FRAME
FORECASTING AND ASSESSING EUROPE'S
STRATEGIC RAW MATERIALS NEEDS

Newsletter
OCTOBER 2019

www.frame.lneg.pt

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Welcome to FRAME Newsletter #4!

It has been a busy time for FRAME in particular for WP8 (Link to the Information Platform). This work package requires to deliver the final data package to the Information Platform as well as testing of internal means in terms of data storage, treatment and delivery.

Because data and data delivery is such an integral part of this work package, a workshop focusing on this was promoted in mid-September. A "Data Collection and Harmonisation Workshop" was held at LNEG in Portugal and attending the workshop were the work package leaders representing 7 EU countries (Portugal, Germany, Sweden, Belgium, Norway, Finland and France) as well as members of Mintell4EU and several IT experts from various countries. Discussions were fruitful and useful to streamline and allow for the supply of prospectivity maps for critical and strategic minerals in Europe. This workshop once again highlighted the connectivity and interaction between the Raw Materials projects as well as other current H2020-funded projects dealing with Raw Materials.

Daniel de Oliveira, FRAME Project Coordinator

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GeoERA RAW MATERIALS

Field visit to historic mining sites of Přibram and Kutná Hora

Petr Rambousek (CGS), Henrike Sievers (BGR), Stanislaw Mikulski (PGI-NRI)

Europe is largely dependent on global raw materials markets and supply from international sources, but has a long mining history. FRAME WP7 investigates whether historic mine sites have the potential to feed in to Europe's future demand for raw materials. Not only the main commodities, but also CRM might still be contained in the remaining resources of those deposits as well as in mining and processing wastes.

WP7 partners CGI, PGI-NRI and BGR together visited the historic mining areas of Kutná Hora and Příbram in the Czech Republic to collect more information on mine wastes and their potential for CRM.

Kutná Hora

The polymetallic Kutná Hora ore district (Ag, Pb, Zn), located about 70 km E from Prague, represents a characteristic Variscian vein type polymetallic mineralization in the Bohemian Massif. The vertical development of the mineralization shows similarities with ore deposits in the Freiberg area in Saxony. The mining activity can be traced back to the 10th century and continues until the 1990's. Base metal sulfide ores in Kutná Hora are known to contain Bi, Cd, In and Sb. Nowadays the mines are closed and flooded (since 1991) and the tailings pond from modern mining has been rehabilitated. Accessible dumps from older mining activities exist in the area. From 1290 until 1800, Kutná Hora produced 2,500 t of silver. During the last mining campange in the 20th century over 2.3 Mt ore with 2% of Zn and 0.4% Pb were excavated from the Turkank mine in the northern part of ore district. This ore contained also up to 350 g/t Ag and In in sphalerite (0.02 to 0.11wt.%). It was calculated that the remaining reserves and prospective resources contain 60 t of In.

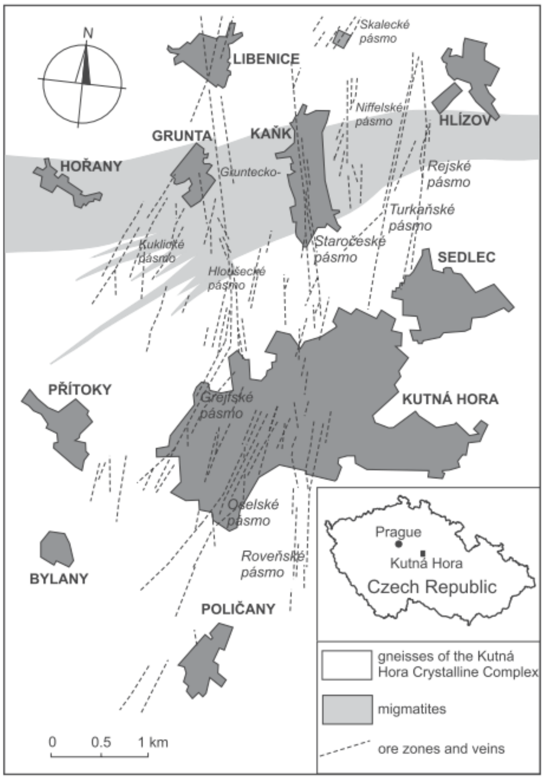

Figure 1: Schematic map of the Kutná Hora ore district with major zones (from Pažout et al. 2017)

Today the Turkaňk mine area is being rehabilitated by the state company DIAMO. Mine water with high content of As and other heavy metals is pumped to the surface for treatment before its release to a nearby stream.

