving as prime conduits for the metasomatic to hydrothermal injections of metal-bearing solutions into the massive marble host rock of the Bretstein Series (Zeiring).

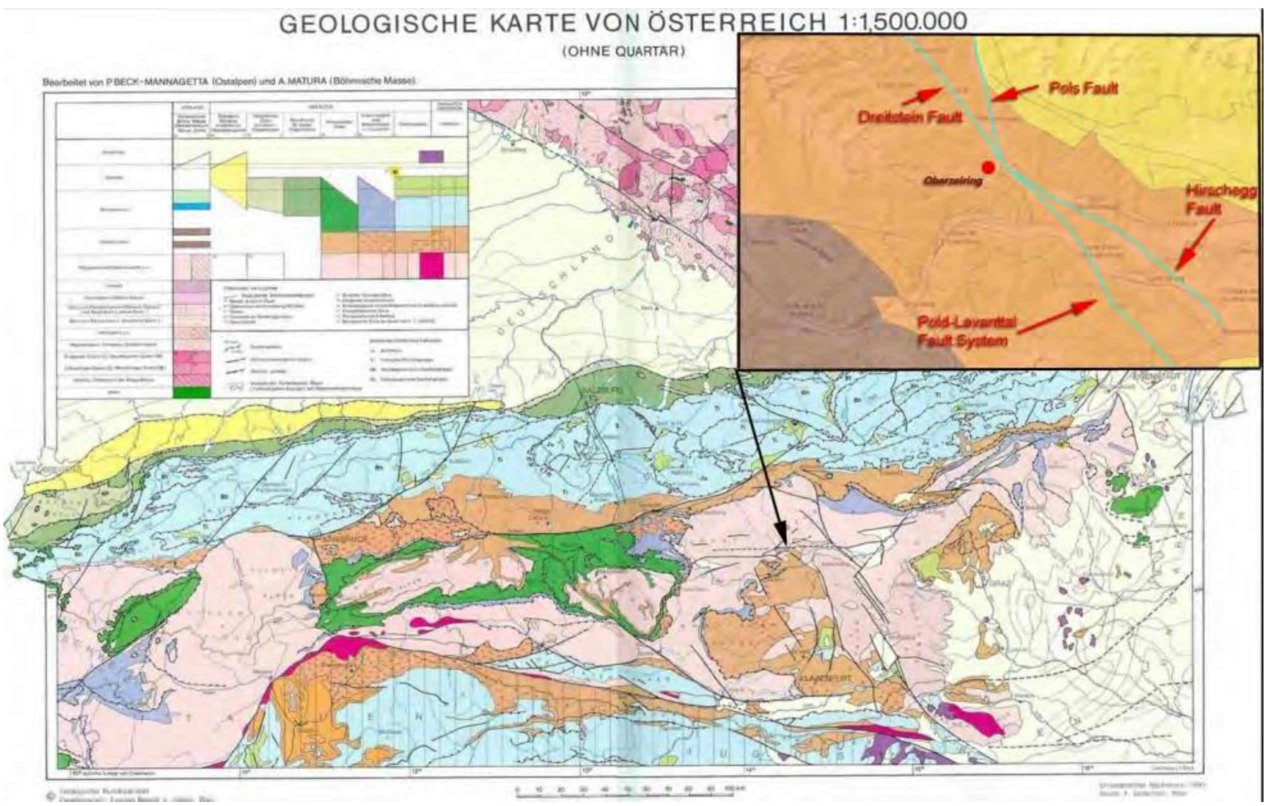

Figure 29: Geological and Structural Map of Austria (Geol. Survey of Austria, 1980) with a more detailed window for the Zeiring Study Area (https://geolba.maps.arcgis.com/...)

Geology of the Zeiring Polymetallic Deposits

A geology map covering the Zeiring target area and its wider surroundings from the Mur Valley at Judenburg – St. Georgen, to St. Johann in the North, to the N of Pusterwald (the second concession held by SMZ) shows in general terms the regional geology and the geological environment between the Zeiring deposit's geology and that of the historical mining district of Pusterwald to the N of Zeiring (Fig. 29).

The polymetallic deposits of Ober-Zeiring are embedded in the rock formation of the Bretstein Series – a unit of the Wölzer Micaschist Series - west of the Pöls River Valley, about 17 km NW of the town of Judenburg/Mur

Valley. Fig. 30, a historical geological map of the Ober-Zeiring Erzberg, shows well the geological structure of schists, calcareous schist and as the footwall the dominant marble formation (in blue), host to the Zeiring polymetallic (Au, Ag, Cu, Pb, Zn, Ba and Fe) mineralization. This map also shows the major fault lines like the Pöls Valley Fault, a Graben structure.

Figure 30: Historical Geological Map of the main Ober-Zeiring Mining District's Area (in dark blue the high grade mineralization-bearing marble formations) (Age and origin/author not known, but possibly by STUR, 1871 or VACEK & GEYER)

Another map of the whole area by an unknown author is shown in Fig. 31.

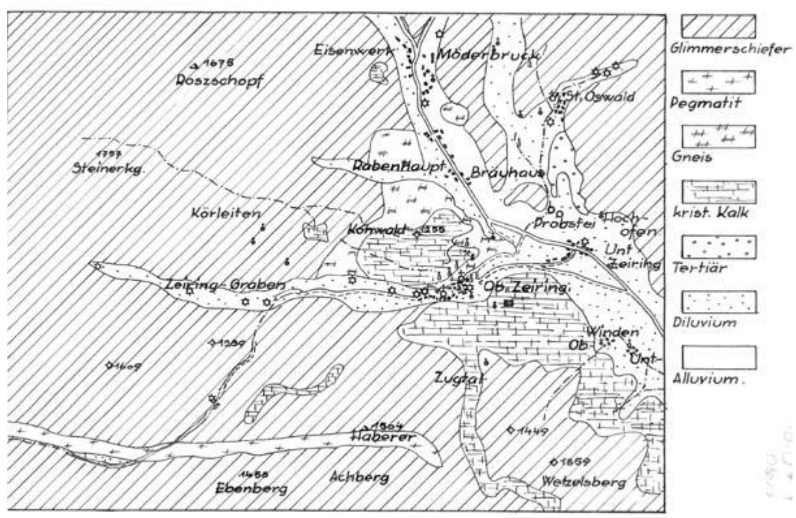

Figure 31: Geological Map of Ober-Zeiring – Möderbrugg – Unter-Zeiring – Winden – Katzling Zone (from: UNKNOWN, Friedrich Mine Archive, Geol.BA., Vienna)

A most recent map of the whole area by an unknown author is shown in Fig. 32. (https://gis.stmk.gv.at/atlas/...)

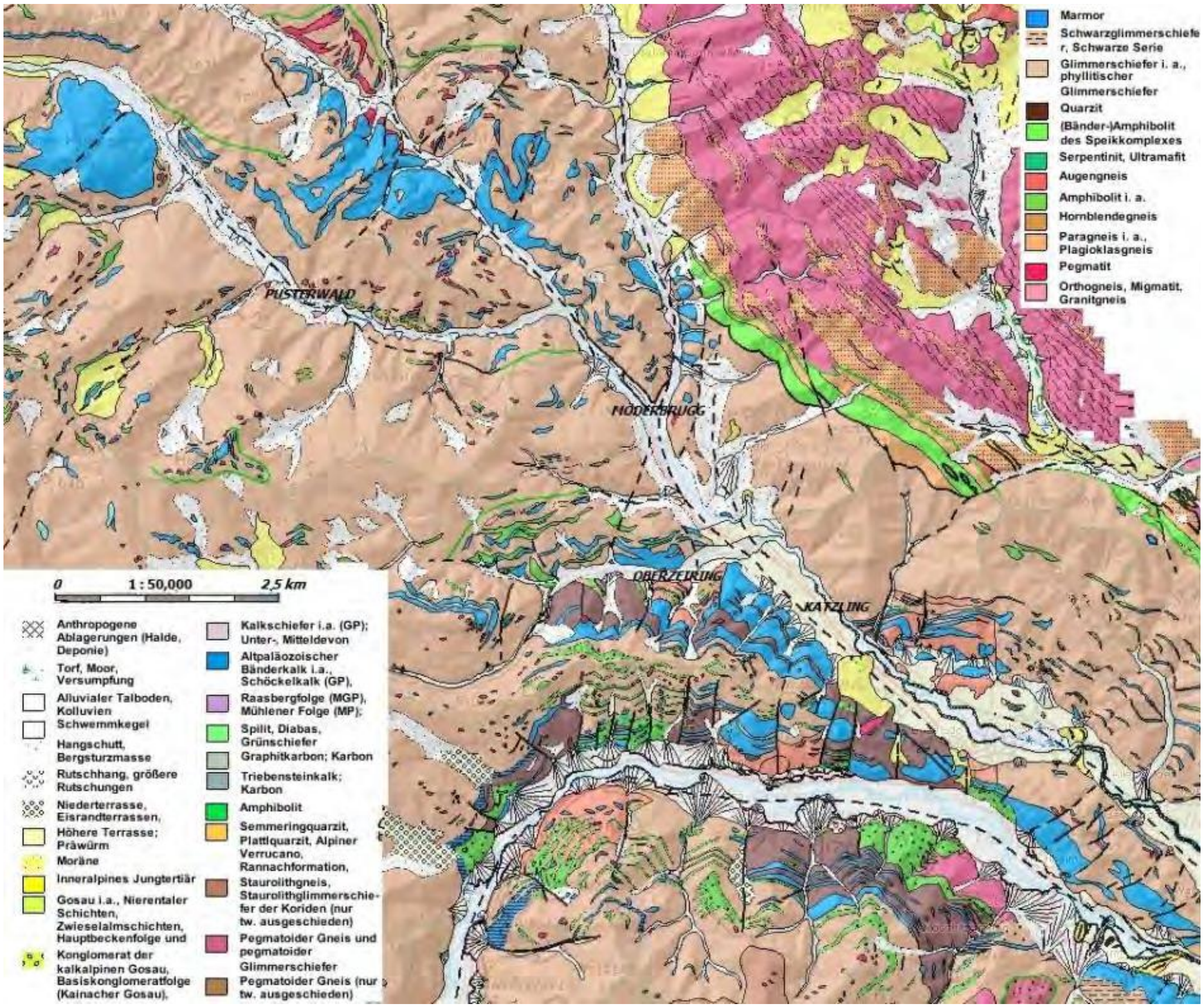

Figure 32: Geological Map Overview of the Area from Mur Valley at Judenburg – Pöls – Katzling – Zeiring –Möderbrugg – Pusterwald; Scale 1:150 000 (https://gis.stmk.gv.at/atlas/...)

One of the geological maps covering the whole area of the Oberzeiring Mining District and surrounding mining areas connected to it was created by NEUBAUER (1952) (Fig. 33).

After studying the area and its mineral deposit(s) in great detail he came to the conclusion that the only way to understand the geology underground was to know the surface geology. NEUBAUER reports that one of the first geological mapping efforts were made around 1871 by STUR followed by a hand-colored geology map of the Lower Tauern mountain range by VACEK & GEYER at the scale of 1:75,000 (Fig. 30). The first authentic report about the Lead – Zinc – Silver – (Gold) - Iron deposit of Zeiring was put together by TUNNER in 1841.

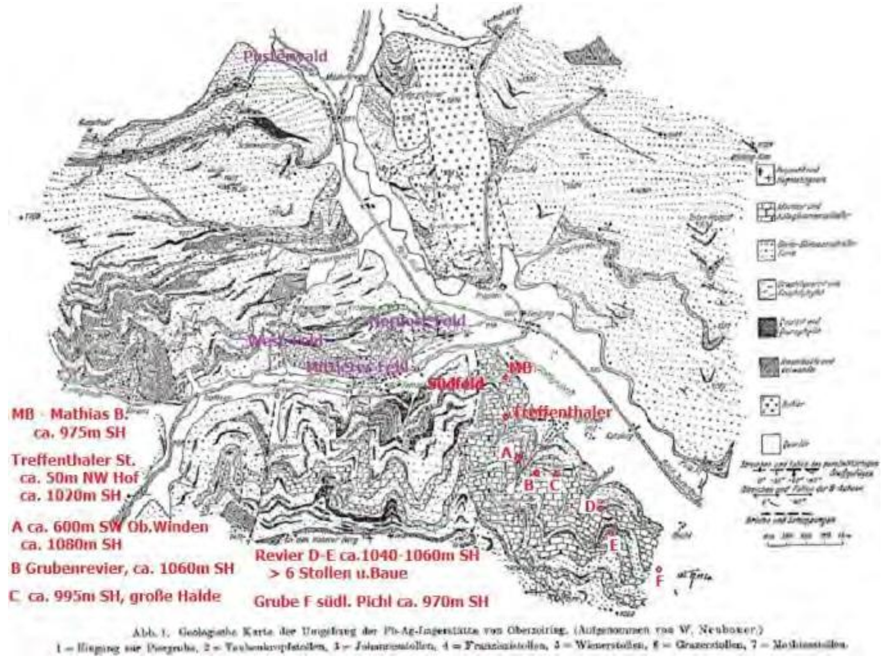

Figure 33: Geological Map of the larger Area of the Ober-Zeiring Pb-Ag Deposit with the Mining Centers West, Central, NE and South Feld and the southern extension of the "Katzling Zone" of mine centers "A" to "F" ("G") (after NEUBAUER, 1952)

Regional and local geology, lithology, and mineralogy of both rocks and mineralized bodies was described in detail and in combination with older literature by NEUBAUER (1952), HADITSCH (1967), WEISS (1967) and WALSER (1974). HADITSCH and NEUBAUER's research work and resulting publications concentrate on the historic Oberzeiring – Erzberg Mining district and its mining fields and underground mines. WEISS reports on his detailed research of the Ober-Zeiring NE Field's Klinger Baue, Taubenkropf Baue, Johannes gallery and the extensive system of interconnected mine workings. WALSER gives an overview of the small mining centers "A" to "G" located from the NW to the SE along the western ridge of the Pöls Valley between Winden – Katzling – Pichl and Mauterndorf (Pöls) – the Katzling Zone.

HADITSCH (1967) had access to the Mining Archive of FRIEDRICH and the University of Leoben. In his Monography about Zeiring he gives an overview and brief summary of the work of earlier researchers and their publications and reports about Zeiring and its mineral deposits.

KINDERMANN (1787) provides one of the oldest descriptions of Ober-Zeiring's Mines in his book about the History and Geography of the Duchy of Styria.

The Zeiring Rock Formation

The rock sequence present in the area of the Ober-Zeiring "Erzberg" (Ore Mountain) and the mineralised part are part of the Bretstein Formation, a member of the Wölz-Mica Schist rock series. This rock sequence begins with a mighty layer of banded metamorphic limestone (calc-marble) at its footwall. It is the main carrier of mineralized bodies. Mineral composition and internal texture vary strongly. Some layers can be rich in mica with transitions to calc-mica-schist.

It is overlain in part by phyllitic to quartz-rich granular muscovite- and muscovite-biotite schists, which show thin intercalations of marble. The schistose rocks of the series often show gradual transitions to gneiss of various compositions or to quartzites with varying content of Graphite. Green schists present in the larger area are completely missing in the area of the mined deposits. Green-rocks in form of flattened lenses-of amphibolite and greenschist are found only in higher elevations like along the ridge of the Oberzeiring "Erzberg" and further to the West, where they can show a larger extension and increasing thickness.

This schist-marble rock series has been penetrated by syn- and post-genetic concordant and discordant pegmatites. The discordant younger pegmatites are usually more strongly deformed than the concordant ones, which can show some thickening and thinning but still form continuous "layers" within marbles.

The best mineralizations occur in the thick marble formation (Bretstein-Marble) of the footwall and in the marble-schist intercalated layers directly on top of this marble unit. The only known exception is found in the Taubenkropf Mine (NE Field). The higher calcareous rock layers of the hanging wall – calcareous schists – show sporadic small pockets of Ankerite-Siderite. The Johannes Base Tunnel ("Erbstollen") has been driven through this series to reach the deposits in the footwall marble. Geological mapping of this gallery is shown in Fig. 34. A detailed geological, lithological and structural description of the tunnel profile is given by HADITSCH (1967).

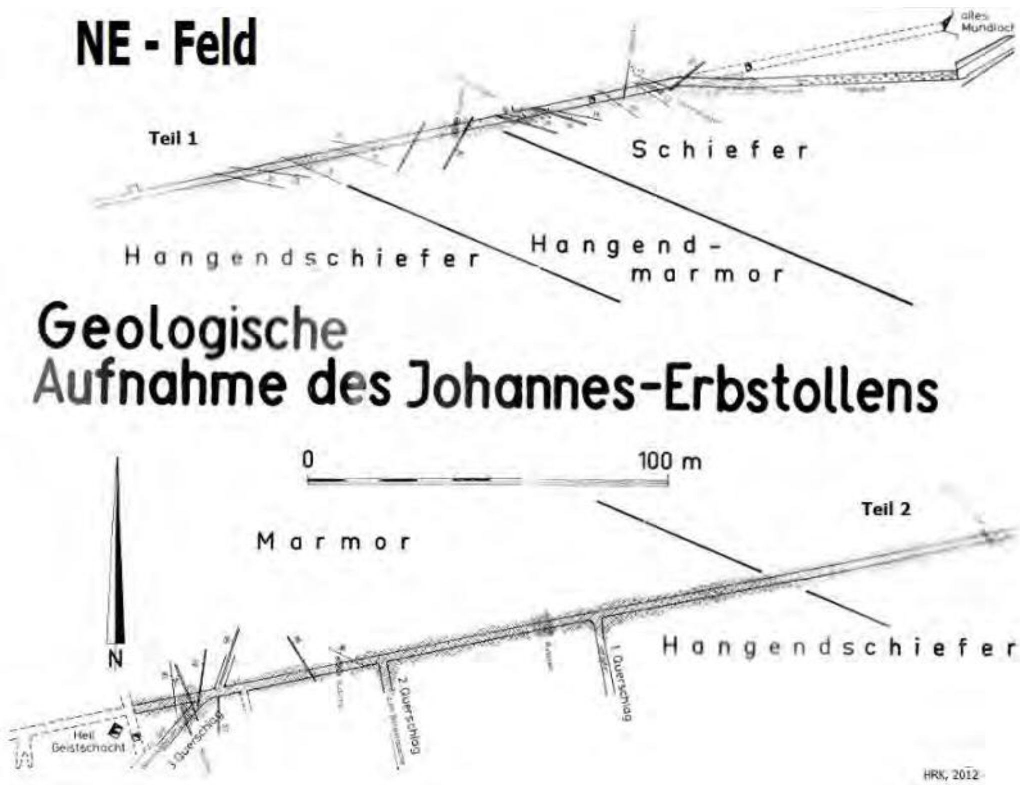

Figure 34: The Johannes Erbstollen (Base Tunnel) at the NE Field – Mapping of the Geology (from HADITSCH, 1967)

At 312m from the tunnel portal the mighty formation of the Bretstein Marble is exposed, the host for the main mineralized bodies of the Ober-Zeiring NE Field, after crossing a package of hanging wall schists intercalated with thin marble bands. The Bretstein Marble shows distinct Karst-type dissolution.

The Karst-type caves, often used by the old miners in their underground workings, were on one side of great advantage for the miners, by providing large open underground ways of access to the mineralized bodies and vast dumping grounds for what was considered to be waste at the time, including Iron ores and Barite. This way, large volumes of Siderite and Barite bearing material, useless at the time were dumped there. On the other hand the cave system may have turned into a disadvantage for the miners in the 14th Century, when they hit an underground "bubble" of water which flooded the old Pier Mine killing a reported 1400 miners.

The Karst-type formation of a vast cave system in the Bretstein Marble is typical for Alpine cave systems in calcareous rock units. Like the many other "Alpine" cave systems the caves at Zeiring are believed to have been formed during the last Ice Age(s), when the area was completely covered by a thick layer of ice with, locally, a glacier flowing down the Pöls River Valley. Then the supply of water in the underground was enormous and it aggressively leached its way along cracks and fissures in the marble. Today and without the ice cover most of the caves are "dry" and have become locations of calcareous deposition on the cave walls ("Sinter" and locally Stalactites and Stalagmites) – but also leaving behind cavities filled with water, which drowned the old mine by accident.

The Zeiring Tectonic Structure

Looking at the tectonic structure the Ober-Zeiring Marble-Micaschist series the formation is folded in the North of Ober-Zeiring into a large anticline (Fig. 35) between Nussdorf and Mödergraben, called the "Blabach-Anticline" (NEUBAUER, 1952).

The core of this generally ENE/WSW to E/W striking anticline is formed by the mineralization-bearing Bretstein Marbles along the Blabach (also known as "Zeiring Bach") valley at Ober-Zeiring (Fig. 35). Local massive increase of the marble's thickness is due to internal folding and accumulations by shearing as it has been observed in the Purgstallofen profiles.

The reason that the mineralization zone are almost uniquely contained in the footwall Bretstein marble are the schists in its hanging wall, impenetrable and serving as a "cap rock" (seal) for the mineralization forming solutions ascending into the marble along cracks, fractures, fissures and faults.

A series of NNE to NW trending faults cutting the Bretstein Marble into several tectonic blocks in the Zeiring area can be well followed underground. The North limb of the anticline is split into three main blocks with one block extending from West of the Franzisci Gallery (West Field) to directly West of the Pier Mine (Middle Field). The Block with a length of about 1100m and a width of almost 500m hosts the Wiener-, Grazer- and Franzisci Mine.

The next block to the East or second block has shown the richest mineralization, which also is indicated by the great number of adits and shafts. The block extends eastward from West of Pier Mine right across Ober-Zeiring to the Taubenkropf base tunnel; that is the Pier Mine in the Middle Field.

The Pier Mine, once very active with mine portals and shafts spread all over the town of Ober-Zeiring is characterized today by an almost complete lack of any visible signs of mining activities. Marbles exposed in this area form thin layers and belong to the hanging wall calc-schists. The mineralized footwall marble is to a large extent below the water mark of the flooding. Since no maps exist of the mine building prior to the flooding accident, it cannot be known how deep historical mining activities had penetrated into these zones. The potential for a continuation of the mineralized bodies down-dip to the East makes drainage of the water for a re-entrance into the now still flooded mine building even more important.

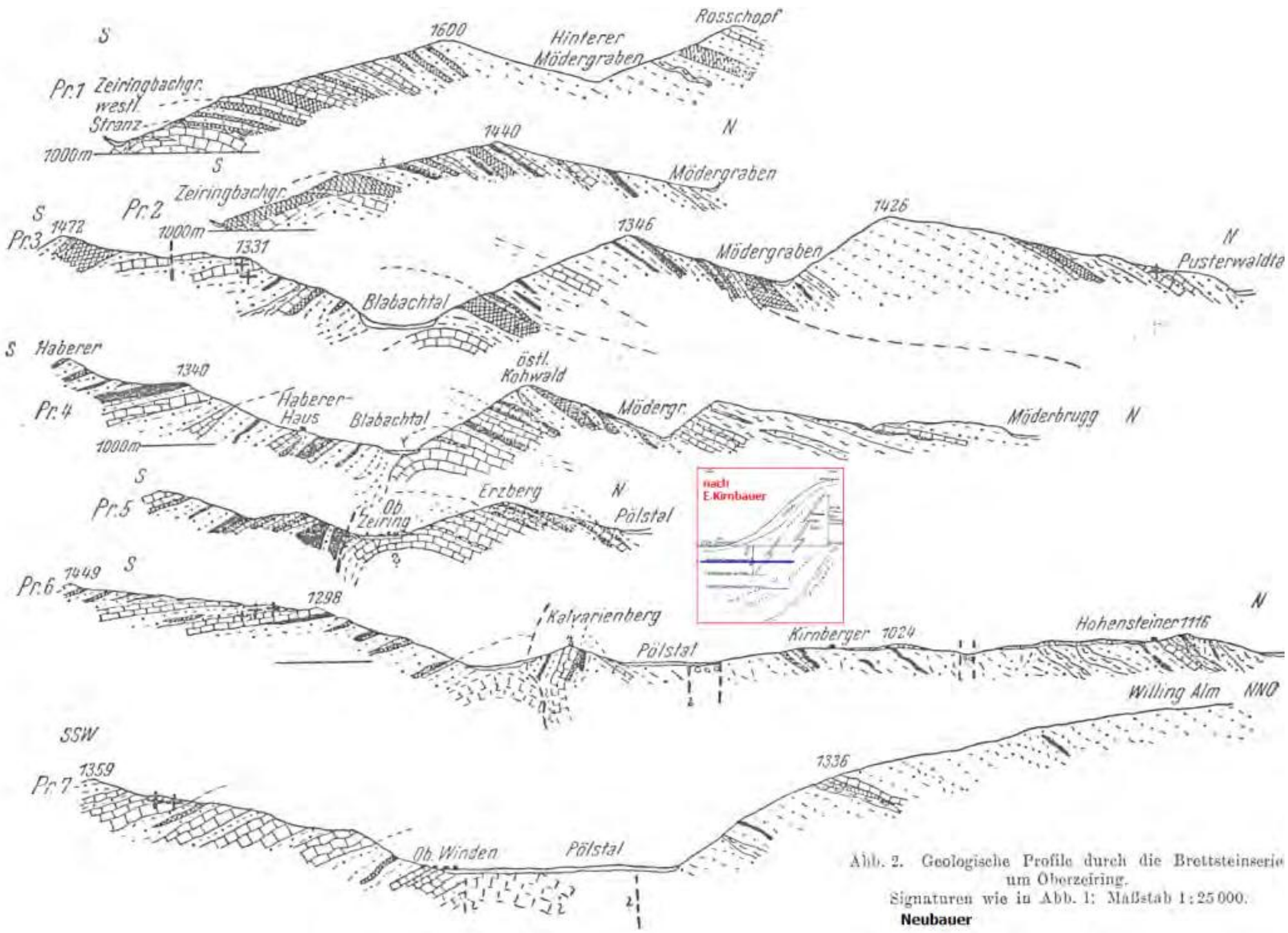

Figure 35: Series of Geological Profiles of the Bretstein Formation at Zeiring (after NEUBAUER, 1952, and KIRNBAUER, 1968)

The eastern block (NE Field) of the three extends between the Johannes and the Taubenkropf base tunnel ("Erbstollen"). Marbles exposed here at the surface are of a small thickness and small in number. HADITSCH (1967) expects the main footwall marble here below the groundwater level. It shows no signs of mining activities, or, they haven't been discovered yet.

The South limb of the anticline shows similar faults. The eastern-most block (at Purgstallofen) appears as a high wall of marble towards the Pöls valley. It hosts the Matthias-Baue (South Field) and the ancient mining area of the Zug Valley ("Zugtal"), S of Ober-Zeiring, where mining exploited small mineralized bodies in smaller calcareous schists and marble layers above the thick footwall Bretstein Marble. The Zugthal - Habererberg – Matthias Baue area in accordance to the research of some historians (BRACHER, 1970) is one of the oldest, if not the oldest parts of Silver mining at the Zeiring District, active already centuries before mining at Ober- Zeiring itself commenced.

Lithology

NEUBAUER (1952) and THURNER (1938) have given a detailed list and description of the rock types present in the Bretstein Sequence or Formation, in the order by rock types and not their stratigraphic sequence:

- Pegmatites and Pegmatite Gneiss
- Pegmatites, layers or vein type, are very common lithologies in the Bretstein Series. They locally can reach up to 80m thickness. Under the microscope they show graphic granite, Muscovite, Zoisite and Clino-Zoisite, occasionally small blue Tourmaline and Garnet appear as a minor component.
- Gneiss – Micaschist Series
- Muscovite Schists: mostly coarse-grained massive mica-rich schists with aplitic-quartzitic inclusions. Outcrops of this rock type North of Ober-Zeiring, West of P. 1120.
- Muscovite schists gradually convert into more quartzitic fine granular two-mica schists with biotite getting dominant. They can contain often chloritized Garnet and/or Biotite. Garnet can become major component in true garnet-mica schists. Mica schists and gneisses appear in all possible mineral compositions, grain sizes and textures.
- Biotite Gneiss, fine grained
- Amphibolites and other related rock types

The gneiss-mica-schist zone is rich in intercalations of green amphibolites and other Hornblende containing rocks (e.g. amphibolites with Garnet, rich in Plagioclase and with Biotite, hornblende schist); mylonitic amphibolite. Intercalations of them in marble are often rich in Clino-zoisite.

- Amphibolites rich in Biotite are more frequent than garnet amphibolite. With Zoisite increasing they gradually become epidote – amphibolites and quartzitic amphibolite
- <u>Graphite-quartzite, graphite schists</u> are intercalated in graphitic mica schist
- Phyllonitic, garnet-bearing graphite-sericite phyllites to graphite schists
- <u>Quartzites</u> are of little importance within the mining area of Ober-Zeiring
- <u>Marbles and calc-mica schist</u> of the lowest part of the schists are the mineralization-bearing formations.

Phyllitic mica schists are dominant in the whole area. The complex contains intercalations of marble, amphibolites, pegmatites and various types of quartzitic rocks. The footwall of this series is the Bretstein Marble, bearer of the mineralized bodies of Zeiring.

Mineralization

Mineralogy, Depositional Conditions and Sequences

Several mineralization types with different typical mineral paragenesis have been recognized and mined in the past. They are mostly vein-type, more rarely metasomatic replacements of irregular shape. They can be subdivided by their dominant Mineral content:

- Galena, with anomalous Silver
- Bournonite – Fahlerz (some also anomalous in Silver)
- Coarse grained Sphalerite
- Chalcopyrite and other Cu-sulfides

- Iron-carbonates, rich in Manganese
- Barite + Marcasite
- Marcasite.

Each of these mineralization types represents their own part in the sequence of the mineral enrichment typical for the Zeiring deposit(s). Details of these sequences, the types of mineralization and their typical mineral parageneses are represented in the following (Tab. 2, Tab. 3 and Tab. 4) (HADITSCH, 1967).

Typical for the sequence of mineralization is that cataclastic events separate each of the early phases from the other and the main phase of mineralization from the early phases. Late phases of mineralization show signs of cataclasis separating each from the other as well. After HADITSCH the most important cataclases took place before the Siderite metasomatosis and between the early Siderite I and Galena I phases.

HADITSCH describes four primary events:

- Iron Carbonate Metasomatosis (Siderite, Ankerite)
- Deposition of Pb – Zn – Ag (Au) – Cu – Sb – Ba minerals
- A second injection of low temperature Iron Carbonate solutions
- A second hot recurrence with Sphalerite, Pyrrhotite and Galena is followed by Marcasite and a second phase of Barite.

In comparison, NEUBAUER (1952) saw only three main phases:

- Arsenopyrite – Gudmundite – Pyrrhotite – Chalcopyrite – Pyrite + Carbonates
- Galena – Sphalerite – Chalcopyrite – Bornite – Fahlerz – Bournonite
- Antimonite (Boulangerite) – Pyrargyrite – native Silver – Chalcostibnite – Jamesonite – Ankerite – Quartz.

Data Confidence		Sequence of Mineralization: Certain Sequence				Uncertain Sequence	
Paleosome		Quartz +	Calcite +	Mica +	Graphite		
Paleosome		Pyrite I				Pyrrhotite I +	Sphene
Primary Minerakization	Main Phases of Mineralization	Ankerite I					
		Siderite I				Anatase	
		- - -	- - -	- - -	- - -	- - -	- - -
		Galena I (+Silver) +	Bornite I +	Calcite +	Galena II	Gudmundite	
		- - -	- - -	- - -	- - -	- - -	- - -
		Galena II +	Quartz			Sphalerite I	
		Chalcopyrite I +	Bournonite I +	Galena II		Sphalerite II +	(Rutile)
						Sphalerite III (in part) + Rutile	
		Fahlore				Boulangerite	
		Barite I					
		Fahlore +	Barite I +	Bournonite II +	Galena III +	Boulangerite	
		Chalcopyrite II +	Bornite II +	Pyrite II +	Jamesonite +		
		Sphalerite III (in part) +	Silver I +	Calcite +	Quartz +		
		Ankerite II +	Siderite II				
		Barite I				Rutile	
		Fahlore +	Chalcopyrite III				
		- - -	- - -	- - -	- - -	- - -	- - -
	Late/Final Phases of Mineralization	Fahlore +	Pyrrhotite II +	Quartz			
		- - -	- - -	- - -	- - -	- - -	- - -
						Pyrargyrite	
		Pyrite III +	Quartz				
		Marcasite I +	Ankerite III +	Calcite +	Quartz		
		Marcasite I +	Sphalerite IV +	Calcite +	Quartz		
		Marcasite I +	Quartz				
		Pyrite IV +	Calcite +	Quartz			
		Marcasite II					
		- - -	- - -	- - -	- - -	- - -	- - -
		Barite II				Dolomite	
		- - -	- - -	- - -	- - -	- - -	- - -
		Sphalerite V +	Pyrrhotite III				
		Pyrrhotite III					
						Galena IV +	Quartz +
						Calcite	
Secondary Mineralizatio n		Chalcopyrite IV +	Neodigenite				
		Neodigenite +	Covellite +	Silver II			
		Galena V +	Silver II +	Py<rite V +	Neodigenite +	Chalcocite +	Cuprite
		Anglesite +	Cerussite +	Quartz			
				Pyrite V +	Calcite		

- - - Dashed Lines indicate tectonic events

Tab. 2: Genetic Sequence of Mineralizations and their Paragenesis at Ober-Zeiring (HADITSCH, 1967)

Phases of Mineralization and their Ore Minerals for Oberzeiring Polymetallic Deposits/Mines

		Veins with about N - S Strike					Veins E - W		Vein NW -SE	Vein NE - SW	
		Franzisci Mine	Gamsgebirge Workings	Gabe-Gottes Workings	Veronica Mine	Weite Zeche Workings	Klinger Mine Workings	Matthias Mine	Golser Mine Workings	Middle Drift Workings	Commentaries
Pre-phases	Ankerite I	+	+	+	+	+	+	+			Iron-Carbonate Metasomatose
	Siderite I	+	+	+	+	+	+				
	Galena I (+ Ag)	+		+	+		+	+		+	
	Bornite I	+									
	Gutmundite	+					+				
Main Phases	Galena II	+	+					+		+	
	Sphalerite I	+	+								
	Chalcopyrite I	+	+				+			+	
	Bournonite I	+	+		+					+	
	Sphalerite II	+	+			+				+	
	Sphalerite III	+	+			+	+				
	Fahlore	+	+	+			+	+	+	+	
	Boulangerite	+		+			+			+	
	Barite I		+	+	+	+	+	+		+	
	Bournonite II	+	+	+	+		+	+	+	+	
	Galena III	+	+	+			+	+		+	
	Chalcopyrite II	+	+	+					+	+	
	Bornite II	+	+	+					+	+	
	Pyrite II				+			+		+	
	Jamesonite			+	+	+		+			
	Silver I	+	+		+		+		+	+	
	Ankerite II		+								
	Siderite II	+	+	+							
	Chalcopyrite III	+	+								
Late & End Phases	Pyrrhotite II	+		+					+	+	
	Pyrargyrite	+							+	+	
	Pyrite III	+	+	+	+		+	+	+	+	
	Marcasite I	+	+	+		+	+		+	+	
	Ankerite III	+		+							
	Sphalerite IV	+									
	Pyrite IV	+	+	+		+	+		+		
	Marcasite II								+		
	Barite II			+			+				
	Pyrrhotite III							+			Recurrance of Hot Fluids
	Galena IV		+				+				

Tab. 3: Polymetallic Deposits/Mines – Phases of Mineralization and their Minerals (HADITSCH, 1967)

Orientation of Vein-Type and Metasomatic Replacement Mineralized Bodies - Relationship between Tectonics and Mineral Sequences

The Zeiring deposit shows great complexity. Mineralized bodies created by metasomatic replacement interfere with true vein-type hydrothermal shoots. Both types seem to represent a sequential emplacement with what appears to be repeated cycles and some kind of zoning with metasomatic Siderite bodies often located in higher elevated parts of the deposit. The mineral composition of the veins not only varies from location to location but also along the strike directions of the veins.

Detailed information about observed orientations typical for the different individual mineralization phases can be seen in Table 4. In general it is clear from the geological observations that different orientations represent different types and generations of mineral deposition (HADITSCH, 1967). What all mineralized bodies have in common is their steep to sub-vertical dip.

Regarding the orientation of the different mineralization processes the first phase of the Iron Carbonate Metasomatosis follows a N-S direction, with the exception of “Klinger Lager” and the Matthias Baue. At the Klinger Bau the ascending low temperature metasomatic Iron-carbonate solutions were retained by an impenetrable s-parallel pegmatite, a process which converted an otherwise N-S oriented vein into an s-parallel layer (WEISS, 1963).

The Purgstallofen Siderite veins have an E-W orientation. They are of a different age compared to the NE Field veins (e.g. Barbara Zeche) and their E-W strike is influenced by the Blabach Anticline structure. E-W veins of Barite in the Barbara Zeche are of younger age. The E-W structure of Klinger Baue represents a reactivation of an older tectonic design, which was active during the Barite vein emplacement. The older Klinger Baue Iron Carbonate Metasomatosis followed a N-S direction, also typical for the Gamsgebirgszeche.

Other prominent orientations are NE-SW to NNE-SSW, which were activated in the eastern part of the deposits by three different phases of mineralization:

- One older than the Pb-Zn-Cu-Ag-poly-metallic Mineralization
- Another one before, and
- the third after the Barite emplacement.

Apart from the different directions of the orientation of sequentialmineralization emplacements there also is a difference in the timing - the beginning and the end - of different phases taking place in the western and/or the eastern part of the Ober-Zeiring deposits. Emplacement for example of Barite lasted until a weak Sulfide Phase took place in the West, but ended sooner in the East. Important NW-striking echelon (block) faulting in the West also influenced mineral emplacement in the East (e.g. SE of “Neue Zeche” or between Franzenszechen II and III – NE Field), where deposition of Barite continued, while emplacement of Marcasite-Pyrite veins already took place at the Gamsgebirgszeche and the Goisernbau.

Correlation Diagram for Tectonic Structures In the Oberzeiring West Field, Middle Field and NE Field Mining Centers								
West Field	Middle Field	North-East Field						
Franzisci-, Wiener-, Grazer Baue	Pier Mine	Gamsgebirgs-zechen	Gabe Gottes, Veronika Baue	Barbara, Johannes Baue	Neue Zeche	Barbara until Barbara Shaft	Base Tunnel	Structural Explications
NNW	NW & N	NNW to N	NNW-NNE	NNW	N	NNE	NNE	Formation of B-2 at Purgstallofen in addition to B-1 Blabach Anticline
	Iron-Metasomatosis shows increase towards E							
Main Ore Forming Phase with Polymetallic Mieralization								
	ENE to NE	E to ESE	E to ESE	E to SE NE	ESE NE	E NE	NE	Deformation of Anticline – B-3
NE	NW	Barite I NW Marcasite I ↓ Marcasite II NE Sulfides		Barite I with Ag-minerals (Bournonite) ↓ Barite II	↓	↓	↓	
NNW NNE	N to NNW	NW N	NW NNW to NNE ENE	N to NNE ENE	N to NNE	NNW to NNE	NNW to NNE ENE to ESE NNW to WNW NE	Postgenetic fractioning, shearing and re-activation of old structures with Intensity increasing from West to East

Tab. 4: Ober-Zeiring – Tectonic and Mineralization Sequences (HADITSCH, 1967)

Minerals of the Zeiring Deposits

Ore minerals found and identified over time at Zeiring have been reported by TUNNER (1841) ROLLE (1854), MILLER-HAUENFELS (1859), HATLE (1885), FREYN (1901-1905), APFELBECK (1919), HLAWATSCH (1925) SIGMUND (1926), TORNQUIST (1930), REDLICH (1931), FRIEDRICH (var.), NEUBAUER (1952), MEIXNER (1963), and WEISS (1963) to name the most important researchers in this field. The following list (from HADITSCH, 1967) presents both main ore minerals (e.g. Galena, Sphalerite, Barite, a.o.) as well as accessory minerals only detected under the microscope (e.g. Jamesonite):

- *Silver (native) and Gold-bearing Silver* – inclusions in Galena, Bournonite, & secondary Cu-minerals
- *Graphite (C)* – layers and pigmentation of Brettstein marble and phyllites, often together with pyrite
- *Sulfur (S)* – alteration product of sulfide mineralss (e.g. Marcasite in Klinger Baue)
- Chalcosite (Cu_2S) – rare accessory
- *Bornite (Cu_5FeS_4)* – often together with Chalcopyrite and Bournonite
- *Argentite (Ag_2S)* – of primary and secondary formation (e.g. in Marcasite vein of Gamsgebirgszeche)
- *Sphalerite (ZnS)* – several generations: (I) round corroded inclusions in Bournonite, (II) Light colored with Rutile inclusions, III: dark colored, in part with Rutile inclusions, IV: light colored variety, together with Marcasite but younger, often together with idiomorphic Quartz, V: youngest generation, dark colored with inclusions of Pyrrhotite
- *Chalcopyrite ($CuFeS_2$)* – four generations: I: older than Galena, II: together with Galena III, Bournonite II, with Fahlerz inclusions (segregation), III: filling cracks , younger than Galena, Bournonite, Fahlerz, dark colored inclusion-free Sphalerite, etc., IV: younger than Pyrite and Marcasite, possibly secondary alteration
- *Fahlerze – Tetraedrite (Cu_3SbS_{3-4}) & Tennantite (Cu_3AsS_{3-4})* - only known from one phase, SCHROLL (1958) Hg =1.6%; frequent accessory
- *Pyrrhotite (FeS)* – three generations: I: component of original un-metamorphosed rocks, II: ultra-fine grains

dispersed, III: formed together with dark Sphalerite during hot hydrothermal recurrence

- *Galena (PbS)* – one of the main carriers of Silver, five generations, I: idiomorphic zoned Galena, when altered with Silver"dust", Cerussite, Covellite and Digenite, (Veronika Zeche, Gabe Gottes Zeche, Matthias Baue), II: Round grains in younger Galena, III: youngest, resistant to alteration, same age to younger than Barite I, filling cracks, IV: xenomorphic, replacing Pyrite, Marcasite and Quartz, V: microscopic idiomorphic grains as product of alteration together with Cerussite, Anglesite, and Digenite, older than the youngest Pyrite
- *Covellite (CuS)* – found in cementation as well as in oxydation zone of Oberzeiring
- *Stibnite (Sb2S3)* – misinterpretation of Bournonite
- *Pyrite (FeS2)* – five generations: I: primary component of pre-metamorphic rocks, crystals sheared and broken/deformed, II: small cubes, same age as Barite I, and Galena III (e.g. Matthias Baue), III: after a strong tectonic phase filling cracks (NE Feld), IV: filling of interstices of Marcasite, V: form in cementation zone
- *Marcasite (FeS2)* – main constituent of Marcasite veins with Ankerite, Calcite, Quartz and sometimes light Sphalerite, in Goisernbau, Gabe Gottes Zeche
- *Arsenopyrite (AsFeS)* – existence improbable and never confirmed
- *Gudmundite (FeSbS)* – Klinger Bau and Franzisci Bau
- *Pyrargyrite (Ag3SbS3)* – reported abundant in the Franzisci Bau (West Feld), where it is the main carrier of Silver, in contrast to Oberzeiring Middle Field and NE Field, where Silver occurs preferably together with Galena and Chalcopyrite
- *Bournonite (CuPbSbS3)* – three generations: I: area of Gamsgebirgs-Zeche III strongly deformed grains together with Galena I and Barite, its fractures healed with Fahlerz, Sphalerite and Chalcopyrite; Bournonite II and III only in Klinger Baue; Bournonite II together with Fahlerz und Galena II, Bournonite III with Barite II and filling cracks in Galena, most occurrences as tight twin lamellae; in Matthias Baue Bournonite II with droplets of Galena III, In the Kli9nger Baue filling interstices
- *Boulangerite (Pb5Sb4S11)* – known from Klinger Baue and other stopes in the NE Field, but also from samples of Franzisci Baue, B. is younger than Galena I, Bournonite II enclosed in Galena II
- *Cuprite (Cu2O)* – described as pseudomorphic after Covellite, sometimes with grains of native Copper
- *Magnetite (Fe3O4)* – accessory constituent of primary mineralogy of mineralization bearing rocks (Marble and Biotite Gneiss)
- *Hematite (Fe2O3)* – accessory constituent of Mica Schist and Biotite Gneiss
- *Bindheimite (Pb1-2Sb2-1(O, OH, H2O)6-7)* – product of alteration of Bournonite (e.g. in Franzisci Baue)
- *Wad* – Product of weathering of Manganese-rich Siderite
- *Smithonite (ZnCO3)* – rare secondary crusts as products of alteration
- *Siderite (FeCO3)* – 2 distinct generations; I: massive coarse-grained Siderite veins, II: idiomorphic crystals older or as old as Barite, often zonar, with Rutile inclusions, as old as Fahlerz, cracks filled with Pyrite & Marcasite; the vein-type Siderite is older as the zonar and all non-zonar Galena
- *Calcite (CaCO3)* – oldest generation is Calcite of Marble host rock, later replaced by various ore minerals with first product, the Ankerite, followed by Siderite and then Pb- Zn- and Cu-ore minerals; during replacement by ore minerals re-crystallization as zonar Calcite twins, again replaced by Pyrite and re-crystallized as non-zonar Calcite with twisted twin lamellae, a later Calcite is product of alteration, and the youngest Calcite formations are white Ca-Carbonate crusts as precipitates of Ca-rich mine waters
- *Ankerite (Ca(Fe2,Mg,Mn2)(CO3)2* – together with Marcasite as accessory of Marcasite veins, filling cracks, older than pyrite, in Gabe Gottes Zeche Ankerite replacing original constituents of host rock
- *Aragonite (CaCO3)* – forming secondary crusts and Sinter in old long abandoned stopes, at Franzenszechen cm- sized "Eisenblüte" ("Flower of Iron"), a variety of Aragonite known for its banded texture is named

- *"Zeiringite"* – a light bluish oriented intergrowth of Aragonite with Aurichalcite
- *Aurichalcite (Zn,Cu)5(CO3)2(OH)6)* – paragenesis with Aragonite forming Zeiringite
- *Barite (BaSO4)* – WEISS (1963) differentiates two types, Barite I and II; Barite I, the older is coarse crystalline, of white to slightly violet color at Gamsgebirgslager (NE Field), Barite II is much younger and found in Klinger Baue; a distinction between different types of Barite is not possible at Barbara and 1958 Zeche, rare in Matthias Baue with fine disseminated Pyrite (II) of same age, replaced by Quartz and Pyrite III; at Gamsgebirgszeche Barite is younger than Sphalerite I and Galena; Barite is also younger than Pyrite associated with Marcasite; altogether two generations of Barite exist separated from each other by the mineralization formation cycle of Pyrrhotite II – Marcasite I & II –and Pyrite III & IV. Barite appears in two types of deposits: the higher temperature hydrothermal vein –type (1) and the "bubble"-shaped irregular mineralized bodies caused by metasomatic replacement of the Carbonate host rock. Dimensions of the metasomatic mineralized bodies are in general much larger than the vein type deposits
- *Anglesite (PbSO4)* – together with Cerussite as alteration product in oxydation zone
- *Gypsum (CaSO4 . 2H2O)* – recent to sub-recent secondary product of dissolution of Sulfides and reaction of Sulfur-dioxide with Ca-rich mine waters as cm-sized clear crystals
- *Copper, native (Cu)* – product of reduction alteration (e.g. Veronika Bauten)
- *Digenite, Neodigenite (Cu9S5)* – formed by alteration of Chalcopyrite (e.g. Franzisci Baue), of Fahlerz (e.g. Gabe Gottes Zeche), of Tennantite (e.g. "Mittellauf")
- *Cinnaber (HgS)* – only one microscopic size specimen found in mineralized sample from Veronika Baue (HADITSCH)
- *Jamesonite (Pb4FeSb6S14)* – enclosed in Quartz idioblasts or Galena, found at Veronika, Gabe Gottes and "Mittellauf" (NE Field)
- *Rutile (TiO2)* – frequent inclusions in Sphalerite, Barite and Quartz
- *Anatase (TiO2)* – as pseudomorphose products after Sphene.

