Project 2011–2013 and from 2025 onward

Exploration of historic Silver Mine Suggental using Geoelectrics
Preliminary Evaluation Profiles 01 to 05

Together with Dr. Bock, the head of the Mining Association, and the miners, the EG Geosciences team carried out a geoelectrical survey.

Objectives:
1. Prospection of undiscovered ore veins
2. Search for historical tunnel sections

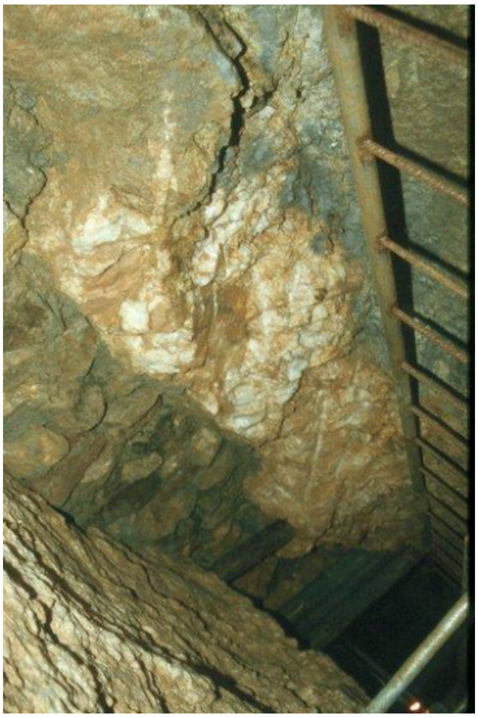
Mining site website [translation]:
"In recent years, various geophysical methods have been tested for their applicability in relation to historic mining and the exploration of hydrothermal barite veins—as in this specific case.
Methods used included geomagnetics, geoelectrics, seismic refraction, and gamma spectroscopy.
The results of the geoelectrical survey proved particularly convincing.
This measurement campaign was conducted in cooperation with EG Geosciences of the Einstein-Gymnasium Kehl. - Our sincere thanks and *Glück Auf!*"
https://www.silberbergwerk-suggental.com/silberbergwerk-suggental/silberbergwerk-geologie-2/

History

Mining in the Suggental probably began as early as Roman times, reached its peak in the 13th century, and ended in 1288 due to a catastrophe. Afterwards, the mine was repeatedly reopened, especially during the 18th century; mining operations have been dormant since 1938.

Miners at Tunnel II 1937, Foto Kury Family, https://www.silberbergwerk-suggental.com/

