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## Mining the energy transition – European young careers on excursion in Spain

GREENPEG 2022 Focus Group Meeting discovers our experts of tomorrow

*By Wolfgang Reimer (GKZ Freiberg)*

The mining industry plays a focal role in addressing global warming and supporting the global energy transition, despite being a notoriously energy-intensive and high CO<sub>2</sub> emitting industry. The green energy generation requires much more metals and minerals, and therefore more mining activity. The reason for this is that many new-energy items – from turbines to vehicles – need greater volumes of minerals than the existing, old-energy equivalents, as new technologies require new raw materials that have yet to be explored. These relationships are rarely considered in the education and training of future specialists. There is a lack of awareness, in particular in the social sciences and energy technology courses, about the contribution that

mining makes to the success of the energy transition and implementation of advanced technologies. In addition, the use of construction materials and land required for plants for the generation of renewable energies are hardly considered. How much cement, gravel and sand are “hidden” behind a dam wall for a hydroelectric power station? How much space and resources are required to generate photovoltaic electricity for the consumption of a small town and how big is the impact of a mine on the environment for the extraction of raw materials for the energy transition? These and other questions were the subject of a week-long field trip to mining and renewable energy production sites in north-west Spain and Portugal, a region where both, mining and modern power plants make an important contribution to value creation. In addition, Spain is not only one of the pioneers in

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Europe in its ambitious expansion of renewables, but also traditionally a mining country. However, it is also a place where the opposition to mining activities is growing. The GREENPEG Focus Group Meetings aim at introducing these topics and the role of raw material exploration to different target groups. [In 2021 science journalists were invited by the GREENPEG partner European Lithium Ltd. to visit Wolfsberg](#) lithium exploration mine in the Carinthian Alps to “look behind the curtain” and to participate in a discourse on the battery metals value chain. This year GREENPEG invited 20 undergraduate and MSc students of energy engineering and social sciences to learn about value chains in the mining and energy industries during a one-week excursion through North-West Spain and Portugal. These are students whose training does not normally deal with the topic of securing raw materials. The aim was to raise awareness of the relevance of raw materials (not only metals but also aggregates and

Cover: Iberdrolas´ [Aldeadávila Hydropower Plant](#) dam viewed from a sky walk close by.  
 Top: Group photo at Iberdrolas [Arañuelo solar farm](#); staying in front of a 3MW lithium batterY storage unit.  
 Bottom: Zamora skyline at the river banks of the Douro river in the early morning hours.



Bottom: Most important time the day in Spain; Dinner. Here at a Belle Epoque Spanish – Moorish style at Bilbao.  
 All photos: Wolfgang Reimer, GKZ



industrial minerals) and the role they play in society, in particular to manage the major challenges of our time such as the energy transition and climate protection as well as the development of advanced technologies. The one-week bus tour included extraordinary pilot projects in generating renewable energy, such as the [Mitruku Wave Energy Converter](#) in the Bay of Biscay, or places like the [Aldeadávila Hydropower Plant](#) in the Province of Salamanca which are important to maintain the stability of the intra-European power grid. At these sites, the students were explained not only the technology behind but also the raw materials needed to build these facilities. [Arañuelo solar farm](#) with its first ever installed 3MW storage unit (a show case example to investigate the minor metals and battery metals needed) and examples of critical raw materials open pit mining with [Saloro´s Barruecopardo tungsten mine](#) and the [Gonçalo Li-Pegmatite quarry](#) in the Guarda district in Portugal.



The Iberian Peninsula is rich in raw material deposits for the energy transition, but their extraction is also the subject of a lively debate among those affected. In order to better understand the positions of both sides, GREENPEG invited representatives of associations, research, mining developers and politics to a Round Table at the University of Salamanca. On the agenda were nine questions that dealt with the challenges of sourcing the energy transition, implementing the European GREEN DEAL, but also the socio-economic challenges and user conflicts connected to this task. Each question was followed by a poll of all participants for their views. In total 20 young students from Germany, Norway, Portugal, Spain and the UK participated.