Oxidation Zone

Like most other deposits the Zeiring Precious Metal polymetallic deposits show various forms of oxidation of the minerals contained in the polymetallic veins, especially in the mine levels that have been the target areas of historical mining. Signs for oxidation range from limonitic crusts covering the walls of old Karst- type caves and ancient underground workings (Fig. 36), to highly limonitized and altered mineralized marble breccias to partly decomposed ore minerals like Galena as often observed under the microscope in polished ore sections. Historical mining operations mostly worked these levels of enrichment by oxidation especially of Precious Metals (Ag and Au). How anomalous these oxidized levels of mining were and how much high grade mineralized material and PMs they extracted and recovered is not known, since for most mining operations, especially of the polymetallic type ofmineralization, there hardly exists any records. For the Pier Mine, which was flooded accidentally in 1361 and which had been the main producer of Silver no plan view and section maps were prepared or they got lost over time. To reconstruct and recalculate the volume of polymetallic material mined over the many centuries of mining activities is not possible either:

Some stopes and other mine workings of the past took advantage of the frequent occurrence of natural Karst-type caving. Often, stopes were back-filled by the metal-mining operations (mainly of mineralized veins with Lead-Silver) with barite and siderite bearing rock mixed with the barren marble host rock, for which there hasn't been any use in the early centuries of mining. Only after the flooding of the Silver mine the value of Siderite was recognized and substantial mining for Iron began as an alternative, very prosperous for the mine owners till the middle of the 19th Century (e.g. NEUPER's Iron Mining Company).

Many sections of the large old mines at the Zeiring Erzberg are no longer accessible.

Figure 36: Reddish-orange Crust of Iron-hydroxides (Limonite) in abandoned Mine Buildings (Photo: silbermine.at)

The mines of the South Field, the Purgstallofen and the Katzling Zone with its Mining Centers "A" to "G" all seem to be older than most of the mining activities in the three main mining fields of the Ober-Zeiring Erzberg (West Field, Middle Field and NE Field), many showing distinct signs of driving tunnels, raises and shafts by fire setting, and or with hammer and chisel. Due to their limited technologies in working these mines SE of Ober-Zeiring the old miners most probably just reached the upper levels, the oxidation zone, of the South-eastern deposits, leaving behind and mostly untouched the high grade mineralizationof the cementation zone.

Cementation Zone

Where and at which depth from the surface the oxidation zone passes into the cementation zone has not been defined and/or even researched. And judging from the existence and varying density of the open caverns of the Karst cave system, the depth of the top of the cementation zone can be expected to vary from location to location. It also is not clear, what influence the waters had with respect to oxidation-cementation process, which circulated in the marble formation under a massive ice sheet during the last main glaciations causing the caverns. The conditions were certainly different during that period than after the end of the ice age, when previously abundant water gradually subsided and the caves and the mineralized zones became dry and exposed to oxygen.

Judging from the condition and appearance of the many small mines from the South Field to the Mine Center "G" of the Katzling Zone one may conclude that the old miners only extracted materialfrom the enriched oxidation zone and were stopped from going further and deeper by a lack adequate technology and also the lack of sufficient aeration in the deeper portions of the mines, where they were confronted by the poisonous H2S gases developing from decomposing sulfides. The story goes that such gases ascended from the flooded Pier Mine through the open shafts into several Ober-Zeiring houses, where mine entrances were located inside their cellars, forcing the owners to fill the entrances and wall them off.

The Zeiring Mining Centers and their Deposits

The Zeiring Silver Mining District is divided into four main Mining Centers, the West Field (Franzisci Mine, Ober-Zeiring), the Middle Field (Pier Mine, Ober-Zeiring), the NE Field (Johannes, Taubenkropf, and Klinger Mine, Ober-Zeiring - Möderbrugg), and the South Field (Zugtal – Purgstallofen – Matthias Mine, Unter-Zeiring) with its extension to the SE along the western ridge of the Pöls Valley from Unter-Zeiring via Winden and Katzling to Pöls, the “Katzling Zone” (Mine Centers “A” to “G”).

The map of Fig. 37, supplied by the Geological Survey of Austria (“GBA”), shows the areas of Mining Centers (“West, Middle, NE and S-Field”), their mine portals (mine dumps, shafts, galleries and adits), and the mine centers/mines of the Katzling Zone along the western ridge of the Pöls Valley, South of Ober-Zeiring. It also shows (in blue) the areas where in the old days slag from the Silver winning furnaces were dumped. They often were described in the more distant past as huge mounds of slag anomalous in Lead and other metals, including remnants of Silver. An analysis for Lead of a sample of slag submitted to the Bleiberger Bergwerks-Union (KRAJICEK, 1956) gave a Pb content of 4.4% for this sample. Today not much is left after the slag was used over centuries to stabilize road beds.More detailed map of the mine dumps at the Middle Field (Mittleres F) is shown in the Fig. 38.

All the information supplied by GBA together with the map are attached to this report as Appedix I – West Field, II – Middle Field, III – NE Field, IV – South Field, and V – Katzling Zone. Each appendix contains a description of the mines, the mineralization types and their chemistry, together with the individual mines’ geographic coordinates, further a list of minerals and results of geochemical analyses of mostly soil samples taken at the locations, plus a list of available literature and of maps concerning each area.

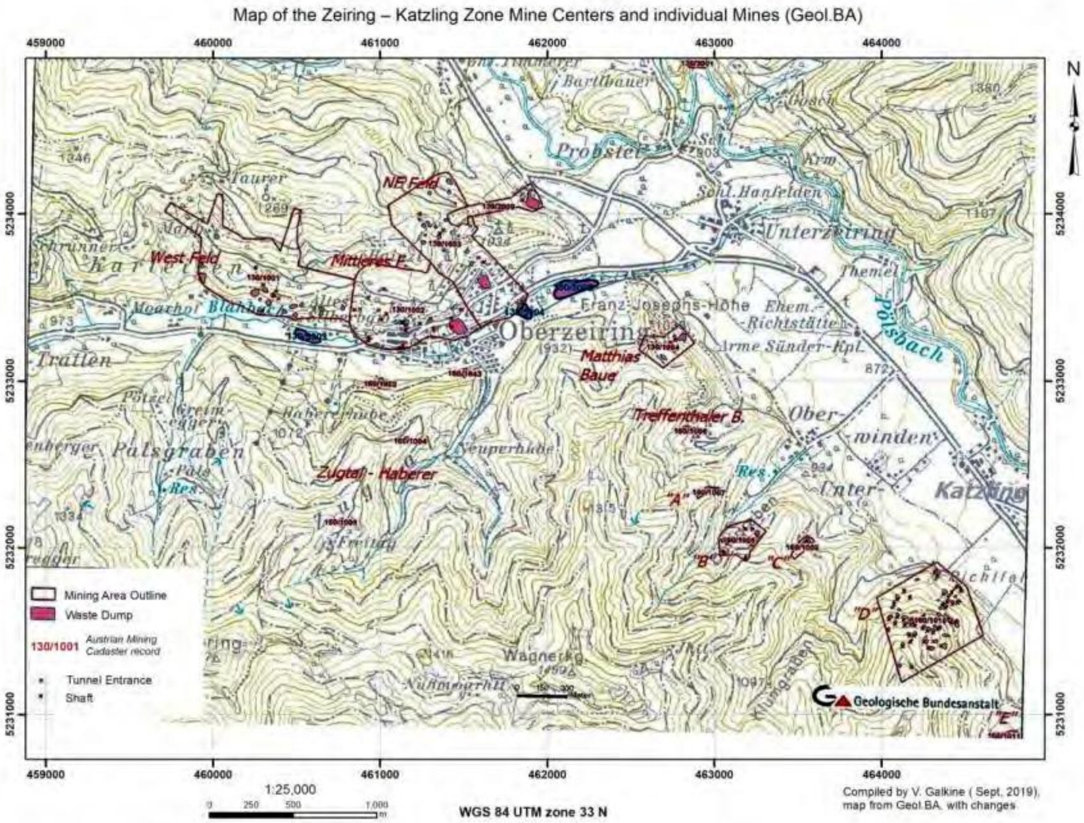

Figure 37: Map of the Zeiring – Katzling Zone Mine Centers and individual Mines: Entrances, Mine (r) & Slag (bl) Dumps (Geol.BA, with changes by V.Galkine, September 2019)

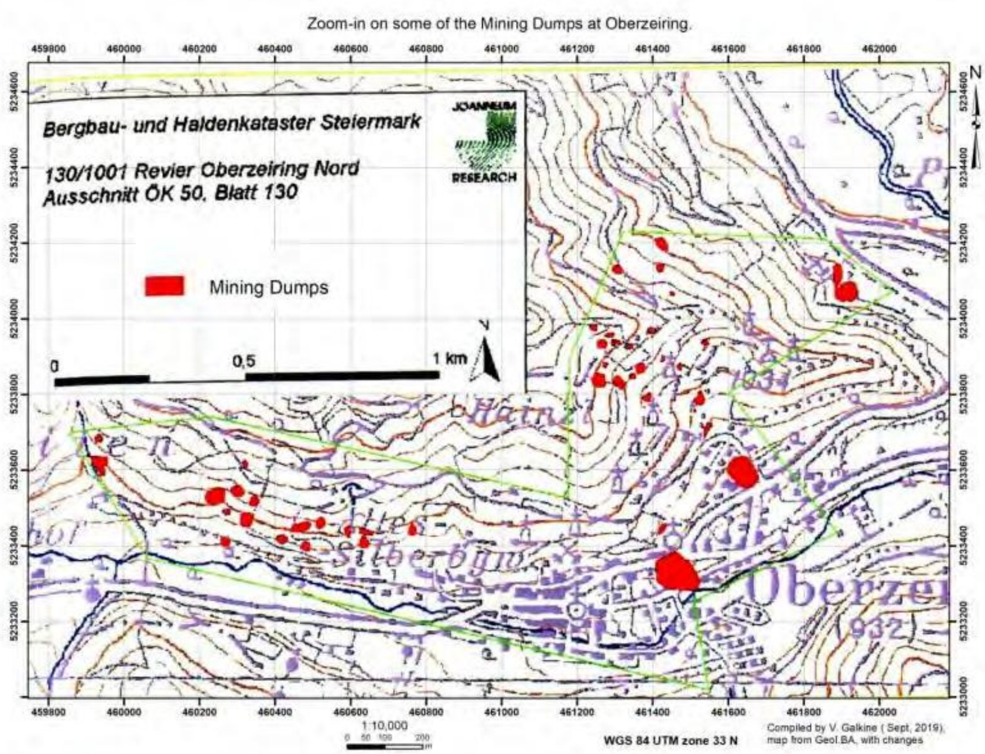

Figure 38: More detailed map of the mine dumps at the Middle Field (Mittleres F)

The West Field

The West Field's ("West Feld") important mine buildings are the Grazer and Wiener Mines ("Baue") and the Franzisci Base Tunnel. The Wiener Bau is described to be the oldest segment followed by the Grazer Bau. Here veins striking mostly N-S with 80°E dips were mined (NEUBAUER, 1952). These veins were interrupted by a W-E striking and 40°S dipping fault zone, erroneously described by HAUPER (1805) as a second mineralized vein type crossing and off-setting the N-S veins (HADITSCH, 1967).

To capture and develop the continuation to depth of the mineralized veins mined at the Grazer mine level the Franzisci Base Tunnel was constructed and it hit at meter 156 a Siderite-Galena dominated high grade mineralized vein, and about 30m further into the mountain another similar vein but of bad (insufficient) quality and grade (TUNNER, 1841). The high grade mineralized vein also was dipping 80°E and at the time (1841) was followed by the miners for 29m along strike and 15m vertically. Earlier reports by MARKO, LIEBMANN and GUMM, owners of the mine at the beginning of the 1800s indicate a Silver-bearing Galena vein with Fahlerz (Bournonite after HADITSCH) at meter 164, probably identical to one of the veins described by TUNNER. However, NEUPER's hopes for more new Silver veins in the newly dug base tunnel (the "Franzisci Erbstollen"), as STEINER- WISCHENBART (1906) reports, seemed not fulfilled at that time and Neuper's mining company again concentrated on Siderite mining (Fig. 39 and Fig. 40). In the 1920s the Galena vein was followed upwards and about 3000kg of good quality Galena were extracted. Neuper's Iron mining operation had to shut down 1898 due to overwhelming competition by the lower cost Styrian "Erzberg" Siderite production.

HADITSCH, in his Zeiring Monography (1967), summarizes the minerals described between the early 1800s and 1900s by several different authors as follows:

- Primary minerals: Galena (coarse grained and Ag-bearing), Fahlerz (later identified as Bournonite).
- Secondary minerals: Malachite, Covellite, Cerussite, Anglesite (Oxidation).
- Accompanying minerals are Barite, Siderite, Ankerite, Calcite and Quartz.

After SETZ four mineralized samples were submitted 1923 for chemical analysis to three well renowned laboratories; one at the TU Vienna, one of Jakob NEURATH, and one at the Montan University of Leoben. Results are shown in Tab. 5. These results are remarkable for, as expected, the Lead grades; the Silver values show that this PM is strongly associated to Lead. Values for Copper as well as Stibium of about 1% or 10kg/t are certainly very interesting and valuable as a by-product, in the case that economically mineable ore stocks can be located and proven.

	Analyse I	Analyse II	Analyse III	Analyse IV
SiO_2	3·29 %			
Pb	75·70 %	76·30 %	73·02 %	78 %
Cu	00·70 %	1·31 %	1·14 %	
Fe	9·50 %			
Ag	930 g/t	1070 g/t	850 g/t	1250 g/t
Au	nicht nachgewiesen	–	–	
Zn		–	–	
S		10·52 %	10·22 %	
Sb		Spur	1·02 %	
As		Spur	0·08 %	
Bi		Spur	Spur	

Tab. 5: Results of chemical Analyses of four Ore Samples from the West Field submitted during 1923-24 by SETZ (1924) to three Laboratories

Figure 39: Detailed Mine Plan and Section of the West Field Underground Workings: Franzisci Base Tunnel, and the Grazer &(Arch.GBA) Wiener Galleries (after NEUPER, from: NEUBAUER 1952)

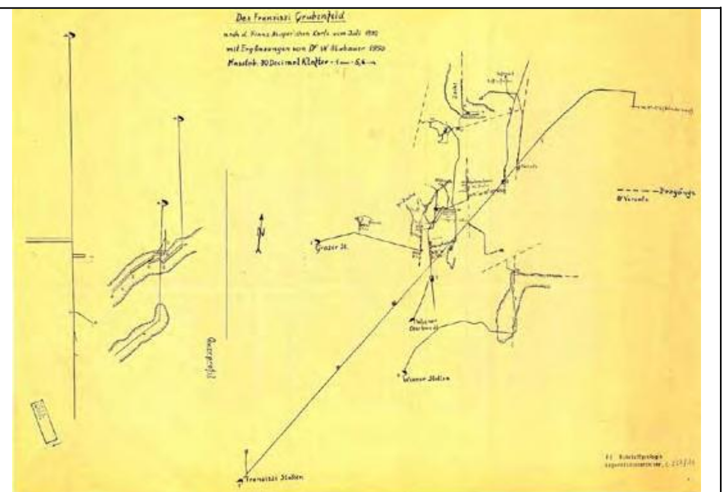

Figure 40: Map hand sketch of the West Field "Franzisci Mine" 1870 by Neuper's Siderite Mining Company the construction of the Franzisci Base

NEUBAUER (1952) studied the Franzisci-Grazer Mine building as far as it was still accessible using the NEUPER mine map as a guide and modifying/correcting it (Fig. 39 and Fig. 40, printed and published version of map sketch Fig. 42). From the portal of Franzisci Portal onward seven Galena veins were intercepted by the tunnel. Crosscuts and exploratory shafts (e.g. the "Bleischacht" (Lead-shaft)) (Fig.41) at the areas of mineralization intercepts are testimony for search and mining activities along the strike and the vertical extension of these veins, some of it in quite extensive stopes. Based on NEUBAUER's research it was possible to correlate the more prominent veins intercepted along Franzisci with veins mined in the higher levels of the Grazer and Wiener Baue (e.g. the vein observed and mined in the Wiener Bau being a sheared off portion of Franzisci Tunnel's vein intercept number Four). Also several Siderite veins were intercepted; one of them is mentioned briefly by HADITSCH at base tunnel meter 280. Fig. 42 shows the plan view and lateral profiles of the mine.

The veins frequently show intensive shearing, with two fault systems and directions:

- An older system with NNW – SSE orientation, and
- A seemingly younger NE – SW oriented system was observed near the "Bleischacht" (HADITSCH, 1967). It displaces the NNW – SSE system.

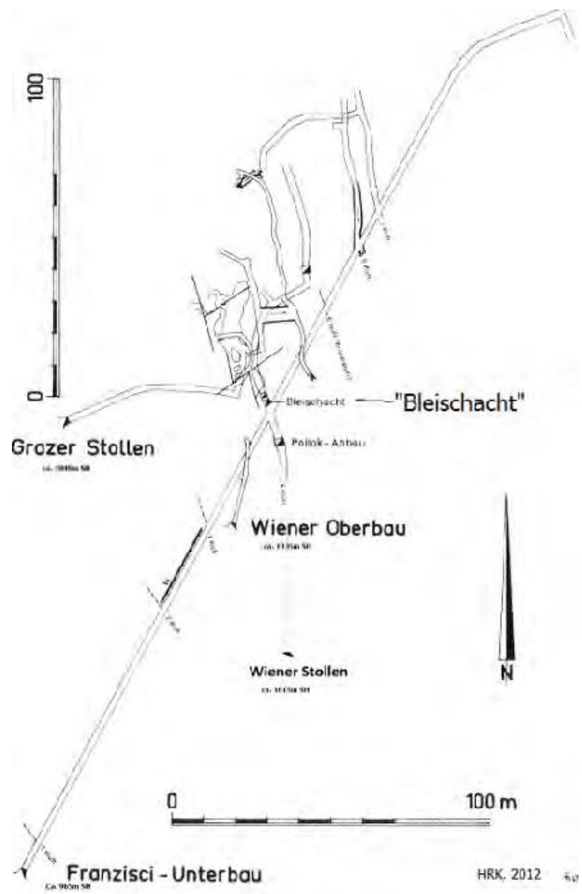

Figure 41: Detailed Mine Plan of the West Field Underground Workings: The Franzisci Base Tunnel, and the Grazer and Wiener Galleries (from: HADITSCH 1967)

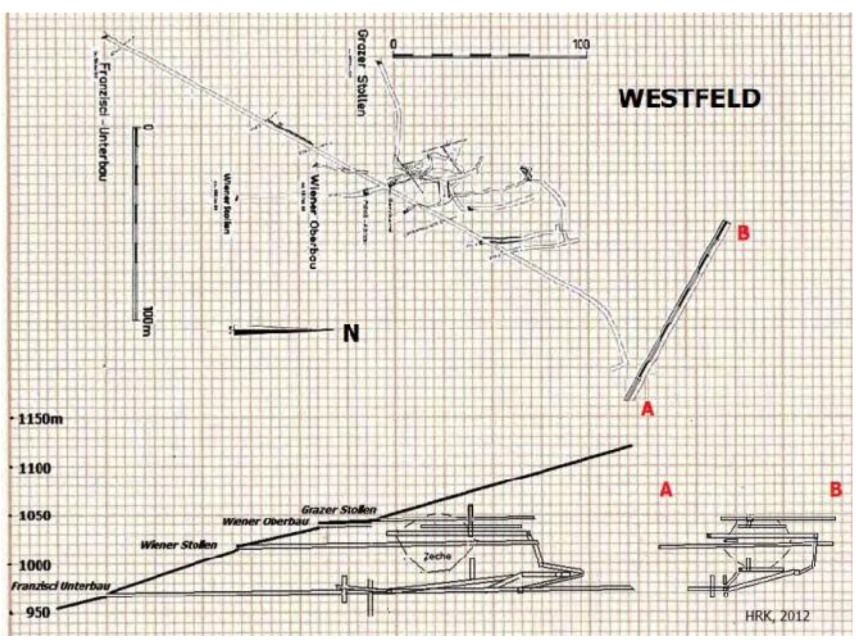

Figure 42: Detailed Mine Plan of the West Field Underground Workings with length-side and front-side Sections in a sketched attempt to show the Mine Building in 3-D

Apart from often intensive shearing the vein-type bodies show both vertically and along strike thickening and/or thinning out as well as changes in their mineral composition with anomalous mineralization dominated by Galena, by Sphalerite, Siderite and/or Barite. These veins often continue barren with only Calcite and Quartz. HADITSCH takes the fifth vein intercept at Franzisci as an example: it quickly became barren along the main drift with only calcite, but was explored and exploited 20m further to the NW by a shaft and a small stope in a mineralized zone.

HADITSCH also mentions his observation of an unusual anomalous number - compared to the other mine centers – of mineralized clefts. He interprets them as signs of extensional stress caused by the tectonic formation of the Blabach Anticline. Another feature typical for the West (and Middle) Field is the dominance of Pb-Ag mineralization versus the NE Field where the sulfidic mineralization was replaced by Barite and Iron-carbonates at higher levels.

The Middle Field

The Middle Field with Pier Grube and Pierer Winze ("Pierer Gesenke") (Fig. 44) right underneath and to the NW of the town of Ober-Zeiring was the center of the middle-age mining and Lead-Silver production until the accidental flooding of the underground workings in 1361 (1365 ?). Huge piles of slag from the many ore processing furnaces active until the accident gave testimony for many following centuries about the once flourishing Silver mine's production. As of today most of the material is gone. It has been used to consolidate local roadbeds.

How closely Ober-Zeiring is related to the Pier Mine right underneath its houses and churches is well shown in the old drawing of Fig. 43, a somewhat three dimensional, hand drawn rendering of Ober-Zeiring and the Erzberg viewed as a S – N cross section. A great number of winzes, galleries and shafts – many more than those drawn on the map – offered access to many individual small but interconnected mine operations.

Many entrances to the mine were located in the cellars of private houses, administrative buildings and even the school building. Many of these were walled off or backfilled after the flooding accident, when poisonous H2S gases are reported to have ascended from the flooded mine originating from decomposing sulfides. The rendering of Fig. 43 also shows the water level in the old flooded mine in comparison to water levels of the Mur valley in the South, the Blabach creek and the Pöls River. None of these surface waterways has caused the flooding due to a "watertight" layer of micaschist on top of the mineralization-bearing Bretstein Marble.

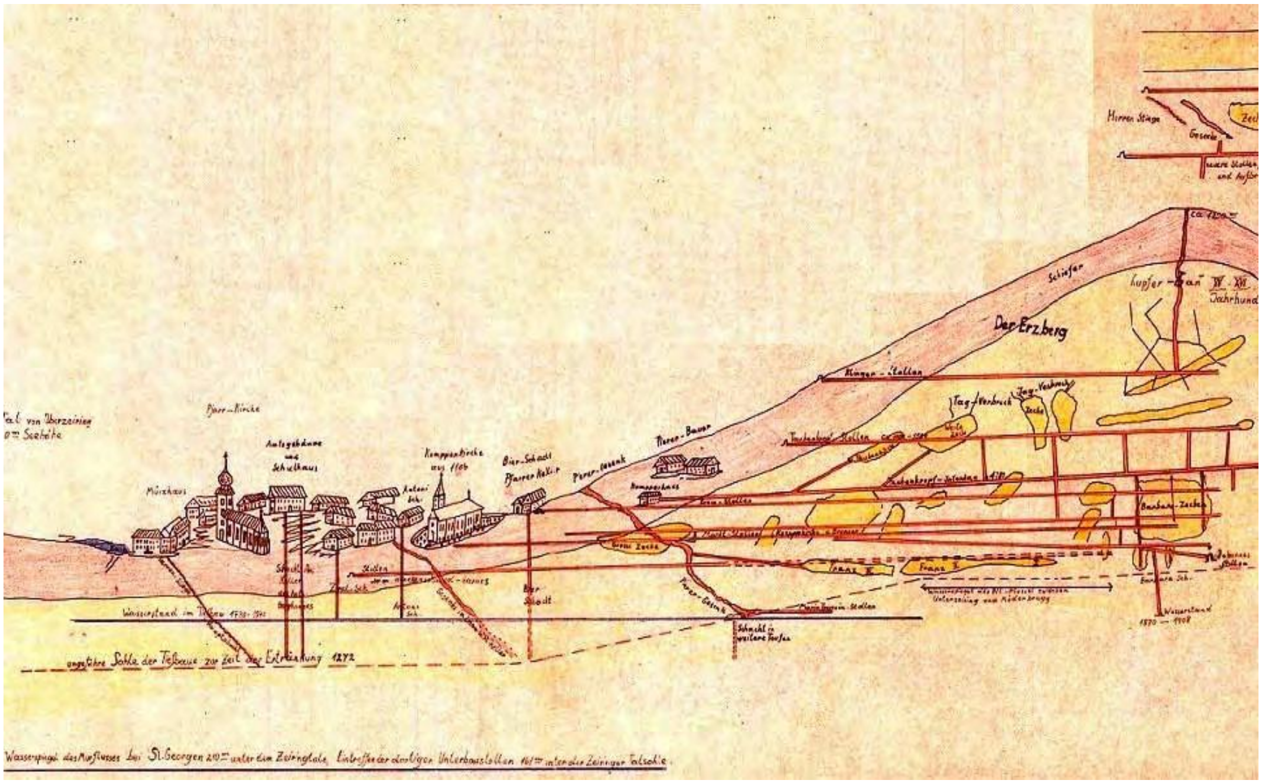

Figure 43: Detail from an ancient Rendering of Ober-Z eiring, the Erzberg and its Underground Workings by ANONYMUS

Figure 44 shows a more recent plan view of the Pier Mine and Pierer Winze with the two drill sites on the surface and inside the mine (see also Fig. 25 and Fig. 26). Figure 45 (SETZ, 1922) is an older plan view version with a NW – SE profile in addition, which shows the water level and the mine building above. Interesting is that in historical time, when this part of the mine was still fully operational no detailed mine maps were drawn or maintained. Over time many attempts to pump and drain the water have either failed for lack of proper technology or of money. Even two Emperors, Emperor Maximilian I and Empress Maria Theresia ordered and even supervised the work. A Government Commission sent by the Empress to Zeiring studied the situation and came to the conclusion that to clear the mine of the water was economically viable, considering the mine's potential for Silver, Base Metals and Gold. Soon after the study work crews began to build a tunnel from the Mur Valley in the direction of the Pier Mine as a base tunnel, which would have allowed draining the mine. Work was abandoned soon after due to Austria's war with Prussia and the necessary conscription of workers.

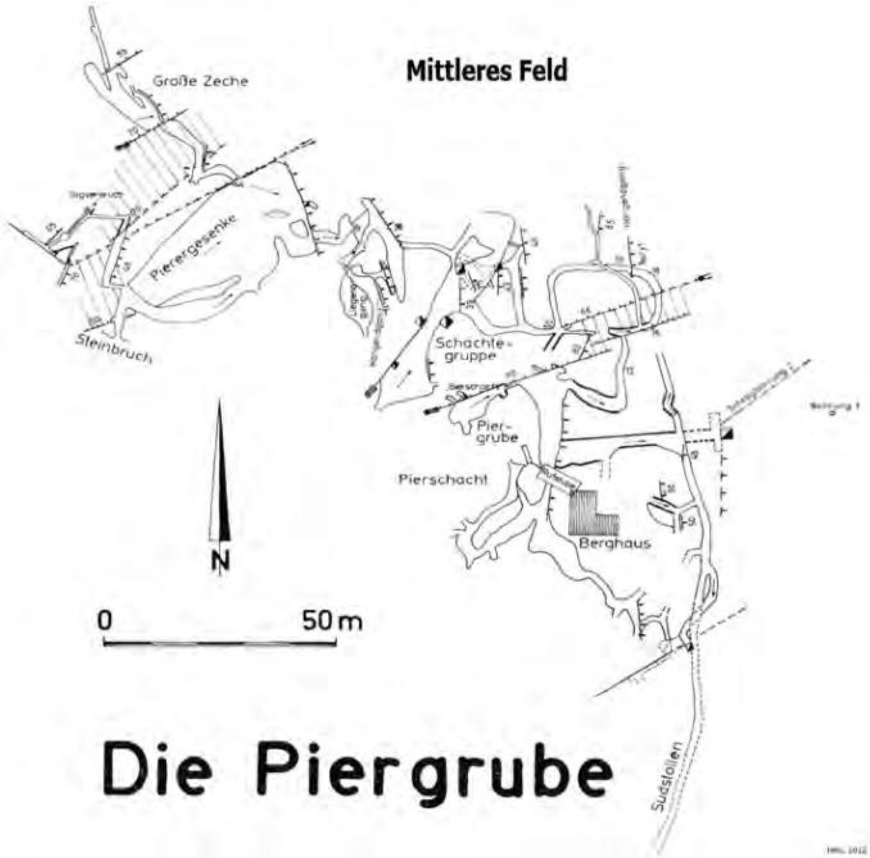

Figure 44: Detailed Mine Plan of the Central (Middle) Field Underground Workings: The Pier Mine and the Pierer Winze located under and to the North of Ober-Zeiring (from HADITSCH, 1967)

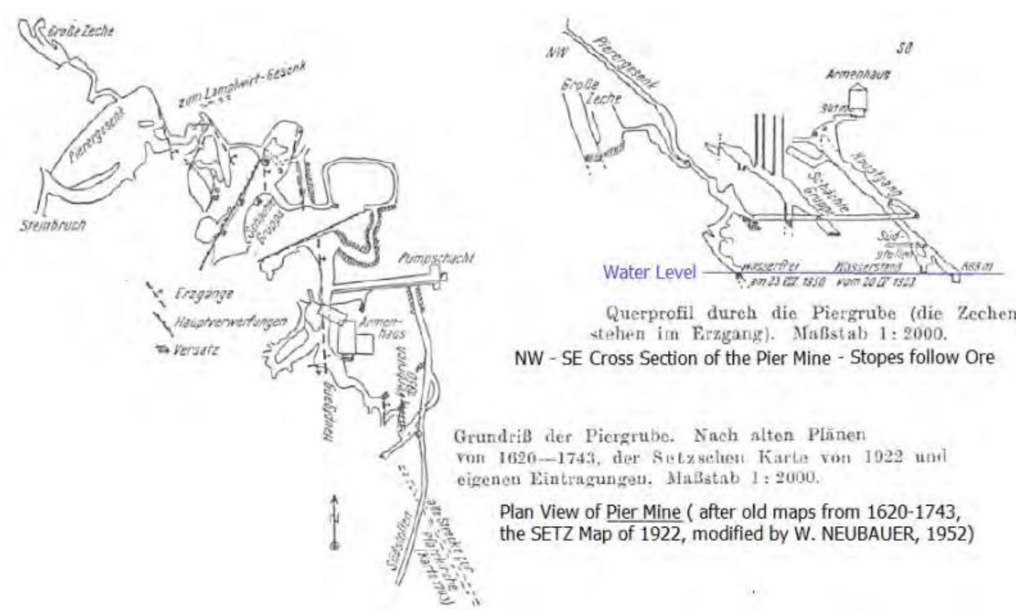

Figure 45: Detailed Mine Plan and NW-SE Cross Section of Middle Field Underground Workings: The Pier Mine (after old maps from 1620-1743, 1922 and modifications by NEUBAUER, 1952)

Of the many galleries and shafts giving access to the Pier Mine in the past today only two are still open. One is the entrance to the Mining Museum in Ober-Zeiring. The other is at the location of a quarry (Fig. 45). It leads directly into the "Pierer Gesenke" (winze).

Middle Field Geology and Mineralogy

The structural tectonic situation in the Pier Mine is shown in Fig. 44 & Fig. 45. It is characterized by a series of strike-slip faults. One of them is encountered after entry into the Pier Mine via the only remaining entrance in town - in the cellar of the old hospital building. It is located in the N of a large stope, which, with a length of 80m along strike probably is the largest stope of the mine. This strike-slip fault shows ENE-WSW strike and it thrust the block to its N about 33m to the W. To quote a vertical extension of the stope is impossible, its lower part being flooded. The S of this stope is limited by a NE-SW striking fault.

In the N of the strike-slip fault follow the stopes of the "Shaft Group" part of the Pier Mine (Fig. 44). Here, the main vein dips 46°E. It again is cut off to the N by a strike-slip fault, which shifted the formation to its N about 11m W. The vein of the Shaft Group block is considered identical to the main vein of the Pier Mine. The banded marble generally dips 45° SSE. Elements of shearing, generally dipping 43-75°ENE to E show limonitic fillings.

The fault block to the NW of the strike-slip fault in the N of the "Shaft Group" is characterized by a two-directional shearing. Here, the mineralization forming solutions used mainly the N-S striking and (steeply) E dipping ruptures. Where these zones meet and intersect (e.g. near survey point "38" – Fig. 43) PM metals may occur as proven by the small stope at survey point "39". Here, the main vein, split and sheared further to the S, becomes one "main" vein. The northern limit of this structural block is a NE-SW striking fault, with only a small lateral shift.

The "Pierer Gesenke" is reached by continuing in NW direction. This part again is cut at survey point "44" by an ENE-WSW fault, which shows the northern block as thrusted 6m westward. The block N of the strike-slip fault limiting the Pierer Gesenke to the N is only 20m wide and again after only 20m cut off by another NW- SE striking and 70°NW dipping strike-slip fault, which shows a thrust of 3 to 4m of the N block to the West.

Here the steep stope of the "Große Zeche" is located in the hanging wall and is limited to the N by a fault dipping 55°NNW. The Große Zeche (Fig. 43) does not contain one uniform vein, but one more strongly mineralized vein in the foot-wall and a much thinner less mineralized vein separated from the foot-wall vein by a layer of barren rock. The Pier Mine building ends about 15m across the strike-slip fault in the N of the Große Zeche.

With regards to the number of veins, their varying strike and dip and mineralization HADITSCH (1967) states that his study's conclusion about the number of veins in the Pier Mine is only two – a main vein and a hanging wall vein. Other researchers like NEUBAUER (1952) suggest four veins, counting mistakenly vein-like looking mineralized structures in strongly sheared areas in the N of the Pier Mine.

The changing intensity of the two veins' mineralization and thickness is described by HADITSCH in the following:

- In comparison to the main vein the hanging mineral vein was poorly mineralized in its southern part, the Pier

Mine. Towards the N (S of the Pierer Gesenke) both veins were about equally mineralized. Further N the foot-wall main vein again was more strongly mineralized than the hanging wall vein and thicker. In the Große Zeche thickness of both was equal.

- Typical for the Pier Mine's vein structures is the fact that the thrust of the thrusted vein blocks westward increases from the S to the N. At the same time the number of the faults and shear zones increases from S to N, too, as their distance from each other decreases from S to N. In other words a tectonic stress uniform over the whole structure resulted in the S with a few faults with a greater thrust distance compared to the N where narrow faulting with associated shearing created smaller structural segments. One of the reasons of this phenomenon is for HADITSCH the increasing closeness to the hanging wall mica schist unit towards the N and changes in the composition and structure of the marble itself. The veins' strike direction varies from S to N and from lower to higher levels and from NNW to NNE to N-S South of the Große Zeche, where the strike again turns to NNW and NE-SW. The veins' dip is steep in the N and flattens out towards the S. The main vein shows a typical structure with a vein "filling" and metasomatically replaced vein walls, more strongly developed in the Pier Mine than in the West Field.

Following a zone of shearing and tectonic weakness the vein increase in thickness from top to base (e.g. in Große Zeche, where the vein in upper stopes is about 1m thick and in its deepest part 4 to 5m).

Water Conditions in the Pier Mine and past Projects to drain the Water

The catastrophic flooding of the Pier Mine underneath Ober-Zeiring happened, after most authors, in the later half of the 14th Century (1361). It instantly cut off the ore supply of the mine for production of Silver that had flourished to that very day. After this event miners cleaned out any ore from the mine above the water, so that later visitors to the accessible parts of the mine could not find any high grade mineralizedsamples in place as leftovers. Also from then on as a consequence mine operations moved to mineral bodies higher up in the West Field, the NE Field and the South Field including the Katzling Zone to its SE, where small scale mining has been reported to be active for many centuries.

Repeated attempts to drain the mine since the accident have always been a sign that the mineralized bodies rendered inaccessible due to flooding had great potential and were sufficient risk the costs of de-watering the mine.

De-watering attempts of the Pier Mine began around 1400 (SETZ, 1922) by the Monastery of Admont. Emperor Maximilian I, made great efforts for several years starting in 1506 and even supervised the work himself to drain the mine. At least 15 attempts were made between 1520 and 1724 by private miners; all of them failed due to the lack of suitable technology and energy sources. However there is a brief reference in HADITSCH (1967) that an attempt in 1738 drained the deeper portion of the Pierer Winze. Samples y taken there reportedly had Galena with 832 g/t and Bournonite with 956 g/t Ag and 5 g/t Au.

1738 a Commission sent by Empress Maria Theresia studied the water situation and the economic validity of draining the mine . As a result a base tunnel starting from the Mur Valley about 4km to the S of Oberzeiring was begun, but shortly after abandoned for a war related conscription order of working men. Initially the Commission had attempted to test draining by employing 12 hand pumps operated by 48 men. In 1740 the St. Antoni shaft was completed and the so-called "Stangenkunst" – (Fig. 46) a water wheel which moved attached rods with buckets up from the water and down again for a re-fill was employed as the de-watering mechanism. It worked for seven weeks, but was too small. It was replaced 1743 by a new machine with a higher capacity, which showed some success until new water came in when the shaft was deepened. In 1745 the planning of the Mur Valley Base Tunnel began, but the project was abandoned 1747 because of war.

In 1770 the last private attempt to drain the mine was attempted. Eventually the de-watering problem was abandoned in favor of the mining of the abundant Siderite discovered in the West and the NE Field mines. The raw Iron produced in those years containing Manganese was a very valuable product, until the much larger Siderite deposit of the Styrian Erzberg began to produce Iron ore at a much faster and cheaper rate and put the Oberzeiring Iron production out of business.

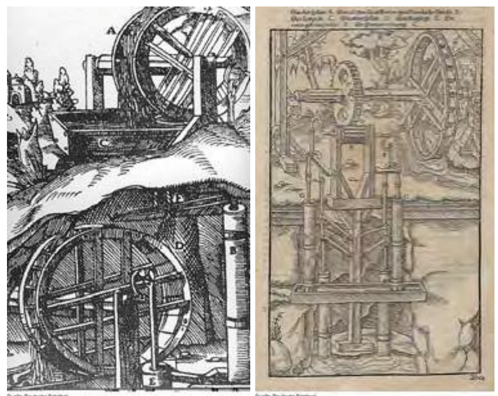

Figure 46: Two Drawings by AGRICOLA of different types of"Stangenkunst", the first wooden apparati developed for mining to lift mine waters from underground to the surface

Beginning of the 1920s H. SETZ employed first an "Electro-turbo-pump" of 15 liters/second capacity, later replaced by a 30 liter/second pump. Due to frequent failures (black-outs) at the Electric Power Station of Unterzeiring, the pump work was rendered ineffective and SETZ halted the operation. A new1800 KW electric power station built near Katzling gave SETZ (1924) hope to restart drainage by pumping. As an alternative he also thought of continuing the Mur Valley Base Tunnel. Other attempts were either interrupted and/or abandoned again due to war or the lack of sufficient funding.

To make his "water" research more complete SETZ also registered the monthly shifts of the mine's water level from end 1920 to mid-1924- The diagrams are shown in Figure 46. His measurement of the water inflow was 30 to 40 l/second. Since the water level over time remains more or less constant it was surmised that an out flow , about equal to the water coming in.