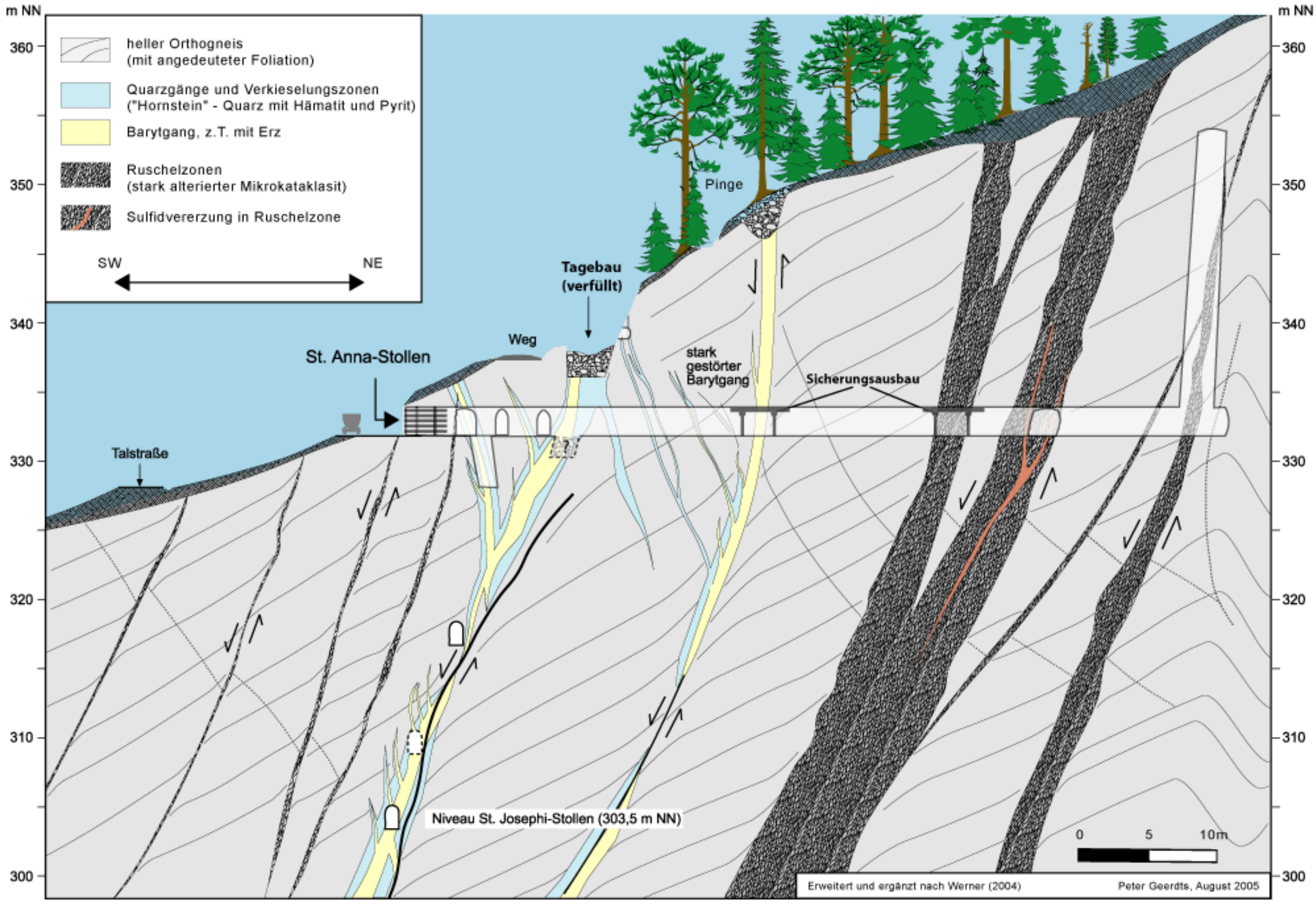
Geology



The Suggental is located within the Central Black Forest gneiss massif, with paragneiss and orthogneiss as the surrounding rocks.

Along a major tectonic fault, a hydrothermal vein deposit was formed. The ore vein consists mainly of quartz and barite, containing embedded sulfides such as galena, tetrahedrite, pyrite, and chalcopyrite, which were mined as silver-bearing minerals.

Several phases of mineralization indicate complex formation processes at temperatures below 200 °C from highly saline solutions.
Source: https://www.silberbergwerk-suggental.com/silberbergwerk-suggental/silberbergwerk-geologie-2/