Ancient mining activities are still influencing the area today. The collapse of a large mining chamber caused an about 100 m long sinkhole, which is located east of the village Kaňk.

Figure 2: Old mine Turkaňk at Kutná Hora

The medieval adit St. Jiří mine in the Oselské ore zone is part of the mining-historical exhibition of the Czech Museum of Silver and can be visited in the historical center of Kutná Hora. This adit was discovered in 1967 during a hydrogeological survey.

Příbram

Příbram is located about 60 km SW of Prague and is a world known polymetallic and uranium hydrothermal deposit. The district contains perigranitic veins and polymetallic deposits in two NE-SW trending zones, which are about 25 km long and 1-2 km wide. The northern zone contains the polymetallic mineralization with Ag, Pb and Zn, the southern mostly uranium, but with occurrences of polymetallic minerals.

Polymetallic base metal ores with Ag, were mined from 11th century on, while uranium mining started after the 2nd World War. Potential CRM contained in polymetallic ores were out of interest during the mining of U ores and were left on large dumps. After the end of the mining activity in 1991, the rehabilitation of this area began.

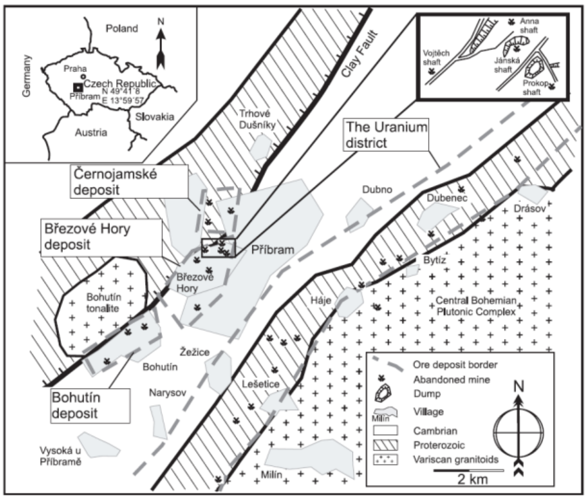

Figure 3: Schematic map of the Přibram Pb/Zn and U deposits (Škácha, 2009)

Mining areas with polymetallic ores were rehabilitated, but the U mining left many huge dumps with an expected rest of base metals and potentially CRM. The state company DIAMO started a project for rehabilitation of these areas.

The dumps with a total volume of over 25 Mm3 of mining waste will be removed to one central dump for sorting the materials for base metals ores with CRM, U ores and building stones. In general, the entire area is well documented from the geological point of view, but there is only little information about the content of minerals in the dumps.

During their visit, the FRAME partners had the opportunity to see the radiometric sorting facilities of the company Ecoinvest and a test facility of the company DIAMO, where sorting is based on X-ray analysis of the rock.

Figure 4: Příbram - Brod. Mining country with huge dumps

During the period between 1945 and 1991 the whole ore district produced more than 65,000 t of Pb (Pb ore grade 1.34 %), 509 t of Ag (Ag ore grade 146 g/t), 37,600 t of Zn (Zn ore grade 0.85 %), 11,000 t of Sb (Sb ore grade 0.25 %) and 48,432 t of U (max. grade up to 100 kg U/m2). In total 23 km of shafts and 2,188 km mine tunnels were built. As the first mine in the world the depth of 1,000 m was reached in 1,875. The deepest shaft in the district was uranium shaft No. 16 (1,850 m).

Figure 5: Sorting facilities at Přibram (company Ecoinvest).

Presently the only mining activity is from the dumps by the company Ecoinvest. Annual production is over 400,000 t of sorted and crushed building stones and additionally 400 t of U ore (uraninite and antraxolite) is extracted from the dumps and sent to the processing facility in Dolní Rožínka near Brno town in Moravia for U extraction.

Today DIAMO uses former buildings of shaft No. 15 as a central archive. The Mining Museum Příbram hosts a well-known mineralogical collection and exposition.