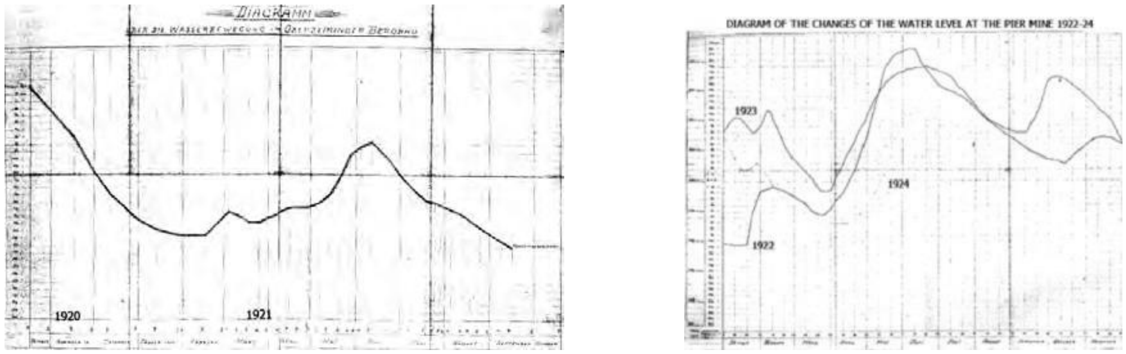

Figure 47: Diagrams of monthly Changes of the Pier Mine/Oberzeiring Water Level observed from Oct. 1920 to June 1924 during pumping efforts

The water level scale of the diagram to the left appears to be set with a water level of 0 m, taken on the day of the beginning of the measurements (corresponding to the beginning of the pumping of water?) and measuring from there the decrease of the water level in meters. The diagram to the right has as scale the actual altitude in m ASL.

In 1968 while the coal mines of Fohnsdorf near Judenburg were in the process of closing down, an effort was made by the Austrian Federal and the local Styrian authorities to find job replacements for the coal miners who were to be laid off. To revive the Zeiring Silver Mine was an obvious option worth studying . Experts such as Prof. PETRASCHEK of the Montan-University of Leoben and several others were called in to conduct these studies, which examined risk, viability and high grade mineralization potential in the sunken portion of the mine, also the “water problem” (PETRASCHEK, 1968; SIK, 1968; ÖSTERR. ALPINE MONTAN GESELLSCHAFT, 1968).

Regarding the mine flood water PETRASCHEK states clearly that the question of pumping the water from the mine is the prerequisite of becoming able to study the potential of the drowned deposit. He considered it very possible that all the galleries and drifts may no longer be usable after more than 600 years under water, having been filled with clay and calcareous deposits on its walls.

PETRASCHEK however states clearly that pumping the water out of the mine and releasing it on the surface would endanger neither groundwater nor the water in the areal and regional streams. Nor would it influence the drinking water supply of Oberzeiring, which originates in springs higher up the mountain slopes to the S of the town. Water samples drawn by PETRASCHEK from the upper layer of the mine water proved to be metal-free.

These reported results are encouraging, nevertheless a repeated sampling and testing of the water still remaining in the mine and the water about to be released on the surface during pumping will be obligatory considering the environmental awareness of today and also as a protection against unjustified attacks, accusations and aggression by environmental anti-mining groups.

The North-East Field

It is obvious that no underground link existed between the mines of the West Field and the Middle Field. As for links between the Middle Field Pier Mine and the NE Field’s complex mine buildings there was a great number of old tunnels, no longer accessible, that had been dug from the Middle Field in the direction of the NE Field at levels mostly below and undercutting the NE Mining complex. HADITSCH (1967) himself believes that such underground link(s) had existed.Figure 48 (WEISS, 1952) shows the different levels of the main sectors of the originalindividual mines (e.g. from top to base: Klinger Baue, Gamsgebirgszeche, Taubenkropf Baue, Johannes Base Tunnel) within the NE Field Mine complex.

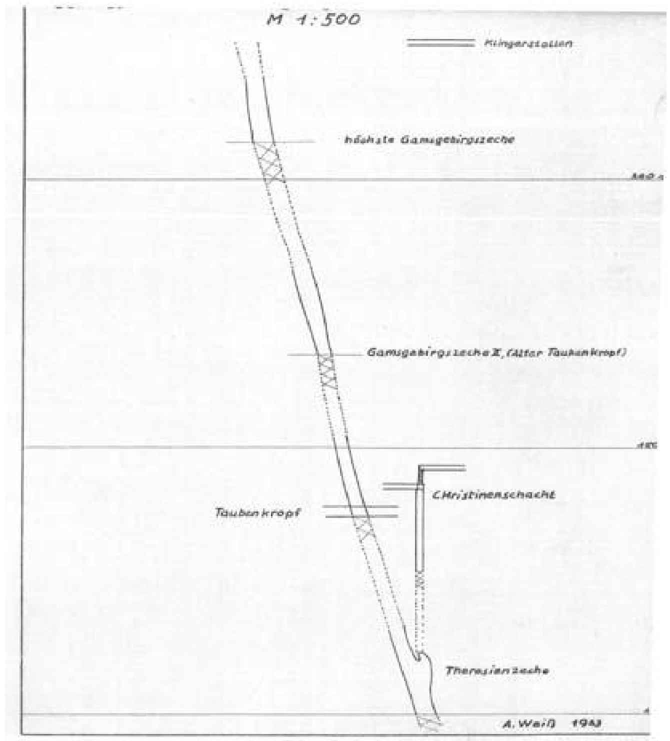

Figure 48: Mine Levels in NE-Field Mine Complex

Entrances to the three interlinked underground mine buildings of the NE Field (e.g. Johannes -, Taubenkropf - und Klinger- Baue are from the deepest gallery the Johannes Base Tunnel ("Erbstollen"), the Taubenkropf Unterbau (Base Tunnel) and the Klinger Stollen (Gallery) (Fig. 48). These main tunnels created access to a great number of stopes ("Zechen") of various sizes, where often high grade mineralized rocks were mined from several vein systems of various strike directions (HADITSCH, 1967). They are:

A: N-S oriented veins and stopes (from W to E):

- Feldort Zeche
- Gamsgebirgszeche II & III and Leozeche in the upper Gamsgebirgszeche and Theresienzeche
- Vein at Kreuzschacht
- Gabe Gottes Zechen with "Old Veronika" and Veronika Baue
- Zeche IX
- Three veins at the collapsed „Middle Shaft"
- Heiligengeist Baue
- Barbara Zeche and sheared off vein of Johannes Zeche
- Vein at the Taubenkropf south of the "Weite Zeche"
- The New ("Neue") Zeche
- Franzenszeche I, II and III

- Vein of Anna Zeche
- Vein at the “Old Shaft”

B. NW - SE oriented Veins:
- Marcasite Vein at Gamsgebirgszeche II and III
- Goisernbau and Gamsgebirgszeche I
- Erika Zeche
- Sigrid Zeche
- Connection from Neue Zeche to Franzens Zechen as well as “Bau” between Franzenszeche I and II
- Taubenkropf Zeche

C. NE – SW “Baue”:
- Klinger “Strecke” and NW portion of Goisernbau
- Weite Zeche
- Baue between Barbara Zeche and Cross cut I
- One Vein at the Franzenszeche II
- Anna Zeche
- Baue SW of Franzenszeche II and two Veins at the “Kalte” Shaft

D. E – W Veins:
- Klinger Bau
- Stope at the “Schleierfall”
- Zeche X
- Stopes at eastern side of “Neue Zeche”.

As described by HADITSCH (1967) the four groups of veins represent different ages of mineralizations’ . The oldest is that of Group “A”, the N-S striking vein. The vein, by average 4m thick, has been followed for 125 m vertical and a length of 75 m.

From the view of the genetic origin and interactions of tectonic structures and mineralizations HADITSCH and WEISS (1962) established the following sequence:
- Structural opening of the N-S fractures
- Mineralization of the fractures in part by metasomatic Iron-carbonates and by Sulfides
- Thrusting of the hanging wall in the range of about 1 to tens of meters to the West along E-W and WNW-ESE faults dipping about 45° to the N and/or the S, subsequently filled by Barite
- NW-SE Fault with strong thrust of N-block to the NW (WEISS, 1967), fractures filled by Marcasite; a thrust of 65m offset Gamsgebirgszeche vein against the vein of Kreuzschacht
- NE-SW faulting with weak Sulfide mineralization, extensive thrust of the Western block to the SW
- Re-activation of NW-SE fault system
- N-S oriented shearing with limited offset of western block to the S, forming open fractures, which served as conduits for karst-type cave formation. Where these fractures affected mineralized N-S veins the sulfides were strongly oxidized with the formation of cementation at the same time.

The more western section of the mine belongs mostly to what is called the Klinger Baue, also the highest mine level in the NE-Field (Fig. 48). The South-Eastern section of the mine building is part of the Taubenkropf

Baue, the Central level, and the North-Eastern segment of the mining complex is accessed by the Johannes "Erbstollen" (Base Tunnel), the lowest mine level (Fig. 48 & 49).

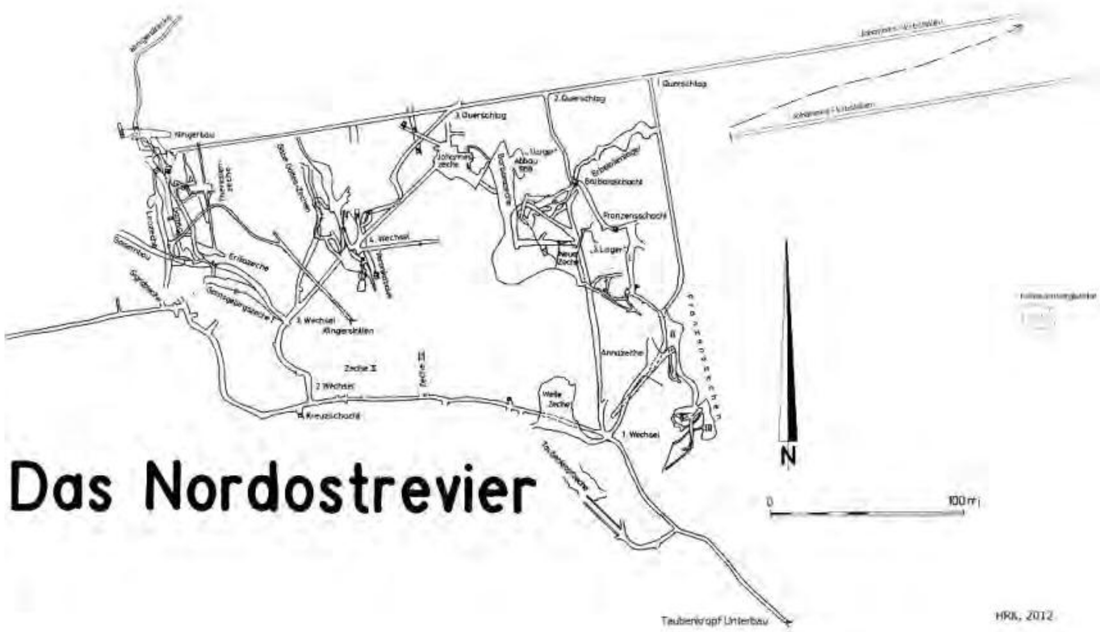

Figure 49: Plan View of the NE – Field Mining District Underground Mine Building (after HADITSCH, 1967)

The following tunnels, drifts and stopes belong to the so-called "Klinger Bau" (Klinger Mine) (Fig. 50):

- Klinger Mine, Klinger Unterbau and Klinger Drift,
- Theresienzeche,
- Gamsgebirgszeche I, II and III, and top of Gamsgebirgszeche – the Leo Zeche,
- Goisernbau,
- Sigrid Zeche,
- Erika Zeche, Feldort Zeche and Stope at the "Kreuzschacht".

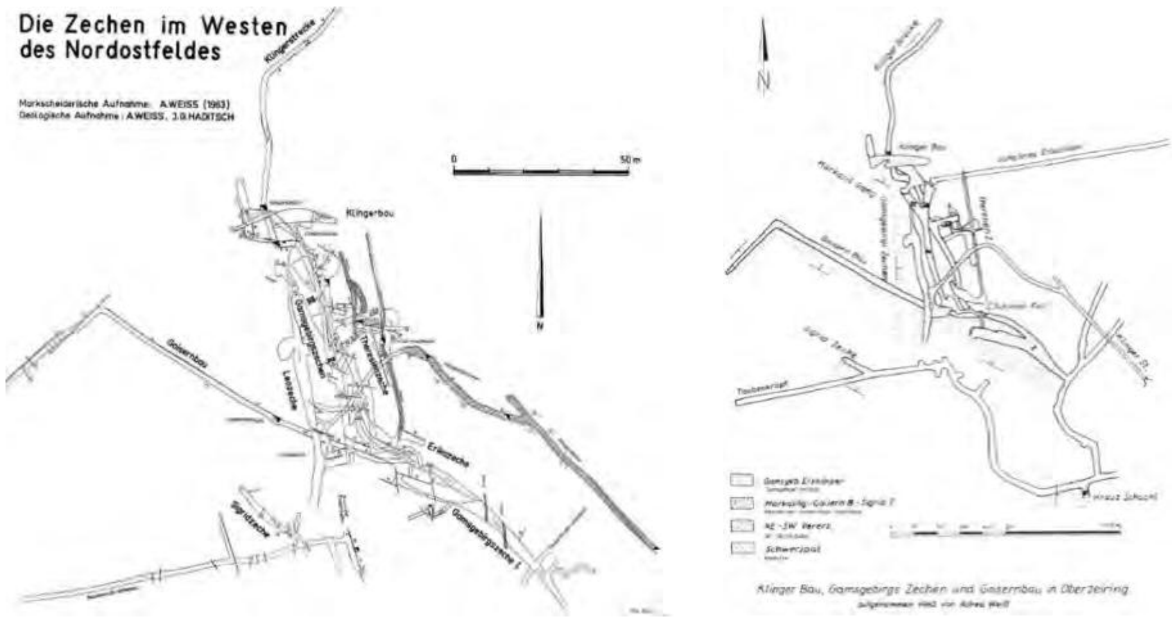

Figure 50: Plan Views W Part of NE Field: Klinger Bau – Gamsgebirgs-, Erika-, Leo-, Sigrid-Zeche, Klinger- and Goisernbau (HADITSCH, 1967 - l) and (mapping by WEISS, 1962 – r)

The mine segments belonging to the **Taubenkropf Baue** (Fig. 51) are Gabe Gottes Zechen I, II and III in the western part (Fig. 51, left) and the Weite Zeche, Anna Zeche, Gabe Gottes Zeche and Taubenkropf Zeche (Fig. 52, left & right).

The N-S striking Veins:-

The N-S striking vein(s) of Gamsgebirgs Zechen II and III, the Leo Zeche and the Theresien Zeche belong to the Klinger Baue level and will be described therein.

The main mineralization of the vein mined in the Gabe Gottes Zeche was Siderite. The steeply dipping and N- S striking veins appear to be broken up by numerous faults. The deepest level, where the vein was mined, is the level of the Johannes Erbstollen (Base Tunnel). The highest level about 66m above is at the Gabe Gottes Zeche (Fig. 51, 52, 54 & Fig. 55). The vein is exposed/was mined over a vertical length of over 100m and a width N-S of about 70m (HADITSCH, 1967). The old stopes at the top haven't been accessible already in the late 1950s.

The Veronika Baue (Fig. 53, & 54, left) have a vertical extent of over 50m with extraction of material from a shaft (Veronika Shaft III) below the Johannes Base Tunnel level. The stopes are limited to the N by a number of narrowly spaced faults, striking WNW to NW – ESE to SE, dipping NNE to NE at a medium angle. They cut off the Siderite and Barite mineralization. Further North old stopes (the "old" Veronika Zeche) continue in what has been Siderite-Barite ore, but there is no longer access to that area. The names of the workings are the "Great" (Große) Veronika Zeche and the Upper (Höchste) Veronika Zeche. Typical for Veronika and especially for the Große Veronika Zeche are small layers and pockets of Barite deposited underneath more or less flat lying pegmatites. The older pegmatites acted like an impenetrable seal for the ascending Siderite and Barite solutions. Polished ore sections from samples collected in the South of Große Veronika showed traces of Cinnaber (HADITSCH). Frequent Karst-type tubes in the marble are often limonite-filled, metal oxides that also were extracted during the Iron-mining cycle of the Ober-Zeiring Mine. HADITSCH also reports that along the footwall boundary substantial stocks of Barite had been observed.

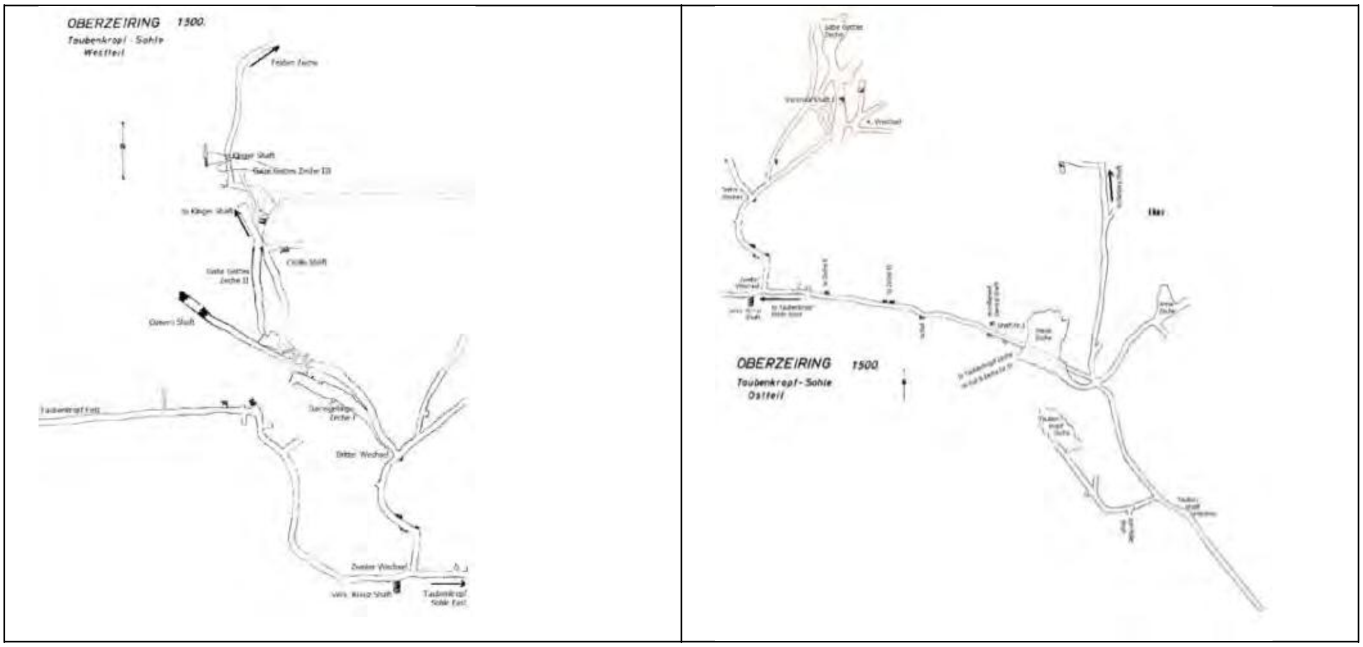

Figure 51: West (l) and East (r) "Sohle" (Horizon) of the Taubenkropf Baue (Mine) with its directly connected Stopes (Arch.GBA)

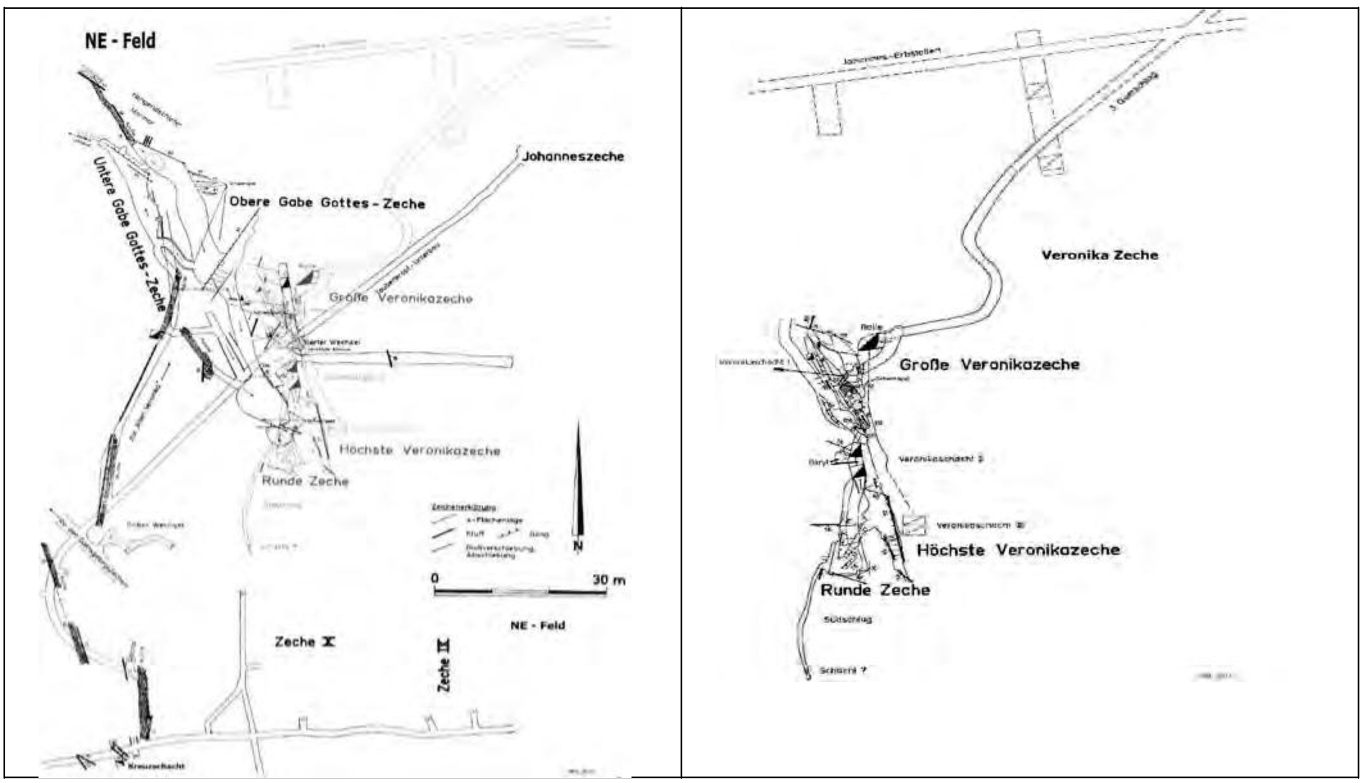

Figure 52: Plan View - lower level mid-part: NE-Field Stopes: Gabe Gottes-, Veronika- & Runde Zeche (l) – Plan View - Lowest Level Central NE Field Stopes: Veronika Zeche & Johannes Base Tunnel (r.) (after HADITSCH, 1967).At the left lower corner is the drift connecting to the Western mine workings.

The Große Veronika Zeche lies between Veronika Shaft I and II with a strike extent of about 22m. To its South mining continued in the "Runde Zeche" (Fig. 52, right). In contrast to the sealing of the ascent of the mineralized solutions by impenetrable pegmatites at Runde Zeche the "seal" has been broken locally by often mylonitic shear zones allowing mineralizationbearing fluids to ascend further up where they were mined in the

“Highest” (Upper) Veronika Zeche. Pegmatite is from flat lying to about 30°SE dipping. The Siderite mineralized rocks of the Runde Zeche in the footwall of the pegmatite are relatively rich in quartz, which means that the SiO2-solutions ascending into the marble formation later were collecting under these pegmatites, too. The upper stopes were back-filled and are no longer accessible.

The upper-most stopes of Veronika still accessible today (e.g. certainly in 1967, after HADITSCH) lie still about 5m below the Taubenkropf Base Tunnel) (Fig. 51, 53 & 54) (“Unterbau”).

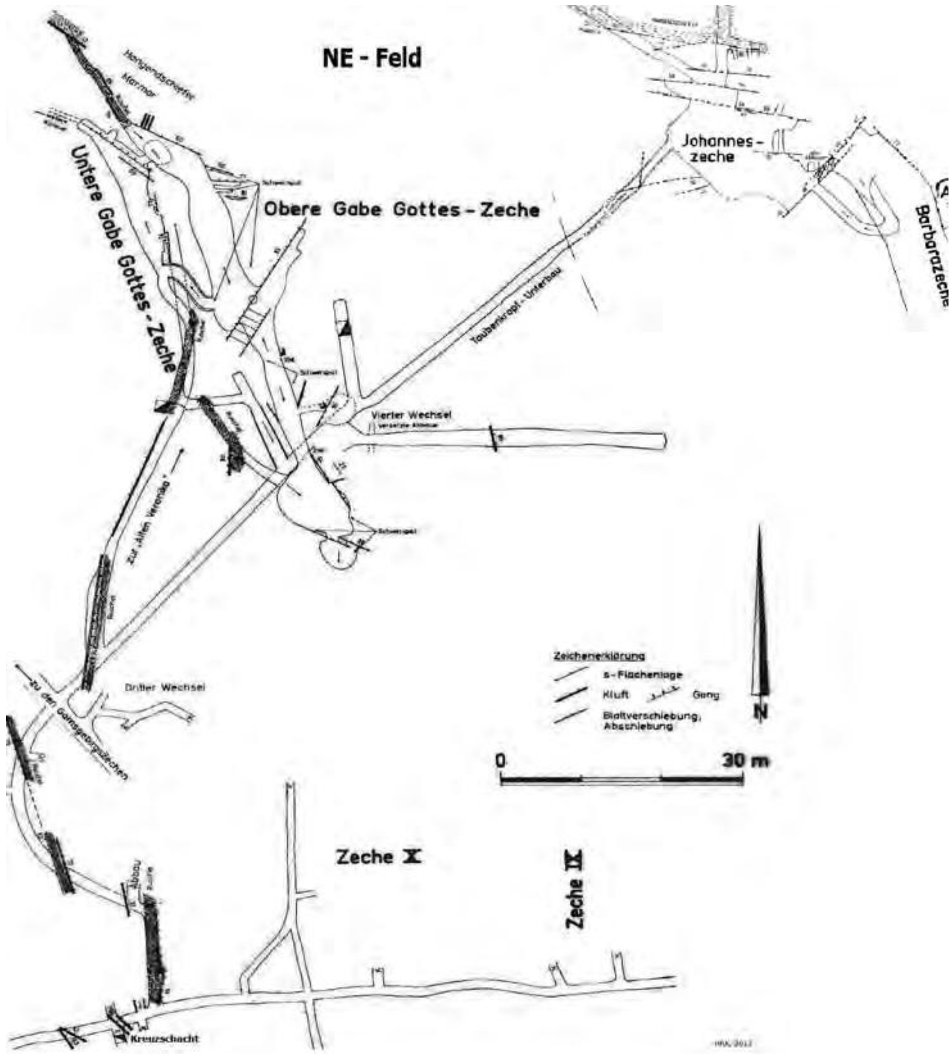

Figure 53: Plan View of the upper – Taubenkropf – level, the mid-part of the NE Field Mine Building: Gabe Gottes-, Johannes- and Barbara Zeche and Taubenkropf Unterbau (after HADITSCH, 1967). At the left lower corner is the drift connecting to the Western mine workings

The extensive Gabe Gottes Zechen (Fig. 50, 51, 52, 54 & 55) are at a level above the Taubenkropf Gallery and could/can (?) be reached from the Taubenkropf Unterbau Tunnel via a raise, which connects to the Lower Gabe Gottes Zeche from the North. The stope has a length of about 25m and a thickness of 3-4m. It shows repeatedly Barite that had replaced the marble. A kink in the Northern portion of the otherwise straight stope room was caused by a fault dipping 60°NE. Many small stopes at the base or below the Lower Gabe Gottes Zeche have been backfilled.

At the southern end of the Zeche is a shallow raising drift, which leads to the considerably larger and more extensive Ober (Upper) Gabe Gottes Zeche. It has a length of about 35m and a maximum width of 5m. A fault along its middle dipping 81° WNW is mineralized and therefore precedes the mainmineralization stage. However younger syn- or post-mineralization fault movements are evident (HADITSCH, 1967).

In the North the Upper Gabe Gottes Zeche is limited by a 60°NNE dipping fault, which disrupts older NNE-SSW striking fractures. Several lateral stopes still show remnants of Barite. HADITSCH observed here that emplacement of Barite, Siderite and possibly also Silver-bearing Galena followed the banking of the marble. Here too, the observation was made that locally pegmatites served as a seal for the ascending mineralized solutions damming them up. A small stope at the southern end of the Upper Gabe Gottes Zeche shows some Siderite and ends in the mica schist of the hanging wall. This is proof that the mineralized solutions were able to ascend all the way up to the mica schist roof of the formation.

The mined space of the Upper Gabe Gottes Zeche is even larger than the one of the Lower, but the amount of replacement of host rock by the ore minerals is less extensive than in the Runde Zeche (HADITSCH).

A comparison of the mineralization of Veronika Baue and Upper Gabe Gottes Zeche after HADITSCH points to the following:

- The lower Veronika Baue show more Pb-Zn mineralization
- The Veronika Baue is always limited by a hanging wall pegmatite
- The Veronika mineralized zones in general are less wide than the Gabe Gottes Zechen:
- The Gabe Gottes Zechen carried more Siderite and Barite
- Pegmatites as upward sealing rocks are much less frequent, and
- The hanging wall mica schists proved impenetrable, damming the ascending mostly Iron and Barium carrying solutions.

The Barbara and Johannes Baue (Fig. 53, 54 & 55) are located in the NE of the NE Field mine building. The Barbara Zeche is the largest underground mine stope known in Ober-Zeiring. The measures of the vein mined here are 80m in length, 9m in thickness to almost 25m in the Southern portion. These dimensions include the Johannes Zeche vein block, which appears sheared off from the Barbara vein. The roof of the Barbara Zeche is about 100m above the Johannes Erbstollen, the lowest part is at 30m but could go as low as 15m above Johannes Stollen(An 80m of vertically mined vein). Features including Remnants of Barite on the stope walls, back-fill material types, larger blocks that resulted from caving, the "vein" mined at Barbara being not a single vein but a vein split up in many parallel veins separated by posts of marble up to a meter wide. These characteristics were most probably the result of mineralized solutions penetrating the more or less vertical shear zone with closely spaced fragmentation of the marble during their ascent into the host rock. The Barbara and Johannes Zeche also show many signs of karst-type dissolution of the marble, indicating that the whole open space of the stope was not solely caused by mining operations.

Barbara Zeche is limited to the S by a 70°ESE dipping fault and to the North by a steeply SE dipping to vertical fault where the Johannes Zeche vein block was thrusted in SW direction. Its Eastern wall is formed by a fault dipping 73°NE, separating the Barbara vein segment from the Barite "1958"-stope. Its Western wall still shows vestiges of the metasomatic Siderite contact of the vein with the marble host rock.

<u>Johannes Zeche</u> lies below Barbara. It has an almost square shape of 23m x 12 m. Its height corresponds to that of Barbara Zeche, its floor is at the mine level of Taubenkropf Unterbau, but is covered with caving-ins. HADITSCH (1967) estimates the whole width of the vein here to be 5 to 6m. Even though the main vein material was Siderite, there is no doubt from fragments left behind that a vein up to 0.5m wide composed of polymetallic sulfides with Silver was asymmetrically accompanied by a Barite contact zone in the marble. Since the top of Barbara Zeche coincides with the upper apex of the Ober- Zeiring anticline and is close to the marble's contact with the hanging wall mica schists, HADITSCH concludes that from Barbara Zeche's floor upwards this polymetallic Sulfide-Silver vein had increasing volume due to damming of the ascending mineralized solutions by mica schists.

By referring to the map of Fig. 54 of the Barbara-Johannes Zechen mine important details about the influence of local tectonic structures on the mineralization forming process can be explained:

<u>N part of Johannes Zeche:</u>

- Three large faults with dip 50-75°N and strike W-E to WNW-ESE, limiting the Siderite bodies of some small stopes verticaly These faults running parallel to the marble.-schist boundary show intensive mylonitization
- N-S striking and W dipping shearing, observed in the drift from Johannes Zeche to N belong to a younger tectonic phase
- Fault in the SW-wall of Johannes Zeche and the drift to Gabe Gottes Zech, cutting the N-S faults are therefore younger events.
- The SE part of the Zeche is of special importance:
- Fault thrusting the Johannes Zeche part of the vein about 12m SW from the position of Barbara Zeche. Old stopes lined up along this NE-SW fault system show post-tectonic veins. These stopes usually show a tube of bubble-type shape. HADITSCH identified it as Bournonite-Barite mineralization.

The <u>Neue Zeche</u> is 7 - 10m wide, 25m long and lies 35 to 60m above the Johannes Zeche. It holds a N-S striking Siderite vein. The S-part is cut off by a steep NNE-dipping fault.

- Of the three drifts on the E wall (HADITSCH) of Johannes Zeche one departs from the lowest Zeche level following a NE-SW fault.

- One departs from the middle of the Zeche leading to the main stope of Lager III.

- The wall between the two and the Zeche's roof still show Barite replacing marble along the s-bands and fractures oblique to s1.

- The boundary of Barite to Marble is irregular with dips of 122°/25° and 273°/83° and probably fault related 89°/82 in the lower drift.

- The NE as well as the SE fractures appear younger than the Siderite vein emplacement. Barite is found either along the contact zone of the Siderite vein with the host rock or in form of a thick vein alone ("III: Lager") – a post-Siderite Barite mineralizedshoot in younger fractures.

The pre-Barite tectonic activities here must have been very weak, since the older Siderite doesn't show signs of cataclasis.

Access to the Franzens Zechen I to III was reopened during the 1950s via the newly cleared 2nd Cross-cut turning off Johannes Erbstollen and the Franzens Shaft. They are the stopes of the lowest level in the NE Field mines, from slightly – 15m (Zeche II) - below to slightly – 32m (Zeche I) - above the Johannes Erbstollen. They extend NNE-SSW over 36m (Zeche I), 55m (II) and 21m (III). A fault dipping 45°NE was observed between Zeche II and III. The one, maximum two veins related to this fault direction carried Siderite, Hematite, Pyrite (after APFELBECK) and Barite (after FRIEDRICH and TOTSCHNIG) plus "noble" Galena mineralization. By average the vein's thickness was 2 - 3m.

The Anna Zeche (Fig. 55) to the W of Franzens Zeche II already belongs to the next higher mine level, the Taubenkropf Unterbau.

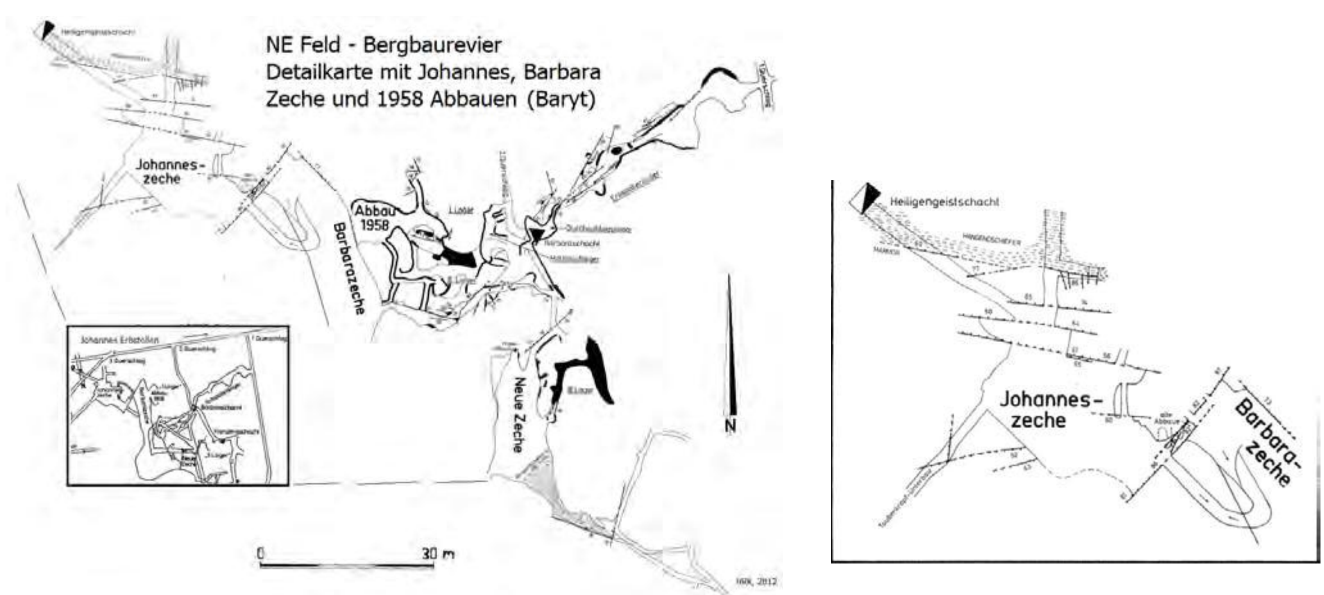

Figure 54: Plan View Detail of the eastern NE- Field Mine Stopes Johannes Zeche, Barbara Zeche and Neue Zeche and the Barite Mining Stope of 1958 (left) – Detailed Map of Barbara and Johannes Zeche (right) (after HADITSCH, 1967)

The NW – SE Vein:

To this type of mineralized veins belong the Marcasite vein of the Gamsgebirgs Zechen II and III (WEISS, 1967). Two to three formerly mineable mineralizations were observed as characteristic

A narrow vein was followed and mined by the old miners between Neue Zeche and the Franzens Zechen. The Southern limit of Neue Zeche (Fig. 54) is a steeply NNE dipping down-thrusting fault. Following this fault along drifts and old stopes the Taubenkropf Unterbau could be reached. A mineralized vein followed and mined here was a vein parallel to the main vein. Further N a third steeply NNE dipping vein was mined. Another vein was mined between the Johannes Erbstollen and Taubenkropf Unterbau via the NW appendices of small stopes of Zeche II and Franzenszeche I (Fig. 55).

All of the veins were mined mainly for Barite, but there is enough evidence that Ag-bearing mineralization were also exploited. Younger tectonic elements are steeply W dipping N to NNE, striking horizontal faults, where the eastern block was moved to the N. Such faults have been observed at Taubenkropf near the Changeover I, along the drift between Neue Zeche and Taubenkropf and at a small stope between Franzens Zechen II and III.

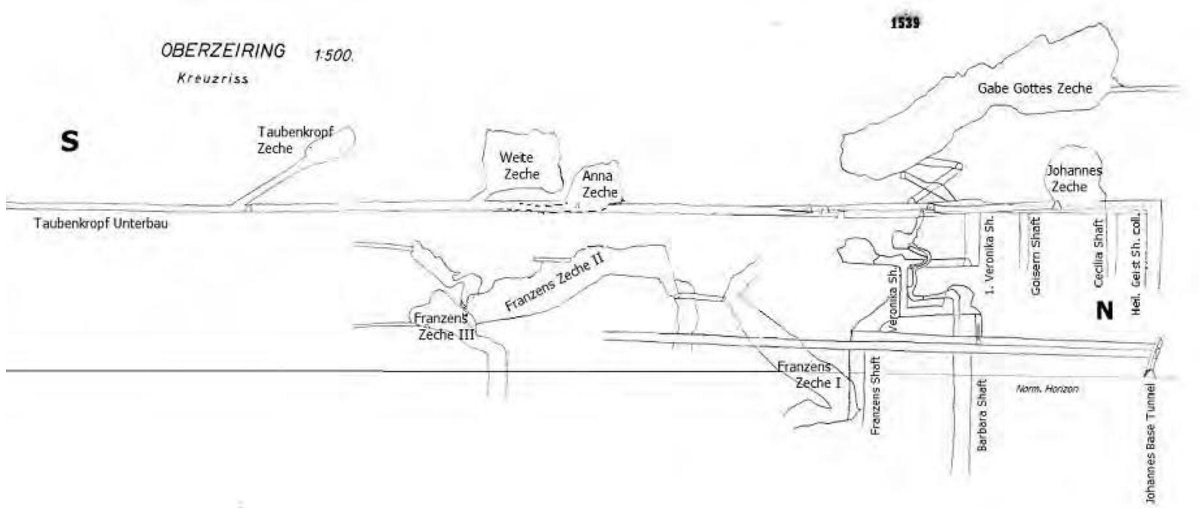

Figure 55: S – N Profile through the Ober-Zeiring NE-Field Mining Complex with the Johannes and Taubenkropf Unterbau Mine Levels (from: Min. Arch. GBA, Vienna)

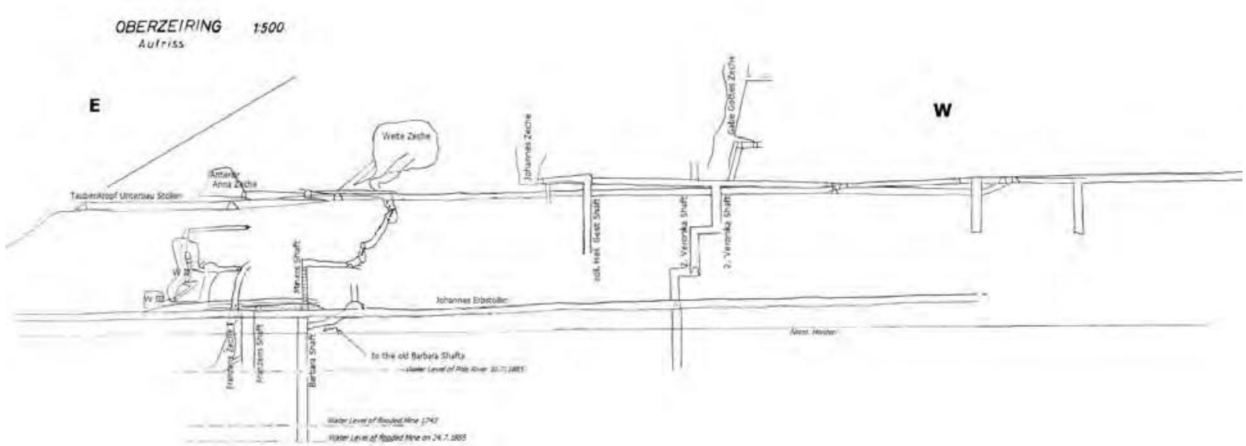

Figure 56: E – W Profile of the Ober-Zeiring NE-Field Mine Complex with Johannes and Taubenkropf Unterbau (from: Min. Arch. GBA, Vienna)

The old Taubenkropf Zeche (Fig. 54, 55 & 56) could be reached from the Taubenkropf Unterbau via a drift traversing a series of mica schists dipping 47°SE and a series of faults in WNW direction over a raise, which no longer is open. The N-S section (Fig. 54) demonstrates that the uppermost part of Taubenkropf Zeche is 61m, the uppermost part of Weite Zeche 60m above the Johannes Erbstollen. Both show a dip S, but are emplaced in different layers of the marble host rock; e.g. they are two different veins. The elongated open space of the Zeche, where the second much thinner vein was mined has a width of about 6m to 10m. It is hosted in upper layers of the marble host, one of few examples for these top marble layers being mineralized.

Here too, like in the western part of the NE Field Mine, NW-SE oriented faults (WEISS, 1963) show shifts of the fault blocks, but these are smaller than in the West:

The shift of Franzens Zeche against Zeche I is about 20m to the SE, and Zeche III only 10-12m NW.

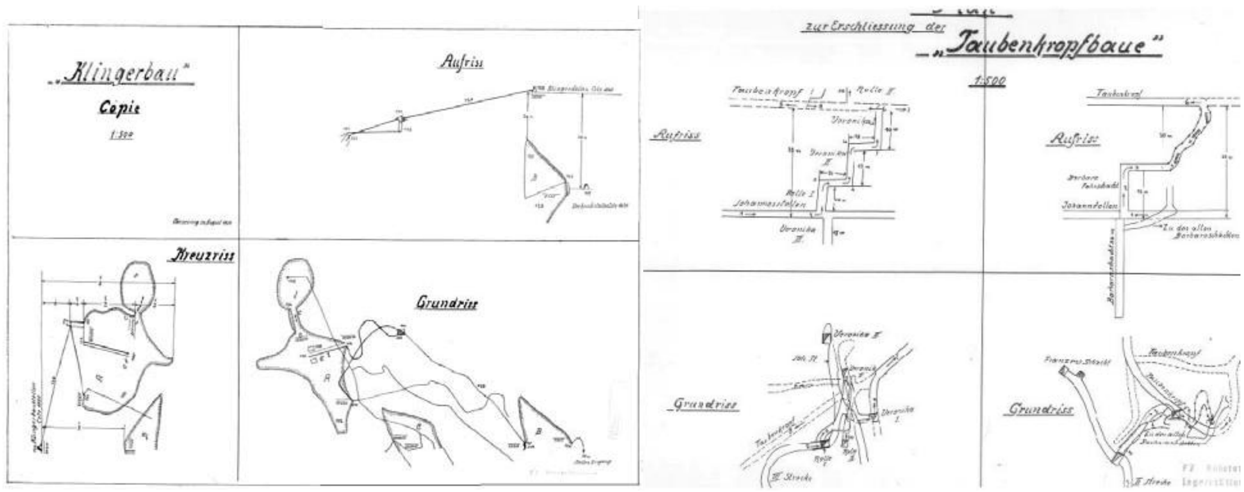

Figure 57: Vertical Profiles of the Klinger Baue (left) and the Taubenkropf Baue (right) with their Connection to Johannes Erbstollen

<u>The NE – SW Veins</u>

There is great difference between the NE-SW veins at Klinger Baue (Fig. 57, lft.) in the W of the NE Field Mine and the East Anna Zeche, Erbstollen Lager; that is in relation to the age of the mineralization emplacement as well as their mineral paragenesis and its intensity (HADITSCH, 1967, WEISS, 1963 & 1967).