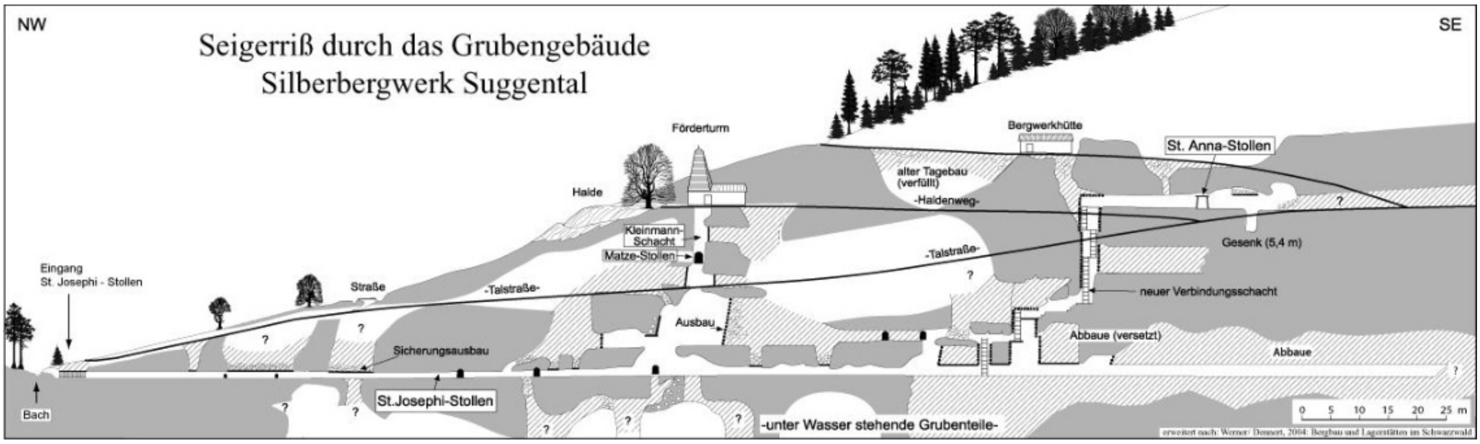


Green Vault: Secondary copper minerals (malachite, brochantite, chrysocolla) formed by the oxidation of copper ores in the quartz veins of the Suggental silver mine (mine website)

Quartz vein with a sulfide ore seam (probably galena or tetrahedrite) from the Suggental silver mine (mine website)

Quartz-sulfide ore from the Suggental silver mine – quartz with pyrite and chalcopyrite (mine website)

Currently accessible sections of the mine



580 meters of tunnels are currently accessible, with a maximum elevation difference of 50 meters