With regard to the application process, they all already had a personal relationship with Spain, spoke Spanish and were curious about the connections between securing raw materials and our social challenges in Europe and the world as described at the beginning. Each delegation was coached by a partner of the GREENPEG consortium. Communication during the excursion was mostly in Spanish! In preparation for the topic and the sites to be visited, so-called fact sheets on the individual subject areas and discourses were handed out before the trip. It was about understanding and critical questioning in order to stimulate a discourse on site. It turned out that this approach of questioning but not presenting ready-made opinions strengthened the discourse.



Spain not only has raw materials and endless energy, but also a rich history with places like Bilbao, Zamora, Salamanca. Embedded in an old cultural landscape in transition like the vastness of the Extremadura or the foothills of the Pyrenees on the Bay of Biscay. And so the excursion was also an opportunity to understand the soul of Spain and to take a look at its cultural treasures. The detour to Portugal also gave insights into cross-border economic cooperation. Ultimately, all passengers, both young and old, were given a variety of opportunities to live the European spirit and listen to the other generation and understand them better. Because both have a common goal: the responsibility for the preservation of creation.

From top to bottom: Dust and earth: in the summer of 2022, Extremadura was hit by an extraordinary drought. Climate change is becoming increasingly noticeable. Scheelite processing at Saloro's Barruecopardo tungsten mine. Salamanca Cathedral at midnight. Round table at Salamanca University. All photos: Wolfgang Reimer, GKZ



# GREENPEG – MINE.THE.GAP cluster conference at Porto, Portugal

By Meng-Chun Lee (GKZ Freiberg)

The International Clustering Workshop initiated by the MINE.THE.GAP project aimed to stimulating inter-regional and cross-sectoral clustering activities and new project ideas focusing on raw materials value chain among participants. Its objective was to help the participants recognising other parties of interest to build a project consortium through information sharing and interactive sessions. The aim and objective of the International Clustering Workshop corresponded to one of the project objectives of the GREENPEG project, clustering in the sense of cross-fertilisation amongst Horizon 2020 and other European projects. The idea was to motivate the GREENPEG project partners to learn the know how from external sources and raise the impact of the exploitable results of the GREENPEG project. Considering the synergies that would be generated between the two projects and their networks (including the MINE.THE.GAP funded projects), the MINE.THE.GAP and GREENPEG projects decided to join forces and co-organised the International Clustering Workshop in order to maximise the impact.

## Output of the International Clustering Workshop

The Workshop took place on 26<sup>th</sup> of October 2022 in Porto, Portugal, home of GREENPEG partner University of Porto, with 85 registrants from 14 countries with diverse backgrounds ranging from private companies, cluster organisations, research institutes, universities, geological surveys, museum, cluster organisations to regional authorities. From the perspective of the GREENPEG project, the highlight was learning from three MINE.THE.GAP funded projects that were specifically invited because of the relevance of their technologies to the GREENPEG toolsets.

The OBIWAM project was led by Muon Solutions from Finland. Muon Solutions uses muon to reconstruct a density profile of the given object (i.e., muography). As a novel technology, Muon Solutions wanted to verify it in a known geological setting in the OBIWAM project. The goals were to detect the dense ore horizon, detect the indicators of known voids (i.e., tunnels) from the density data, guide further detector R&D and remove barriers from the successful commercialization of the used detectors. The test took place at the St. Christoph mine in the western Erzgebirge, Saxony, Germany, which is part of the Hämmerlein-Tellerhäuser-St. Christoph mineralised system. As the OBIWAM project was funded by the first MINE.THE.GAP Open Call, it was finalised in September 2022. The test results proved that the method can be successfully used in geology and mine technical/mining engineering and Muon Solutions is looking into further developing the methodology in the upcoming projects.