At the Klinger Baue, for example SW of Goisern Bau, there is a weak mineralization of vein-like fractures filled with sulfides. In contrast at the Erbstollen Bau there is an intense replacement of older host and vein material by Barite - (Bournonite) that is older than the Klinger Baue mineralization. At the Erbstollen a strong revival of the NE-SW faults is observed, which is much weaker along the NE-SW faults between Barbara and Johannes Zechen and nonexistent in the western area of Klinger Baue.

At the Johannes Erbstollen level HADITSCH suspects that stopes for Siderite had once existed. The Erbstollen Lager, however, has been dominated by Barite metasomatosis, which followed areas of fine brecciation of the marble, leaving larger unbroken blocks unaltered. The matrix of the vein was Barite with Bournonite as the Silver bearing mineral.

HADITSCH summarizes the structural and the mineralogical sequence as follows:
- Pre-metasomatic Phase
- Expression of a WNW trend with opening of fractures, and
- Brecciation along SW-NE fractures, leaving finely ground network and large unbroken blocks of marble followed by Barite metasomatosis.
- Post-metasomatic Phase
- Steep NNW to NNE/SSE to SSW striking faults with slip and /or upward thrust,

- ENE to ESE/WSW to WNW striking shearing dipping flat to steeply to the S
- WNW/ESE striking faults with steep SSW dip
- NE/SW striking medium to steeply dipping NW horizontal slip faults.

The E – W Veins

HADITSCH discerned two different types of veins: Type 1. The Siderite vein of Zeche X, and Type 2. The Barite veins of Klinger Baue, the stope near Neue Zeche and the Barbara and Neue Zeche, and the Barite "Lager" I, II and III.

The Zeche X vein started directly above the Taubenkropf Unterbau and was mined over a vertical 38m and a length of 48 m. The vein's thickness increased in an even way from the bottom of the stope to its roof to about 18 m. The vein's limits are a N-S fault in the West and mica schist at the roof. The dip was 70° S, and it is interpreted as a mineralized h01 opened fracture (HADITSCH). Mineralization was by metasomatosis.

The mineralized bodies of the Klinger Bau and the Stope near the "Schleierfall" are located 70-80m and 124m above the Johannes Erbstollen.

The Zugthal Mines

Historical research by BRACHER (1970) points out that it was this area, where mining activities started long before they spread out to the North to Ober-Zeiring and its "Erzberg". A report by DEADDA (1743) somewhat supports these findings.

HADITSCH (1967) reports that on a map by DEADDA three mine locations are indicated:

- An Adit of possibly 113m directly S of Blabach, where a vein was followed southwards, which corresponds in its strike to the vein in Pier Mine, e.g. the direct southern continuation of the main Pier mine vein.
- An adit on the western slope of the Zugthal, also in the continuation of the Pier mine vein trends. About 47m long it encountered only Quartz veins, but no ore was reported.
- Directly next to the path up the Zugthal is an adit at mineralized outcrop. Its strike corresponds to the strike of the Pier mine vein, too. Barite and Quartz have been identified.

The South Field Mines

The South Field or the "Mines at the Purgstallofen" are located to the SW of Unter-Zeiring, where a tectonic block of E-W striking Bretstein Marble forms a distinct marble cliff, the so-called "Purgstallofen". The block is limited at both sides by mainly N-S striking faults. Here the main and most prominent mines of the South Field are the Matthias Baue (Fig. 58). The mapping is by TOTSCHNIG and has been verified by HADITSCH, 1967.

At Matthias Baue two mine adits are or have been still open by 1967. The first and smaller one including a small stope is the "Oberer Stollen". A few meters after the entrance begins a 55° inclined shaft, which led to small stopes. It is no longer accessible after a few meters, however strong air draft from its depth points to the fact that it must have been connected to the larger and by its altitude lower Matthias Bau. Material found at the dump indicates that a rather poor mineralized material was mined here.

Another parallel vein was mined at Matthias Bau, in a stope of about 100m extent along strike and an estimated 90 to 100m down-dip. The stope's mineralized body is embedded in a strongly brecciated marble, very rich in Graphite at the W end. Little remnants of mineralized rocks and also traces of "Zeiringite" have been found.

(WALSER, 1974) reports of "very strong" geochemical anomaly for Lead and Silver in the area of the old workings, however, there is no more detail about the source, the type of samples and actual results of the geochemical analyses.

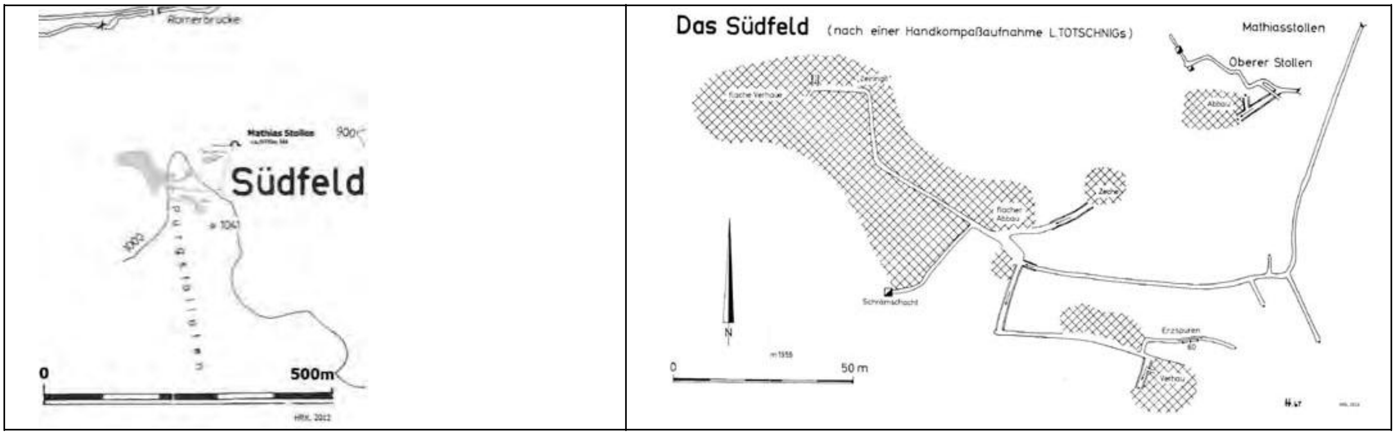

Figure 58: The Geography of the South Field (left) and a Plan View of the Matthias Baue (right).

The Katzling Zone

As described earlier the Katzling Zone of ancient mining centers extends from Unter-Zeiring, S of Matthias Baue via Winden, Katzling, and Pichl to Pöls (Fig. 59) along the western ridge of the Pöls Valley. There are a number of old mining centers beginning with the "Treffenthaler" Stollen (Adit), S of Matthias Baue, and further to the SE along the ridge and/ or the foot of the ridge with centers "A" to "G". Of these the Center "D" on the South side of the Klum Creek valley is showing the most intensive and frequent signs of former exploitation (Fig. 61).

Figure 59: Topographic Map of the Katzling Zone with Locations Matthias Baue, "Treffenthaler" Stollen, and Mine Centers "A" to "G"

The Treffenthaler Stollen (Adit)

The Treffenthaler Adit is located about 50m NW of the farm house "Treffenthaler", but its entry is collapsed and only visible by its glory hole. The adit was oriented towards 270°W (WALSER). Judging from the lack of an extensive mine dump it must have been just an exploratory adit, even though there are stories that once there was some mining activity. In contrast to Matthias Baue, where geochemical anomalies around the mine are external signs of Silver-bearing minerals having been mined, no such anomalies have been found here.

The Katzling Zone Mine Centers „A"and "B"

The entrance to the mine at "A" is located (Fig. 59) about 600m SW of Ober-Winden at an altitude ASL of 1080m (WALSER, 1974). With a system of Karst-type caves in the massive marble at this location nature simplified the old miners' work to find and follow the mineralization. The orientation of the mine and cave follows two main faults with polished slickensides. Two stopes are lined up along the fault striking NW-NNW to SE-SSE and dipping 45E. There, WALSER could only observe limonitic crusts on the marble. Along a drift following the same fault at a lower level only clayey joint filling was found. At the sidewalls WALSER observed hand-sized pods of Barite (Fig. 59) and he speculates that PM-bearing minerals was mined. There a hand-carved crawling drift (H) probably was used to transport the mineralized material to the surface. It is collapsed close to the surface.

To the S of the Mine "A" (Fig. 60) a blind shaft follows the other fault striking ENE-WSW with a dip 85°N. The shaft is filled after several meters, but its purpose must have been to connect from the higher "A" mine level to several lower stopes and adits, which are no longer accessible, but numerous dumps below "A" give testimony that mining activities were spread out.

WALSER mentions a weak Silver anomaly in this area (without showing detailed analytical results), and larger boulders of very porous limonite-stained marble with traces of Malachite below some of the dumps. This observation together with the showing of Barite along the side walls of the Mine "A" lead to the conclusion that Silver ores were mined here before.

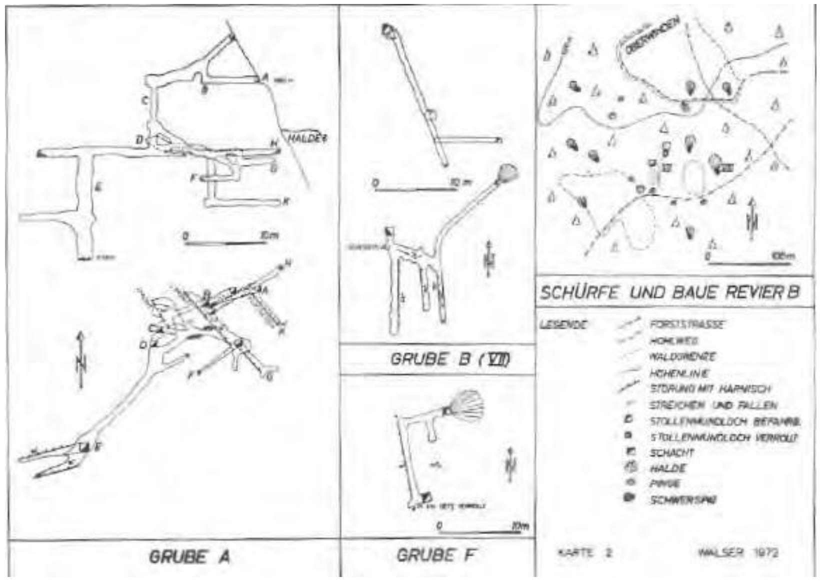

Figure 60: Plan View of Katzling Zone Mine Centers „A", „B" and „F" Adits and/or Adit Locations

Mine Center "B" is located from "A" right across the valley about 600m to the S of Ober-Winden. Here a hand-carved crawling tunnel leads to the Mine "VII" in NE direction. The entrance to the mine is located in a Karst-cave. The tunnel continues along a fault with strike and dip 355°/70°E. Apart from some pieces of Arsenopyrite found at the mine entrance, no other indication was found about what minerals were mined here. Another mine portal (Mine "VIII") located about 50m to the E of "VII" is surrounded by numerous collapsed galleries with mine dumps.

The Katzling Zone Mine Center „C"

Mine "C's" location is W of Unter-Winden at the bottom of a small valley. The gallery was oriented in SW direction. The portal is collapsed, but a large mine dump of about 500m³ indicates very active and extensive mining in the past. This seems to be confirmed by a weak Silver anomaly.

The Katzling Zone Mine Centers „D" and "E"

The old Mine Center "D" is located slightly to the S of Katzling. It is spread out over the Eastern slope and ridge of the Klum Creek valley covering an area of about 500 by 400m. WALSER counted up to 18 old mines with a significant enough mine dumps, plus an uncounted number of collapsed exploratory adits (Fig. 61).

There is a anomalous level of Silver, Lead, and Zinc in the soil around the cluster of mines, with the exception of mine site V (Fig. 60), which did not show anomalous values (WALSER, 1974). The host rock to the mineralization is a massive to brecciated marble steeply dipping, with a NW-SE strike. A set of parallel faults with the same NW-SE strike have cut through the marble. They also are parallel to the main Pöls River Valley "Graben-bruch" faulting, recognized and accepted by researchers of the Zeiring deposits as the main conduit for the ascent and the emplacement of the mineralized solutions into the Bretstein Marble.

WALSER's research work (1974) included a study of the material deposited on the Mine IV dump. Polished sections of mineralized rocks were studied by HADITSCH, who found droplets of Chalcopyrite in Galena-bearing rock with Sphalerite, indicating a mineralparagenesis of Galena, Sphalerite and Chalcopyrite as the main constituents and pyrite as a frequent accessory. The Bretstein Marble itself also contains a elevated primary content of disseminated Pyrite.

- The Adit of Mine I (Fig. 60) is at 1070m ASL. It follows a 160°/70°W joint. A cavernous cross-cut follows a fault of 280°/85°S with slickenside. After a few meters both are collapsed. The only indication for mineralization is limonitic crusts.
- Mine II at 1030m ASL also follows the strike of the marble split up by a bundle of joints oriented 135°/65°. Mine II is no longer accessible, but a large mine dump indicated substantial mining activity.

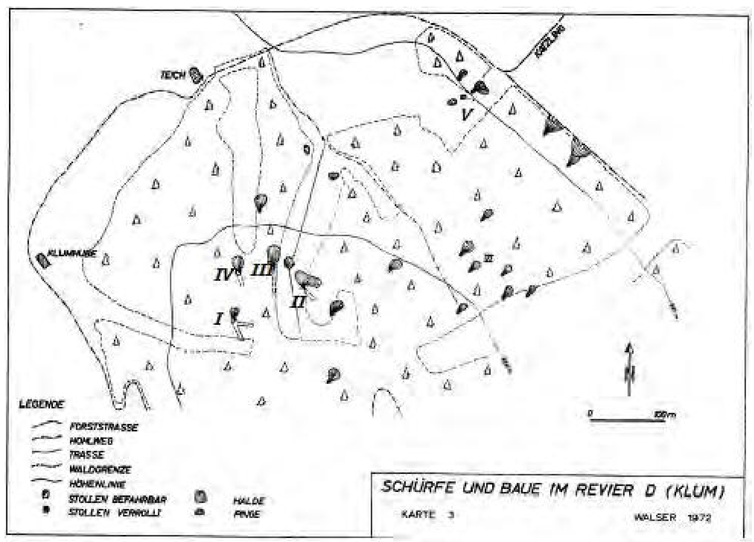

Figure 61: Plan View of the Katzling Zone Mine Center "D"

- Mine III at 1020m ASL shows a similarly large mine dump. The adit following a fault of 145°/40°NW direction is collapsed after 14 m (WALSER).
- The portal of Mine IV at 1010 m ASL, W of III, is no longer accessible. It followed a 330°/55°W oriented fault line. WALSER doesn't report any findings of mineralized samples here.

The substantial dump site and collapsed portal of Mine V is located close to Katzling and can be reached via a forestry road to the Klum. A 50m hike westwards up the slope leads to mine and mine dump at 900m ASL. Judging from the line of sink holes the gallery of Mine V followed a direction of 235° SW. The size of the dump indicates a deeply penetrating tunnel, which probably never reached the mineralized zone (e.g. lack of mineralized sample material and no signs of a geochemical anomaly at the Mine V site). 30m further W is a small dump with a collapsed adit portal in the outcropping marble.

By following the forestry road eastwards for 100m and 150m after a turn two substantial mine dumps of two no longer accessible galleries can be found. They were interpreted by WALSER as base tunnels to undercut the mines above (VI). WALSER visited the mine dumps right after a new a forestry road cut through them, offering

fresh material to be collected, but couldn't find any mineralized samples.
Mines at the area "VI" showed a considerably anomalous value for Silver and very large mine dumps, both indicating that a fair amount of Zeiring's Silver production took place here (WALSER).

Figure 62: Discovery of old adit in Mine Center "D" with a Karst-cave type of entrance (silbermine.at)

The Mine at point "E" (Map, Fig. 59) further up-hill and S of zone "D" (Fig. 62), about 100 m to N of the peak 1188 m (ASL), is considered as a part of Mine Center "D" by WALSER. The entrance to what was a small exploratory adit or mine is collapsed.

Figure 63: Entrance to Mine "F" in brecciated Marble (Photo silbermine.at)

The Katzling Zone Mine Centers “F” and “G”

Mine and dump of Center “F” are located at ASL 960m about 50m above the tree-line, to the SSW of Pichl in the Pöls Valley at the foot of a high cliff of brecciated marble that forms a ridge there. Drifting of the tunnel (Fig. 63) of 1.20m was by setting fire (WALSER, 1974). 6m from the entrance it traversed a fault (350°/60°W), followed to the S by the old miners for 10m, reaching a cave-like opening. There a blind shaft was bored, which today is filled to a depth of 4m. A layer of black schist runs parallel to the fault. No mineralization is noted here except the often encountered limonitic crusts covering the mine’s wall and roof. Geochemical analysis shows slightly anomalous Zinc values (WALSER). Compared to the size of the part of the mine still accessible today (1974) the mine dump’s volume indicates a much larger mine building, when the mine was in operation.

Mine “G” after WALSER can be reached to the S of the Katzling Zone SW-ward from Mauterndorf – Thaling up-hill in the direction of Gatschkogel (1231m ASL). About 500m N of the Kraberger Farm House a swampy meadow is reached with a huge sink hole. With its diameter of about 8m and a depth of 5m it cannot be missed. Here a Pegmatite with large Muscovite plates crops out. Huge mine dumps are indicative of extensive mining and a large mine building. WALSER reports finding samples containing Arsenopyrite at these dumps, in polished sections the Arsenopyrite showed signs of cataclasis.

A tunnel was built to undercut the extensive mine in its deeper part to simplify the transport of the ore from the mine. This tunnel was commenced in outcropping marble about 115m to the N and 30m below the level of the sink hole. Using drilling and blasting the gallery was driven in the direction of 174°S. At meter 13 a 110°/70°N shear zone was encountered with the transition from solid marble to weak calc-mica schist (90°/80°N). At 22m from the portal marble was reached again concordant to the calc-schist. At meter 28 from the portal the boring of the gallery must have come to an abrupt end, since the miners left some drilling and blasting equipment behind. WALSER also reported that geochemistry conducted at the site gave no indication about the type of mineralization, its mineralogy and grades.

Item 8: Deposit Types

The deep-seated Pölstal (Valley) Graben Fault and the Lavanttal Fault system, which has more or less the same strike direction as the Pölstal Fault have been instrumental to the mineralization at Zeiring – Pusterwald (Pölstal Fault system) by serving as prime conduits for the metasomatic to hydrothermal injections of metal-bearing solutions into the massive marble host rock of the Bretstein Series (Zeiring).

The host rock for the mineralization is a massive calc-marble of the Bretstein Formation, which forms an anticline at Ober-Zeiring and is cut into several blocks along a series of steeply dipping faults and shear zones with a strike direction varying between NE-SW and N-S. The thrust along these faults is from a few meters to 10-20 meters, with movement and shifting of the more westernly block to the N.

At the Zeiring Mining District there are up to eight vein structures in the Mining Fields of Ober-Zeiring (the West-, the Middle- and the NE-Field) and there are the deposits of Unter-Zeiring and the Katzling Zone reaching all the way to the Mur River Valley. The deposits are emplaced along trends of structural weakness, mostly plus or minus N-S to NE-SW striking and steeply dipping fault and shear zones, that have split the mineralization-bearing formation, the Bretstein Marble into fault blocks that were shifted in steps northward, from E to W.

The host rock, the Bretstein Marble is the lowest and most prominent rock layer of the Bretstein Formation, an Early Paleozoic crystalline sequence of the Wölz Mica Schist Unit belonging to the East Alpine Crystalline Complex. The Marble's top is sealed off by layers of mica schist, which prevented the mineralized solutions from ascending further up the formation composed of various kinds of mica schist and calcareous mica schist to calc schist, which normally are not mineralized. The thick layer of the Bretstein Marble also has been affected by an intricate system of Karst-type caves created during the last Ice Age, when aggressive waters flowing at the bottom of mighty glaciers and underground fissures dissolved the carbonate rocks forming cave tunnels and large cave rooms, many parallel to the vein structures. They, too, followed the zones of weakness in the marble, and many of them were used as passage ways and/or as areas for stoping and as depositories for waste and backfill material by the old miners.

The Zeiring deposit shows great complexity. Mineralized bodies created by metasomatic replacement interfere with true vein-type hydrothermal shoots, with metasomatic Siderite-bearing bodies often located in higher elevated parts of the deposit. Not only does the mineral composition of the veins vary from location to location but also the strike directions of the veins can be different.

The emplacement of mainly three types of mineralization happened in several cycles of mineralization:

(1) the metasomatic replacement of the marble by Iron-carbonates (e.g. Siderite) of the marble along N-S striking tension joints in the marble host rock, followed by
(2) hydrothermal veins with poly-metallic Lead-Silver mineralization (also Zn, Sb, Cu, Ba), followed by
(3) a new phase of abundant Siderite, of Silver–carrying sulfides (Bournonite), of metasomatic Barite, and finally of
(4) veins of (Gold-bearing ?) Marcasite.

The first phase of the Iron Carbonate Metasomatosis follows a N-S direction, with the exception of "Klinger Lager" and the Matthias Baue. At the Klinger Bau the ascending low temperature metasomatic Iron-carbonate solutions were retained by an impenetrable pegmatite, a process which converted an otherwise N-S oriented vein into a strike parallel layer (WEISS, 1963).

The Purgstallofen Siderite veins have an E-W orientation. They are of a different age compared to the NE Field veins (e.g. Barbara Zeche) and their E-W strike is influenced by the Blabach Anticline structure. E-W veins of Barite in the Barbara Zeche are of younger age. The E-W structure of Klinger Baue represents a reactivation of an older tectonic design, which was active during the Barite vein emplacement. The older Klinger Baue Iron Carbonate Metasomatosis followed a N-S direction, also typical for the Gamsgebirgszeche.
Other prominent orientations are NE-SW to NNE-SSW

The mineralized bodies mined in the old days and the ones indicated by geophysics are most probably poly-metallic Silver veins. Whether these veins are accompanied by metasomatic accumulations of Siderite and Barite like in the Ober-Zeiring West-, Middle- and NE-Mine Fields is unknown. A difference in mineral paragenesis and grades between the Northern Zone and the Southern Katzling Zone is not impossible, since it is much closer and parallel to the deep-seated Pöls River Valley Graben-Fault system. Here the hydrothermal metal-bearing fluids, which ascended along this fault system, intruded the Marble most probably under a higher temperature, because of the greater closeness to the source than the fluids that formed the mineralizations of Ober-Zeiring's mineralized bodies further away from the source to the West, where also low temperature metasomatic replacement of the carbonate host rock by Siderite and Barite is sign of low temperatures. This of course is hypothetical, since not too much is known about the composition of the Katzling Zone mineralized bodies, except for few pieces of Silver-bearing rock found at some of the mine dumps or pick samples from outcrops.

To summarize, the Oberzeiring deposit can be described as a complex combination of replacement-type mineralized bodies and several distinct mineralized vein-type systems. Most often, these lenses-shape bodies and veins contain significant amount of conductive or magnetic minerals and elements – sulfides like pyrite and pyrrhotite, oxides and hydroxides like magnetite, hematite. Therefore, geophysical methods such as variations of airborne and ground electric/electromagnetic surveys, magnetic surveys and induced polarization (IP) have been and will be used for recent and future exploration.

Traditional diamond drilling is another important method for testing geophysical targets, as well as for following the strike/dip of the existing and testing estimated veins spatial locations.

More detail surface sampling of the existing historical tailings, old mine workings rock sampling and soil sampling may be also among the useful exploration methods for the Oberzeiring property.

Item 9: Exploration

SMZ has acquired the exploration licenses ("Freischürfe") covering the mining area of Unterzeiring and beginning with Jan. 1st, 2005 large parts of the mining/prospective area of Oberzeiring – Möderbrugg, Unterzeiring and the range on the western side of the Pöls Valley between Oberzeiring – Winden – Katzling – Pöls, the Katzling Zone. The acquisition of exploration licenses covering the prospective gold district of Pusterwald - Goldriegel to the North of Zeiring followed during 2008 – 2009 (Fig.). Since the acquisition of these licenses the management of the company has conducted exploration and research programs with surveys of geochemistry, geophysics and geology over historical mine areas, including core drilling and reconnaissance inside the vast underground mine buildings of the district.

SMZ owns its own drilling equipment: one for shallow surface and/or underground drilling to a depth of 50-100m depending on the lithological conditions, the other a wire-line diamond core drill rig, able to drill vertical to oriented core holes to a depth of up to around 150m. For geophysical surveys SMZ is using geophysical contractor services. For geological work programs SMZ is retaining the services of specialized Exploration and Mining Consultants.

The Zeiring Mining District, once an important center of metal production (Ag, Cu, Pb, Au, Fe), has received frequent and repeated attention by geologists and mining engineers, but despite these reports the area's potential remained underexplored by modern technology. SMZ was founded in 1988 and acquired exploration licenses ("Freischürfe") covering historical mining fields of Ober-Zeiring – Möderbrugg and Unter-Zeiring and adjoining areas with the goal to bring the district back to production with the help of modern exploration technologies:

- Geophysical Surveys over historical mines and over anomalous areas defined by geochemical analysis and the existence of old mine workings or signs/traces thereof;
- Geochemical soil and systematic rock sampling at the surface, over defined anomalous areas, at old mine dumps and at mineralized bodies left behind underground by the old miners;
- Core Drilling at areas found anomalous by geochemical and/or geophysical surveys and geological, mineralogical and geochemical analysis of the core samples taken.

Geophysical Surveys

General Information

Fairly recently (2006) Dr. R. ARNDT, a certified expert for geophysics, was asked by Mr. Langer, then representative of the Schwerspat Veredelungs- GmbH of Ober-Zeiring – the predecessor of SMZ – to evaluate all available/acquired data of previous geophysical surveys in an Expert Opinion Report. The surveyors had used IP electromagnetic and DC methods and ground magnetometer surveys.

The electrical and electromagnetic (EM) methods are used to map or image the electrical conductivity (σ) and dielectric (ε) properties of the ground. These methods are active methods – a controlled source is used to make current (I) flow in the ground. The distribution of current in the ground depends on the distribution of the conductivity. The current is measured indirectly either by inserting pairs of electrodes in the ground to measure voltage drops or by measuring the magnetic field produced by the current. The current can be made to flow either by directly injecting it with ground contacting electrodes or by inducing it to flow by creating a time varying magnetic field.

A time varying magnetic field in the conducting earth produces an electromotive force (emf) via Faraday's Law of Induction which in turn drives currents. A complete description of the fields created by currents and the interaction of the resulting electric and magnetic fields in the time varying case is provided by the laws of **electromagnetic theory**. All the electrical and electromagnetic methods are governed by these electromagnetic (EM) laws.

The DC Resistivity method (DC = direct current) is formally the low frequency limit of the general electromagnetic (EM) method where the time rate of change of any magnetic fields is so small that Faraday induction can be ignored. (DC or dc is short for direct current, but the term is widely used to describe current and field behavior in the zero frequency limit.).

At DC, or zero frequency, a current can only be created by contacting electrodes connected to a DC supply (i.e. a battery). At higher frequencies the supply wires for the contacting electrodes also create time varying magnetic fields and so the currents in the ground have a component created by Faraday induction from the source. Purely inductive sources, such as loops of wire carrying alternating current, need not contact the ground nor will they induce any current at zero frequency (DC).

Finally the time varying currents in the ground have their associated magnetic fields, which interact with the source field modifying the whole induction process – this is the subject matter of EM theory.

Very high frequencies (> 1.0 MHz) are used by Ground Penetrating Radar (GPR). Here the concept of induction is replaced by the concept of propagating waves (like radio, radar or light,) in which the electric and magnetic fields are tightly coupled. The response of the ground is now described in terms of the propagation velocity of a wave or wavelet, which depends on the dielectric properties.

Electrode Arrays for EM and IP:
• Pole-Pole
• Pole-Dipole
• Dipole-Dipole

All the arrays of electrodes used to obtain the apparent resistivity are variants of the four-electrode scheme. All are basically superpositions of the fundamental equation for the potential from a current source with appropriate sign for the current. To investigate the resistivity distribution with depth, called a sounding, the arrays are expanded about a center point and the apparent resistivities are plotted vs spacing usually on a log-log plot. In the more general case the apparent resistivities are plotted as a function of array spacing and lateral position using plotting conventions that have become accepted for each type of array.

Application

The results of two recent geomagnetic surveys are reported by OCZLON (2004) and by PANACEK et al (2006). OCZLON conducted a survey covering a prospective area N of Ober-Zeiring (Fig. 64) W, N and NE of the country inn “Hoanzl”. The magnetic survey of six IP (pole-dipole) profiles was combined with a number (six) of soil samples taken to the North and NE of “Hoanzl”.

These samples were analyzed for Au, Ag, Cu, Pb, Zn, Mo and As. Results are reported in “Geochemical Surveys Ober-Zeiring – Möderbrugg Area” later in this Chapter.

The extent of the area covered by the geophysical survey was about 1300m E-W and about 200 to 250m N-S. OCZLON’s interpretation of the vertical magnetic gradients led him to the conclusion that the causes for the magnetic anomalies were located at 30 – 50m below surface (ARNDT, 2006). Their source were either marble and/or sulfide concentrations following the direction of the main mineralized body, NNW-SSE and N-S. One large magnetic anomaly 100m to the West of “Hoanzl” extends over an area of N-S about 200m and E-W 300m, its cause expected to be zones of deformation.

Interpretations for the IP survey results (VIELREICHER, 2012) are reported as follows: Six IP profiles laid out over an area of 1300m (E-W) and 150-300m (N-S) were surveyed with a Scintrex IPR 8 and results were processed using the RES2DINV inversions software allowing for an interpretation to 185m (below surface). Results of the processed data give an image of the old mine workings with mineralized bodies in N-S and NE-SW orientation. Highly chargeable areas can be explained by lenses of sulfides in marble.

The Pole-Dipole Profile “A” (Fig. 64), oriented NNE-SSW, was laid out to explore marcasite veins; its orientation vertically to the strike of the vein. Results point to five vein-type sub-vertical structures in a depth of 50m to 100m, correlatable with known and partially exploited veins in the NE Field (VIELREICHER, 2012).

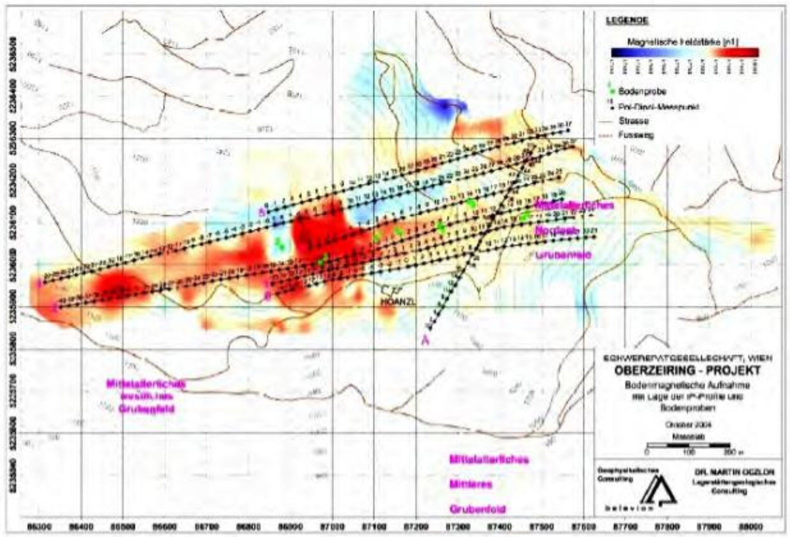

Figure 64: Magnetic Ground Survey Results with IP Profile Lines and Soil Sample Locations laid out over the Ober-Zeiring Erzberg by OCZLON (2004) for Schwerspatgesellschaft GmbH, Wien – Ober-Zeiring Project (from ARNDT, 2006)

The 2006 survey was conducted by the company GeoComplex of Bratislava, Slovakia along six SSW – NNE oriented lines measuring Total Magnetic Intensity (Fig. 65). The presentation of the magnetic data and their interpretation was only completed on paper , not digitally, and no depth calculations were made for the indicated anomalies nor were corrections made for the daily magnetic variations of the Earth (ARNDT, 2006).

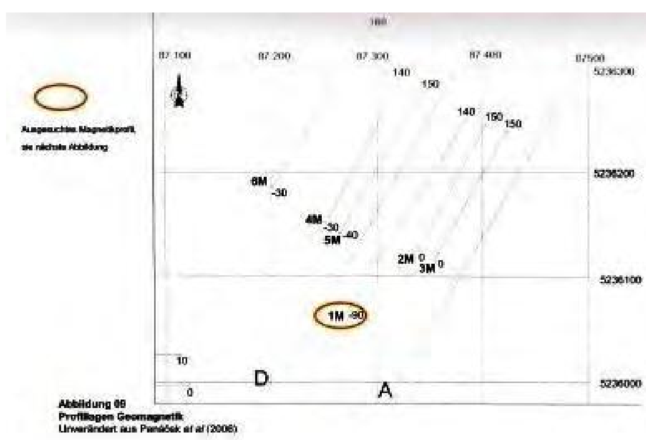

Figure 65: Map of the Geomagnetic Survey Lines of the GeoComplex Survey (PANACEK et al. 2006) (from ARNDT, 2006)

Induced Polarization (IP) Surveys are reported from OCZLON in 2000 (Report OCZLON, 2004). The area covered by the survey, however, did not reach the prospect area of Möderbrugg. During 2004, 2005 and 2006 IP surveys were conducted including measurement of Geo-electric Resistivity (DC) in the area of Möderbrugg. The field measurements used a Pole-Dipole setting with 10 meter spacing. Results were recorded only graphically by survey line and no depth calculations were presented (ARNDT, 2006).

Simultaneous to IP measurements, the contractor, the Romanian company BELEVION (with OCZLON) also measured Direct Current (DC). Here too, recording and presentation of the results were only graphic and per line, without any further calculations (ARNDT, 2006).

To close the gaps of the geophysical surveys of 2004, BELEVION continued its research in 2005 (NISTOR & ONESCU, 2005). The two main targets were areas “A” and “B” (Fig. 66) (*not to be mixed up with Mining Centers “A” and “B” of Katzling Zone*). In area “A” five profile lines of 500m length each were laid out in NE-SW orientation (red lines), parallel to the lines of 2004 (blue lines). Their main purpose was to gain further information on the gold-bearing Marcasite veins. In the “B” area West of “Hoanzl” two additional lines, each about 750m long and sub-parallel to the 2004 profile lines, were all measured using a Scintrex IPR 12 instrument and the RES2DINV software for processing the data.

The resulting IP anomaly at the northern part of “A” (Fig. 67) points to a WNW-ESE striking sub-vertical vein associated with a fault zone, and to a NE-SW striking fault zone with possible mineralization of disseminated sulfides. Measurements in area “B” did not add new results to the 2004 survey. In addition NISTOR & ONESCU proposed drill-sites to test the anomalies (red circles, Fig. 67).

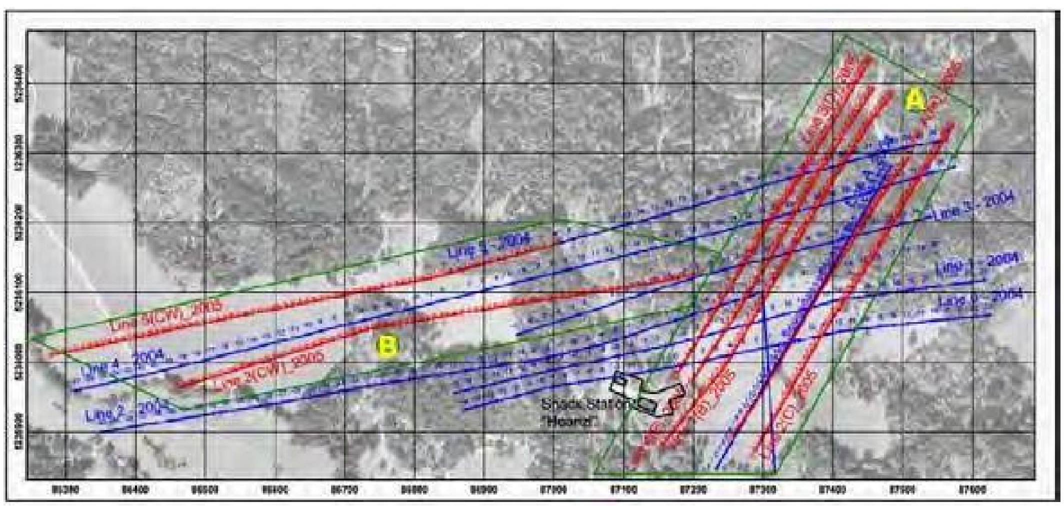

Figure 66: Ortho-photo Projection, area N of Ober-Zeiring, 2004 (in blue) and 2005 (in red) geophysical IP survey profiles in areas “A” & “B” to the N & W of the country inn “Hoanzl” by BELEVION (NISTOR & ONESCU, 2005)

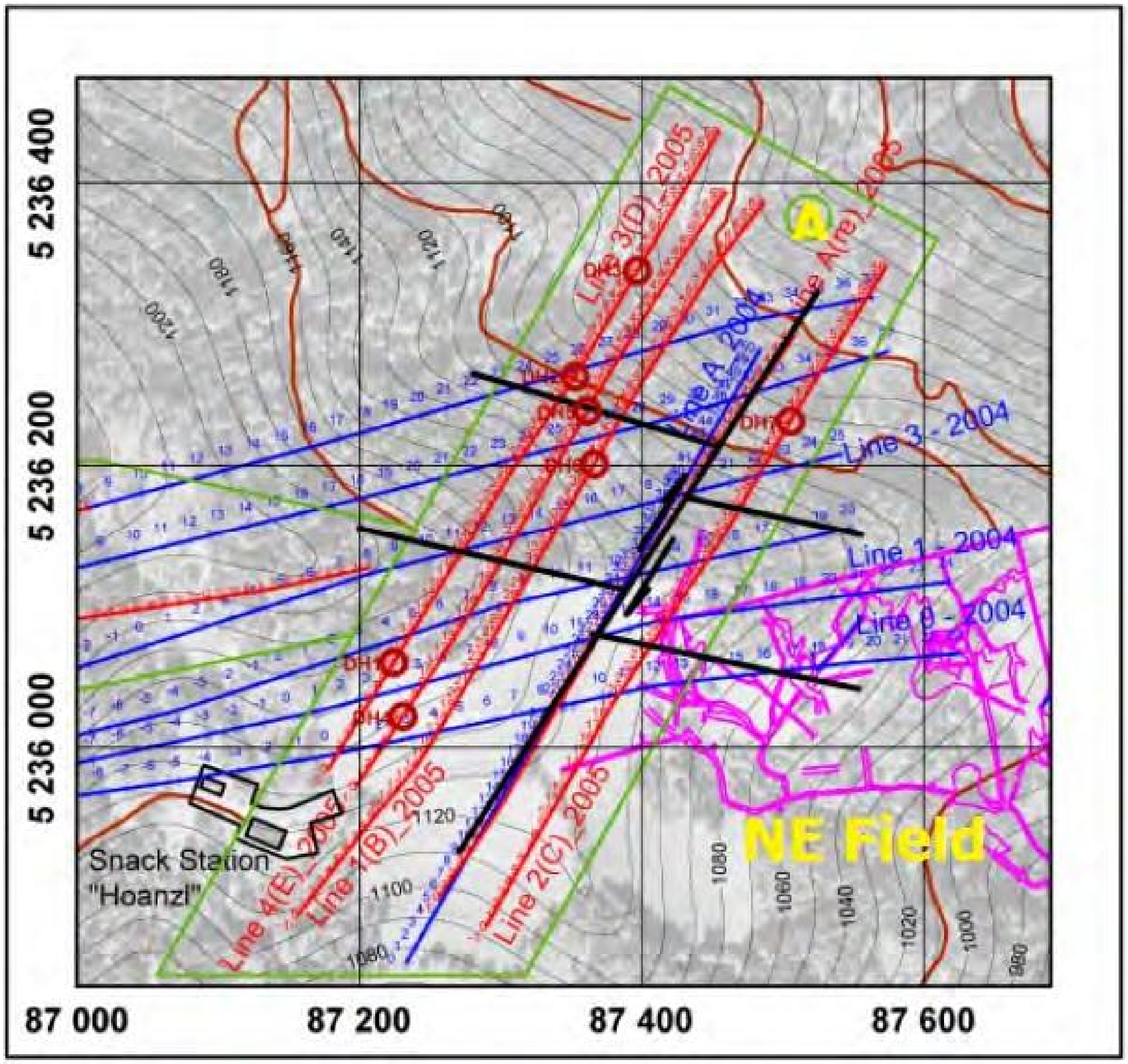

Figure 67: Enlarged NE Section of geophysical (IP) Surveys of 2004 and 2005 with projection of the NE Field Underground Workings and the Area "A" Profile Lines NE of "Hoanzl". Red circles indicate proposed drill sites for testing of the IP anomalies (NISTOR & ONESCU, 2005)

The Slovakian geophysical company GEOCOMPLEX of Bratislava (PANACEK et al. 2006) was contracted to continue geophysical survey work in 2006 in the area North of "Hoanzl". The goal was to expand the surveyed area "A" (2004 and 2005 surveys, Fig. 66 and Fig. 67) further to the NNW and add a survey area located to the NE towards Möderbrugg (Fig. 68), over two recognized anomalous mineralized areas – the Martin Ore Vein and a zone of potentially gold-bearing Siderite mineralization near Möderbrugg. The distance of the two survey areas to "Hoanzl" was 400m N and 750m NE. The profile lines were covered by IP (a GEVY-1000 Transmitter, a GEP Pulsator, and an IP-2 Receiver), with ground magnetometer (Proton PM-2), and VES.

In total 23 profile lines were surveyed, the majority of them laid out parallel to sub-parallel to the profile lines of area "A" (Fig. 67) of 2005 in NW-SE direction and several profile lines more or less rectangular to them. Nine profile lines covered the area to the NE, Möderbrugg (see also Fig. 65 and critical review by ARNDT, 2006). Magnetic anomalies detected by these surveys were interpreted as related to the occurrence of Magnetite - Pyrrhotite in rocks to a depth of 10m. SP and IP results especially in the survey area near Möderbrugg, point to the occurrence of rocks with disseminated sulfides.