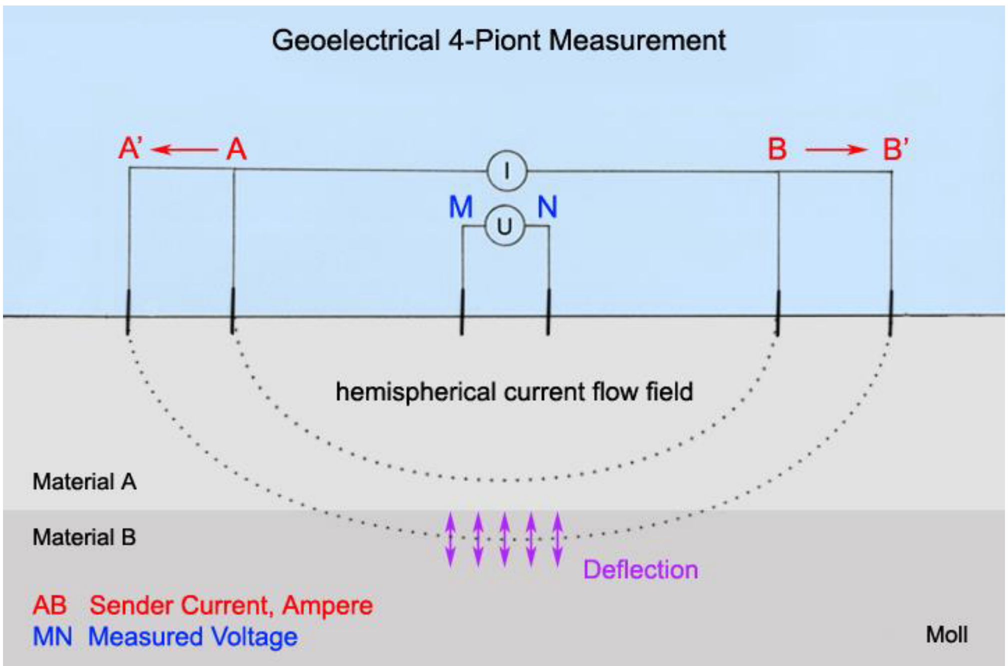
Geoelectrics

Methods Used

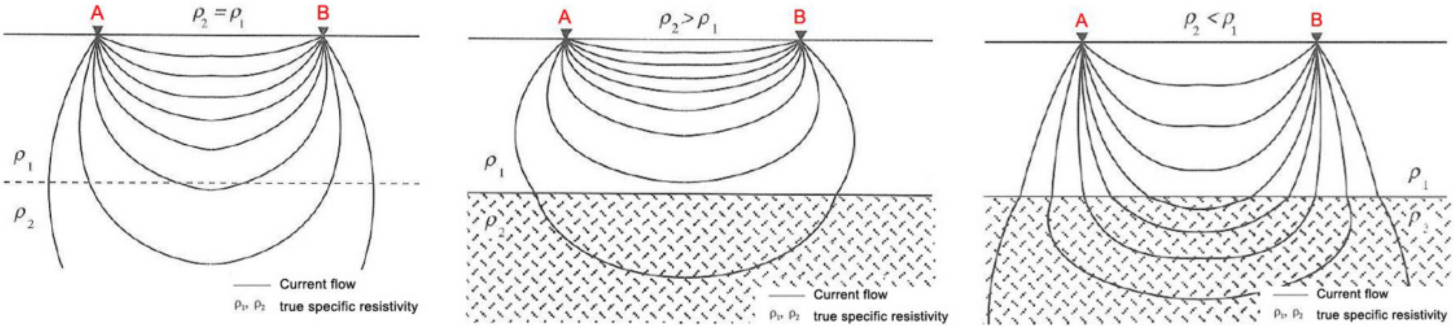
Electrical Resistivity Tomography (ERT):
ERT determines the spatial distribution of electrical resistivity in the subsurface by injecting current and measuring the resulting voltage response. Differences in resistivity allow conclusions to be drawn about lithology, porosity, water content, and structural disturbances of the Earth's crust.

Induced Polarization (IP):
IP measures the delayed decay of the electric field, capturing the ability of rocks to store electrical charges. This behavior is typical of clay-rich or sulfide-bearing zones and is specifically used for mineral exploration and the characterization of fine structural features.

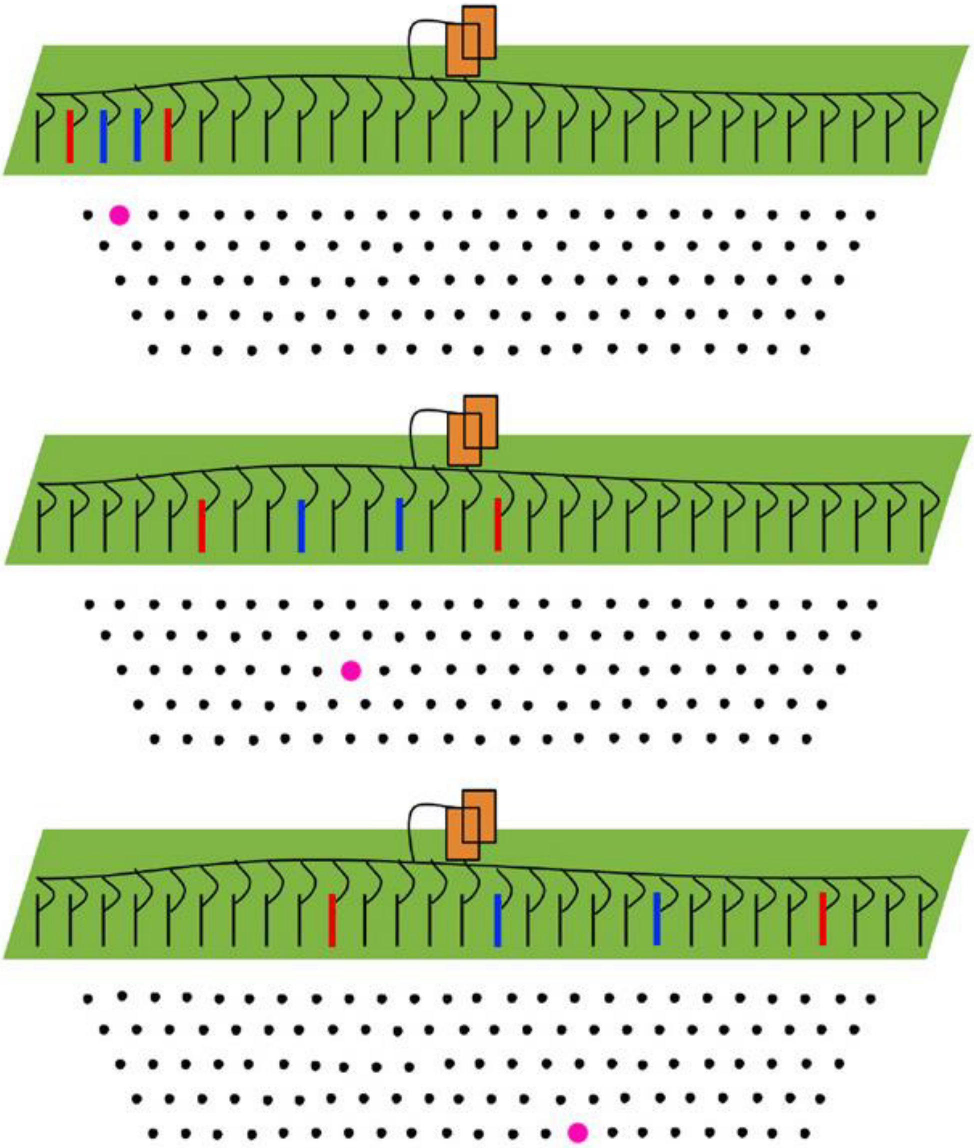
Both methods are measured **simultaneously** and provide a complementary electrogeophysical model of the subsurface.