The SMARTMINING project was introduced by TerraDat Geophysics S.L., Spain. The project expected to demonstrate that a better geological, petrophysical and geophysical knowledge would focus the exploitation works in high-grade mineralization areas. The objectives include 3D mining models with geophysics, monitoring of the mobile fleet and integration of non-invasive mineral exploration, mobile fleet monitoring and mining operations. TerraDat foresaw analysis and planning of mining works before extraction, integration of other monitoring system during mining works, digital twins and new exploration technology with seismic nodes.

The 3DMAInt project was presented by in.mat-Lab. from Greece. The 3DMAInt project would develop a digital solution providing a 3D interactive imaging for smart exploration and exploitation of an industrial minerals deposit according to its final uses (e.g., insulation, construction, agriculture, etc.). The key of this solution lie in the combination of artificial intelligence and geo-statistics. The innovation will allow users to define their own scenarios regarding final applications for the deposit and retrieve a 3D bloc model of the corresponding market value. As a result, the solution would provide a better use of mineral resources and be a powerful leverage in raising awareness regarding resource optimization.

The technologies and solutions introduced by the MINE.THE.GAP funded projects were generated a lively interaction during the Q&A. Some questions targeted the technologies itself and the other were about the project ideas in general. Another proof was the positive feedback after the workshop.

## GREENPEG

- Learn about innovative technologies/solutions related to exploration
- Exchange ideas for potential follow-up activities, e.g., how the innovative technologies/solutions could be built on the GREENPEG toolsets
- Promote the GREENPEG project to increase impact

## MINE.THE.GAP and the funded SMEs

- Improve visibility of the funded projects and SMEs
- Learn about the mature Innovation Action funded by EU H2020
- Network with participants from the raw materials industry with different backgrounds
- Exchange ideas for potential follow-up activities, e.g., could the GREENPEG toolsets be integrated into the solutions
- Promote the MINE.THE.GAP project to increase impact

## D-MTUC an airborne multisensory platform

By Prof. Rainer Herd (BTU Cottbus-Senftenberg)



Ultimately, high resolution airborne geophysics assists with preliminary resource quantity and quality estimations, helps in efficient mine development and organization, and provides knowledge for managing detailed exploration. During the GREENPEG progress meeting, held in Porto in conjunction with the MINE.THE.GAP cluster conference Prof. Rainer Herd, geologist and head of the chair for raw materials and resource management at the Brandenburg Technical University of Cottbus-Senftenberg speak about a new airborne carrier system, the D-MTUC, developed at his unit and at present being used in Mongolia. D-MTUC is a measuring system based on an ultra-light aircraft, whereby the aircraft was specially built to be extremely low-interference (keyword "low noise") for

use as a measuring device carrier. This is a huge advantage over other measurement systems that use regular aircraft as instrument mounts. The D-MTUC measuring system currently has magnetic, gamma spectrometry and VLF sensors with the option of integrating other processes. Prof. Herd presented the results of raw material exploration with this system in Mongolia. He offered GREENPEG consortium to test use the system for the search for Li-bearing pegmatites within the framework of the project.

See also: [D-MTUC, an airborne investigation system based on a full composite ultra-light aircraft](#)

Figure / photo: Courtesy BTU Cottbus-Senftenberg, Rainer Herd



# GREENPEG Porto progress meeting resumes achieved milestones

By Carla Pueyo Lloret (UIO)

At the Douro's mouth, 3 km inland from the Atlantic Ocean, the GREENPEG Partners and Think Tank members met the last week of October. Porto (Portuguese Oporto), a fascinating and vibrant setting for the fourth consortium meeting hosted by the partner UPORTO (University of Porto).