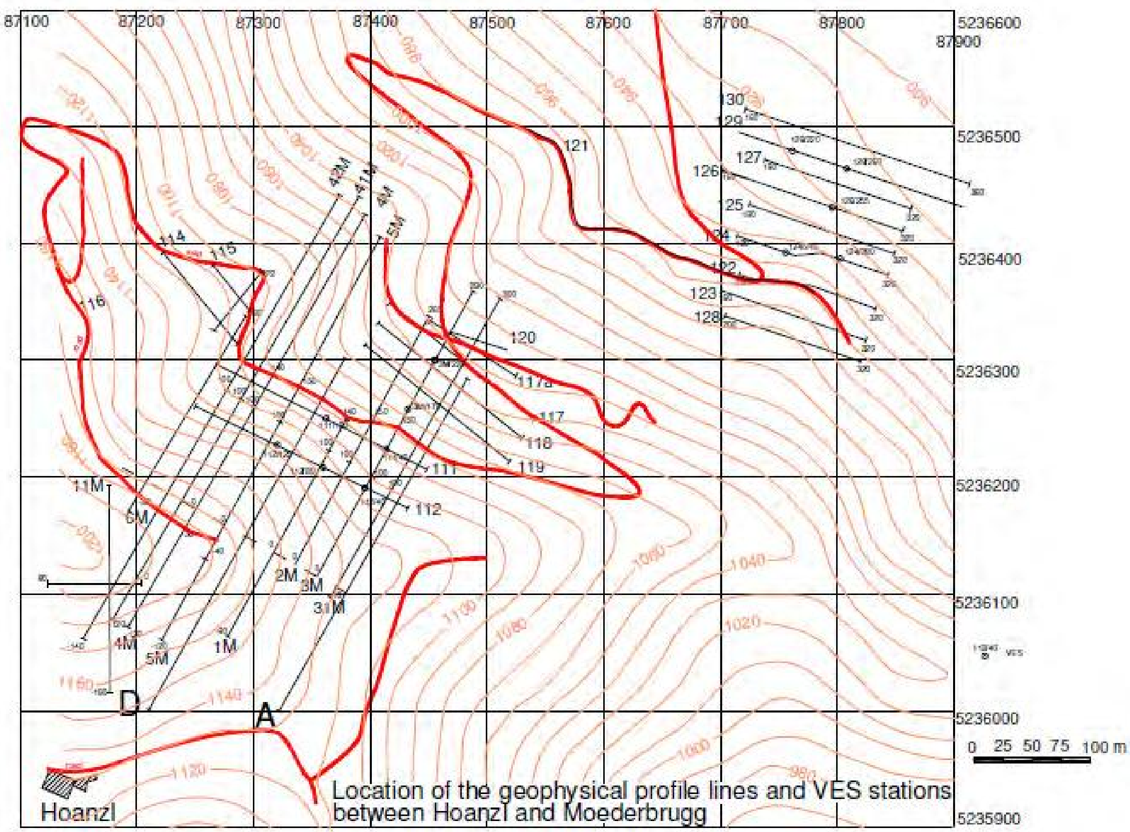

Figure 68: Coverage of Areas at the NE Field and close to Möderbrugg by Ground-magnetic and IP Surveys in 2006 by the Slovakian Geophysics Company GEOCOMPLEX, Bratislava (PANACEK et al. 2006) Dark red lines are forestry roads. The Martin Ore Vein, the geological continuation of the Klinger Bau (NE Field) deposit, is located in the West of the SW grid, in the NE of the map is the location of a potentially gold-bearing Iron mineralization (www.silberbergbau.at).

In his critical review of all the described geophysical survey data (See above – ARNDT, 2006) ARNDT proposes a drill site, from where a potentially gold-bearing Marcasite vein can be attained and cored at about 120m drill depth, its coordinates in the Austrian Meridian 31 system at x= +87 361m and y= +5 236 185m) (ARNDT, 2006). In case a directional inclined (45° to 70° from the vertical) drill hole is chosen its proposed position in the Austrian M31 (Gauss-Krüger) system would be x= +87 386m and y= +5 236 232m.

THE AREA OF SOUTH FIELD – "Katzling Zone"

The area spreads over a length of about 4 to 4.5 km along the NW – SE trending western ridge of the Pöls Valley down-river and to the SE of Ober-Zeiring. This area extends from the S end of the Oberzeiring South Field, the Matthias Baue, via Treffenthaler Gallery and historical mine centers "A" to "G" (Fig. 69). Despite its numerous historical mining sites in nine small Mining Centers the "Katzling Zone" has received little attention by active progressive exploration until SMZ acquired the concession covering the area. More recent research was done by

NEUBAUER (1952) like Geological Mapping of Ober-Zeiring – Möderbrugg and the northern half of the Katzling Zone, and HADITSCH (1967). WALSER's (1974) research work was concentrating on the "Katzling Zone".

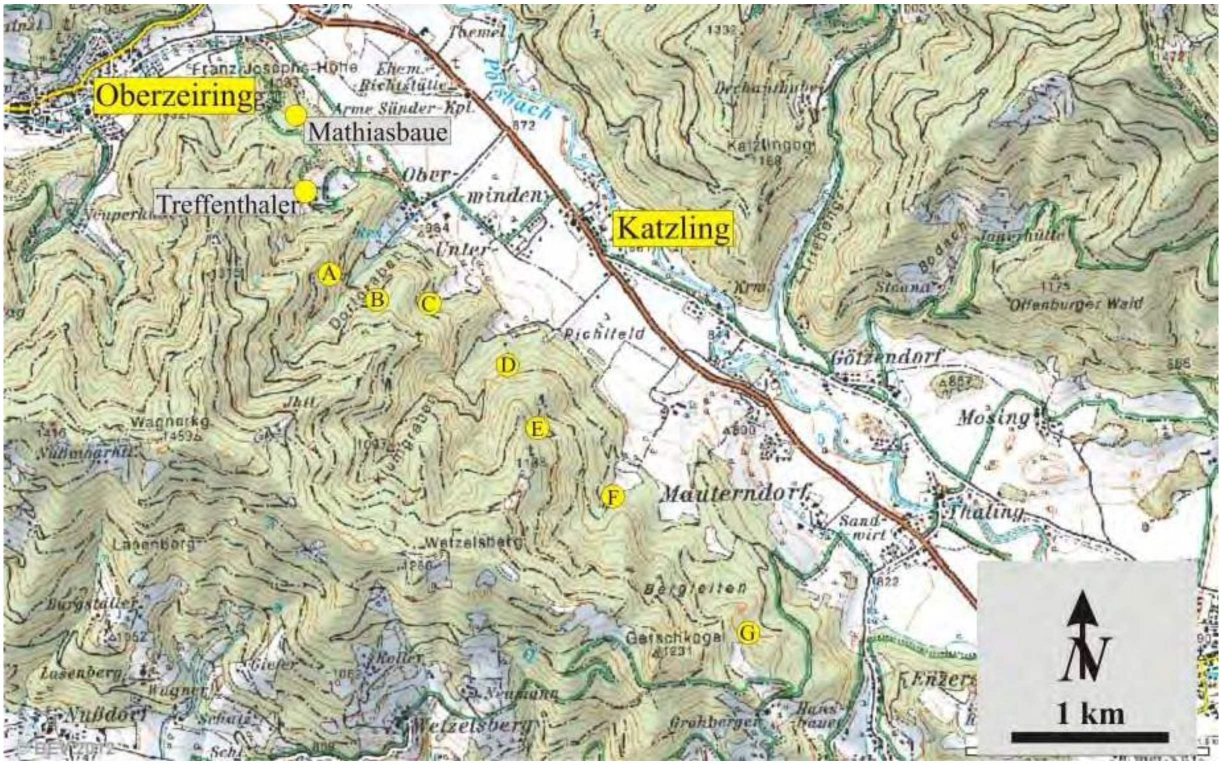

Figure 69: The Historical Mining Area between the Ober-Zeiring South Field and Mauterndorf-Pöls – The Katzling Zone – with Matthias Baue, Treffenthaler Gallery, and the Mining Centers A to G (from North to South) along the Western Mountain Ridge of the Pöls River V alley (after OCZLON, 2004, modified by VIELREICHER, 2012)

Very recent geophysical research was done here, too, by OCZLON (2006) using IP (Chargeability and Resistivity) and ground magnetic surveys (in combination with geochemical sampling and analysis of soil and rock samples). It was an integrated part of the geophysical survey by OCZLON to test the geophysical anomalies through soil samples and rock chip samples from outcrops for geochemical analysis. (For details see Geochemical Surveys – The Katzling Zone).

Results, obtained by processing chargeability (IP) data from this survey, are shown in Fig. 69, a contour map based on survey profile lines covering the area of Matthias Baue and Treffenthaler Gallery (Ober-Zeiring South Field), and the contiguous area of the western Pöls Valley ridge with Mine Centers "A" (near Winden) to "G" (South of Mauterndorf). Survey data of the South Field area at the Northern end of the "Katzling Zone" have been presented in part only as a contour map and have not been processed.

Note from OCZLON (2004) to Fig. 70: The southern-most panel was measured with a NW-SE oriented current injection line of 1.2km. The northern-most panel only shows the non-interpolated survey points; there, measures were taken using variable current injection lines (700-1200) and directions. This departure from the 900m injection profile lines, applied over the remaining area of the "Katzling Zone" was implemented on the request of the client.

Measurement of the cumulative rock resistivities shown in Fig. 71 demonstrate that potentially mineralized areas are located in zones dominated by marble. The relatively broad zones (50m to 100m) of high chargeabilities possibly indicate a fine disseminated sulfide mineralization (OCZLON, 2004 & VIELREICHER,
2012).

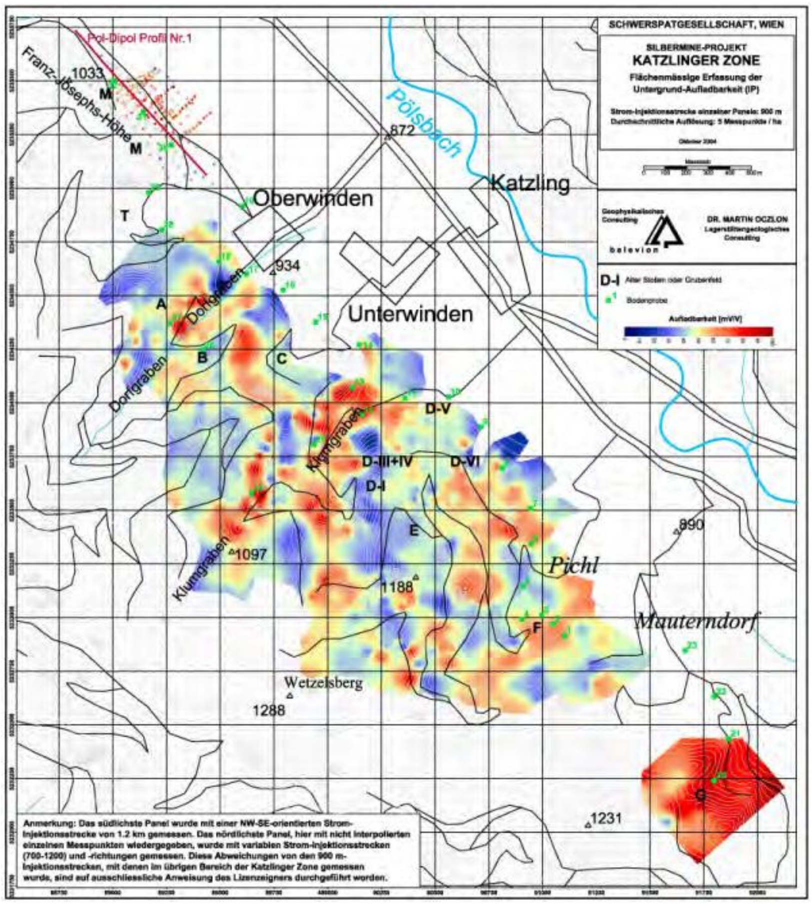

Figure 70: Surface Contour Map of Ground IP-Chargeability (IP) in the "Katzling Zone" (from OCZLON, 2004). Geophysical IP results of the NW-SE trending geophysical profile to the East of M (=Matthias Baue) in the NW corner of the map is shown in Fig. 71 and expla ined below. (Processing was for surface only, without any indication of the underground depth of the anomalies)

OCZLON's interpretations of the anomalous IP- chargeabilities (Fig. 70) are as follows:

Strong chargeabilities (over 80mV/V, red zones) appear to follow three different directions:

• NW-SE in Area Pichl - lower Klum Creek, and vertical to this
• SW-NE, along Klum Creek and through Mining Center "F".
• N-S orientation shows between Klum Creek and Wetzelsberg, as well as in the zone between Mine Centers "B" and "C" and the Upper Klum Creek.

The N-S trending "chargeable" zones are considered important considering the fact that the main mineralized bodies in the historical mines North of Ober-Zeiring show this N-S orientation.

It is also notable that a zone of medial chargeability (green zone) in the mining area of “D-I” to “D-VI” extends in a SW-NE direction seemingly interrupting the NW-SE trend of the zone Pichl - lower Klum Creek.

The high chargeabilities in the area of the mine center “G” are interpreted at least in part as an artifact caused by frequently disturbed measurements (e.g. electric fences for cattle).

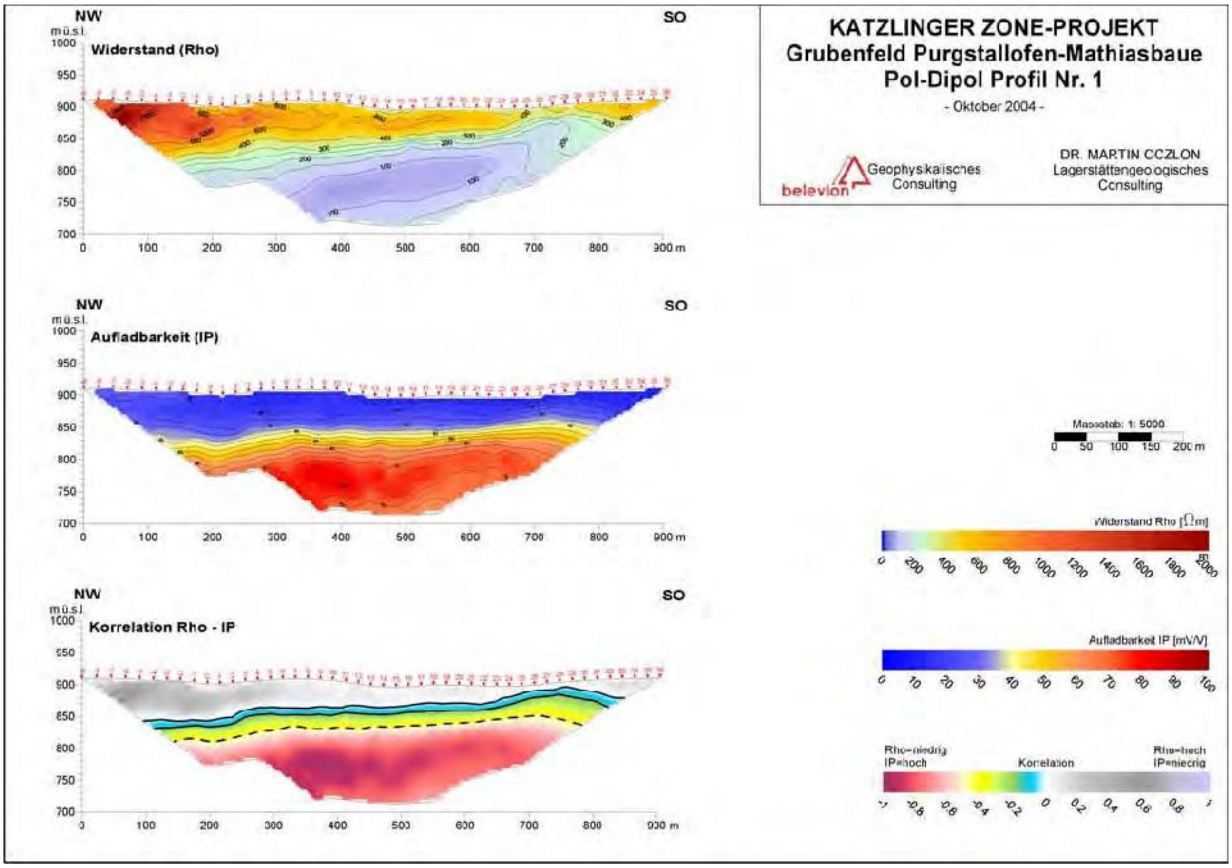

Figure 71: IP Pole-Dipole Profile 1 (OCZLON, 2004) to the East of Matthias Baue (Fig. 29), the N of the Katzlinger Zone - one example of a geophysical profile section with depth indication of anomaly (OCZLON, 2004)

On request by SMZ the geophysical survey company laid out a Pole-Dipole profile parallel to the Pöls Valley (NNW – SSE) in the northernmost part of the Katzling Zone, about 100m East of Matthias Baue. Together with the mining area “D”, Matthias Baue is one of the most important mine Center of the Katzling Zone (OCZON, 2004). The coordinates of the profile’s end points are E88827/N235733 and E89435/N235062 (GK M31 System). Horizontal spacing of the measuring points was 20m to reach a depth penetration and resolution for levels of 10, 35, 65, 90, 120, 145,165 and 185m below surface (Fig. 70 and Fig. 71).

A “layer” close to the surface shows higher resistivity, with 80-95m in the SE and 10-20m in the NW. It possibly is caused and represents the marble and/or the Neogene/Quaternary layers of the Pöls Valley. A zone of high chargeability (100-150 Ohmm) is met at a depth of 90-110m with a thickness of 30 to >80m increasing it thickness to NW. The good correlation of resistivity and chargeability indicates possible mineralization with mineralized minerals in contact with each other and not disseminated in the rock. OCZLON describes the profile line to run sub-parallel to one of the “Graben”-faults, a part of and parallel to the Pöls Valley Fault system, defined as a

Graben fault system. The intercept with the fault is represented by the high chargeability caused by conductive minerals typical for fault gauge such as gauge clays, graphite or ore minerals. This would correspond to an observation by HADITSCH (1967, p. 105) inside the Matthias Baue of graphitic fillings of and/or layers in fault zones, which he interprets as a horizon blocking the mineralization bearing fluids to move further upwards. Should this be the case for the anomaly in the profile it would indicate a layer of Graphite with ore minerals.

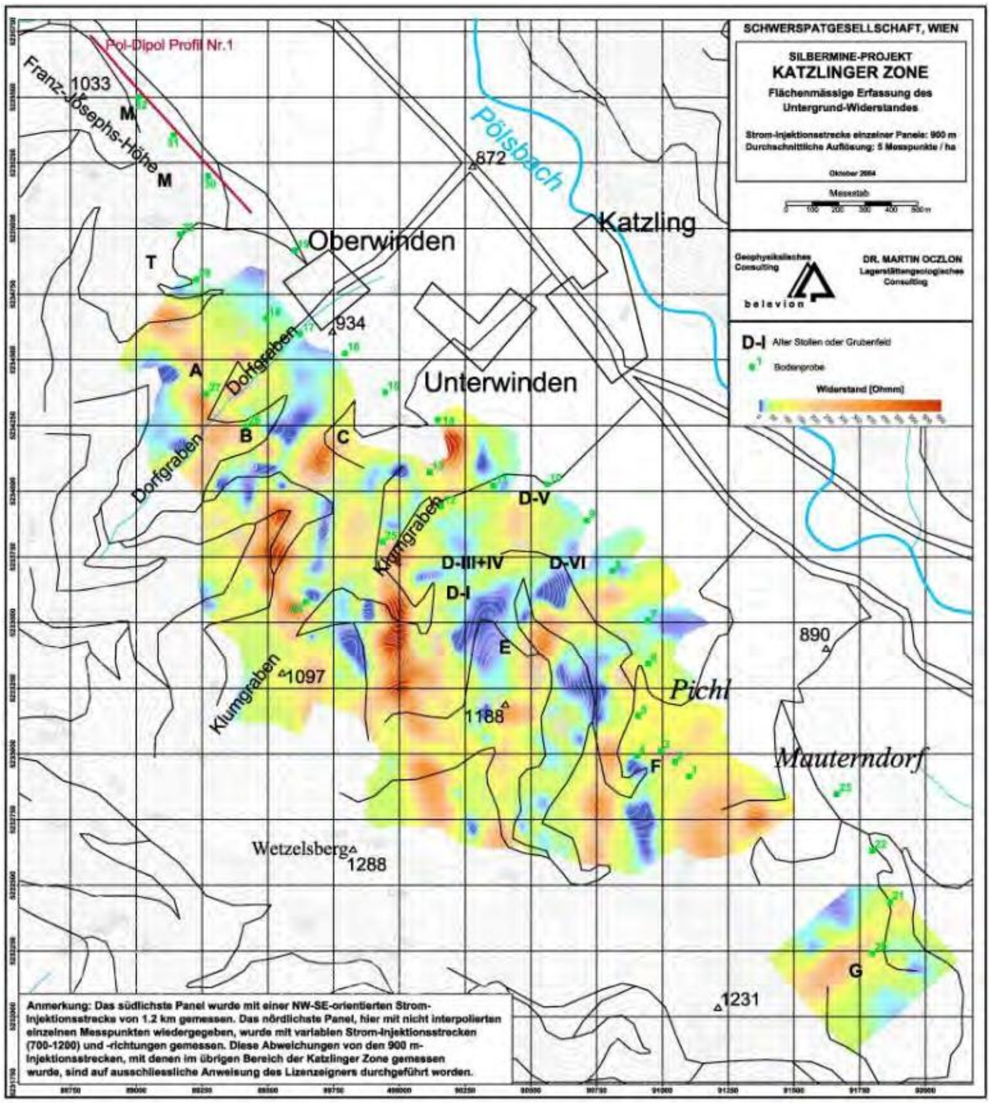

Figure 72: Surface contour Map with the Ground Resistivity (IP) of the "Katzling Zone" (OCZLON, 2004) (Processing was for surface only, without any indication of the underground depth of the anomalies)

Results of the Ground Magnetic Survey (Fig. 73) show that areas of positive magnetic anomalies coincide with areas of elevated (anomalous) chargeability. After OCZLON's interpretation such anomalies may indicate potential blind mineralized bodies located at a depth of 50 – 70 meters. The locations of such anomalous areas are (OCZLON, 2004):

• A zone 200m to the South of Mining Field (Center) "A".
• A zone 300m to the East of Mining Field "E", and
• A zone 650m to the South of Mining Field "F".

• A zone in the Upper Klum Valley (near Mining Field "D"), and

Several anomalies about 500m to the North of Gerschkogel (1231m ASL) between the Mining Fields "F" and "G" are showing a SW-NE orientation.

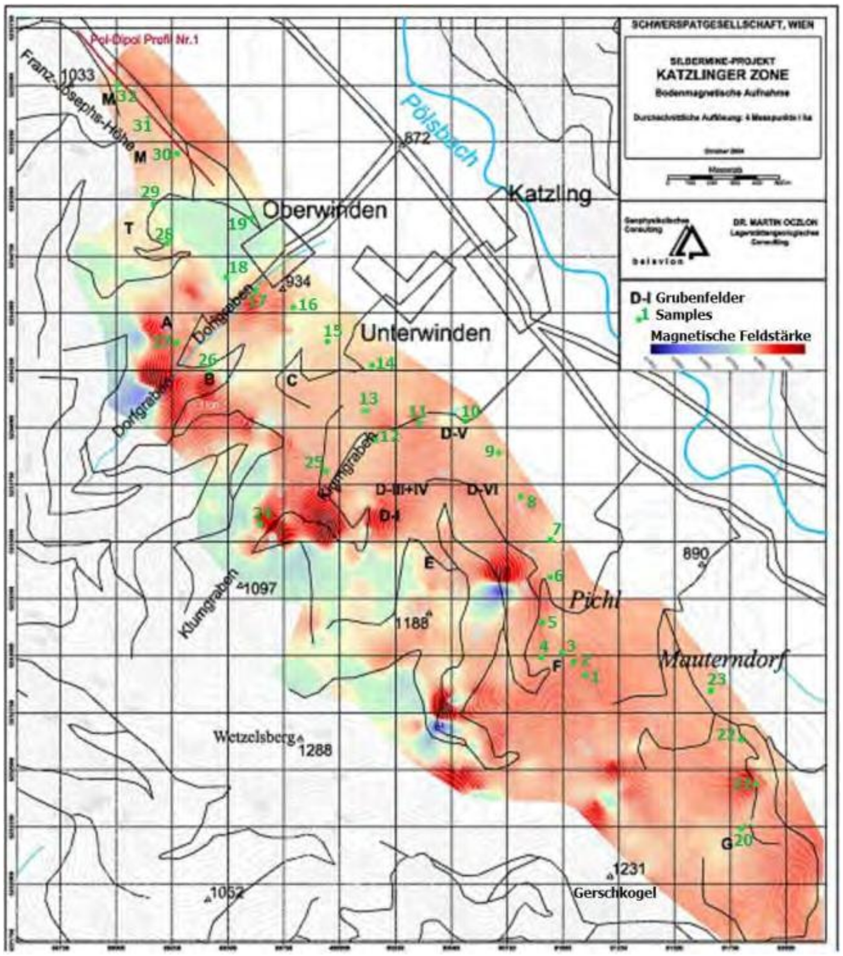

Figure 73: Surface Map of the Geomagnetic Survey Results over the "Katzling Zone" (OCZLON, 2004) – Green numbers 1 – 32 are soil sample locations for geochemical analysis to test the geophysical anomalies

Positive (red & dark red) magnetic anomalies are usually caused by the presence of magnetic minerals like Magnetite and Pyrrhotite, with other minerals of lesser influence. These two ore minerals if present influence and increase the strength of the local Earth magnetic field. In the Katzling Zone a correlation between magnetic anomalous highs and areas of high chargeability was observed. The two can match exactly (that is overlay each other) like areas 200-500m W of Mining center "D-I" and 300m E of mining center "E" or positive magnetic anomalies lie right next to or between anomalous areas of high chargeability, like the magnetic anomaly 500-650m S of the Mining Center "E", the anomaly directly to the S of Mining Centers "A" and "B", and the mining Center "D-I".

In the anomalous area directly SW of "B" there is a match with the area of slightly higher but with 55-60mV/V still below anomalous chargeability. The zone's closeness to "A" and "B" as well as soil samples KTS26 and KTS27 (Tab. 6) anomalous in Silver (with the origin of the soil anomalies usually located uphill from the sampling point) indicate that mineralization must be present in medially chargeable zones.

As depth for the magnetic anomalies in the Katzling Zone OCZLON (2004) quotes about 50m or less below surface for the strong anomaly 200m S of “A” and 300m E and 650m S of “E”. Strong anomalies in the area of Klum Creek (between soil sample KTS24 and “D-I”) come from a depth of 50-75m.

Regarding the areal association of magnetic and chargeability anomalies OCZLON quotes the observation of HADITSCH from the historical Ober-Zeiring Mines of mineralized bodies rich in a Fe-bearing Sphalerite associated with Pyrrhotite and accumulations of Pyrrhotite-bearing sulfides, either as part of the Sphalerite mineralization or in disseminated form. Magnetite was never observed as a part of the mineralization, but can be found disseminated in the marble.

After delivery of the report, Dr. Oczlon made recommendations that seven IP-pole-dipole sections should be added during the further work in order to determine the precise location of potential drill targets (Fig. 74). The sections are placed over the most promising zones and have lengths of 760-1060 m, so that the most interesting sectors are caught in the range of greatest survey depth (ca. 200 m). The distance between reading points shall be 20 m.

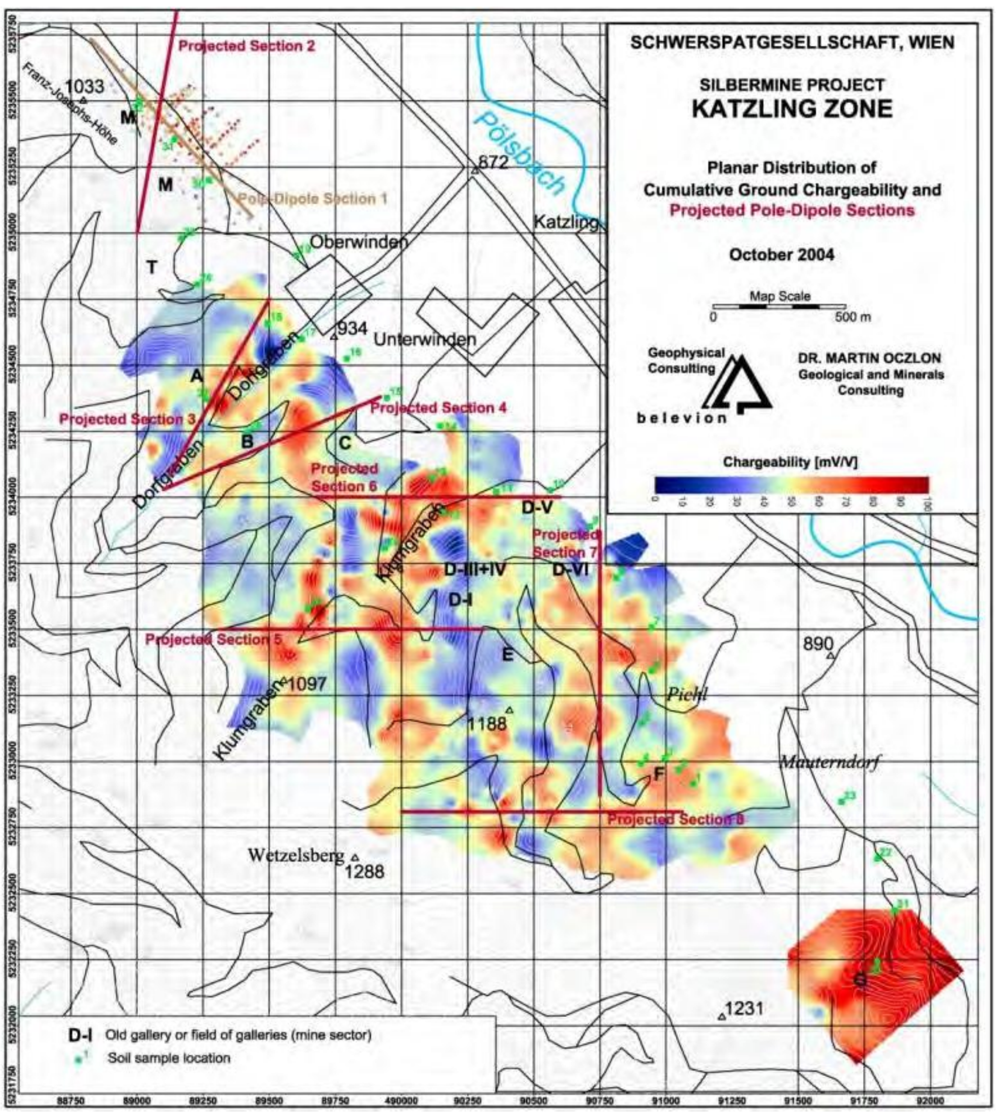

Figure 74: Recommended pole-dipole sections in the Katzling Zone. Depth resolution max. 200 m, beginning at a distance of ca. 200-300 m from the end points of a section.

Geochemical Surveys Ober-Zeiring – Möderbrugg Area

Individual sample collections and analysis and/or systematic sampling surveys have been done by SMZ over selected old mining sites or otherwise anomalous areas within the company's concession. Two geochemical surveys of soils and rocks were part of two geophysical surveys; one covering the surrounding area of the country inn "Hoanzl" towards Möderbrugg in the NE Field of the Ober-Zeiring Erzberg, the other covering the "Katzling Zone", the continuation of the Ober-Zeiring Mining District to the SE.

During a geophysical survey (OCZLON, 2004 and 2006) covering the whole prospective area of Ober-Zeiring (Fig. 64) W, N and NE of the country inn "Hoanzl" with geo-magnetic and six IP (pole-dipole) profiles six of soil and 15 rock chip samples was taken to the N and NE of "Hoanzl" and analyzed for Au, Cu, Mo, Pb, Zn, Ag and As. Results are presented in Tab.6 (soil samples) and Tab. 7 (rock chip samples).

Sample	Easting	Northing	Slope incl.	Soil Horizon and Rock Chip Description	Au g/t	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag g/t	As ppm
OBS 1	87104	5236064	20 SE	A - 5cm, dark brown; B >60cm, brown; chips: unaltered micaschist with biotite; qtz along schistosity	X	27	X	19	66	X	X
OBS 2	86971	5236005	32 SE	A - 10cm, dark brown; B >50cm, brown; chips: weathered micaschist with biotite	X	135	5	10	73	X	1625
OBS 3	87163	5236074	25 SSE	A - 8cm, dark brown; B >40cm, brown; chips: metam. Qtz, fissured, with lim along fissures (80%), biotite schist/amphibolite (20%);	X	40	X	15	64	X	X
OBS 4	87256	5236091	32 SSE	A - 12cm, dark; B >45cm, brown; chips: part. weathered micaschist (75%), dark marble with mica (20%), metam. qtz (5%)	X	155	6	14	124	X	180
OBS 5	87326	5236150	35 ENE	A - 30cm, dark; B >30cm, brown-light brown; chips: metam. qtz with chlor. crusts (70%), schist (30%);	X	25	X	12	74	X	X
OBS 6	87457	5236110	10 E	A - 20cm, dark brown; biotite schist (30%), metam. qtz (45%), marble with bt (25%)	X	42	X	52	242	X	X

Tab. 6: Sample Description, Location and Geochemistry of six Soil Samples from Area „Hoanzl" (NE Field) (x = below detection limit)

Sample	Easting	Northing	Sample description	Outcrop/boulder description	Au g/t	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag g/t	As ppm
OBR 01	87315	5236112	brecciated rock with schist fragments up to 3 cm;	Outcrop	0.01	29	X	X	65	X	X
OBR 02	87190	5236178	greyish white marble with grey bands and py 1%;	road cut outcrop;	X	7	8	16	17	X	X
OBR 03	87185	5236049	breccia on schist	outcrop	0.01	63	6	X	149	X	X
OBR 04	87185	5236049	weak. arg., weak-mod. ferr. breccia	boulders on N side of track	X	64	9	X	95	X	50
OBR 05	88093	5235982	weak.-mod. ferr., in places weak arg. schist	outcrop, long 30m along large E-W fault zone with track	X	21	X	X	19	X	X
OBR 06	87144	5235925	brecciated, mod. ferr. rock;	scree boulder from excavation at Hoanzl's house	X	397	6	X	16	X	2750
OBR 07	87950	5236100	strong. brecciated, weak. ferr. schist	road cut outcrop;	X	50	8	23	69	X	295
OBR 08	87815	5236215	marble lens in ferr. schist; dissem. py (<0.5%); garnets;	road cut outcrop; marble lens strike: 345/45; 50m S of gallery at 87825/5236180	X	4	9	19	55	X	X
OBR 09	88145	5236056	brecciated schist with limonite matrix;	track cut outcrop S of Kalvarienberg: near-vertical strike-slip fault zone; strike/dip 110/80S	X	3	7	12	16	X	X
OBR 10	87184	5236193	qtz vein (1m thick) in fissured biotite schist, lim coating on fissures	road cut outcrop; altit. 1238m;	X	17	X	11	17	X	X
OBR 11	87256	5236072	dense biotite schist with pink calcite nests and fine dissem. py;	road cut outcrop; altit. 1184m; Hoanzl new access track to antenna, 10m N of meadow	0.01	32	X	X	56	X	X
OBR 12	87486	5236227	marble with dissem. py (0-3%) interbedded with marble or biotite schist;	road cut outcrop; altit. 1080m;	X	14	10	X	12	X	X
OBR 13	87536	5236198	calcite vein (up to 10cm) with py in biotite schist and calcschist;	road cut outcrop; land slide over 60x30 m	X	7	9	X	18	X	X
OBR 14	87536	5236198	strong. ferr. hydrothermal breccia	boulder in land slide over 60x30m	0.01	5	14	X	13	X	X
OBR 15	87680	5236120	5-cm-calcite vein in black biotite schist	road cut outcrop;	X	14	9	X	12	X	145

Tab.7 : Description and analytical Results for 15 Rock Chip Samples taken in Area of NE Field Ober-Zeiring (x = below detection limit)

These samples were analyzed for Au, Ag, Cu, Pb, Zn, Mo and As. With a detection limit for Gold at 0.01 ppm and Silver at 1 ppm no Gold and/or Silver were detected. With detection limits for Copper at 2 ppm, Lead at 10 ppm, Zinc at 2 ppm, Molybdenum at 5 ppm and Arsenic at 50 ppm the range of analytical results obtained for Cu was 25-155 ppm, for Pb 12-52 ppm, for Zn 64-242 ppm, for Mo 0-6 ppm and for As 0-1625 ppm.
Analytical results of eight pick samples of rocks taken at the same time from outcrops to the North of “Hoanzl” showed practically no Gold, no Silver, 7-397 ppm Copper, 0-16 ppm Lead, 17-149 ppm Zinc, 0-9 ppm Molybdenum and 0-2750 ppm Arsenic. Seven additional rock samples from North and East of the NE Field show similar results (Au 0-0.01 ppm, Ag 0 ppm, Cu 3-50 ppm, Pb 0-23 ppm, Zn 12-69 ppm, Mo 7-14 ppm, and As 0-295

ppm (VIELREICHER, 2012).More details on the sampling program can be found in the OCZLON, M. (2004), available from Richmond Minerals Inc. by request.

Geochemical Surveys – Katzling Zone

An integrated part of the geophysical survey by OCZLON was to test the geophysical anomalies through sampling soils for geochemical analysis. This was accomplished by laying out a very coarse grid over the "Katzling Zone". 32 soil samples were taken. Their exact location is shown on map of geomagnetic survey results in the Katzling Zone (Fig. 73; soil sample locations are marked with numbers 1 – 32 in green).

Assaying was carried out by the reputed Australian laboratory SGS-Analabs (subsidiary in Romania) at a price of US$ 12.50/sample, including sample preparation, with detection limits as follows: Au (0,01 g/t = ppm), Ag (1 g/t = ppm), Cu (2 ppm), Pb (10 ppm), Zn (2 ppm), Mo (5 ppm), As (50 ppm). Some of these detection limits are relatively high for soil samples, in particular for Au, Ag, Mo, As, but appear acceptable for mountainous, mineralized regions, where the metal source is in most cases hardly more then 500 m from the sample location. Down-slope displacement leads to primarily mechanical dispersion and dilution (relative to the mineralization) remains rather low (dilution factor perhaps on the order of 100-1000).

Analytical Results: Gold at 0.01 ppm – 2 samples

- Gold - above detection limit – 3 samples
- Silver - above detection limit - 10 samples (max. 4 ppm)
- Copper - 10 – 90 ppm
- Lead - 16 – 458 ppm
- Zinc - 36 – 194 ppm
- Molybdenum - (0)
- Arsenic - 0 - 280 ppm.

A detailed description of each sample, its location (geographic coordinates) and analytical results are shown in Table 8.

More details on the sampling program can be found in the OCZLON, M. (2004), available from Richmond Minerals Inc. by request.

Metals considered of great importance in the soil of the Ober-Zeiring and Katzling Zone are Ag, Pb and Zn. Analytical results (Tab. 8, part 1 to 3) show a good correlation between Ag and Pb. In 10 samples Silver values were at or greater than 1g/t Ag. With Silver being more mobile than Lead its concentration decreases faster than Lead with its downhill distance from the source. The ten samples show that Lead values of around 70 to 150g/t Pb correspond to Silver values of about 1g/t Ag, higher values of Lead in the range of around 300-450 g/t Pb show Silver at around 4g/t Ag. Soil anomalies characterized the area of "D" and "A", of the Matthias Baue, and the lower Klum Creek and areas "B" and "F" (OCZLON, 2004).

It is important to mention the fact that these anomalies are located at or downhill from the metals' source, but they do not indicate the size and form of the source itself. Also contaminations by human (mining, ore sorting and processing) activities have certainly to be considered, a good example Mining Center "D" with its multitude of galleries and adits and an active Lead-Silver production.

For Zinc a good correlation was observed with the higher Ag/Pb values, an indication for the three metals' coexistence in the mineralized rock. Zinc has an even higher mobility than Silver, which explains its absense in samples with low Ag/Pb values. Two samples show good correlation of Zinc with Copper (e.g. sample KTS25 from the lower Klum Creek). OCZLON suggests that the paragenesis of these two elements compared with Ag/Pb/Zn indicates different mineralization levels (horizons) in a zoned deposit. However, WALSER (1974) reports of HADITSCH's observation under the ore microscope of the parageneses of Chalcopyrite, Galena and Sphalerite in samples taken from the Klum ("D") area. Silver is part of Galena, and Pyrite is a frequent accessory.

Sample	Easting	Northing	Slope incl.	Soil Horizon and Rock Chip Description	Au g/t	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag g/t	As ppm
KTS 01	491102	232915	20 N	A – 10 cm, dark brown; B >35cm, brown; chips: metam. Qtz.(80%), weathered micaschist (20%)	X	43	X	34	71	X	X
KTS 02	491048	232969	25 N	A – 5 cm, black; B >30cm, brown to light brown; chips: weathered micaschist, mod. Ferr., occ. Metam. Qtz. (100%)	X	59	X	101	70	X	150
KTS 03	490995	233012	32 NNE	A – 3 cm, dark brown; B >30cm, brown to light brown; chips: weathered marble with lim on fissures.(70%), weathered micaschist (20%), metam. Qtz. With red hem (10%)	X	90	X	71	76	1	X
KTS 04	490904	232992	30 NNE	A – 10 cm, black; B >20cm, dark brown; chips: weathered brecciated marble with lim on fissures (100%)	X	18	X	137	70	1	X
KTS 05	490908	233145	20 E	A – 3 cm, dark brown; B >20cm, brown; chips: weak to mod ferr sil micaschist (or quartzite) (90%), gossanous chips (10%)	0.01	44	X	80	101	X	X
KTS 06	490946	233344	20 E	A – 5 cm, black; B >25cm, dark brown; chips: not too weak ferr micashist, occ part sill (or quartzite)(100%)	X	39	X	78	89	1	X
KTS 07	490945	233508	30 NE	A – 8 cm, dark brown; B >20cm, brown; chips: white marble (75%), impure weak. Ferr. Marble (25%)	X	38	X	66	59	X	60
KTS 08	490811	233696	20 SE	A – 6 cm, dark brown; B >25cm, brown; chips: micaschist (95%), weak.-mod. Ferr. Micaschist (5%)	X	36	X	42	65	X	X
KTS 09	490713	233889	25 NE	A – 2 cm, brown; B >20cm, light brown; chips: marble (90%), schist (8%), brecciated weak. Ferr. Marble (2%)	X	48	X	458	157	3	X
KTS 10	490562	234027	35 NE	A – 10 cm, dark brown; B >20cm, brown; chips: marble occ. Brecciated +/- ferr., occ. With 10-20% mica (100%)	X	33	X	42	55	X	X
KTS 11	490358	234021	5 N	A - ; B >25cm, brown; chips: weak. Ferr. Micaschist (100%)	0.01	34	X	352	107	2.5	X
KTS 12	490159	233943	20 NNW	A – 5 cm, dark brown; B >30cm, brown; chips: weak. To mod. Ferr. Micaschist (90%), metam. Qtz. (10%)	X	32	X	22	56	X	280
KTS 13	490115	234072	35 SSW	A – 15 cm, dark brown; B >20cm, brown; chips: dark marble, occ. Brecciated, ferr. On fractures (100%)	X	23	X	70	80	1	X
KTS 14	490146	234271	30 NE	A – 10 cm, dark brown; B >20cm, dark brown; chips: marble, occ. Mod. Ferr. Zones (100%)	X	17	X	84	68	X	X

Tab. 8: Soil and Rock Geochemistry, KATZLING Zone, part 1 (OZCLON, 2004) Samples 1 – 14

Table Part 2 - OCZLON, 2004

Sample	Easting	Northing	Slope incl.	Soil Horizon and Rock Chip Description	Au g/t	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag g/t	As ppm
KTS 15	489945	234376	30 ENE	A - 3 cm, dark brown; B >10cm, brown grey; chips: fine-grained grey to dark grey carbonate, prob. near outcrop (100%)	X	11	X	28	89	X	X
KTS 16	489793	234525	30 ENE	A - 4 cm, dark brown; B >25cm, brown; chips: weak brecciated marble (70%), biotitic schist (20%), breccia withh mm-scale dark fragm. and ferr. (Fe-carbonate?) matrix (10%)	X	53	X	22	113	X	X
KTS 17	489623	234599	20 NNW	A - 5 cm, dark brown; B >30cm, brown; chips: biotite schist weak part sil (80%), pegmatite (15%), marble (5%)	X	44	X	57	147	X	X
KTS 18	489494	234658	30 ESE	A - 5 cm, dark brown; B >20cm, brown; chips: micaschist occ part sil (100%)	0.01	28	X	23	53	X	X
KTS 19	489603	234916	25 NE	A - 10 cm, dark brown; B >20cm, grey brown; chips: marble (100%)	X	22	X	65	36	X	X
KTS 20	491798	232241	16 SE	A - 3cm, B >30cm, brown; chips: amphibolite (10%), quartzite, not mod. ferr. (50%), micaschist (10%), orthogneiss (50%);	X	36	X	22	73	X	X
KTS 21	491865	232436	30 NE	A - 3cm, B >30cm, light brown; chips: micaschist (60%), mod. ferr. micaschist (20%), quartzite (20%);	X	34	X	54	48	X	X
KTS 22	491798	232632	12 ENE	A - 8cm, B >30cm, brown; chips: quartzite (70%), micaschist (10%), orthogneiss (20%);	X	32	X	30	77	X	X
KTS 23	491663	232847	16 ENE	A - 5cm, B >30cm, brown; chips: quartzitic micaschist (30%), amphibolite (20%), pegmatite (50%);	X	29	X	20	56	X	X
KTS 24	489646	233578	38 ESE	A - 3cm, B >40cm, dark brown; chips: marble, occ. weak. ferr., occ. brecciated, with 2 cm veinlets of coarse Fe-carbonate (100%);	X	10	X	39	44	X	X
KTS 25	489936	233807	30 NNE	A - 5cm, B >40cm, dark brown; chips: marble, occ. weak. to mod. ferr. (100%);	X	54	X	55	194	X	X
KTS 26	489417	234245	28 NNW	A - 5cm, B >35cm, brown; chips: Fe-carbonate with ferr. veinlets (5%), brecciated marble with ferr. matrix (15%), marble (75%), pegmatite (5%);	X	31	X	82	93	1	X
KTS 27	489267	234371	38 S	A - 5cm, B >35cm, grey brown; chips: marble (70%), schist (10%), weak. to mod. ferr. marble (10%), weak. to mod. ferr. schist (10%);	X	34	X	343	168	4	X
KTS 28	489228	234806	28 NNW	A - 3cm, B >35cm, orange brown; chips: micaschist (60%), quartzite (35%), MnOx-rich (breccia matrix?) (5%);	X	31	X	45	48	X	X

Tab. 8: Soil and Rock Geochemistry, KATZLING Zone, part 2 (OZCLON, 2004) Samples 15 - 28

Sample	Easting	Northing	Slope incl.	Soil Horizon and Rock Chip Description	Au g/t	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag g/t	As ppm
KTS 29	489166	234979	35 SE	A 3cm, B >25cm, brown; chips: micaschist (50%), quartzite (50%);	X	47	X	16	83	X	X
KTS 30	489272	235200	12 NE	A - 3cm, B >25cm, dark brown; chips: marble, rare mod. ferr. (95%), bluish qtz (hydroth.) (5%);	X	28	X	138	53	1.5	X
KTS 31	489142	235355	26 NE	A - 3cm, B >20cm, dark brown; chips: marble (100%);	X	34	X	23	48	X	X
KTS 32	489008	235500	18 NE	A - 3cm, B >25cm, dark brown; chips: marble (95%), Fe-carbonate (5%);	X	35	X	147	65	1	X

Tab. 8: Soil and Rock Geochemistry, KATZLING Zone, part 3 (OZCLON, 2004) Samples 29 – 32

Breccias found at the upper N slope of the Klum Creek show fragments of Ca- and Fe-carbonates in an iron- rich matrix, with Calcite veins and Siderite (Fig. 75 & Fig. 76). This indicates that sulfidic deposits have been created by hydrothermal processes. Strong chargeability is present over this large area.