Deformation of Geo-Electrical Current Fields depending on Changes in Ground Conductivity:[1]



2-dimensional Resistivity Measurement:



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[1] Script "Geophysik", Prof. Dr. A.Henk,

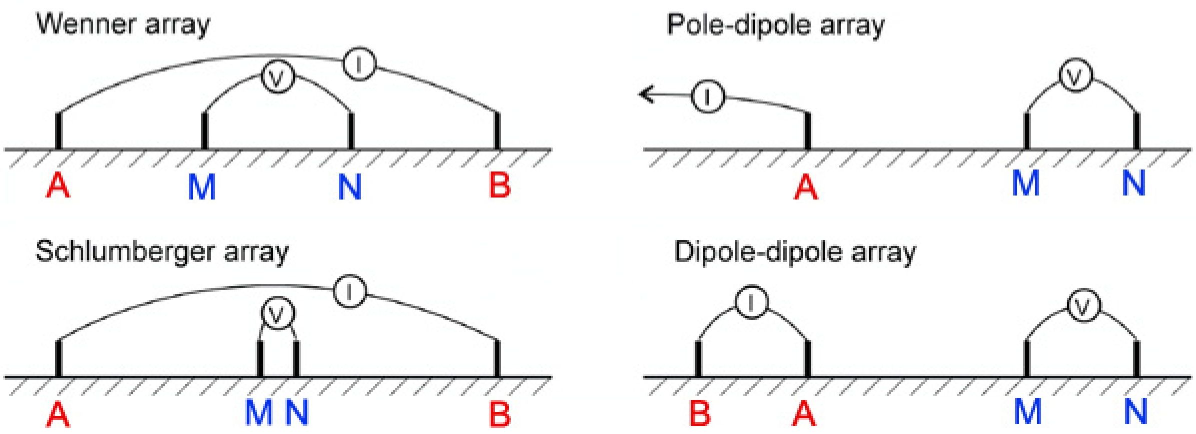
In **2D ground resistivity measurements**, the four-point electrodes are gradually shifted horizontally and their spacing is increased. This produces a dataset that captures both horizontal and vertical variations of the subsurface. Using forward-modeling software, a two-dimensional resistivity profile of the subsurface is calculated.
The resulting, differently sized hemispherical current flow fields are simultaneously used to detect zones of varying chargeability (inducibility) and to compute a **2D IP profile**.

<u>Measured Quantities and Derived Units for the Profile</u>
During **resistivity measurements**, current (I) and voltage (U) are recorded. From these values, the **apparent specific resistivity [Ohm·m]** is calculated, since the ground acts as an inhomogeneous conductor, and the measured data represent averaged conductivities of different layers.

In addition, during **IP measurements**, the chargeability is determined — the phase shift between current and voltage in **milliradians (mrad)**, which describes the delayed discharge of stored electrical charges.

