

Field Trip Report 2022/2023
University of Helsinki SEG student chapter



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Introduction

In November, our chapter organized an excursion to explore two significant mining sites in Eastern Finland: Talvivaara mine and Outokumpu historical mine. The excursion was aimed at chapter members and students with an interest in economic geology. A total of 16 enthusiastic students participated in this educational journey, with transportation generously provided by the Department of Geosciences and Geography at the University of Helsinki.

Day 1: Journey to Tahko

Our journey commenced with a 450-kilometer drive from Helsinki to our accommodation in Tahko. This was our base for the whole excursion, from where the Talvivaara mine located 130 kilometers north and Outokumpu 100 kilometers south.

Day 2: Talvivaara mine

Geology of Talvivaara mine

The Talvivaara deposit is located about 15 kilometers south of the Lahnaslampi mine, within a geological formation called the Early Proterozoic Kainuu schist sequence. This area contains fragments of serpentinite rock mixed in with the metamorphic sediments of the Kainuu schist sequence, which have transformed into talc-carbonate rocks.

The Talvivaara deposit itself contains a substantial amount of ore, totaling 300 million metric tons. This ore has relatively low grades of nickel (0.26%), copper (0.14%), and zinc (0.53%). These ores were formed from organic-rich muds with metals that were deposited in oxygen-deprived conditions in a basin linked to seafloor spreading.

Due to geological processes, there's a specific layer within the deposit that contains higher concentrations of nickel, copper, and zinc, with more than 0.8% of these metals. This layer can be as thick as 330 meters and stretches continuously for 10 kilometers according to geophysical maps.

The primary types of sulfide minerals found in this deposit are pyrite and pyrrhotite. Additionally, chalcopyrite, sphalerite, alabandite, and pentlandite are also present, occurring as both fine-grained disseminations (very small particles) and as larger grains within quartz-sulfide veins. During geological changes like recrystallization and remobilization, some of the nickel initially locked in fine-grained pyrite has shifted into pyrrhotite and pentlandite minerals (Kumpulainen, 2001).

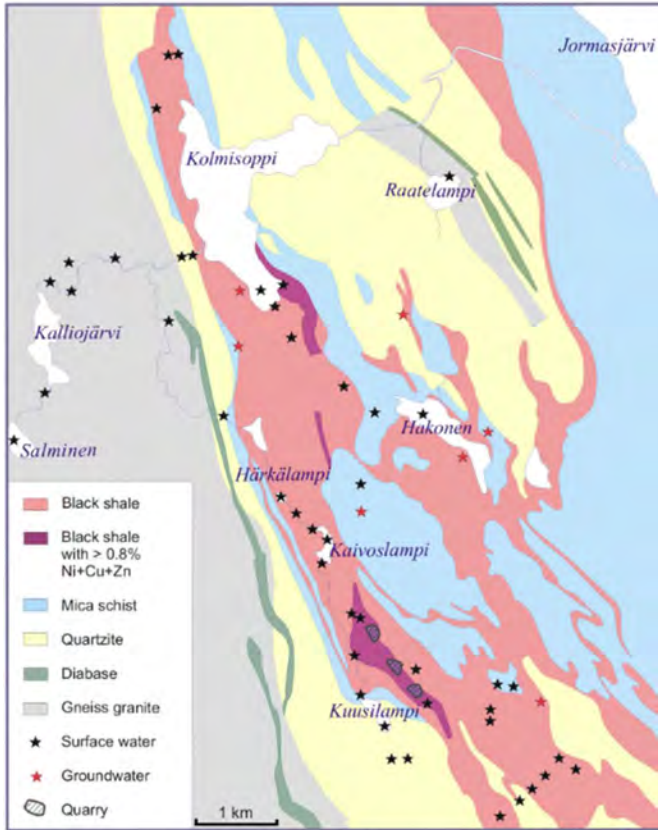


Figure 1. Geological map of the Kuusilampi-Kolmisoppi black-shale area (Loukola-Ruskeeniemi et al., 1998).

Visit to Terrafame

Upon our arrival at Talvivaara, we were greeted by the chief geologist, who provided an informative presentation about the company and emphasized safety measures for our visit. Following these introductions, we embarked on a guided tour of the mine offices. Terrafame generously hosted lunch for the group, after which we toured the bioleaching facilities and construction sites, ultimately reaching the mining site hut.