Only three soil samples show traces of Gold (at and above the detection limit for Au). This indicates that Gold is not an important factor in the upper levels of mineralization.

Arsenic also showed up in only three samples but with values distinctly over the 50 ppm detection limit (e.g. 60, 150 and 280 ppm). Arsenic has shown not to correlate with any other of the main elements, Ag, Pb, Zn (and Cu). It appears to have its origin in a different mineralization phase with mainly Arsenopyrite. Arsenopyrite only was reported by WALSER (1974) from one sample from an adit of zone "B" and one from the mine at area "G".

Figure 75: Rock Sample from near soil sample KTS 24 location: Low T .Calcite veins in Breccia, limonitic Matrix

Figure 76: Klum Creek Location near Soil Sample KTS24 – Tectonic Breccia cemented with Limonitized Siderite Matrix (OCZLON, 2004)

Ten rock samples (Tab. 9) were taken for geochemical analysis from old mine dumps and/or rock outcrops in the area of the Katzling Zone as an integrated part of the area's geophysical survey (OCZLON, 2004). Most of them were brecciated marble with sulfide mineralization. Analyzed the same way as the soil samples at SGS's branch in Romania, they gave the following summarized geochemical results. (For sample by sample details see Tab. 9):

- Gold and Silver (0),
- Copper (< 27 ppm),
- Lead (< 45 ppm),
- Zinc (< 84 ppm),
- Molybdenum (< 10 ppm), and
- Arsenic (0).

All samples are from a more or less strongly brecciated marble generally showing Pyrite (and oxydized Pyrrhotite) in a limonitized matrix (Fig. 74 and Fig. 75) (Tab. 9). The content of the other metals Cu, Pb, and Zn does not reach anomalous levels – Gold, Silver and Arsenic are below detection limit. OCZLON (2004) suggests that this Iron-sulfide matrix filling of the marble breccias comes from mineralized shoots left rich in Iron after depositing the other metals at deeper levels. He also cannot find any correlation between soil and rock samples, which indicates that many of the soil anomalies that have been found and will be found in the future in the Katzling Zone are a result of "contamination" of the soils by various mining related historical activities. In case they are real, that is from an mineralized source in the ground, such a source is either still hidden somewhere uphill under the soil and talus or it has been discovered and mined.

TABLE 4 ROCK SAMPLE DESCRIPTION "KATZLING ZONE" (OCZLON, 2004)

Sample	Mine Sector	Easting	Northing	Sample description	Outcrop/boulder description	Au g/t	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag g/t	As ppm
KTR 01	50 m N of D-V	490484	234045	breccia with 25% matrix containing dark, very fine-grained mineral;	slope boulder, from waste dump; gallery to SSW;	X	5	8	29	44	X	X
KTR 02	50 m N of D-V	490484	234060	brecciated marble with disseminated py	slope boulder, 15m N of gallery;	X	4	6	X	X	X	X
KTR 03	150 m W of D-I	490078	233595	marble with sulphide (pyrrh.?) impregnation, sulfur smell	road outcrop;	X	3	7	X	X	X	X
KTR 04	150 m SSW of D-I	490107	233449	brecciated marble with very fine-grained dark-grey mineral on fissures and limonite;	slope outcrop;	X	4	6	22	10	X	X
KTR 05	350 m NE of B	489648	234459	fault zone in marble: brecciated marble and calcschist, mod. to strong. ferr., with calcite +/-qtz vein (1-4m);	road cut outcrop; altit. 990m;	X	27	X	18	53	X	X
KTR 06	200 m N of C	489807	234409	calcite vein with a network of mm fissures filled with lim;	boulder	X	3	10	X	4	X	X
KTR 07	500 m S of B	489384	233732	brecciated, mod. ferr., part. sil. marble;	road cut outcrop;	X	4	9	45	84	X	X
KTR 08	500 m S of B	489454	233751	brecciated, ferr. marble	road cut outcrop;	X	24	5	X	56	X	X
KTR 09	50 m west of F	490893	232945	brecciated, mod. ferr. marble in contact with schist(N);	road cut outcrop;	X	11	7	13	40	X	X
KTR 10	500 m east of E	490880	233395	fault breccia (50cm thick) in marble;	angular boulder, fallen from cliff outcrop;	X	2	9	X	8	X	X

Tab. 9: Description, Location, geochem Results of 10 Rock Chip Samples Katzling Zone (OCZLON, 2004)

Geochemical sampling program of 2012

In September 2012, six samples were taken and analyzed from the Oberzeiringer mine. The results (Table 10, ALS certificates can be found in the Appendix) show no outstanding element concentrations.

	Au	Ag	As	Ba	Sb	Pb	Zn	Cu	Bi	Co
OZ - 1	0.001	0.31	9	10	5.1	14.2	3	1.7	0.01	0.5
OZ – 2A	0.003	3.64	29	10	283	240	6	5.8	0.52	1
OZ – 2B	0.002	1.09	17	10	244	387	7	1	5.73	0.8
OZ - 3	0.002	15.65	18.6	40	43	52.7	45	173.5	0.15	1.9
OZ - 4	0.005	8	60.4	10	381	723	5	146	1.24	2.9
OZ - 5	0.002	27.3	18.8	140	423	7190	33	21	1.88	1.1

Table 10. Assays results from the 2012 sampling (Vielreicher, 2012)

Gold levels are around the detection limit (0.001 ppm) whereas the silver values are between 0.31 and 27.3 ppm. The average silver content is about 10 ppm. Due to the limited number of samples, it is difficult to discern regularities in element distribution. However, it is suggested that elevated silver values correlate with higher barium and zinc concentrations, as well as lower neodymium, tantalum, and yttrium values. For elements such as arsenic, lead or antimony there are no clear correlations. However, it is noteworthy that two samples (OZ - 2A, B) from the area of a so-called marcasite passage in the Goisernbau differ from the others. Although there is hardly any increase in the silver content compared to the other samples, there is a positive correlation with bismuth, lead and (perhaps) antimony, as well as a negative behavior with barium and cobalt; this is probably due to an overprint of the deposit by circulating fluids.

Geochemical sampling program of 2013

In 20013 limited sampling program was conducted on the eastern licenses of the Oberzeiring Property.

Table 11 shows the locations and description of the samples.

Sa	E	N	Easting WGS	Northing	Location	Description
BL	14.539	47.223	465110.947	5230048.763	Bergleite	boulder at road side;
BL	14.538	47.224	464994.074	5230200.721	Bergleite	road cut; qt-bearing
FJH	14.504	47.249	462475.500	5232985.295	Franz-	road cut, mica-marble
GB	14.512	47.241	463095.831	5232012.039	Grubenfe	boulder at road; near
GB	14.513	47.241	463161.234	5232048.676	Grubenfe	dark breccia from
GB	14.513	47.241	463161.234	5232048.676	Grubenfe	sulphide-rich, massive
GB	14.513	47.241	463161.234	5232048.676	Grubenfe	brecciated marble with
GB	14.513	47.241	463161.234	5232048.676	Grubenfe	dark, grey/red
GC	14.520	47.236	463669.075	5231554.684	Grubenfe	jasper-like; from waste
GD	14.527	47.237	464184.239	5231560.799	Grubenfe	waste dump material;
GD	14.528	47.237	464251.518	5231560.391	Grubenfe	waste dump material
GD	14.514	47.233	463202.216	5231202.559	Grubenfe	road cutting; breccia,
GD	14.514	47.233	463202.216	5231202.559	Grubenfe	silicified, banded,
GD	14.530	47.238	464397.371	5231689.168	Grubenfe	waste dump material
GE	14.526	47.233	464156.893	5231212.125	Grubenfe	waste dump material
GF	14.533	47.230	464669.464	5230779.935	Grubenfe	waste dump material
GG	14.545	47.222	465520.440	5229944.487	Grubenfe	silicified, sugary
GG	14.545	47.222	465520.440	5229944.487	Grubenfe	biotite schist from
GG	14.544	47.221	465488.119	5229811.932	Grubenfe	asp-rich ore from
GH	14.527	47.233	464232.549	5231205.493	Grubenfe	Near Wetzelsberg;
MB	14.508	47.252	462792.411	5233239.518	Area	brecciated marble
MB	14.508	47.252	462792.411	5233239.518	Mathiasb	laminated marble from
MB	14.508	47.252	462792.411	5233239.518	Mathiasb	waste dump material
PI	14.529	47.236	464346.055	5231547.472	Grubenfe	road cut; unknowm
PI	14.526	47.237	464150.731	5231582.612	Grubenfe	waste dump material

Table 11. Locations and descriptions of the samples

Fig. 76 demonstrates the location of the samples on the satellite image:

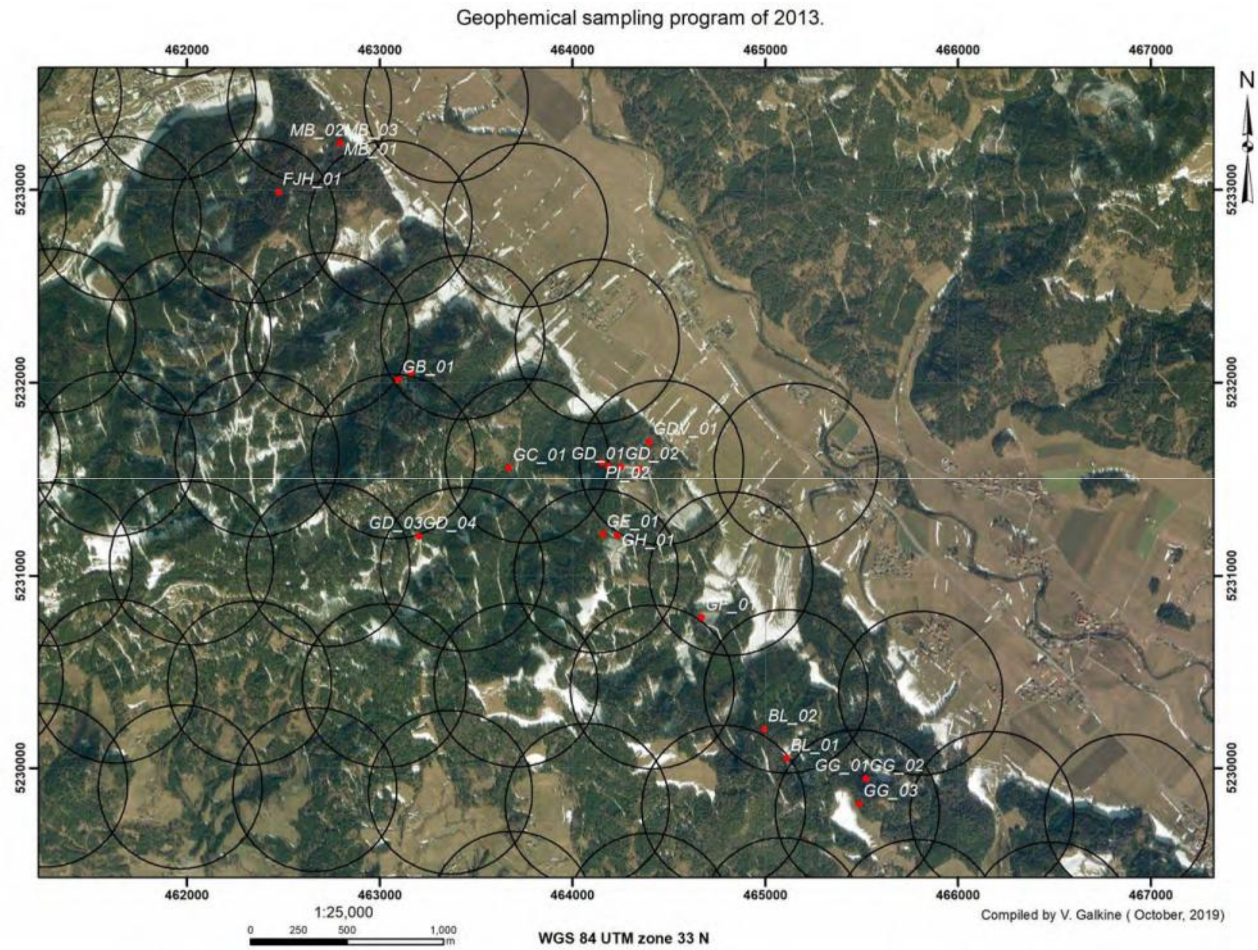

Figure 77: Geochemical sampling program 2013. Locations of the samples.

The results of the assays are shown in Table 12, ALS certificates can be found in the Appendix.

	Au	Pt	Pd	Ag	As	Bi	Co	Cr	Cu
Sample	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
BL_01	0.002	<0.005	0.001	0.01	49	<0.01	0.6	9	9.3
BL_02	0.006	<0.005	<0.001	0.01	57.1	0.02	52.2	374	33.5
FJH_01	0.002	<0.005	0.001	0.02	19	0.03	1.4	30	12.5
GB_01	0.004	<0.005	<0.001	0.16	29	0.02	2.9	104	10.3
GB_02A	1.2	<0.005	0.001	2.06	>10000	53.1	83.5	143	1830
GB_02B	3.88	0.007	<0.001	3.36	>10000	72.3	3.4	1010	219
GB_02C	0.012	<0.005	0.001	0.03	163	0.29	1.4	250	12.7
GB_02D	1.25	<0.005	0.001	0.75	>10000	**519**	23.4	27	1160
GC_01	0.005	<0.005	<0.001	0.04	259	0.75	25.2	277	29.1
GD_01	0.004	<0.005	0.001	0.86	168	0.03	1.1	72	22.2
GD_02	0.004	<0.005	0.001	6.94	200	0.02	2.8	194	29.4
GD_03	0.002	<0.005	<0.001	0.05	29	1.88	2.1	56	9.3
GD_04	0.001	<0.005	0.001	0.03	24	0.16	1.2	61	9.9
GDV_01	0.002	<0.005	<0.001	0.07	34	0.04	1.6	49	10.2
GE_01	0.001	<0.005	0.001	0.01	8	<0.01	1	38	7.4
GF_01	0.002	<0.005	0.001	0.06	25	0.01	3.1	83	8.2
GG_01	0.002	<0.005	<0.001	0.01	40	<0.01	1.4	19	9.5

GG_02	0.002	<0.005	<0.001	0.07	36.4	0.71	35.5	265	22.9
GG_03	4.2	<0.005	0.001	5.59	>10000	7.84	395	**1360**	**>10000**
GH_01	0.001	<0.005	0.001	<0.01	24	0.05	0.8	20	9.9
MB_01	0.008	<0.005	<0.001	0.49	188	0.13	2	672	8.8
MB_02	0.007	<0.005	<0.001	0.03	132	0.05	1.1	38	13.2
MB_03	0.002	<0.005	0.001	0.06	35	0.01	1.4	13	16.4
PI_01	0.079	<0.005	<0.001	**14.6**	1160	0.09	8.7	148	12.6
PI_02	0.004	<0.005	0.001	0.02	25	0.02	3.7	29	18.9

	Ni	**Mo**	**Pb**	**Sb**	**Te**	**Zn**
Sample	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
BL_01	2.1	0.36	9.2	0.51	<0.05	5
BL_02	63.6	2.44	10.3	0.44	<0.05	114
FJH_01	5.7	1.06	13.5	0.75	<0.05	13
GB_01	7.7	0.87	67.5	20.6	<0.05	381
GB_02A	6.1	1.19	38.8	185.5	0.08	265
GB_02B	5.7	0.37	19	335	0.08	10
GB_02C	4.9	0.41	3.9	2.89	<0.05	12
GB_02D	<0.2	0.64	59.6	380	1.84	9
GC_01	58.8	2.54	12.7	4.27	<0.05	76
GD_01	4.1	0.76	276	15.45	<0.05	49
GD_02	7	1.04	886	37.1	<0.05	88
GD_03	4.5	1.42	13.6	0.31	<0.05	10
GD_04	4	1.04	24.5	<0.05	<0.05	16
GDV_01	4.2	0.64	8.3	5.77	<0.05	28
GE_01	6.1	0.43	3.4	<0.05	0.05	11
GF_01	9.9	0.1	7.5	6.91	<0.05	60
GG_01	3.6	0.57	5	0.26	<0.05	8
	Ni	**Mo**	**Pb**	**Sb**	**Te**	**Zn**
	ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
GG_02	43.1	1.71	22	1.31	<0.05	186
GG_03	66.3	0.89	15	128.5	3.38	14
GH_01	5.6	0.4	6.4	<0.05	0.06	9
MB_01	5.8	1.9	20.9	5.85	<0.05	7
MB_02	3.3	0.52	18.3	1.62	<0.05	15
MB_03	4.2	0.35	27.4	3.99	<0.05	13
PI_01	8.4	**23.3**	**5600**	186.5	<0.05	68
PI_02	11.7	1	8.6	0.23	<0.05	12

Table 12. The results of the assays

Proposed drilling

After completion of a geophysical survey with Geomagnetic and IP-Dipol Tomography combined with soil geochemistry OCZLON (2004) proposed seven core drill holes plus two alternative drill holes in the Hoanzl area NE of the Ober-Zeiring NE Field, the location of the geophysical survey (Fig. 78). The drilling program is designed to test as many different structures as possible, which may represent different mineralization types and grades. OCZLON states that at this stage and without testing it is not possible to determine, which of the structures indicated by geophysics may carry economic quantities of mineralization, or to determine what structures with a higher chargeability or conductivity reflect which type of mineralized body.

The program's design to test as many structures as possible is to ensure better knowledge about the underground and to increase odds for success. . Proposed drill holes should be drilled with an inclination of 60° angle to assure intersection of the mostly vertical structures. The estimated depth of drilling needed for the drill holes should be around 250m.

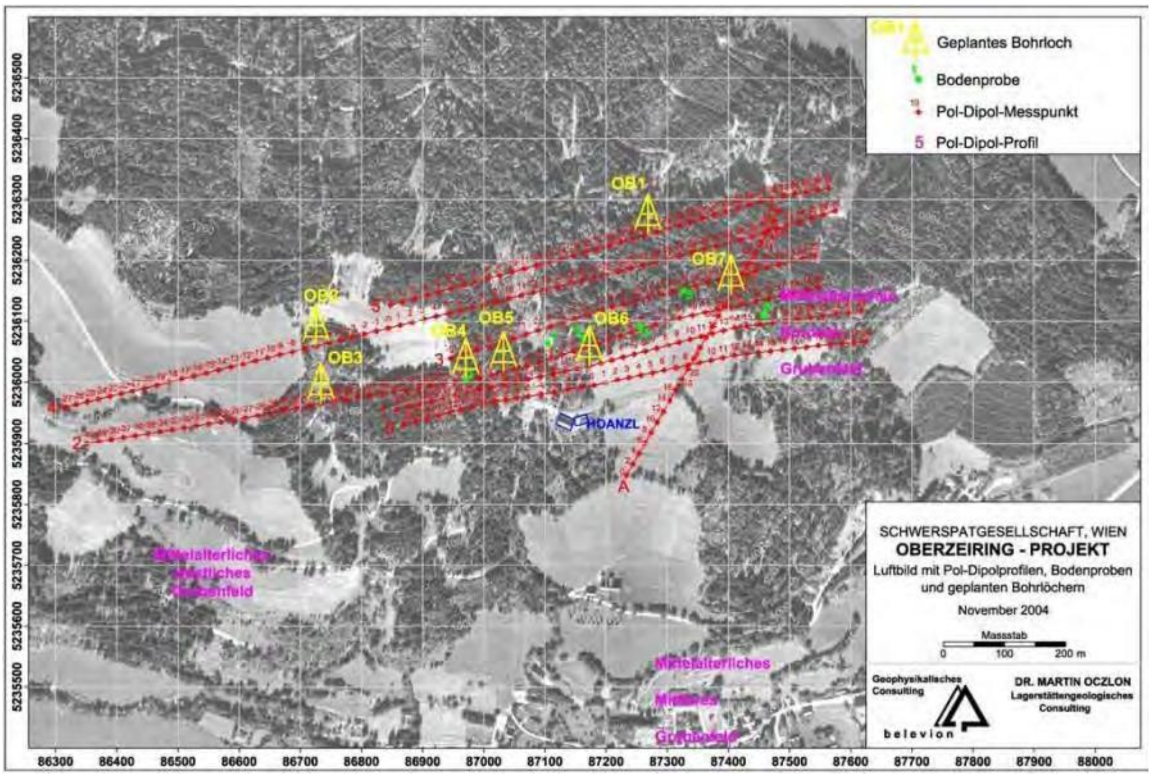

Figure 78: Location of Geophysical Lines and Drill Points NE of Ober-Zeiring towards Möderbrugg near Hoanzl (from: OCZLON, 2004)

Drill Hole	OB 1	OB 2	OB 3	OB 4	OB 5	OB 6	OB 7
East (+/-5 m)	87268	86726	86734	86970	87032	87173	87403
Nord (+/-5 m)	5236242	5236058	5235965	5236004	5236016	5236026	5236143
Azimut	N254°	N75°	N256°	N75°	N73°	N74°	N210°
Inclination	60°	60°	60°	60°	60°	60°	60°
Drill Depth m (Length o fDH)	200 m	200 m	110 m	90 m	200 m	140 m	200 m
Vertical depth	173 m	173 m	95 m	78 m	173 m	121 m	173 m
Horizontal Deviation	100 m	100 m	55 m	45 m	100 m	70 m	100 m
Comments	Intercept of a strongly chargeable and conductive structure, possibly with vertical components	Intercept of a strongly chargeable and conductive dome structure, possibly with certical components	Intercept of a 40° E dipping stronly chargeable structure. Onlly after confirmation by Pole-Dipole Tomography, as recommended	DH to intercept extemely strong chargeable area below the schists at roof, about 25°W dipping, possibly with vertical components	Same structure as the one at OB4, 60m to E and closer to surface (continuity to OB4?) in depth intercept of another highly chargeable structure	Intercept of a large vertical stronly chargeable structure	DH to intercept Marcasite veins potentially Au-beraing

Tab. 13: Seven Core Drill Holes proposed by OCZLAN (2004) NE of NE Field near Hoanzl

In case one or the other DH is not feasible and a replacement DH needs to be drilled, there is a strongly conductive80°W dipping structure in Profile 1, which has an extension from about 1100 to 1060m NN beneath measure point -5. The DH should be placed exactly between the measuring points -7 and-8 (E87002/N5235990), with 60° inclination with an azimuth N74°, and a l depth of 140m (Tab 13).

In case that the extremely chargeable feature close to the surface in the western part of the Pole-Dipole Profile 2 is proven (Fig. 79), another DH is recommended placed at Measuring point -30, with 60° inclination with azimuth N87° and a drilling depth of 100m..

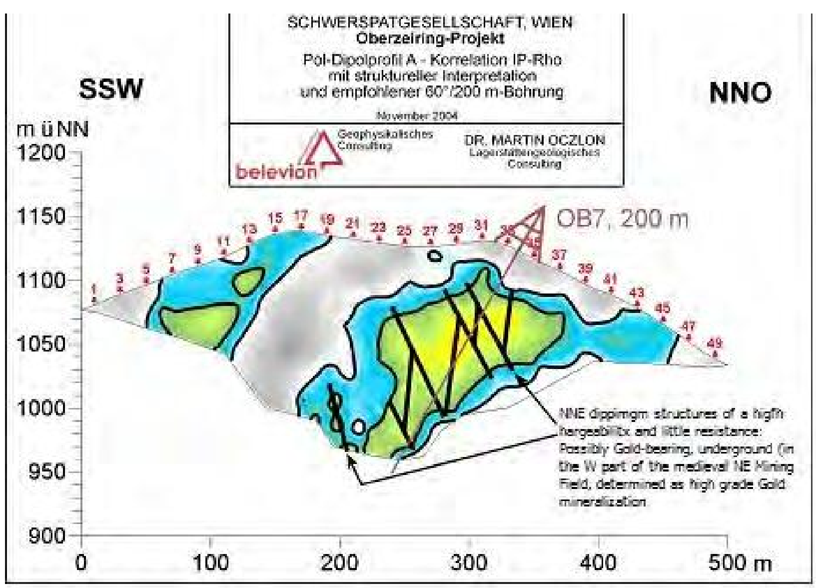

Figure 79: IP-Pole-Dipole Profile A: with structural Interpretation and proposed DH 7, to intercept potential Veins.

Item 10: Drilling

There has been no drilling done by SMZ on the Oberzeiring Property since acquisition of the license package. Historical drilling and results were discussed in ”Item 6: History”. After completion of a geophysical survey with Geomagnetic and IP-Dipol Tomography combined with soil geochemistry OCZLON (2004) proposed seven core drill holes plus two alternative drill holes in the Hoanzl area NE of the Ober-Zeiring NE Field. The details of the proposed drilling program have been discussed in the “Item 9: Exploration”.

Item 11: Sample Preparation, Analyses and Security

The Author did not receive from Silbermine Zeiring GmbH any specific information regarding security measures taken to ensure the validity and integrity of samples taken during the Geochemical Surveys at Oberzeiring and Katzling (see Item 9: Exploration) before dispatch of samples to an analytical laboratory. There exist, though, detail descriptions of the samples taken, together with their locations coordinates and the rationale (geophysical anomalies areas) for the sampling.

Sample preparation and analytical procedures have been carried out by the reputed and Certified Australian Laboratory SGS-Analabs (subsidiary in Romania) at a price of US$ 12.50/sample, including sample preparation, with detection limits as follows: Au (0,01 g/t = ppm), Ag (1 g/t = ppm), Cu (2 ppm), Pb (10 ppm), Zn (2 ppm), Mo (5 ppm), As (50 ppm)..

SGS is independent from Silbermine Zeiring GmbH. In 1992, SGS reestablished SGS Romania SA, with headquarters in Bucharest. SGS’s Constanta Office, located in the largest Romanian Black Sea port, hosts mineral laboratory, accredited according to ISO 17025 (https://www.sgsgroup.ro/en/our-company/about-sgs/sgs-in-brief/sgs-in-romania). To Author’s knowledge and personal experience with the SGS, the Lab follows internal quality control procedures while assaying the samples.

The assay results are shown according to standards accepted by mining industry. In Author’s opinion, the sample preparation and assaying procedures are adequate and the published assay results are valid.

Item 12: Data Verification

As it was stated in the “Item 3: Reliance on Other Experts”, in the preparation of this report, the author has relied on information provided by Richmond Minerals Inc. and Silbermine Zeiring GmbH, as well as published historical information obtained through the open source web accessible data. The author has reviewed a number of historical reports that were prepared by various consultants working for Silbermine Zeiring GmbH. Those reports outlined various aspects of the exploration programs dealing with drilling/sampling methods, assaying protocols, density determinations, geologic interpretations, historical production, and discussions on amount of mineable mineralization. The Author has made every attempt to accurately describe and convey the information contained in these sources, however he cannot guarantee the accuracy, validity or completeness of the data. Therefore, the Author relies on the accuracy presented to him in the sources used to prepare this report.

With regard to the Table data on the soil and rock samples assays reported, it was stated in "Item 11: Sample Preparation, Analyses and Security" that, in the Author's view, the sample preparation and assaying procedures are adequate and the published assay results are valid.

The Author conducted a site visit at the Oberzeiring Property on September 11, 2019, and spent approximately 8 hours at the Oberzeiring Property visiting and sampling the available outcrop, visiting the entrance to the old mine, and visiting and sampling the underground workings of the old mine which nowadays serves as a tourist and schooling attraction (Schaubergwerk Museum Oberzeiring).

Samples M-1 - M-4 were taken underground in the old Mine; the location of the Mine Entrance (Fig. 80) is shown in Table. 11 Samples have been taken underground, at different locations in the sub-crops of the tunnel walls (foot-base), between galleries "B" and "L" (Fig. 81), at elevations between 973.6 m and 924 m (Fig. 81-82).

Figure 80: Entrance to the Silbergruben Mine (Oberzeiring)

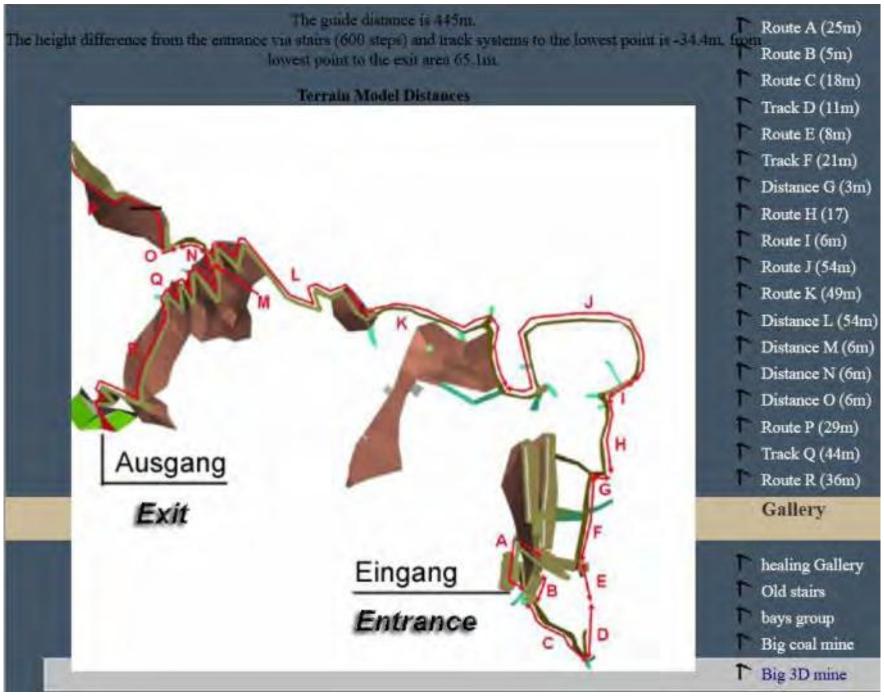

Figure 81: Plan view of the accessible part of the mine

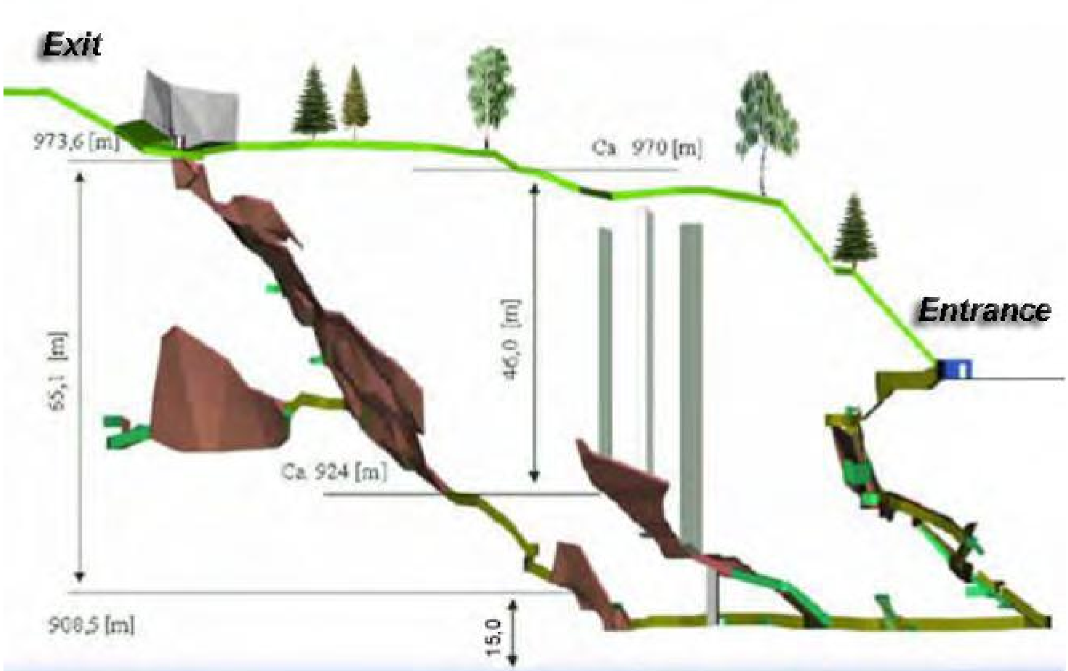

Figure 82: Profile of the mine

Table 14 . Coordinates of the sample locations taken at Oberzeiring Property, WGS 84, UTM 33N

Sample #	Location	LAT	LONG	Easting	Northing	ALTITUDE	COMMENT
W. Hawkins Sample	Outcrop	47.221	14.544	465482	5229806	1020	

M-1	Mine	approx 47.25172838	14.487	461156	5233266	860-918	11-SEP-19
M-2	Mine	approx 47.25172839	14.487	461156	5233266	860-919	11-SEP-19
M-3	Mine	approx 47.25172840	14.487	461156	5233266	860-920	11-SEP-19
M-4	Mine	approx 47.25172841	14.487	461156	5233266	860-921	11-SEP-19
1	Outcrop	47.221	14.544	465476	5229815	1020	11-SEP-19

These samples, though taken from different locations, look similar. They are represented by strongly oxidized non-magnetic to slightly magnetic dark-brown and dark-grey rock, maybe dolomite/siderite breccias with hematite, goethite (?), limonite, and possible pyrite; heavy, from massive to cavernous (Fig. 83 shows sample #2 and the location of it).

a b

Figure 83: Tunnel where sample #2 (b) was taken (a).

The samples were packed in individual plastic bags, marked and tied (Fig. 84).

Figure 84

Sample # 1 was taken about 7 km to the SE from the mine, at the outcrop/subcrop in the hill slope (Fig, 85 a,b). The rock – pegmatitic schist, gneiss, with quarts, muscovite-phlogopite-biotite, with intensely deformed and folded lamination - Fig. 86

Figure 85: Location of the sample #1 (a) and the outcrop/subcrop view of the bedrocks.

Figure 86: Highly deformed pegmatitic schists and gneisses.

Near this location Mr.Warren Hawkins (Richmond Minerals Inc) took the sample (in the table marked as W-1) during the spring of 2019.

All 6 samples were packed in individual plastic bags, and sent by DHL from Oberzeitring to Toronto, Canada on on September 13, 2019, and delivered by car to the AGAT Laboratories in Toronto by V.Galkine on September 20, 2019.
AGAT Laboratories is independent company from Richmond Minerals Inc.
AGAT Laboratories is accredited for specific tests as listed in the laboratory's current scope of accreditation by the following organizations:

- The Standards Council of Canada (SCC)
- The Canadian Association for Laboratory Accreditation (CALA)
- SAI Global

AGAT Laboratories is accredited to the following standard: ISO/IEC 17025:2005. The particulars on the accreditation can be found in the Appendix

The samples were analyzed by Sodium Peroxide Fusion by ICP/ICP-MS Finish, by Ag by 3Acid Digestion by ICP Finish and Au, Pt & Pd by Fire Assay by ICP Finish methods. For Au values > 3 g/t additional Gravimatric Finish method has been applied.

Table 15 provides the results of the 2019 assays (certificates cab =be seen in the Appendix).

Table 15 . Assay results for the selected samples

	Analyte:	Au	Au-Grav	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge
	Unit:	ppm	g/t	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
Sample Description	RDL:	0.001	0.5	1	0.01	5	20	0.5	5	0.1	0.05	0.2	0.1	0.5	0.005	0.1	5	0.05	0.05	0.05	0.01	0.01	0.05	1
M-1		0.004		384	0.1	181	<20	250	<5	9.6	7.66	0.5	2.2	2	<0.005	0.5	842	0.23	0.1	0.3	44.9	1.62	0.29	2
M-2		0.005		126	0.08	114	<20	5.5	<5	4.6	21.2	<0.2	25.9	1.7	<0.005	0.2	245	1.15	0.37	1.45	18	0.72	2.31	<1
M-3		0.011		12	0.03	468	21	49.1	<5	3.9	2.6	<0.2	3	3	<0.005	0.7	11	0.35	0.21	0.36	>50	1.24	0.38	<1
M-4		0.004		47	0.05	154	<20	988	<5	3.2	2.21	0.5	1.3	1.1	<0.005	0.2	49	0.2	0.11	0.12	49.5	1.23	0.18	<1
W-1		1.06		3	0.53	219000	<20	23.8	<5	8.5	0.46	<0.2	2.9	429	0.019	0.3	156	0.2	0.08	0.07	17.5	1.28	0.26	<1
1		6.4	6.86	1	0.38	265000	<20	164	<5	21.4	0.06	<0.2	3.6	345	0.013	0.6	636	0.42	0.21	0.12	20	1.38	0.42	<1

Sample Description	Hf	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	S	Sb	Sc	Si	Sm	Sn	Sr	Ta	Tb	Th	Ti	Tl	Tm
	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm
	1	0.05	0.2	0.05	0.1	10	0.05	0.01	10	2	1	0.1	5	0.01	5	0.05	0.2	0.01	0.1	5	0.01	0.1	1	0.1	0.5	0.05	0.1	0.01	0.5	0.05
M-1	<1	<0.05	0.4	<0.05	1.6	<10	<0.05	0.26	35000	24	<1	1.1	<5	0.01	838	0.26	1.7	0.13	883	<5	1.47	0.3	<1	259	<0.5	<0.05	<0.1	<0.01	1.1	<0.05
M-2	<1	0.16	0.3	<0.05	14.6	<10	<0.05	0.16	7080	3	<1	10.8	<5	<0.01	3400	2.91	0.8	11.2	625	<5	1.66	2.3	<1	90.1	<0.5	0.26	<0.1	<0.01	1.4	<0.05
M-3	<1	0.07	0.3	<0.05	2	<10	<0.05	0.2	49800	5	<1	1.5	<5	<0.01	738	0.36	1.5	0.16	223	<5	1.49	0.3	<1	308	<0.5	0.06	0.1	<0.01	<0.5	<0.05
M-4	<1	<0.05	0.3	<0.05	0.8	<10	<0.05	0.21	43500	14	<1	0.7	<5	0.01	258	0.16	1	0.08	247	<5	1.45	0.2	<1	225	<0.5	<0.05	<0.1	<0.01	<0.5	<0.05
W-1	<1	<0.05	0.2	0.14	1.6	<10	<0.05	<0.01	177	13	<1	1.1	179	<0.01	58	0.35	7.5	9.2	145	<5	21.6	0.2	<1	12.4	<0.5	<0.05	0.4	<0.01	<0.5	<0.05
1	<1	0.08	0.3	0.21	1.9	<10	<0.05	<0.01	50	12	<1	1.7	63	0.01	9	0.43	15	7.27	186	<5	12.4	0.4	<1	6.6	<0.5	0.07	1.2	0.02	<0.5	<0.05

Sample Description	U	V	W	Y	Yb	Zn	Zr
	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	0.05	5	1	0.5	0.1	5	0.5
M-1	18.3	27	<1	1.2	0.1	38	3.4
M-2	1.08	12	<1	6.3	0.2	26	5.7
M-3	11.8	31	<1	2.1	0.2	5	1.5
M-4	13.5	31	<1	1.2	0.1	61	1.1
W-1	0.52	10	<1	0.9	<0.1	<5	2.4
1	0.98	14	1	1.9	0.2	<5	5.9

The assays show anomalous numbers of gold for samples #W-1 and #1, anomalous silver for 4 samples out of 6, and anomalous assays for barium, iron, manganese and lead.
The sampling program conducted during the visit of the property totally confirms historical data on Oberzeiring Polimetallic Property mineralization.

In addition to sampling, the Author visited the entrance to the old mine and the location of the old facilities nearby (Fig. 87 and 88), owned by Silbermine Zeiring GmbH where he was able to see the remnants of the old drill core.

Figure 87: Entrance to the old mine.

Figure 88

General location of the points of visiting and sampling are shown in Fig. 89.