4-Point-Measurement Arrays:

In geoelectrical surveys, various electrode configurations (arrays) are used to visualize different subsurface structures as effectively as possible.



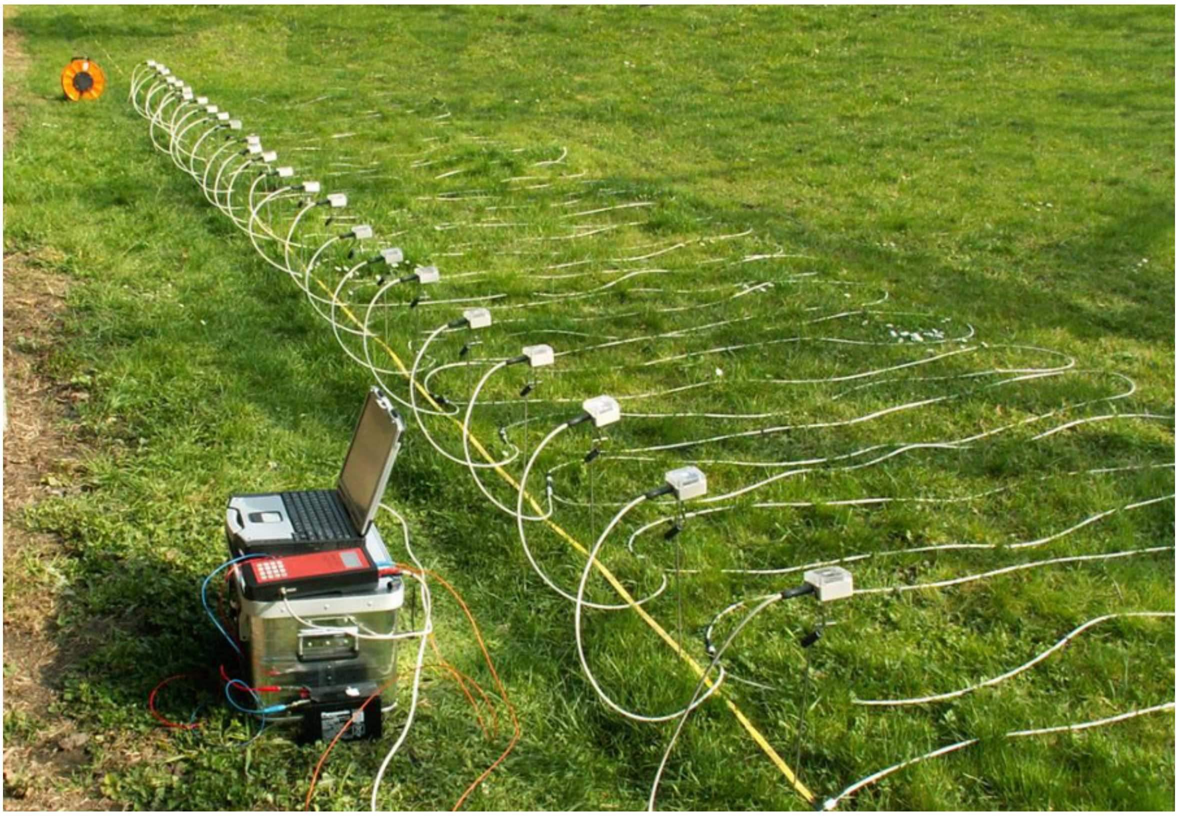
The **Wenner array** provides stable, high-quality data and is used for a general overview of the subsurface.

The **pole–dipole array** enables the detection of broad horizontal structures at greater distances.

The **Schlumberger array** allows for detailed depth exploration and offers good resolution of horizontal layering through localized current loops.

The **dipole–dipole array** provides high sensitivity to vertical resistivity alteration and delivers fine resolution of vertical structural changes.

Manual Measuring Equipment:
Student-built system: 370 m serial cable, 75 stainless steel electrodes, connection box.
Loan from Lippmann company: 4-Point Light measuring device, maximum sender current 50 mA (Moll)



Automatic Measuring System: Loan from Lippmann company – active electrodes with **4-Point Light** measuring device, maximum output current 100 mA; (Moll)