The Porto Faculty of Sciences 'rector' opened the Progress meeting, then an intense morning filled with presentations of the latest project updates followed. Since spring, major achievements took place:

- a very comprehensible spectrometric database of European pegmatite ores and minerals gathered by UPORTO is now available in the GREENPEG Zenodo Community and new algorithms for satellite data processing have been developed
- The helicopter-mounted nose stinger is expected to arrive to TERRA in 11/2022
- The UPV's recently published results of geochemical haloes show, for the first time, evidence of anomalous concentrations of highly mobile elements (> 200 ppm Li, 30 ppm Cs, 300 ppm Rb, and 15 ppm Sn) forming the greatest haloes in regional metasediments indicating proximity to pegmatites
- The UIO Trace-element-in-quartz mapping results determine that quartz is a mineral that can be used as Li pathfinder (>30 ppm Li in and >100 ppm Al in quartz indicates spodumene mineralisation)
- The UCD and UNEXE suggested that using Principal Component Analysis (PCA) together with mineral associations can determine the presence of the different types of pegmatites if used as a vectoring tool
- The NGU developed a pilot for a piezoelectric instrument using state-of-the-art electronic components and advanced processing adapted to the measurements of piezoelectric signals

In the afternoon, the turn for a challenging discussion arrived: the 30 participants engaged in an energetic dialogue about the GREENPEG Toolset design and layout. The result was a more clear vision of the Toolset structure and its components. The Toolset will be based on the Duuring's mineral system analysis and a choice of a 4-type-model (anatectic NYF, anatectic LCT, pluton-derived-NYF, pluton-derived LCT) pegmatite ore body. Besides, the list of methods to be integrated in the Toolset was approved. Furthermore an Evaluation of radioactivity of pegmatite ores and best practices for exploration was recently delivered by the UNEXE; PNO started interviewing the selected GREENPEG stakeholders to gain a better understanding of the Market fundamentals for pegmatite exploration and mining, of the Pegmatite related Critical Raw Materials trends and opportunities, and about the latest Innovations in the exploration sector. After a long first day of technical content, the University of Porto team

is produced hundreds of kilometers upstream in the Douro district, stored in the red-tiled warehouses and cellar of the South bank town of Vila Nova de Gaia, then shipped worldwide by long-generations of expert British traders. One is captivated by the magic scenery and its view towards the UNESCO World Heritage designated historic centre of Porto with its most emblematic buildings: the gothic Se (cathedral), the tiled-faced of the Igreja (church) do Carmo and the Livraria Lello (bookshop) and two of the six bridges that connect the north and south banks, notably the Dom Luís I Bridge (180 metres), built in 1881–85 from a design by a disciple of the civil engineer Gustave Eiffel, and the Maria Pia Bridge (1876–77), designed by Eiffel himself. Portuguese hospitality did not fall short and the second evening entertaining consisted of an extraordinary walk in the 19<sup>th</sup> century-designed Botanical gardens, which hosted a spooky display of Alice in Wonderland. Photos: Reimer, Lee (GKZ).



had kindly prepared a surprise for the evening: a relaxing walk along the trendy South banks of the river Douro, topped with a mighty evening on board of a boat tasting the delicious Portuguese fish and seafood, and the famous Port wine. Such ruby liqueur



# Research collaboration with HORIZON Europe EIS project

By Wolfgang Reimer (GKZ Freiberg / GREENPEG) and Munia Hafsa (GTK / EIS)

Strengthen the cooperation between EU research projects and enhancing exploitation of their innovations to foster domestic sourcing. That was the message of the cluster conference of the EU HORIZON Europe funded Exploration Information System (EIS)–project which aims at mineral prospectivity mapping by use of artificial intelligence to make better use of mineral exploration data. In this regard GREENPEG project felt attracted as much of the data processed by this project can feed the EIS algorithms.