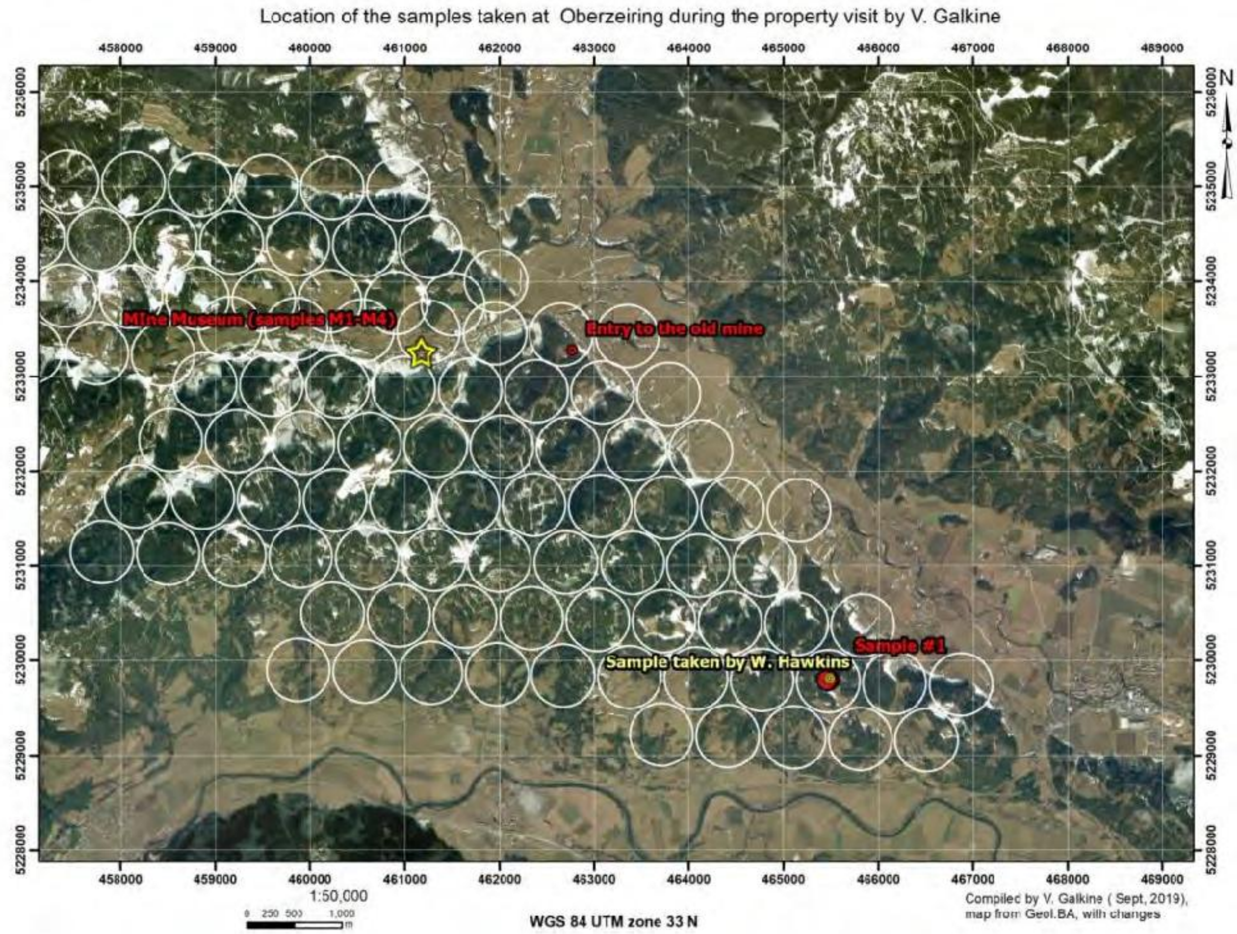

Figure 89: Locations of the sampling stations and old mine entrance,

Item 13: Mineral Processing and Metallurgical Testing to Item 22: Economic Analysis

These Items are not applicable in full coverage. There are some historical data about mining methods and metallurgy, some historical and very speculative mineral stockpile projections, some elements of viability analysis till the year 2012. None of those pieces of information and/or analyses can be considered as full enough to fill out Items 13-22 properly, without gaps and/or speculations.

Nevertheless, there is valuable (and valid) amount of information which could be interesting and helpful to potential investors to better understand the historical and technical background of mining on the Oberzeiring Property, the economic position of this mining region as compared to other mining enterprises in Styria, its potential etc.

Therefore, the Author compiled and all such information and put it in the **Item 24: Other Relevant Data and Information.**

Item 23: Adjacent Properties

There are no historical or current data available on the existing and desctiption of the adjacent mining properties.

Item 24_Other Relevant Data and Information

The information in this Item does not directly affect the main content of the current Technical Report.
Nevertheless, it could be interesting and helpful to potential investors to better understand the historical and technical background of mining on the Oberzeiring Property, the economic position of this mining region as compared to other mining enterprises in Styria, its potential etc.

Historical Zeiring Exploitation and Production Data

The Zeiring District's mining activities have already begun around 900 AD with the settlement of German people in the Pöls River valley region of Zeiring. Historical research by BRACHER (1970) points out that it was the Zugthal – Haberer Berg area to the South of Ober-Zeiring and its "Erzberg", where mining activities started long before they spread out to the North to the deposits of "Erzberg". A report by DEADDA (1743) supports these findings. .

The Zeiring Mining District's mines have been operational over at least 900 years, most probably longer. Over the centuries the mines have produced important volumes of ores of different types, origin and metal content with varying success and under continuously changing political, economical and technical conditions. As one of the largest, Ober-Zeiring had its own mint for valuable Silver coins. Zieiring first developed its own Mining Legislation, which was later adopted later all over Europe. Zeiring in its prime had a great and wide-reaching influence (e.g. there is a saying that Zeiring's riches built Vienna, the growing residence of the Habsburg Emperors).

It is a regrettable fact that despite its successful establishment as a productive Lead-Silver Mine, (which attracted the attention of the reigning Duke (Heinrich II. of Austria), a King (Ottokar of Bohemia and Austria) and several Emperors (Rudolf v. Habsburg, Emperor Maximilian I, and Empress Maria Theresia, Arch-Duke Johann of Habsburg) as well as that of influential and wealthy Austrian monasteries (e.g. the Benedictine Monastery of Admont)) very little information – mining and production records, mine sections and other mine plans etc. – exist and/or are available today. The first several hundred years of mining was carried out by a number of small individual miners. A lot of information may have been lost; or was never documented The first recorded mine map (HADITSCH, 1967) was prepared only in 1643 by the miner WASSINGER – a map of the Pier Mine.

Emperor Rudolf von Habsburg's visit to the mines in 1200 preceeded the granting of the license to mint the "Zeiring" Silver Pfennig, attesting to the importance of Zeiring Silver Mining.

Over several centuries the Zeiring District's Silver mine production made important contributions and had great impact on the local, regional and national economy. However, despite its local importance and the value of its deposits' resources exploited during historical times they could not compete with the ore deposits found by the

Spaniards in the New World of the Americas. Hit by the mine's flooding accident in 1361 resulting in the loss of most of its Silver ore stockpile, the much cheaper Gold and Silver imports from the Americas to Europe caused the beginning of the decline and ultimately the demise of the Zeiring District's mines at the beginning of the 18th Century.

Many technical reports by experts in Geology, Mineralogy and Mining are mostly detailed documentations of mine inspections and studies of the mine buildings, the structures of the mineralization-bearing formation, and of the mineralized bodies and their mineral content (see Bibliography; e.g. APFELBECK, HADITSCH, KIRNBAUER, NEUBAUER, PETRASCHEK, TUNNER, WALSER, WEISS, to name a few).
When judging and evaluating the viability and potential of the poly-metallic Zeiring District, several points have to be considered:

• That the historical Zeiring mining operations of many centuries past were successful until hit by the catastrophic flooding accident, which rendered the source and resource for Silver and other valuable metals inaccessible.. Up until this event mine production flourished s supplying wealth to miners, mine owners, the town of Ober-Zeiring and potentates (e.g. financing construction of the Emperor's Viennese residence; construction of houses, administrative buildings and churches in Ober-Zeiring).

• Determining the volume/tonnage of the different mineralization types mined (e.g. Silver – Galena – Bournonite, Siderite – Ankerite – Iron-hydroxide, Barite) directly is practically impossible due to the lack of historical records.
To determine the quantities of material extracted on the basis of mining records or (in case of insufficient production data) on the basis of estimates or calculations of the space left open after mining and the ratio of high grade mineralized rocks to waste is a common exercise viable in many mines with mineralized bodies well defined (e.g. veins, sills, large replacement or dissemination high grade mineralized bodies). In the case of the Ober-Zeiring Mine Fields' it is an impossible exercise today. The reasons for this are multiple:

• <u>Firstly</u>, the Zeiring mineralization processes took place in several repeated sequences and their phases, ranging from at least two phases of Siderite and Barite metasomatosis to the intrusion of several types of hydrothermal veins of varying temperature (Galena – Silver, Bournonite – Silver, Sphalerite, Copper-Stibnium-sulfides, Marcasite - Gold). The successive emplacement occurred along the same zones of structural weakness – faults and shear zones - within the Bretstein Marble formation host rock. With regards to the conduit for the metal-bearing fluids most scientists agree that it has been the major NW-SE tectonic structure of the Pöls River Valley graben-fault. The result of these processes is an ill-defined mineralized structure composed of hydrothermal Pb-Ag, Zn-Ag, Bournonite-Ag, Cu veins often with contact zones to the host rock or to the irregularly shaped metasomatic replacement Iron carbonate and Barite bodies.

• <u>Secondly</u>, the area was covered by a thick layer of ice during the last ice age and melt waters flowing beneath the ice produced an underground Karst-type system of caves by leaching the carbonate of the Bretstein Marble. Leaching generally took place in most cases along the same zones of weakness used by the different mineralized shoots.

• <u>Thirdly</u>, mining happened in three main phases or periods: The Silver- , the Iron- and the Barite-Phase.

- o *The first and only target* of historical mining from the very beginning to some time after the flooding catastrophe of the Pier Mine were the *Galena-Silver* and *Bournonite- Silver* veins. Many of them were found by the old miners following the tunnel system of the old Karst-caves. During that period only the Silver bearing ores were extracted. Iron and Barium ores were either left in place or if necessary removed and back-filled as waste in cave chambers often attached to the much wider stopes (Zechen) of the mineralized zones. The old miners at the time, until about the 17th - 18th Century, did not yet recognize the value and use of Siderite and Barite. To dispose of the "waste" including waste marble host rock, directly on site brought financial savings. Mining of Silver and Lead lasted until about 1696 (HADITSCH, 1967) and a latest attempt in mining of Lead and Silver took place at the Matthias Baue in the South Field in 1745.

- o *The second target mineral* was *Siderite* and other Iron-ore minerals (Ankerite and limonitic oxidation products in the oxidation zone). Iron-mining commenced about 1696 while Silver mining was gradually abandoned being longer profitable. 1783 began regular Iron ore production followed by the construction of a furnace in Unter-Zeiring in 1784. The Iron-mining period ended in 1868.

- o *The third mining target* was *Barite*, for which the base tunnel, the Johannes Unterbau and other internal drifts and cross-cuts etc. of the complex NE-Field mines were reopened by engineer, R. HIRN, in the late 1950s. Mining of Barite lasted until 1964.

To summarize the above:

- The size and volume of the total open space of the old stopes can be measured and calculated as far as they are still accessible.
- What is impossible to calculate or even evaluate are the ratios between the original cave space, the space created during the Silver-, the Iron- and the Barite-mining Periods and the spaces used for backfilling a mixture of unknown quantities of waste rock, Siderite and Barite bearing rock.

To bypass this problem many authors have pointed to the large quantity of slag, which was still piled high at Ober-Zeiring in 1840 (TANNER) despite the fact that unknown loads of the material already had been used over centuries for consolidation of roadbeds in the larger Zeiring area. It had come from eight to ten furnaces that had been active until after the flooding accident. TUNNER (1840) and many others after him described having still seen the large slag piles.

At the time APFELBECK (1920) described the material "as black, heavy slag, which can be seen still today". Analysis of samples showed 1,000g/m³ Silver, a result which confirmed for him the anomalous grades of Silver mineralization. APFELBECK further stated that during the century before the flooding accident eight to ten smelters produced about 100,000m³ of slag. This together with the fact that at the time of the accident the town of Ober-Zeiring was in the midst of construction of sturdy two- to three-storey buildings, had a flourishing mint and had about 1400 miners underground, who all are said to have perished. For Apfelbeck this is certain proof that Silver ores were mined at the time in the Pier Mine and remain still in the underground. That is, the reason for the decline in production was NOT caused by exhaustion of silver.

Several analyses registered by documents of the Admont Monastery (the owner of the Ober-Zeiring mines at the time of the accident) show the results for slag samples from different dump sites (APFELBECK, 1920):

o "Schlackenbrad": 7.31gAg/56kg = 1.305g Ag/t slag
o "Blabach": 36.54gAg/56kg = 6.525g Ag/t slag
o "Salblkeuschen": 14.62gAg/56kg = 2.610g Ag/t slag
o Lead mineralization and slag at "Scharte Fischer": 42.49gAg/56kg = 7.588g Ag/t slag.

APFELBECK (1920) also quotes an analysis of Lead-Silver mineralized rocks from the documents, sample taken in 1593 at the mine (Matthias Baue) of Purgstallofen (South Field of Ober-Zeiring): Lead 53 to 60%, Silver 522 to 653g/t.

Two analyses of Ober-Zeiring Pb-bearing rock made 1919 on order of A. MÜLLER showed 85.87% and 81.93% Pb.

At the conclusion of his 1920 Report APFELBECK presents a projection of the total metal content recoverable from Pier Mine plus the Matthias Baue at Purgstallofen, South Field. There is only the expected total of metals, without a breakdown for Lead, Silver and other metals:

Length of vein 400m, 6 veins of 1m thickness	2,400m²
Vertical extension of veins reduced from 80 to 50m = volume	120,000m³
Specific weight of ore (8g/cm³) – Total weight of oreresource	720,000 t
With a metal content of 60% 720,000t of Lead-(Silver) ore	432,000 t total Metal

Plus the mineralized vein at Matthias Baue/Purgstallofen: 180,000t ore with 50%Metal
90,000 t total Metal
Total Metal 522,000 t

It is clear that assumed thickness, extension of the veins and average density of mineralized material constitute the basis for potential quantity and grade have been determined, which is insufficient.

In QP opinion, therefore, the reported potential quantity and grade are conceptual in nature. There has been insufficient exploration to define a mineral resource and it is uncertain if further exploration will result in the target being delineated as a mineral resourse.

Another attempt and approach by TANNER (1840) to determine the original quantities of slag were quoted by APFELBECK (1918): "The quantity of slag accumulated gives the only indication of the quantities of ores produced." TANNER had seen large slag heaps during visits to the site in 1840. 20 years later in 1860 these huge heaps of slag had been used for road construction almost completely. TANNER calculated about 20 to 22km for the length of constructed road beds. He estimated the volume of slag still observed in 1840 at about 20,000m³. Of a total production over 660 years estimated at about 660,000m³, reduced to 300,000 – 400,000m³ by deducting the spaces between the slag pieces, he attributes about 2/3 as being produced between 980 and 1180 in the Upper Mines (Klinger Baue etc.) and the remaining 1/3 between 1180 and 1272 in the Lower, the Pier Mine (he still claims 1272 as the year of the catastrophe, after later research it was clearly 1361!).

Based on this difference in the year of the disaster the split between the earlier period (980-1180) and the later period (1180 to at least 1400) would be rather 50 : 50. The result of the projection is that at least 200,000 to 300,000 m³ of material was produced from the lower mines.

The other way to estimate, how large a mine building was and how much ore had been produced, is to take a look at the mine dumps. The results for Ober-Zeiring and Zeiring South (Süd) of an Austria-wide study to create an inventory of mine dumps (SCHEDL & others, 2008) are presented in Tab. 16. It shows the areas of Pusterwald (also held by SMZ) with 12 dumps of a total of 2,500m³ and Ober-Zeiring with 43 dumps of a total of 60,000m³ (or about 1,396m³ per dump. At Ober-Zeiring - South 60 (!) mine dumps of a total of 25,000m³ were mapped, giving an average of about 417m³ per dump. In the case of Ober-Zeiring most of the 43 mine dump sites are in the area of the four Mining Fields of the "Erzberg". The data for the numbers and the volume of mine dumps do give a good indication that the "material flow" at the Erzberg was larger for a lower number of dumps in contrast to the South were the numbers are reversed. Here they indicate a high mining activity with probably many exploratory adits and small mines, which stayed within the oxidation zone, without the technical capacity to go deeper.

Mine #	Mining District	#dumps	Volume Dump
129/1003	Pusterwald-Plättental	12	2.500
130/1001 - 130/2006	Oberzeiring	43	60.000
160/1001 (a-b)	Oberzeiring Süd	60	25.000

Tab. 16: Mine Dump Register for the area of Pusterwald near Zeiring and Ober-Zeiring

Historical Mining Methods and Technologies

Mining, the driving of tunnels, cross-cuts, drifts and shafts etc., was performed with the use of two methods from prehistoric times to the late Middle Ages, when the invention of gun powder and other explosives replaced them: with fire setting wooden logs were set ablaze directly at the face of the tunnel or stope to heat up the rocks to be removed and then douse the face with water. This was supposed to weaken and crack the rock and ease the work of driving the tunnel by removing the affected layer with hammer and chisel. This procedure was not only slow but also very dangerous for the miners considering the smoke and poisonous fumes, which at least in part had to dissipate before entry could be made to douse the heated rock with cold water. The average rate of progress was, depending on the type and hardness of the rock, only about 10-20cm per miner per day. When miners were able to drive a tunnel underground by taking advantage of a rock formation weakened by fault or shear zones progress was faster.

Fire setting required a sufficient aeration of the mine. Often this couldn't be achieved and the maximum depth mines could be driven to was 50 to 100m into the underground. This is the reason why mines from very early days remained small and many small adits had to be driven in order to extract a maximum amount of ore. With the limited depth oxide zone material was mined. To reduce the amount of work, tunnels were kept as small as possible and the miner strictly removed the ore alone from the stopes, if this was possible. Waste rock was piled up orderly piece by piece along tunnel walls or as backfill in stopes cleaned of ore. This reduced the amount of material to be carried from the mine and at the same time provided support for wider open stopes.

Production during the 18th and 19th Century

The introduction and growing acceptance and use of powder for blasting in mining in the 18th Century simplified and accelerated the underground work progress. Also Lead became a metal of high demand during the Napoleonic Wars (1799 – 1815), which revived the interest and production in Styrian Lead mines. There are no records that the Zeiring mines geared to exploiting Iron ores (Manganese-rich Siderite, Ankerite and Limonitic Iron s) also went back to Lead-Silver production, even though this is probable with the metasomatic Iron mineralized bodies and the hydrothermal veins of Galena-Bournonite-Silver tightly interlocked within the same mineralized zones. It is also possible that the exploitation of pockets of Sphalerite mineralization – previously not recognized as useful and valuable and therefore dumped or back-filled –were recovered during the process of Iron mining.

The Industrial Revolution commencing and gaining speed at about the middle of the 19th Century again brought significant changes to the existing operating mines by easing the work of the miners with a rapidly growing development of mining machineries and the expansion of railway lines bringing cheaper ways of transportation of their products – ores and /or raw metals. This allowed mines with hugeresourses, e.g. the “Erzberg” Mine Fig. 90), a mostly surface mining operation, to grow and expand, and forced the smaller operations, which could not afford the new technologies, to gradually close down. With its overwhelming competition by the Erzberg ore supply, mined at a lower cost and larger quantities the NEUPER Iron mine in Ober-Zeiring finally was closed down in 1886.

Figure 90: The Styrian “Erzberg” Iron Mine of Manganese-rich Iron-carbonate ore

Historical Mining in Styria in Comparison to Zeiring

In order to get an impression of the historical and present importance of the Zeiring Lead-Silver Mining District and to understand the still existing potential of remaining mineralized bodies, it is necessary to take a look at the historical mining situation of the surrounding larger political environment of the Austrian Province of Styria.

The density of mining operations in Styria in the 16th Century was around six mines per 1,000 km². Most of them were small operations with only very localized influence. Some of the mining districts, including Zeiring, however, had a much farer reaching effect and importance within Europe long before the 16th Century.

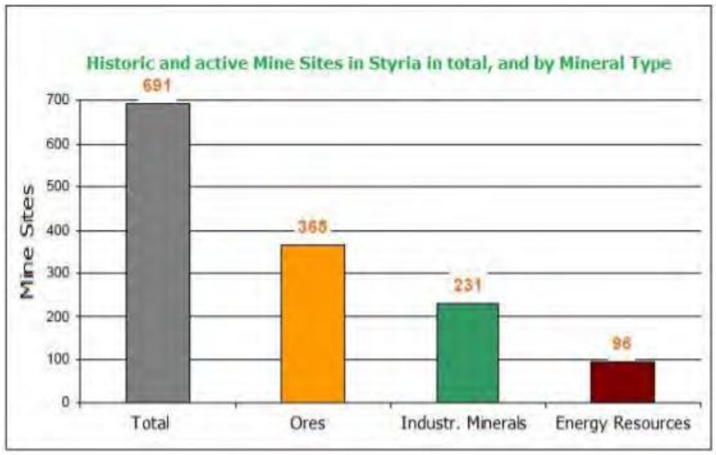

Figure 91: Diagram of the number of mines - historical or active until recently - in Styria, by produced Mineral Type

After the middle of the 16th Century the import of minerals and metals (especially PMs) from the New World overseas reduced the number of small mines substantially. Some of the mining districts like (Ober-)Zeiring were able to switch eventually from a small Lead-Silver- to an Iron-production, more profitable at the time, and were able to survive until the end of the 19th Century.

The diagram of Fig. 91 shows the number of mines for three main raw materials: Ores, Industrial Minerals, and Energy-related resources in Styria. Out of a total of 691 mines 365 – that is more than ½ of the total - have been producers of ore, 231 have produced industrial minerals, 96 Coal.

The following diagram of Fig. 92 shows a summary of non-ferrous Metals produced in Styria before 1700. Lead and Copper are predominant. Silver produced, of course, as an accessory to Lead ores seems low, but is still remarkable, coming mostly from only two mining districts, Ober-Zeiring and Schladming.

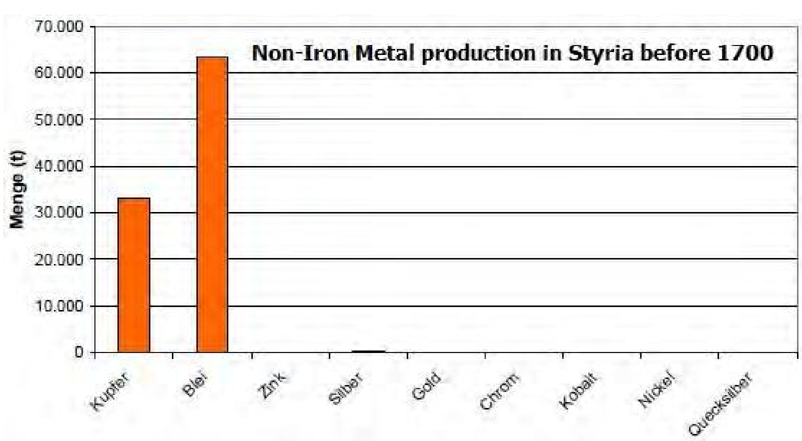

Figure 92: Diagram of total Production of Non-Fe Metals in Styria before 1700. Based on Archive Data and other Sources of information (from www.abfallwirtschaft, Steiermark/Bergbau)

Fig. 93 and Fig. 94, Diagram of the Lead and Silver Production in Styria, for two metals strongly related to each other: both diagrams show metal production before 1700 and after 1700 at all known mining areas. Ober-Zeiring and Schladming were the biggest producers of Silver before 1700. Fig. 94 shows Zeiring with a production of an estimated 80,000 kg the by far most productive mine for Silver.

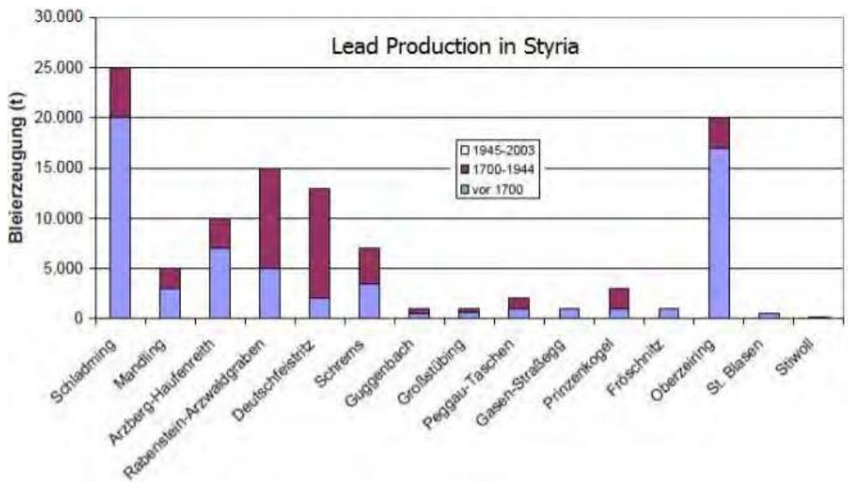

Figure 93: Diagram of Lead Production of Styrian Lead Mines showing the amounts produced before and after 1700

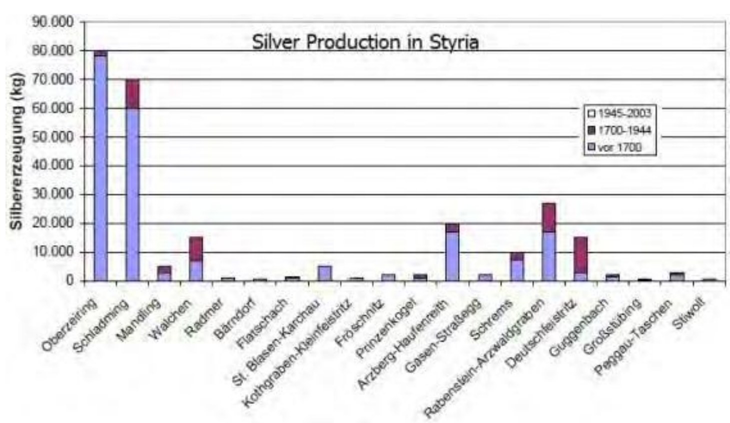

Figure 94: Diagram of Silver Production of Styrian Lead-Silver Mines showing the amounts produced before & after 1700

The Three Main Mining Periods of the Zeiring District

The history of Zeiring's exploitation of high grade mineralization, its processing and metal production can be classified in three mining phases: The Lead-Silver Period, the Iron Period and the Barite Period.

Lead - Silver Mining Period

Lead and Silver

The Period of Lead and Silver production from poly-metallic hydrothermal veins at Zeiring was the longest and the most successful period for the Zeiring Mining District. Its mining activity began around 900-1000 and lasted on a small scale until the late 17th Century. Production began in the Zugthal – Purgstallofen – Haberer Berg Region to the S of Ober-Zeiring and activities are said to have covered the whole area southward to the Mur Valley (BRACHER 1970) about 100 years before mining at the Ober-Zeiring Erzberg (Klinger Baue, Taubenkropf Baue in the NE Field and Wiener und Grazer Grube in the West Field) was started gradually. With the beginning of exploitation of ore bodies below the Blabach valley level underneath the town of Ober- Zeiring (the Pier Grube – Middle Field) the Zeiring District's production of Lead and Silver flourished until 1361, when a sudden flooding catastrophe happened in the underground workings of the Middle Field. Until then the Zeiring Silver Mine was considered the richest mine in the Eastern Alps; the town was awarded the license to mint its own Silver coins and three times, in 1326, 1336 and 1339, decrees for a mining regulation was passed on to Ober-Zeiring and constitutes a sure sign of the great importance of the Silver mine. This mining regulation later was adopted by mining administrations in Europe as the mining law (KIRNBAUER, 1962). Ten smelters were actively producing Lead and Silver at the time of the accident, and if it is correct that 1400 miners perished in the flooded mine, this after KIRNBAUER would indicate about 50 active locations of exploitation in the underground, producing sufficient ore for the smelters.
After the catastrophic event in 1361 and the loss not only 1400 men but also of access to the ore stocks Lead – Silver production continued on a steadily decreasing scale. 1365, about 4 years after the accident, the mint was closed. Towards the end of the 17th Century Lead – Silver Mining at Zeiring came to an end.

In Ober-Zeiring at least eight veins were exploited (KIRNBAUER, 1962) with a thickness from 10-20cm to 8- 10m. The average thickness varies between 1.5m and 5.9m, depending on which stopes had been accessible during visits of the experts.
The main use of Lead in the Middle Ages was for Silver smelting. However, no record-keeping about the quantities of Lead-Silver ore exploited and Silver produced has ever been done, nor do we have any analyses of bulk ore samples that could give an indication of Lead- and Silver grades of the ores mined. To determine the quantity of Lead ore produced from the often humongous open spaces of the old stopes is practically impossible because of the existence of the Karst cave system, which, like the ore, followed (often the same) zones of weakness in the marble host rock. To determine today, which or how much open space was created by Karst dissolution of the marble, how much was created by the mining of Lead-Silver veins and how much by the extraction of Siderite, is not really feasible.
After KIRNBAUER (1968) the total open space could be equivalent to 2 Million t of produced ore. Assuming that about 10% of the open spaces can be attributed to the Lead – Silver ore extracted with a Lead content of 7% the resulting quantity of Lead produced would be about 14,000 t. Including the ore potential for Lead – Silver in the S and SE of Ober-Zeiring (area of the Katzling Zone) the production could total 20,000 t Pb.
Production of Silver was the main source of importance and wealth for the Zeiring Mining District and the clearest sign how well and how flourishing Zeiring must have been during the early years of the 14th Century in order to be awarded the right to mint its own Silver coins.

Like with Lead to calculate and/or estimate the quantities of Silver produced is not possible for all the same reasons discussed above. However, in order to continue KIRNBAUER's above projections for Silver in the Pb- Ag ore the minimum total of Silver extracted and produced could be 2,000 t at a yearly rate of 20 t.

In addition Silver is not only bound to Lead but shows also higher grades in Bournonite-dominated ore (NEUBAUER, 1952). Additional volumes of Silver after NEUBAUER have to be added from ore production in the S Field and the many mines of the Katzling Zone. It is estimated at about 80 t, most of it produced long before 1700. Silver grades quoted by KIRNBAUER (1968) range from 500 to 1350 g Ag/t.

Copper

Copper sulfides can be an accessory mineral component of Zeiring mineralization types: Lead-Ag, Bournonite-Ag, Sphalerite and disseminated in Barite.

The Copper minerals are Bornite (Gamsgebirgszeche, Franzisci Baue) and Chalcopyrite. HADITSCH, in his ore microscopic research differentiates between four types of chalcopyrite, representing different generations of mineralization. It was found together with Galena-Silver mineralization and with Marcasite veins.

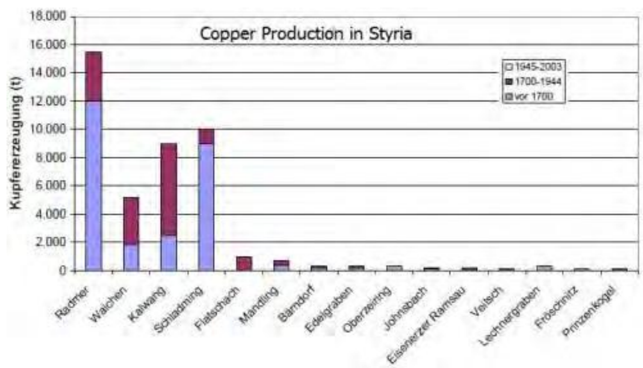

Figure 95: Copper Production in Styria before and after 1700 – All of the small Zeiring Production was before 1700

Copper and its mineral representatives have never been of great importance for Zeiring, but occasionally must have been mined and from this probably about 300 t of Raw Copper had been produced before 1700 (Fig.95).

Zinc

The main carrier of Zinc in the Zeiring poly-metallic deposit is Sphalerite. Except for Klinger Baue and Matthias Baue it is quite common. HADITSCH (1967) describes Sphalerite strings in Barite of the Upper Barbara Lager (NE Field).

Sphalerite often appearing in pods and independent veinlets within the Zeiring veins had been of no use for the old miners. Like Siderite and Barite it was either left in place, discarded as waste or back-fill inside the mines or thrown out onto the Mine dumps. Its usefulness was only recognized during the 19th Century, when it was also discovered, how to produce Zinc in metallic form. For Zeiring in historical times it was never of any importance.

Gold

The Zeiring District's mines have been predominantly Silver producers. Gold is contained at various grades in Zeiring's Silver. Whether this was known by the old miners of the Middle Ages and whether they were able to separate Gold from Silver is unknown. No such records are available.

During the last two Centuries researchers had begun to examine and analyze poly-metallic mineralized samples collected during tours through the mines and/or from the old mine dumps. Their goal was to determine mineral content and the sequences of mineralization during the emplacement of the Zeiring mineralized bodies.

One of the first discoveries under the ore microscope was that Silver often had a yellowish tint, which identified it as an alloy with Gold (RUECKER 1906 and HADITSCH 1967). After NEUBAUER 1952 the sample came from a dump holding material from an area in the Pier mine now under water.

A sample with Galena from the Klingerbau, submitted to SCHEID's Probieranstalt (LUGINGER, 1987) in Vienna contained 315.5g Ag/t and 2.5g Au/t. Older analyses made at the TU Vienna 1923/24 of samples from the West Field showed average grades of Silver of 930g Ag/t, 850g Ag/t, 1250g Ag/t and 1070g Ag/t of Galena (concentrate) (SETZ, 1923).

Samples from the Piergrube (Middle Field) showed Ag-grades in Galena of 832g Ag/t and in Bournonite 5g Au/t (SETZ). After NEUBAUER the average Gold grade contained locally in Oberzeiring's Siderite-bearing rock was 5g Au/t .

A sample from the mineralized lens exposed during HIRN's Barite mining operation, submitted to the Austrian Gold und Silber Scheideanstalt (ÖGUSSA) 1963 for a PM Analysis: Fine Silver 1106g Ag/t, Fine Gold 114g Au/t

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The Siderite (Iron) Mining Period

The metasomatic formation of Siderite at Zeiring is considered the initial phase of the cycle of mineralization formation. It is followed by hydrothermal fluids that formed poly-metallic veins with Pb, Ag, Cu, Sb, Zn and Ba (HADITSCH, LUGINGER). The third phase brought a renewed injection of Siderite (metasomatic replacement) and low temperature hydrothermal Marcasite veins that can contain Gold. The fourth and last mineralization phase was by higher temperature Sphalerite, Pyrrhotite and Silver- bearing Galena.

After Silver mining was abandoned during about the first half of the 18th Century a Baron from Vienna, KRANZ reopened the Taubenkropf Mine and began Siderite mining in 1783. He also installed a small smelter and a forge. About 50 years later, in 1832, F. NEUPER, owner of several forges in the area acquired and developed the Siderite mine. Before the transfer in 1832 the average yearly production only had been 500 – 800t of Iron ore per year (e.g. over 25,000t between 1783 and 1832). Under NEUPER production was increased between 1832 and 1886 to about 1250t/y, in total 65,000 to 70,000t (NEUPER). Including the previous mining activities to the total Siderite ore produced, KIRNBAUER (1971) suggests a quantity of 80,000 t. During NEUPER's operation a larger smelter was erected in Unter-Zeiring.

Although the saying is that the NEUPER family became wealthy from the Siderite mining, it must have been a continuous competition with the rival Siderite producers. The largest of them, the Styrian "Erzberg", which by the size of its Iron deposit and a much larger and less expensive production finally won the race. NEUPER was finally forced to close down his Ober-Zeiring Siderite Mine (Fig. 96 and Fig. 97) in 1886. An important factor also was the introduction of large coke furnaces for the production of high quality Iron and Steel.

The Styrian "Erzberg" had been the largest Iron producer in Europe already in the 16th Century. The mine produced 10-15% of the total Iron production (FETTWEIS, 1996).

In Styria there were a total of 231 occurrences of Iron mines, but only a small group of them were of any importance (KIRNBAUER, 1971). Table 17 shows the produced volume of Iron ore at several of the most important Iron ore producers in Styria, amongst them Ober-Zeiring with a tonnage of 40,000 t. This amounts to about half the tonnage quoted by KIRNBAUER (1971). The difference may be due to the method of deducting the volume of a mine's ore production from the volume of the past mine dumps, which was the case for the volume given in Table 17.

	vor 1700	1700 - 1944	1945 - 2003	Gesamt
Steirischer Erzberg	1.260.000	30.203.000	49.430.000	**80.893.000**
Radmer - Bucheck	0	128.000	1.497.000	**1.625.000**
Region Neuberg	?	220.000	0	**220.000**
Steinhaus - Fröschnitz	2.000	58.000	0	**60.000**
Oberzeiring	0	40.000	0	**40.000**
Salla - Stubalpe	?	19.000	0	**19.000**
Gesamt	**1.262.000**	**30.668.000**	**50.927.000**	**82.857.000**

Tab. 17: Iron ore (in t) produced by a selected group of the most important historical Styrian Iron Producers

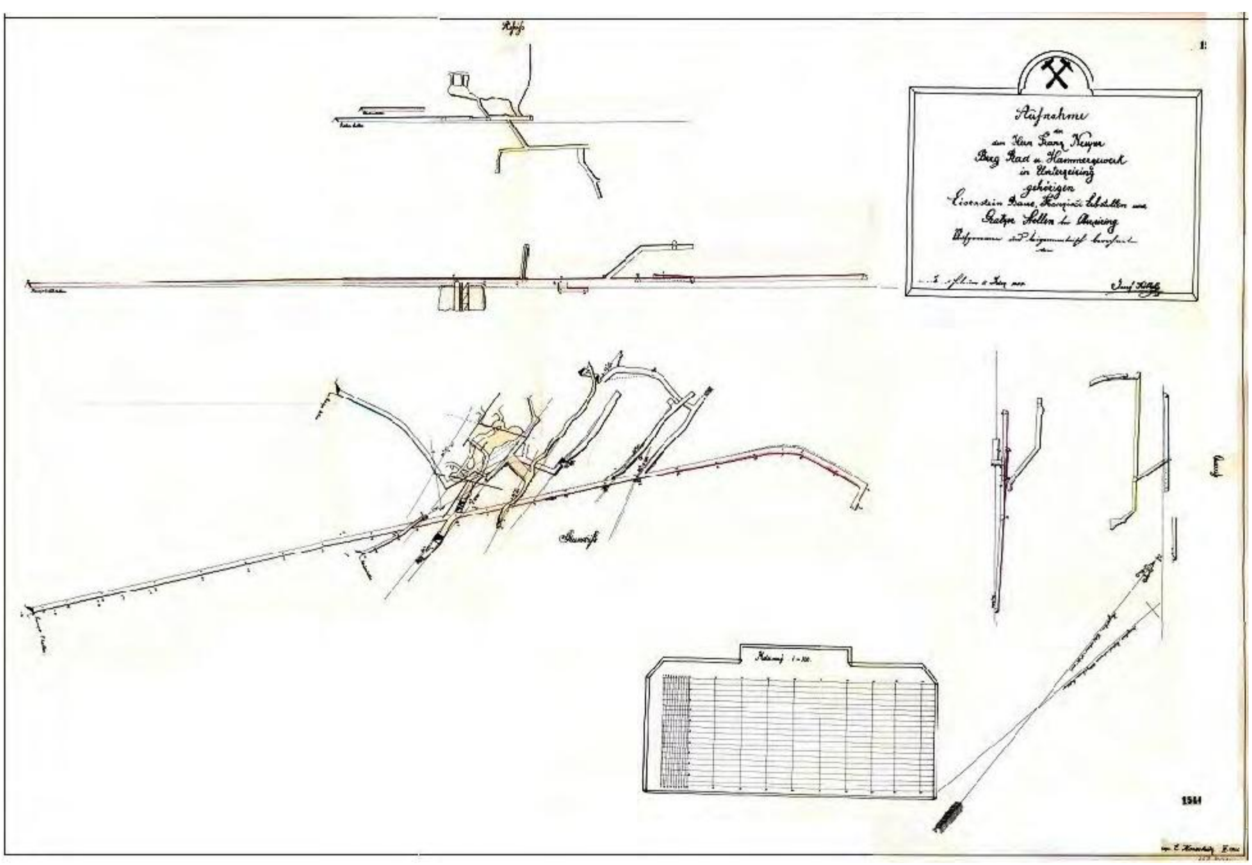

Figure 96: Map from 1884 of NEUPER's Franzisci-Grazer Iron-(Siderite) Mine, W Field, Oberzeiring

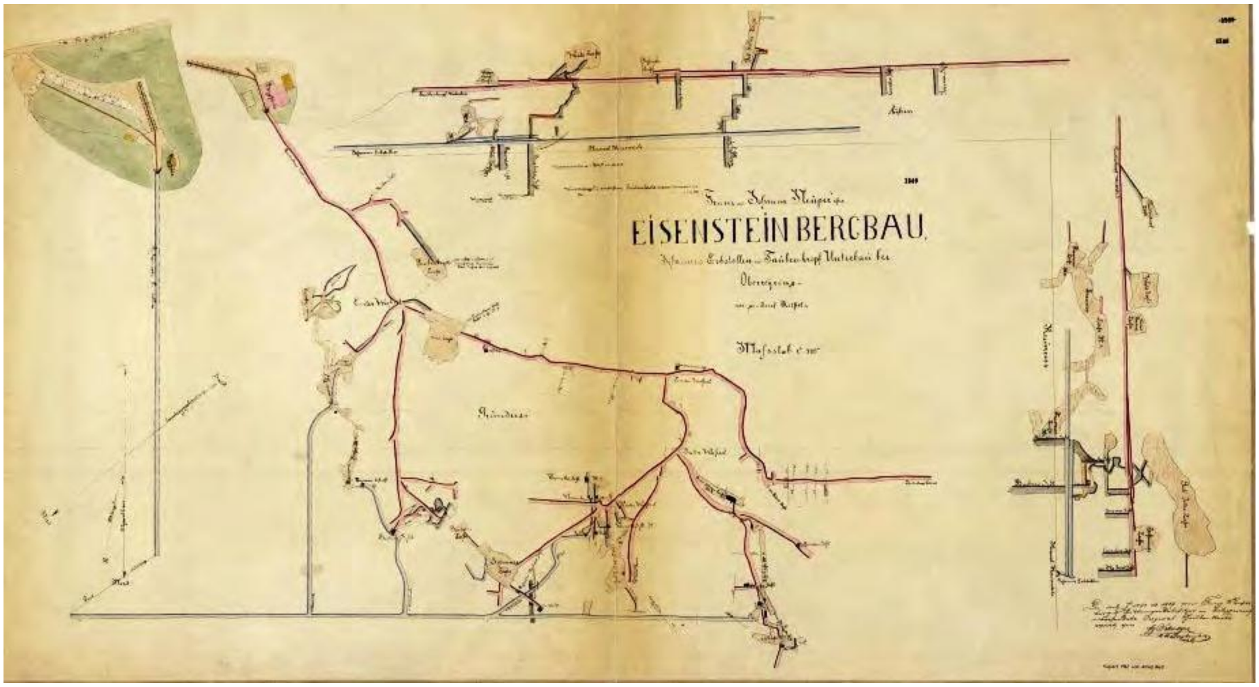

Figure 97: Map of Franz and Johanna Neuper's "Eisenstein" (Iron Stone = Siderite) Mine at NE Field Johannes Erbstollen, and Taubenkropf Unterbau at Oberzeiring, 1885, Scale 1:500.

The Barite Mining Period

Barite occurs rarely in form of a single mineral deposit. Due to its chemistry it is usually accompanied or accompanies deposits of Pb, Zn, Cu and Fe-sulfides, in form of pods, dikes or veins. This is also true for the Zeiring poly-metallic deposit(s). Here, Barite is found in two types of deposits (LUGINGER, 1987):

- The vein-type, and
- Metasomatic lenses and round "bubbles".

The sizes of the metasomatic mineralized bodies are usually much larger. LUGINGER states further that there are differences between the two types in their content of accessory "noble" minerals:

- The vein-type's Lead-Silver mineralized material in the richer Barite veins show better "quality" and have been "cleaned" almost perfect. The veins of poorer quality were left in place, especially Barite along the contact to the marble-host.

- The metasomatic Barite often contains Bournonite (with Silver and Gold).

Barite in the old days was considered useless and the old miners either left it untouched or if it had to be removed to reach other mineralization types, valuable at the time, like Lead – Silver veins or later Siderite, it was used as back-fill or simply dumped in some of the Karst-type caverns.

In the mid-1950s an Austrian engineer, R. HIRN acquired the mining concession over the NE Field and began to reopen the collapsed tunnels and other workings to get access to these stockpiles of Barite. Mining of Barite finally took place during the years 1959 to 1964. A decree from the Austrian Mining Authority (now: Mine Department or Mining Administration) from May 22nd, 1959 (AZ, 1852/59) giving HIRN the mining rights for Barite at the NE Field Johannes Base Tunnel – and attached historical stopes states that the Barite is almost clean of any accessories.

Of about 6,900 t of Barite produced in Styria between 1945 and 1964 about 98% or 6,735 t were produced from Zeiring's NE Field by HIRN. Figure 81 shows a diagram of the Barite production in Styria between 1945 and 1964.