During our visit, we had the privilege of meeting various geologists working at the mine, each of whom presented different projects and work tasks within the company. These presentations were delivered by the chief geologist, exploration geologist, mine geologist, structural geologist, and a processing plant engineer. The engagement of students in discussions and questions during and after these presentations enriched our learning experience. The visit concluded with a trip to a viewpoint overlooking the open pit mine.

One notable aspect of the excursion was the opportunity for students to network with recruiters and employees at Terrafame. As a result, one student secured a master's thesis topic and a Summer Intern position, while another was offered a permanent position within the mining company.



Figure 2. Attending students in the viewpoint of the open pit mine.

After an enriching first day at Talvivaara, we returned to our accommodation in Tahko, where we had spent the previous night.

Day 3: Outokumpu Historical Mine

Geology of Outokumpu

The Outokumpu ore type consists of two main types of deposits: one with concentrated copper, zinc, and cobalt (Cu-Zn-Co) known as "massive," and the other with dispersed nickel (Ni) sulfides called "disseminated." These ore formations are found alongside a variety of rocks such as serpentinites, calc-silicate rocks, quartzite with chert, and dark-colored schists within mica gneiss sedimentary rocks.

The Outokumpu Cu-Zn-Co deposit is mostly rich in pyrite, while the other deposits are mainly composed of pyrrhotite. These ores initially formed through hydrothermal processes on the seafloor but were later affected by thrust tectonics, causing the originally thin layers of ore to transform into thick, massive plates.



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The unique mineral composition, including a significant presence of chrome silicates, is a result of the metamorphic changes that occurred under specific conditions known as the middle amphibolite facies within a hydrothermal deposit associated with ultramafic rocks (Papunen, 1987).

Visit to the Outokumpu historical mine

On the third day of our excursion, we embarked on a 100-kilometer journey from Tahko to the Outokumpu historical mine and museum. The Outokumpu mine, which operated from 1910 until 1989.

Our guides for the day were geologists and engineers who had worked in the mine, providing valuable insights into the historical development of the mining industry and the Outokumpu mine deposit type. This guided tour offered a unique perspective on how the mining sector has evolved over the years. There is to this day exploration potential in the area, which made discussing with older generation of geologists in the area the whole visit educating and useful for future career.

In a noteworthy follow-up to our excursion, one of the guiding geologists, Eero Rauhala, was invited to speak at an anniversary event for the geology program's student organization in Spring 2023.

With the conclusion of our tour at the Outokumpu historical mine, our excursion came to an end, and we made the journey back to Helsinki.



Figure 3. Attending students in Outokumpu historical mine. Eero Rauhala, former Outokumpu geologist and guide on the left.

Budget

University of Helsinki SEG student chapter applied for funding from Round II 2022 Student Chapter Funding Disbursement from the Stewart R. Wallace Fund. Total of 750 US dollars, equivalent to 703.15 euros at the time, was distributed in 03/07/2023 for the excursion that happened between 11/10/2023—11/12/2023.

Different expenses are specified in Table 1. Total cost of the excursion was 1314 US dollars, equivalent to 1287.72 euros. From granted Stewart R. Wallace Fund 564 US dollars, equivalent to 552.72 euros, was left for University of Helsinki SEG student chapter to pay.

Previously acquired funding from K.H. Renlund Foundation for starting the student chapter activities was used to cover expenses after using the fund granted from Stewart R. Wallace Fund. Participants were not required to pay the leftover sum, as to encourage future interest to join excursions.



Table 1. Specified costs of the excursion.

BUDGET		
Category	Total price (€)	Total price (\$)
Cabin x2	640	627.2
Outokumpu Old Mine entrance fee	64	62.72
Outokumpu Old Mine guided tour	120	117.6
Gas for the van x2	490	480.2
Total	1314	1287.72

Conclusion

The excursion to Talvivaara active mine and Outokumpu historical mine was a valuable learning experience for our chapter members and students interested in economic geology. It provided us with practical insights into the mining industry, fostering connections between students and professionals. We extend our gratitude to the Department of Geosciences and Geography at the University of Helsinki and the staff at Terrafame for their support and hospitality during this educational journey.

References

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