Figure 6: Native silver on the quartz-carbonate (Barbara vein, the Březavé Hory area), Mining Museum Přibram

Acknowledgements

The participants of this field trip thank DIAMO for allowing access to the mining objects and for detailed explanations. Many thanks to the Czech Museum of Silver in Kutná Hora and also to the Mining Museum Příbram. As part of the GeoERA FRAME project this field trip was supported by Czech Geological Survey.

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Preliminary prospectivity mapping on energy critical elements (Lithium- cobalt- Graphite) in Europe

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The FRAME project is part of the H2020 GeoERA platform and consist of 19 partners from different geological surveys in Europe. A working group (WP5) collected raw data related to energy critical elements from partners and non-partners countries across Europe (Gautneb et al., 2019). One main objective of WP3 is predictive targeting based on GIS exploration tools and prospectivity assessments at continental scale for the targeted energy critical elements (Cobalt- Lithium- Graphite).

It aims a producing mineral prospectivity maps based on geostatistical tools, of high potential mineral provinces covering all EU member states and neighbouring countries. These prospectivity assessments will benefit from the latest developments in "data driven" mineral prospectivity methods that allow mapping at continental scale, such as the CBA, or "Cell Based Association", method developed by BRGM. CBA is an alternative to GIS supported prospectivity methods. It has been developed to better manage uncertainties related to cartographic data (highly significant at continental scale) (more details on methodology can be found in Tourliere et al., 2015). In addition, others methods will also be used: a classical WofE method and hybrid fuzzy weights-of-evidence (WofE) model for mineral potential mapping that generates fuzzy predictor patterns based on (a) knowledge-based fuzzy membership values and (b) data-based conditional probabilities applied to a comparison of the results.

Lithium:

Lithium mineralisation can be categorised as: Li (Greisen); Li (Pegmatite-aplite); Li (rare metal granite); Li (sedimentary-hydrothermal); Li (Brine) and unclassified Li occurrences in Europe. The distribution of lithium in Europe shows a strong clustering highlighting the Li potential of the Variscan belt in south and central Europe.

Graphite:

Graphite occurrences can be categorised into three different types; amorph, flake and unclassified based on classification carried out by WP5 in the FRAME project. Some of graphite occurrences occur in Archean or Proterozoic rocks in Fennoscandia and Ukraine, as well as Austria and graphite.

Cobalt:

Cobalt can be found as associated elements in several different type of mineralisation such as IOCG, VMS, laterite, magmatic Fe-Ti-V associations, magmatic Ni-Cu-Co associations, sedimentary hosted environments, etc. in Europe, most of the Co-bearing deposits show clusters in the Nordic countries. In the central part of Europe most Co mineralisation are associated with sedimented hosted to lateritic while in northern countries Co mineralisation are associated with magmatic Ni-Cu / Fe-Ti-V and VMS deposits.

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NOBEL prize to Li-ion battery inventors

By Håvard Gautneb

The 2019 Nobel prize in chemistry was awarded to John B. Goodenough, M. Stanley Whittingham and Akira Yoshino "for the development of lithium-ion batteries." This is a very good example research is a long as step wise process. **Stanley Wittingham** started in the 1970 to investigate on technologies that could lead to fossil free energy. He discovered an anode made of Li metal with a strong property to release energy. **John Goodenough** found out that even greater potential and more energy release was achieved by using with lithium oxide intercalated with cobalt metal. **Akira Yoshino** created the first Li-ion battery in 1985, it used petroleum coke intercalated with lithium.

The first Li-ion battery entered the marked in 1991, instead of petroleum coke it used graphite in the anode material. Lithium-ion batteries have deeply affected our lives and laid the foundation for a fossil free fuel, the greatest benefit to our environment.

This story and the technology that lie behind the Li-ion batteries, starts with the 3 basic raw materials lithium, cobalt and graphite, commodities that are all found in Europe, but the batteries as well as their raw materials are presently for the most part produced outside Europe. The main aim of the FRAME project is to assess the occurrences and potential for all raw materials in our fossil free future.

Link: https://www.nobelprize.org/prizes/chemistry/2019/summary/

Jong B. Goodenough

M.Stanley Wittingham

Akira Yoshino

Ill. Niklas Elmehed. © Nobel Media.

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