LUGINGER (1987) states that he had located and defined 25,000 t of mineable Barite during a mine visit 1987. He proposes a mining production at a scale of 2,000 t of Barite per year. This means that even without the work to locate further mineralized stocks in other now inaccessible parts of the vast NE Field Mine production would last for over 10 years.
The Author of the current report did not find any information which could support the numbers reported by LUGINGER apart from his statement above. The reported potential quantity and grade must be taken as conceptual in nature.
With a market price for Barite of an average quality of US$ 250/t Barite ore this would mean 6.25 Mio US$ in total or US$ 500,000 per year. Whether this would be economic or not will depend on the quality of Barite produced, the market price for the determined quality, the cost of opening the mine accesses again, of equipment, mining and overhead. A yearly production of 4,000 t Barite/year paired with research to locate additional economically mineable stocks would raise the yearly margin between revenues and cost for the benefit of the company.

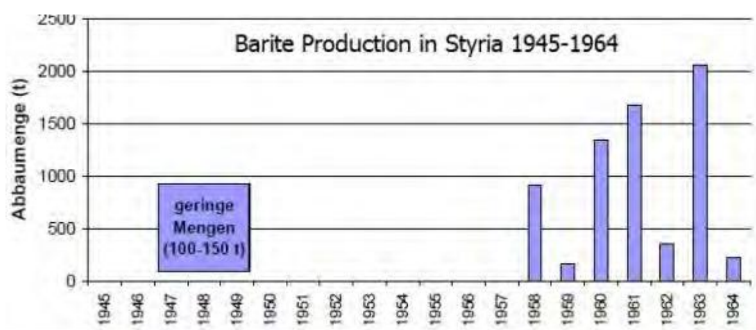

Figure 98: Diagram of Barite Production in Styria between the Years 1945 and 1964 (from: Österr. Montanhandbücher)

This way Ober-Zeiring became the only Barite mine in Austria after 1945, which showed some form of economic results. However, the expenses were high for getting the mine permit: the re-opening of collapsed mine workings, to secure a safe access to the stopes, safe exploitation and transport of the Barite ore to the outside (Fig. 98). In order to get production to an economic level, HIRN would have needed more working capital, which he couldn't raise.

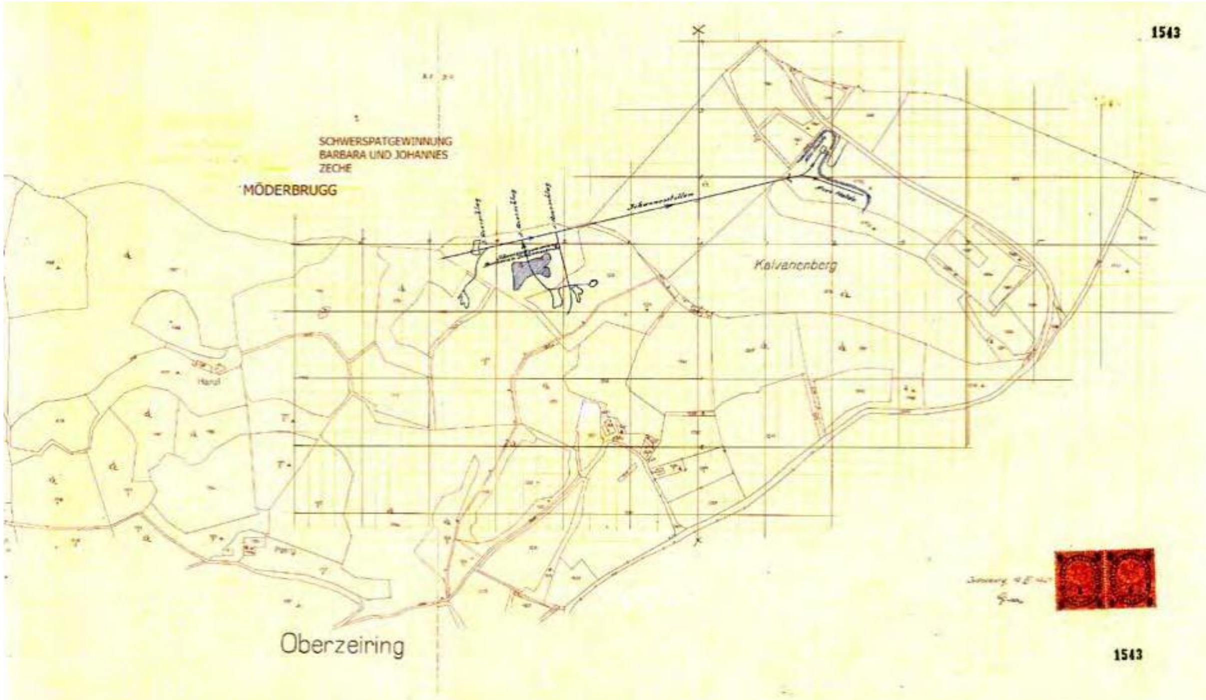

Figure 99: Map of NE-Field Barite Mining around the early 1960s at Johannes Zeche and Barbara Zeche Showing the hauling of ore via the Johannes Base Tunnel (HIRN, ca. 1959/60 from the Min. Arch. GBA)

The Surface Expressions of Mining at Ober-Zeiring's Erzberg

The most obvious surface signs of underground mining usually are mine portals and mine waste dumps at the mouth of the adits, galleries and tunnels. Like in the case of Ober-Zeiring large cavities have been created by extraction of the material, or have been widened by it, where natural Karst-type caves already had existed.
Over the whole area of the SMZ Zeiring concession small cave-ins often paired with dumps of various sizes point to former mine entrances.
Another type of sign of underground mining can be subsidence of areas of different sizes caused by the collapse or caving-in of larger open underground structures of natural origin (Karst caves in Carbonate rock formations, created by the flow of aggressive waters underneath a thick ice cover in the area at the last Ice Age) or man-made by the extraction of material from the underground. At the Ober-Zeiring mines both types can be found together. Metasomatic and hydrothermal fluids created the Zeiring mineralized bodies by following zones of weakness, mainly fault and shear zones, in recurring phases forming metasomatic replacement mineralized bodies of irregular shape and size and veins. The aggressive underground water flows followed the same zones of weakness and often formed tunnel-like cave water conduits by leaching the carbonate host rock widening existing fissures and cracks and forming huge domes many times next to the more resistant mineralized bodies.

At Ober-Zeiring's Erzberg huge open cavities were such created by water and by mining. Eventually some became instable and collapsed. Depending on their size and closeness to the surface small cave-in pits to large areas of subsidence formed on the surface.

In the case of the NE Field, where very large open rooms exist like Johannes and Barbara Zeche A. WEISS, a mining engineer form the Montan University of Leoben studied and mapped these surface features in the area over the Klinger Baue (Fig. 100) and over the Barbara Zeche further to the S (Fig. 101).

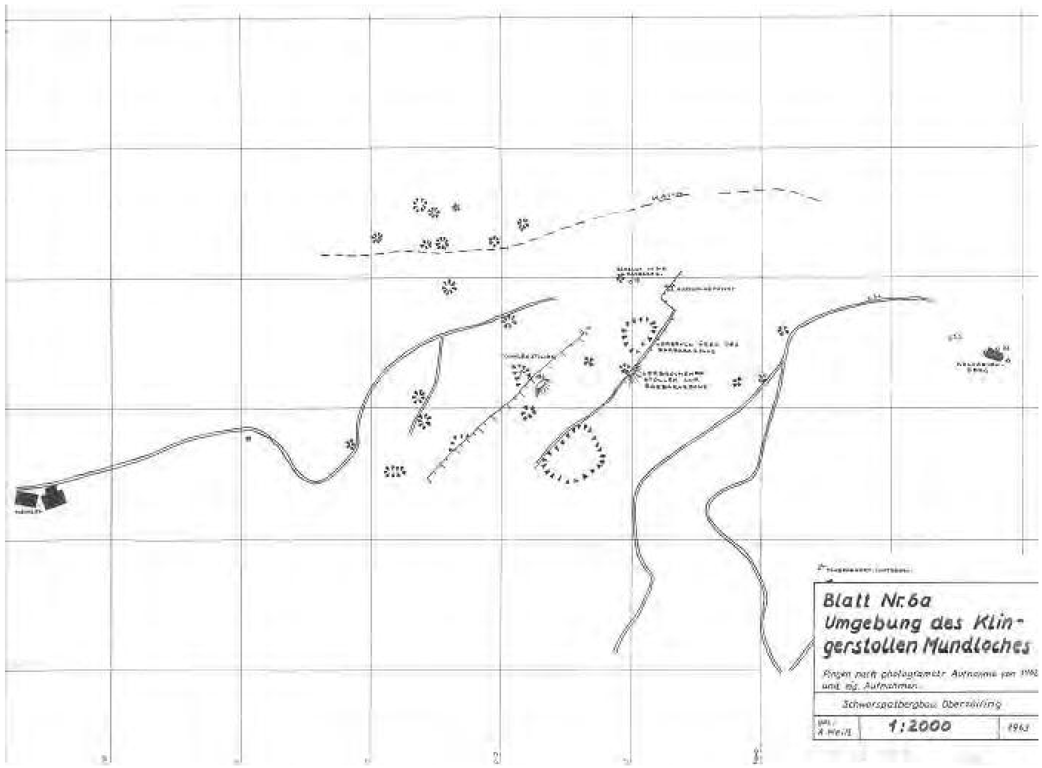

Figure 100: Map of the Surface Signs of Mining above the Klinger Baue, NE Field, Ober-Zeiring

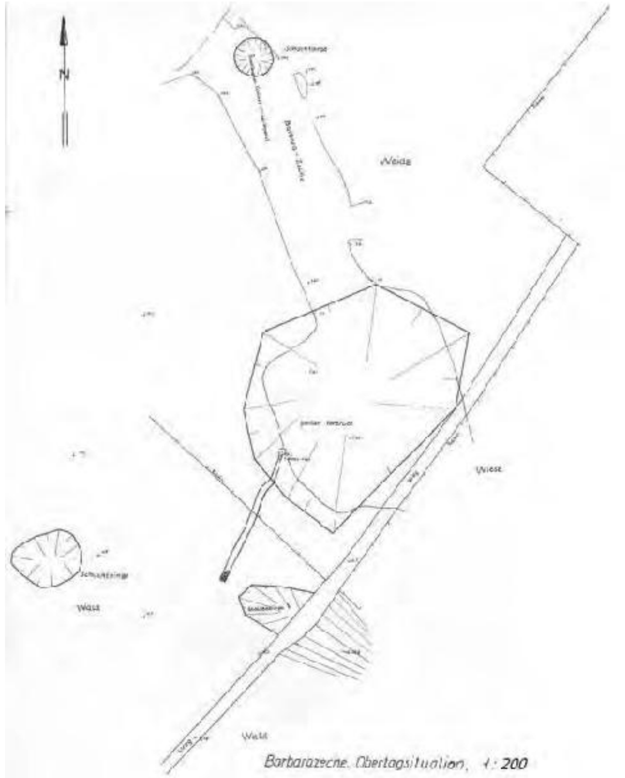

Figure 101: Map of the Surface Signs of Mining above Barbara Zeche, NE Field, Ober-Zeiring

Ore Processing

Historical Ore Processing

The procedures of historical ore processing have caught the interest and attention of scientists, geologists as well as Environmental researchers in recent decades, especially in areas of the exploitation of materials containing heavy metals, like Zinc, Lead and Arsenic together with rare and often very poisonous elements, like Gallium and Cadmium enriched in the process and left behind as waste.

In Austria a Research Project – the search for and the registration and analysis of old mine dumps and mine dump sites has been completed covering the whole of Austria, including Styria and the Zeiring area (SCHEDL et al, 2008 - The Mine Waste Dump Registration). All the information in the Zeiring area is attached to this report as APPENDIX.

Local anomalous concentrations of elements are often found in the direct vicinity of old mine sites, when ore processing was begun more or less right at the mine entrance and dump. This was mainly a process of sorting and enriching the ore and throwing the less suitable pieces onto the waste dump. In many cases the pieces of ore brought to the surface were crushed on site and ore minerals enriched by a process of panning. They were eventually washed away and spread out over the area by rain and flowing water.

The losses of valuable metal elements like Lead and Zinc and other elements by this very inefficient procedure was measured by the Waste Dump Project (the "Project") and the results were quoted for the mines at Rabenstein and Haufenreith, where losses of Lead varied from 25% to 41-68% and losses of Zinc between 50 and 75%.

With regards to the ore processing techniques there were generally three stages, which have caused different types and grades of pollution (SCHEDL et al.):

• The first method was by hand after visually sorting the mined material into two categories – ore or barren rock, whereby larger pieces were cracked on site and the pieces again were sorted. The "barren" rock pieces together with the fines, often stillmineralized, were dumped. This primitive way of initial processing caused high losses of metals, which ended up on the dump. Hand sorting, as a first step of enrichments remained in use at many mining sites until the end of the 19th Century despite the availability of increasingly effective ore processing machines.
• The second step was reached with the invention and introduction of rock crushing, grinding and washing machines, and ore concentration by gravity before the concentrate went to the smelter.
• The third step in mineral processing began with the introduction of ore flotation, which meant high efficiency in the recovery of the metals and smaller dumps much less to very little loaded with heavy metals and trace elements. Since most of the Styrian mines had closed down by the beginning of the 20th Century there is only one mine that introduced flotation in 1921 (SCHEDL et al.).

Smelting of the concentrates was the next factor for additional losses of the metals to be produced. They ended up either in the slag on a slag heap, or were volatized by the roasting process to convert sulfides into oxides. In Zeiring during its "high" time 8 to 10 smelters existed to process the Lead-Silver concentrate. Huge slag heaps still mineralized with Silver and Lead were piled up. In time the slag was used to consolidate roadbeds on the vicinity of Zeiring. By about 1860 hardly any slag was left (APFELBECK). Analysis of slag samples at different times showed 4.4% Pb; Silver 4.5g to 22.5g/t slag (APFELBECK, 1920).

Elements other than Pb and Ag have never been analyzed.

Search and Location of valuable Mineral Stocks remaining in the mines of W, Middle and NE Field of Ober-Zeiring

• HIRN's venture to mine remaining mineralized bodies of Barite has proven the possibility of potentially locating economical quantity of valuable minerals left behind in place or dumped into cavities as waste and take it all the way to exploitation. The Marcasite veins of NE Field are a good example of another potential stockpile left in place and totally underexplored. Few analyses indicate that it could become a potential source for Gold mining.
• The same will be the case on a much larger scale once the Pier mine is free of water. There, as most of the people involved in this subject agreed in the past, the one, who succeeds in accessing the old mine now under water, will have created access to substantial stocks of Silver mineralization. But since there are no guarantees available, it is an open question that only will be answered and resolved once the mine is dry.
• This work certainly should be combined with a program of sampling and geochemical analysis for selected rare trace elements of mineralized samples from old stope faces, as proposed in the fourth point above.

The host rock for the mineralization is a massive calc-marble of the Bretstein Formation, which forms an anticline at Ober-Zeiring and is cut into several blocks along a series of steeply dipping faults and shear zones with a strike direction varying between NE-SW and N-S. The thrust along these faults is from a few meters to 10-20 meters, with movement and shift of each block's more westerly block to the N. This fault system is more or less parallel to the Pölstal graben-type fault zone, with deep seated thrust faults, which are recognized as the conduits for the metasomatic to hydrothermal metal-bearing fluids ascending and intruding into the marble host along the fault and shear zones in the Zeiring Mining District.

The intrusion of mineralization forming solutions happened in four phases:

- The metasomatic formation of siderite by replacement of the marble along N-S striking tension joints in the marble host rock.
- A hydrothermal phase forming veins with Pb, Ag, Zn, Sb, Cu, Ba minerals
- A phase of abundant formation of siderite mineralization, and
- A hot hydrothermal recurrence of Sphalerite, Galena, Pyrrhotite followed by Marcasite veins

The time of fortune of Zeiring lasted well until 1361, when miners hit an underground water source, which flooded the Pier Mine, and made the mineralization no longer accessible, forcing the Ober-Zeiring mint to close down. Many attempts, already soon after the catastrophe, to drain the mine failed, mostly due to inadequate technologies available at the time. Despite their failure they demonstrate very well that at a time, when knowledge and the memory of the conditions of the flooded underground were still fresh, miners and owners wanted to regain access to the lost mineralization zones. Had the supply been exhausted at the time of the accident, nobody would have cared and dared to regain access by draining the water. The most effective plan was developed by a government commission of Empress Maria Theresia, when construction of a base tunnel of about 4km undercutting the Pier Mine base level was started from the Mur Valley in the South. The promising project had to be abandoned due to war-time conscription of able men.
Except for few analyses of ore and slag there was never any book-keeping of the volumes of ore produced, nor were any maps and mine plans and sections made.
Other detailed analyses were made spectrographically for trace elements in 1952 (NEUBAUER) on a sample of Sphalerite from Taubenkropf mine by SCHROLL, a Professor for Geochemistry at the University Vienna with the results:

Ag: 3g/t	Cd: 1000g/t	Ge: 50g/t	Ga: 300g/t	In: 10g/t.

An elevated Ga-content is an indication for the mineral's formation under low temperatures (OFTEDAHL, 1940). The usefulness of this analysis is that it brought to light the necessity to analyze the Zeiring mineralization not just for Pb, Ag, Zn and Cu, but for a whole series of trace metals including Gold.

With the beginning of the 18th Century mining of Siderite was started, with a smelter for Iron built in Unter-Zeiring. It was a successful business with an Iron produced that was rich in Manganese until 1886 when the production finally had to close due to the overwhelming competition by the Styrian Iron Mountain, the "Erzberg", plus the introduction of the coke steel furnaces. The data of the volume of Siderite and Iron production vary greatly. One source (NEUPER) quotes about 70,000t. The Mineral Handbook of Austria quotes 40,000t. It is not clear, what the product was for each quote, but presumably the 70,000 t are total Iron Ore and the 40,000t represents total Iron production.

The third Phase of mining after the Silver and the Iron Phase commenced in the late 1950s, when an engineer (HIRN) reopened large parts of the NE Field Mine by clearing the base tunnel, the Johannes Erbstollen and other tunnels, drifts and raises etc. to mine the left-over Barite. The mining operation lasted until 1964 and had produced a little over 6,700t of medium to high grade barite. KIRNBAUER, Prof. for Mining at the Univ. Vienna, who had studied Zeiring thoroughly, quotes the following amounts of Barite at Oberzeiring:

- Occasionally the thickness of the Barite mineralized bodies reaches 3 – 4m or more, the height of the Barite
"veins" (metasomatic replacement bodies) 80 – 90m.

- As a result of his calculations/estimates he classifies the Barite amounts as follows as of Dec. 1st, 1961:
  - Proven 100,000 t
  - Possible 100,000 t
- Proposing a production of 4,000 t per year his estimated life-time for the Barite venture could be 50 years.

It is clear that only assumed thickness and extension of the veins constitute the basis for potential quantity and grade have been determined, which is insufficient.

In QP opinion, therefore, the reported potential quantity and grade are conceptual in nature. There has been insufficient exploration to define a mineral resource and it is uncertain if further exploration will result in the target being delineated as a mineral resourse.

LUGINGER (1987) states that he had located and defined 25,000 t of mineable Barite during a mine visit 1987. He proposes a mining production at a scale of 2,000 t of Barite per year.

Metallurgy – Metallurgical Testing and Mineral Processing

The mineralization of the Zeiring Mining District is composed of six main types:

- The Siderite in form of irregular metasomatic mineralized bodies, which replaced the marble host. Unless geochemical analysis for trace elements of samples taken at different locations of the Ober-Zeiring Mine Fields finds any elements of economic interest and merit, Siderite, due to its low iron content and compared to huge stockpiles of Siderite at the Styrian Erzberg, is of no economic interest.
- Poly-metallic and poly-mineral veins with Galena, Silver, Chalcopyrite and other minerals containing Sb, Zn and many more elements not yet determined and
- Bournonite- Silver and Sphalerite veins
- Marcasite – Gold ? veins
- Barite free of impurities of sulfidic Pb-, Zn-, Cu- and other minerals, and
- Barite with such impurities.

To get to mine all these mineralization types together would be the most ideal, if a process can be found or developed to separate each of the minerals contained in the bulk ore. Such an idea is probably very unrealistic, and even if such a process – unless it is simple – would exist, there is the question of economies: which is better, an easier and less expensive bulk mining and on the other side an ore processing that is very involved and therefore probably more expensive. Most probably it would involve all three types of mineral separation and metal winning: Gravity separation, flotation and some sort of leaching.

The process of Thiourea leaching, which is modular and environmentally safe and friendly, also is very effective in separating Au, Ag, Cu and Zn and producing these metals in a clean and pure form.

In the case other valuable trace elements are found in economic quantities to find a way of their separation and concentration will be another question to be answered.

Viability and Potential

When one makes a judgment and evaluation on the viability and potential of the poly-metallic Zeiring District several points have to be considered:

- That the Zeiring mining venture of many centuries past was successful until it was hit by a catastrophic flooding accident, which took away the source and resource for Silver and other valuable metals from one moment to the next. It happened obviously by surprise in the midst of a flourishing production, which did not see an end and was supplying wealth to miners, mine owners, the town of Ober-Zeiring and potentates (e.g. financing construction of the Emperor’s Viennese residence; construction of houses, administrative buildings and churches in Ober-Zeiring).

- That to determine the volume/tonnage of the different mineralization types already mined (e.g. Silver – Galena – Bournonite, Siderite – Ankerite – Iron-hydroxide mineralization, Barite) directly is practically impossible due to the lack of any (continuous) registration of daily (weekly, monthly, yearly) quantities produced.
- Nevertheless, Geologists and Mining Engineers have repeatedly attempted to come up with at least reasonable estimates of the volumes of material mined and the stockpiles still in place.

For **Siderite** there are only production figures available, one is about 70,000t of Siderite produced (NEUPER; the last owner of the Siderite Mine) the other is from the Minerals Handbook of Austria with 40,000t production (most probably production of Iron).

Unless geochemical analysis of trace elements, in demand presently and in the future can prove existence of economic grades of such elements, and provided a technically and economically viable method of their concentration and extraction can be found/developed the rather low grade (e.g. low Iron content) Iron-carbonates at the Zeiring Mining District have no economic value. Their usefulness due to a Manganese content expired 1886, when the competition by the much larger and less expensive production of Manganese-rich Siderite at the Styrian “Erzberg” plus the introduction of coke as carburant and reagent in steel furnaces forced NEUPER’s Zeiring Iron Mining Company to close its operation. Even the Erzberg Iron production today is ways down compared to former days and only is able to continue as a Mn-containing additive in the steel production process at Austria’s steel industry center at VOEST Alpine – Linz.

LUGINGER’s (1987) statement that he had located and defined 25,000 t of mineable Barite during a mine visit 1987 is considerably less proven Barite mineralization than KIRNBAUER’s. This difference may be due to the fact that LUGINGER was more conservative than KIRNBAUER, or that KIRNBAUER in 1920 and LUGINGER in 1987 did not have access to the same areas in the NE Field Mines, or they were the same areas but for LUGINGER less of it was accessible than for KIRNBAUER.

Item 25:_Interpretation and Conclusions

The Zeiring Silver Mine GmbH, Vienna Austria is holding 99 Exploration Permits ("Freischürfe") in the area of the historical Lead-Silver Mining District of Zeiring (Fig. 102).

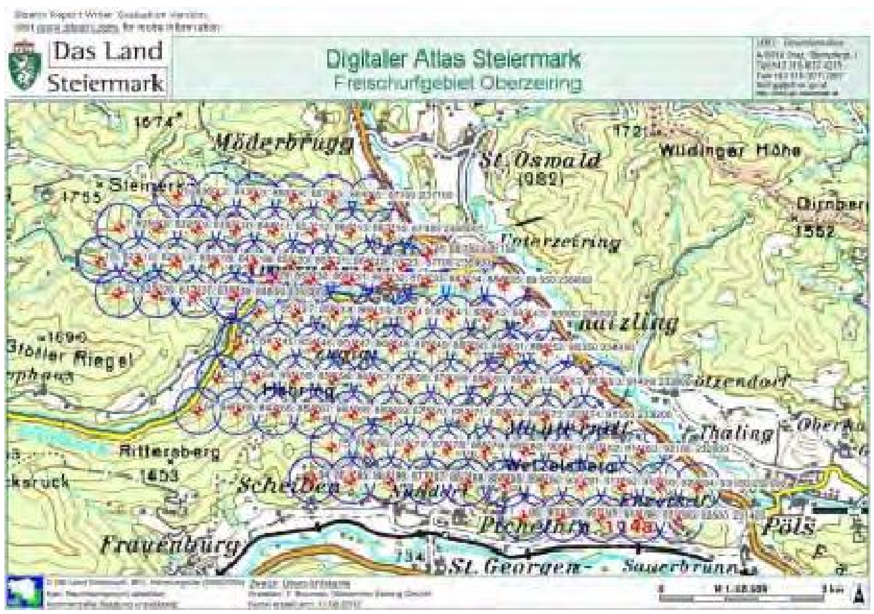

Figure 102: Map of SMZ Zeiring Concession

At the Zeiring Mining District there are up to eight vein structures in the Mining Fields of Ober-Zeiring (the West-, the Middle- and the NE-Field) and there are the deposits of Unter-Zeiring and the Katzling Zone reaching all the way to the Mur River Valley. The deposits are emplaced along lineations of structural weakness, mostly N-S to NE-SW striking and steeply dipping fault and shear zones, that have split the mineralization-bearing Bretstein Marble formationinto fault blocks that were shifted in steps northward, from E to W.

The Bretstein Marble is the mineralization host rock and is the lowest and most prominent rock layer of the Bretstein Formation, an Early Paleozoic crystalline sequence of the Wölz Mica Schist Unit belonging to the East Alpine Crystalline Complex. The Marble's top is sealed off by layers of mica schist, which concentrated the mineralized solutions and prevented them from ascending further up the formation. . The thick layer of the Bretstein Marble has also been eroded into an intricate system of Karst-type caves created during the last Ice Age by aggressive glacial melt waters flowing from the bottom of glaciers underground through existing cracks and fissures in the carbonate rocks forming cave tunnels and large cave rooms, many parallel to the mineralized vein structures. Many of the cave tunnels and rooms were used as passage ways and/or as areas for stoping and as depositories for waste and backfill material by the old miners.

The main tectonic structure of the area is the deep-seated NW-SE striking Graben-type Fault system of the Pöls River Valley, a valley carved out by a large glacier along the fault lines. Scientists agree that it is this deep-seated fault system, along which the metal-bearing fluids ascended into the Bretstein Marble. The emplacement of mainly three types of mineralization happened in several cycles of mineralization: The initial cycle wa s the metasomatic replacement of the marble by Iron-carbonates (e.g. Siderite) followed by hydrothermal veins with poly-metallic Lead-Silver mineralization, by a new phase of Siderite, of Silver–carrying sulfides (Bournonite), of metasomatic Barite and finally of veins of (Gold-bearing ?) Marcasite.

Silver Mining in the area began first to the South of Oberzeiring in the Zugtal (Zug Valley), on Haberer Berg, around Purgstallofen and Oberwinden, and further South, closer to the Mur Valley, at "In der Scheiben". Gradually the mining operations moved North to the Lead-Silver veins of the Ober-Zeiring "Erzberg" and into the underground underneath the town of Ober-Zeiring. By the 13th Century Silver mining at Ober-Zeiring was so successful that the town was allowed to open its own mint of well- sought-after Zeiring Silver coins, while up to ten smelters were processing the Silver ore. In the midst of this booming production and with no end to the stocks in sight, the Pier Mine hit by accident an underground water source in 1361, which flooded the mine so fast that, it is said, 1400 miners drowned Soon the mine closed, and repeated attempts to drain the mine failed due to insufficient technologies. Still the memory of the rich deposits lost brought often very influential people, amongst them Emperors Rudolf von Habsburg, Emperor Maximilian I (he actually supervised drainage attempts himself) and a Government Commission sent by Empress Maria Theresia to study ways to regain access and to start Silver mining again. The outcome of their study was to build a 4km base tunnel from the Mur Valley North undercutting the flooded mine and to drain it that way. The tunnel was commenced but work had to be halted due to conscription of all able men before the start of a pending war. Two analyses from the literature show the grade of the mineralization:

- A sample from the Matthias Baue/S Field: Lead 53 to 60%, Silver 522 to 653g/t.
- Two analyses of Ober-Zeiring Pb-bearing rock (1919) on order of A. MÜLLER showed 85.87% and 81.93% Pb.

Mining of Silver lasted to about 1700 on a small scale, when it was replaced by the more lucrative production of the Iron-ores (Siderite, Ankerite and Iron-hydroxide form the oxidation zone). Iron production with a furnace at Unter-Zeiring from the Manganese-rich ore closed down in 1886 due to overwhelming competition by the much larger Styrian Iron-Mountain, the "Erzberg", and the introduction of coke steel furnaces. The end of Ober-Zeiring's Iron-production reminded people again of the Silver mineralization under water, and several companies employed renowned experts and scientists, especially from the Montan University in Leoben, Styria, to study the feasibility and economic viability of draining the Pier Mine. Their findings, opinions and conclusions all have been included and discussed in this report.

It was only in the 1950s that engineer R. HIRN, who had acquired the mining rights over the NE Field Mines of Ober-Zeiring had cleared the cave ins and collapsed mine workings, began to exploit Barite from the mine, a mineral that had been regarded as waste for the longest time. After investing a fortune HIRN's small operation took off and produced about 6700t of high grade Barite until 1964, when he had to close down operation for lack of working capital.

The study of the existing and available technical expertises and scientific publications, mine maps, technical reports and expert statements and detailed descriptions of the Zeiring Silver Mining District in general and especially the Ober-Zeiring area's West-, Middle- and NE Field for this report draws the following conclusions:

- Apart from the many studies concentrating mainly on the underground, the whole district is under-explored by modern technologies. Long overdue, exploration has been commenced by SMZ using various geophysical and geochemical surveys and some drilling.

- The potential for adding new volumes atthe historical mines of Ober-Zeiring, especially the flooded Pier Mine, is excellent At the time of the flood catastrophe ten smelters produced Silver and Ober- Zeiring's mint was in full production. Furthermore the mine's owners and even Austrian Emperors many repeated attempts to drain the flooded mine and re-start Silver production is evidence of this potential. . Therefore It is doubtful that the sudden decline in 1361 – the year of the flooding - had been caused by exhaustion of silver supplys.

- The Pier Mine needs to be de-watered to re-access the poly-metallic Silver stockpiles, and to re-evaluate tand make them available for mining exploitation. There is some risk involved in re-habilitating old mine workings, however the potential certainly exists.

- Given the number of artisanal mines found through the property claim area, the entire property area is is prospective for finding new potential high grade mineralization and therefore modern geophysical/geochemical surveys need to be completed followed by core drilling of identified targets identified by the surveys.

Appendix I contains a description of the mines, the mineralizations and their chemistry, together with the individual mines' geographic coordinates, further a list of minerals and results of geochemical analyses of mostly soil samples taken at the locations, plus a list of available literature and of maps concerning each area. This information was supplied by GBA for main mining fields– West Field, II – Middle Field, III – NE Field, IV – South Field, and V – Katzling Zone.

In Aurthor's opinion, one of the important aspects of the future exploration in the area may be re-visiting and re-sampling the dumps using the ICP MS Finish laboratory technique, with additional testing for rare earth elements. It is also quite possible that many mine dumps were not mapped, or properly mapped due to abundant forest and difficult terrain of the property. Modern satellite images may be very helpful in doing this mapping. The end-goal of such exercise would be calculation of some kind of the "Dump Resource Estimate" which may potentially become an important part of the Property development.

Exploration work in the District can be divided into two areas:

- The Zone extending from Unter-Zeiring along the western side of the Pöls River Valley mountain range via Katzling all the way to the Mur Valley near Pöls (the "Katzling Zone"), including the Zeiring South Field, the Zugthal-Haberer Berg and the Purgstallofen area at the zone's N-end, and

- The Ober-Zeiring West Field, Middle Field and NE Field Mines, all of them to the North and/or underneath the Blabach ("Bla Creek") Valley and the town of Ober-Zeiring.

The Unter-Zeiring –Zugthal - Katzling – Pöls Zone is described by more recent research as the area, where mining of Lead and Silver is said to have begun a century or more before mining activities moved further North to the three mining fields of Ober-Zeiring. It began presumably around the 10th Century in the Zugthal – Haberer Berg area and spread South to the Mur Valley, but little is known about these activities. From there mining spread eastward to the ridge on the West side of the Pöls Valley, SE of Unter-Zeiring, the Katzling Zone. The host rock for the mineralization here is the thick Bretstein Marble.

Nine mining "centers" or locations can still be recognized today (e.g. the South Field – Purgstallofen Center with the Matthias Baue, the largest and most extensive mine of the whole Zone, the Treffenthaler caved-in Adit (?) and Centers "A" to "G"). Of these the Matthias Baue was still accessible at least to some extent for WALSER in 1974. Judging from his detailed descriptions mining activities must have continued at Center "G" to the time when blasting was applied to driving tunnels. The remaining centers "A" to "F" show only mine dumps and caved in tunnel entrances. Center "D" near Katzling has the highest and densest number of such caved-in locations with small mine dumps. This area also has the widest spread "contamination" in form of Lead (and Silver) soil anomalies around some of the mine dumps.

Small mine dumps are typical for the Centers, except Matthias Baue, pointing to small mines or exploratory adits. They also indicate that the subject mines are older, from a time, when it was not possible to penetrate more than 50 to 100m into the mountain due to the ancient mining practice of driving tunnels and extracting ore by fire setting at the face, dousing the heated rock with cold water to weaken and crack it and then remove it with hammer and chisel.

That Lead and Silver mineralization were hit in these mines is indicated by mineralized pieces found on some of the mine dumps and by some soil anomalies around the sites. That the whole zone is prospective is also shown by several anomalies pointing at potential mineralized bodies made visible by geophysical surveys conducted by ZSM over almost the whole area between 2004 and 2006. The mineralized bodies mined in the old days and the ones indicated by geophysics are most probably poly-metallic Silver veins. Whether these veins are accompanied by metasomatic accumulations of Siderite and Barite like in the Ober-Zeiring West-, Middle- and NE-Mine Fields is unknown. A difference in mineral paragenesis and ore grades between the Northern Zone and the Southern Katzling Zone is not impossible, since it is much closer and parallel to the deep-seated Pöls River Valley Graben-Fault system. Here the hydrothermal metal-bearing fluids, which ascended along this fault system, intruded the Marble most probably under a higher temperature, because of the greater closeness to the source than the fluids that formed the mineralizations of Ober-Zeiring's bodies further away from the source to the West, where also low temperature metasomatic replacement of the carbonate host rock by Siderite and Barite is sign of low temperatures. This of course is hypothetical since not too much is yet known about the composition of the Katzling Zone mineralized bodies, except for few pieces of Silver-bearing mineralization found at some of the mine dumps or pick samples from outcrops.

The potential exists for finding and proving poly-metallic high grade mineralized veins and possibly other mineralizations in this Southern Zone - by geophysics followed by core drilling - as the continuation of the mineralized bodies that had been exploited from only very shallow mines in the old days. That such deeper mineralized bodies had not yet been touched by mining of deeper levels certainly adds even more to the potential of the Zone.

In comparison to the South Field's and Katzling Zone's mines the mines of the three Ober-Zeiring Mining Fields, West-, Middle and NE-Field, show a much higher grade and size of mine development with each of them reaching much deeper mining levels. This is due to the fact that the old miners in search of the vein- type Lead-Silver ore had discovered and were able to follow an extensive Karst-cave system with cave tunnels and huge openings parallel to many of the main mineralized bodies. The fluids that brought the mineral wealth of Zeiring, the mineralizing metasomatic (Fe, Ba) and poly-metallic hydrothermal Silver solutions, had followed N-S to NE-SW striking zones of weakness – fault and shear zones – in the Bretstein Marble host. The aggressive waters that created the caves did the same, often carving out large open spaces parallel to the mineralized bodies. This natural situation and setting offered three main advantages to the old miners:

- A much easier access with less tunneling work to often huge cave rooms next to the mineralized bodies.

- A natural and sufficient aeration of the (cave) mine buildings allowing the old miners to follow the mineralized bodies deep into the underground..
- Enough "empty" space underground at or near the stopes to dispose of all materials considered waste at the time (e.g. the marble host rock as true waste, and Siderite, Barite, and Sphalerite mineralization without known use at the time). This way only the ore mined at the time had to be transported to the outside to feed the smelters.

What makes an accurate assessment of the tonnage of Lead-Silver ore exploited from the mines and Silver produced by the smelters before and after the flooding catastrophe in 1361 a very difficult, if not impossible task is the fact that mining most probably commenced in form of many small individual mine operations, which neither recorded their production nor established plan views of their underground workings. They soon were acquired one way or the other by wealthy and often influential entities such as the Benedictine Monastery of Admont, which had the resources and the interest to make the Silver production at Ober- Zeiring profitable and prosperous. Huge piles of slag from up to ten smelters have been described repeatedly with still anomalous contents of Silver and Lead. Over time their volume decreased, the slag being used as material to consolidate the main roads of the larger area so that only little was left by 1860. Attempts to infer the tonnage of Lead-Silver ore produced and its Silver grade from the volume/tonnage of slag piles is similarly an impossible task for the lack of precise data. Analyses made in the past of slag samples showed a Lead content around 4.5% and Silver between 1.3 and 22.5g Ag/t.

It is clear that mining of the Lead-Silver at the Pier Mine/Middle Field did not come to a sudden halt because of exhaustion of the mine's supplys, but because of their (temporary) loss due to the flooding catastrophe.

No records or mine plans are available until the 18th to the 19th Century, when the deposits and "waste" piles of Iron ore (Siderite, Ankerite and Iron-hydroxide) were "discovered" as a resource in growing demand and readily available in the old Ober-Zeiring Silver mines. Only then mining engineers and scientists by necessity began to map the underground workings and to study the deposits. Iron mining and production from a smelter built by KRANZ at Unter-Zeiring commenced around 1783 with a yearly production of 500-
700t until 1832 (Total over 25,000t). 1832 NEUPER, owner of several local forges, took over. His operation lasted until 1886 with a yearly production of about 1,250t or a total of 65,000 to 70,000t.

From the turn of the Century (19th – 20th) on there was repeated strong interest to revive Lead-Silver Mining including draining the flooded Pier Mine, but the Great Depression and WWII stopped these ventures until the late 1950s, when HIRN reopened the NE-Field mines via the Johannes Base Tunnel to mine the Barite mineralization. He produced in total 6,735t of pure Barite, but had to abandon the operation for lack of capital. During this mining operation the old mine buildings were surveyed and mapped in great detail.
Silbermine Zeiring GmbH has already conducted geophysical surveys, combined with soil and rock geochemical surveys, and with surface and underground reconnaissance. Important targets are veins of Marcasite exposed underground in the NE Field Mine and indicated further to the North by geophysics. Samples of this vein are said to have shown interesting values of Gold. There are also reports about ore microscopic research, which found that the Zeiring Silver contains Gold. Another target for SMZ's exploration was the Barite high mineralization.

Few words, in Author's opinion, should be said about the Geochemical Surveys at Ober-Zeiring – Möderbrugg and Katzling Zones (see Item 9: Exploration). Although the results, in the Author's view, are valid (see Item 11) they, nevertheless seem not to be representative of the area. First of all, the soil samples were taken on the hill sides with the slope angles mostly of 25-30 degrees, and this fact makes it very probable that gravitational and fluvial processes played an important role in the soil movements. Second, the number of samples is very low for the survey, and the distribution of the samples is far from areal; it is rather linear. The sampling was done by the geophysical team unsystematically. The Author believes that systematic geochemical areal survey on a grid with at least 100m interval should be conducted over the areas covered by geophysical survey.
Richmond Minerals's acquisition of 99 permits from Silbermine Zeiring GmbH is made with purpose to further explore and develop Oberzeiring Property. In Author's opinion the Property has great potential not only as an area where the old mines could be brought back to life, but also it is very promising for discovery of the new polymetallic deposits.

Item 26: Recommendations

The Author made the following recommendations on the basis of the evaluation of the previous reports on various aspects of historical mining and geological investigations, on recent geophysical and geochemical exploration results, on the discussions with geophysical consultants for Richmond Minerals Inc, and on the personal observation during visiting the property:

- Completing detailed Structural Analysis of the Satellite and other available aerial images of the Oberzeiring Property to develop a better understanding of relationship between structural deformation and mineralization.
- Re-visiting, re-sampling and assaying the dumps (ICP MS Finish, with additional testing for rare earth elements). It is also quite possible that many mine dumps were not mapped, or properly mapped due to abundant forest and difficult terrain of the property. Modern satellite images may be very helpful in doing the mapping. The end-goal of such exercise would be calculation of some kind of the "Dump Resource Estimate" which may potentially become an important part of the Property development.
- Compilation of the known geophysical data on a new base map
- Systematic geochemical areal soil survey on a grid with at least 100m interval should be conducted over the areas covered by geophysical survey.

- Seven IP-pole-dipole sections, recommended by OCZLON (2004, 2006), should be added during the further work in order to determine the precise location of potential drill targets
- Research and test by diamond drilling the structures indicated by geophysical surveys 2004 and 2006 (OCZLON) in the area to NE of the NE Field mines, NE of Hoanzl and SW of Möderbrugg, and other targets in the Katzling Zone. The drilling results should feed a proper re-interpretation of the available geophysical data.
- Additional ground magnetic surveying of the property to obtain information on the structural setting and geology - IP / resistivity and ground EM (VLF or a loop method) surveys over the areas where there are mine galleries (old mine works).

Approximate estimated costs for the phase 1 exploration program in Oberzeiring (CAD):

- Structural analyses of satellite and other images: **$ 5,000**.
- Compilation of the known geophysical data: **$ 10,000**
- Geophysical program (IP/geomagnetics/VLF/radiometry): **$ 150,000**.-
- Geochemical areal soil survey, additional mapping of unknown mine dumps and sampling of all existing mine dumps: **$ 120,000**.

Approximate estimated costs for the phase 2 exploration program (contingent on phase 1 results) for Oberzeiring are (CAD):

- Drilling - 2000m x $ 290/m = **$** 580,000-
- Sample preparation/lab analysis: **$ 30,000**.-
- Renovation/reopening of two main mine tunnels to gain access to the big old mine so that sampling, underground geophysics and drilling can be carried out: **$ 150.000**.

The minimum cost to prepare, initiate and conduct the above phase 1 and 2 programs is estimated at **CAD $1,045,000**

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Certificate of Author-Vadim Galkine, Ph.D., Dr. Sc., P.Geo

I, Vadim Galkine, Ph.D., P.Geo. do hereby certify that:

1. I am an independent consulting geologist and a citizen of Canada residing at 69 Yore Rd., Toronto, ON, M6M 1VV8.
2. I am a graduate ofthe Moscow State University, 1982, Majored in Geological mapping and reconnaissance of mineral deposits, and Ph.D - Moscow State University, 1988. Majored in Geotectonics, and Dr. Sc. - Moscow State University, 1997. Majored in Geotectonics.
3. I am a Professional Geoscientist (P. Geo.) in good standing with the Association of Professional Geoscientists of Ontario.
4. I have been practicing my profession related to mining and mineral exploration for over 30 years in a wide variety of locations in North, South, and Central America, Russia, Armenia, Africa, Middle East, New Caledonia. Specific to the content of this report is my work in Ontario on gold and silver deposits (Red Lake, Wawa, Timmins area), and work on the gold and silver deposits in Colombia, Chile and Armenia.
5. I have read the definition of "Qualified Persons" set out in N143-101 and I certify that by reason of my education, affiliation with a professional association (as defined in N143-101) and past relevant work experience, I fulfill the requirements to be Qualified Person for the purposes of NI43-101.
6. I visited the Obezeiring Project property (Austria) on September 11,2019 and collected samples for data verification
7. I am responsible for all Items in the current technical report
8. I am independent of the issuer applying all of the tests in section 1.5 ofNI 43-101.
9. As at the date hereof, to the best of my knowledge, information and belief, the technical report contains all scientific and technical information that is required to be disclosed to make the report not misleading.
10. I have read National Instrument 43-101 and Form 42-101FI, and this Technical Report has been prepared in compliance with that instrument and form.
11. I consent to the filing of the Technical Report with any stock exchange and other regulatory authority and any publication by them for regulatory purposes, including electronic publication in the public company files on their websites accessible by the public, of the Technical Report.

Dated this lOth day of January, 2020

Vadim Galkine, Ph.D., Dr. of Sci, P.Geo. "