At the same time, it was clear that GREENPEG would be present at the EIS Cluster Conference held on 30<sup>th</sup> of November in Dresden, Germany. The one-day Clustering Workshop & Panel Discussion invited six panelists from three different mining developments in EU and three EU research projects to the workshop:

- Professor Vesa Nykänen: Exploration Information System (EIS) project
- Dr. Wolfgang Reimer: New Exploration Tools for European Pegmatite Green-Tech Resources (GREENPEG) project
- Dr. Richard Gloaguen: Vectors to Accessible Critical Raw Material Resources in Sedimentary Basins (VECTOR) project
- Martin Köhler, BEAK Consultants GmbH: Deutsche Lithium GmbH Zinnwald/Altenberg lithium mining prospect
- Mr. Jamie Newall (Golden Pet): Klingenthal copper exploration prospect
- Dr. Marco Roscher (SAXORE Bergbau GmbH): Tellerhäuser tin, zink, indium, tungsten mining

The aim of the panel discussion was how to better promote the cooperation between EU-funded research projects and industry and how to achieve synergies between the research projects itself. There is no doubt: such discussion is very much needed in order to maximise the impact of exploiting results and to respond on the challenges that mining projects are facing in the EU. It is common knowledge that the exploration and exploitation of more domestic resources is vital to the EU in order to overcome supply distortions.

On the one hand there is a lack in financial support and speeding up permitting. On the other hand Europe faces substantial lacks in technological exploration know-how in a number of ore deposit types. Social, environmental, and regulatory issues make these challenges even more complex. Another problem identified also during the workshop was public acceptance and making exploration more environmentally friendly as well as in line with EGS.



In this regard EIS and GREENPEG have much in common: One potential solution is to achieve synergies on the joint research work but also to learn how best to communicate the findings to the public. Further, it seems that exploitation and defending IPR is an issue that deserves more actions just from the beginning as it became clear in the GREENPEG exploration seminar held in summer 2022 also in Dresden. It has been recognized that EU projects tend to one-way roadmaps: they are less flexible they could the way they interact each other as part of the clustering and joint exploitation. In times increasingly online participation the participants felt not only in Dresden but also at GREENPEG Porto Cluster Conference this autumn how important personal meetings are in order to contribute to above mentioned measures. In consequence thereof, EIS and GREENPEG agreed on more ad-hoc actions, such as expert round tables, bilateral personal meetings, and site visits at their distinct test sites and / or mining developments in the respective partner countries. Both projects confirmed

that a major target group of concern are the Members of the European Parliament to be invited to such meetings and /or to organize special formats fit for purpose. For example a kind of satellite event to the EU Raw Materials Week together with the European Technology Platform on Sustainable Mineral Resources. In short: new ideas to make a real difference! EU raw material needs more campaigns tailored to specific target groups: Successful project stories need to better be advertised to a larger audience including the exploration & mining community and the regional authorities. More than this, junior mining companies need to work together with researchers also as full partners in European R&I projects. However, due to the quite often negative balance sheet, this would require a change of the EU grant mission guidelines. As the world seems to be retreating into a protectionist era where supplies could suddenly run dry, it is now the time to boost the implementation of EU projects that way in order to make them more sustain; a promise EIS and GREENPEG have given!

## GREENPEG at a glance

Many of the raw materials for green energy production can be sourced from lithium-caesium-tantalum (LCT) and niobium-yttrium-fluorine (NYF) pegmatites. Being relatively common in Europe, pegmatite deposits have the size and grade to especially attract small mining operations. GREENPEG aims at reducing exploration costs and impact on environment by developing two innovative and competitive toolsets, including: three new instrumental techniques and devices (piezoelectric sensor, helicopter-complementary nose stinger magnetometer, drone-borne hyperspectral imaging system), two new datasets and work flows for prospect scale (<50 km<sup>2</sup>) and district scale (50–500 km<sup>2</sup>) exploration. Validation will be ensured from industry-led trials at locations in Norway, Austria, Ireland, Finland, Portugal and Spain testing different surface environments, morphology and geological settings.

With the development of exploration technologies tailored to pegmatite ore, GREENPEG closes a technology gap, counteracts the lack of specific exploration strategies and increases the competitiveness of users. Furthermore, GREENPEG will feed the EU raw materials data base in support of responsible and secure sourcing and attracting investments.



# What's up in 2023?

## International Conference in Uppsala, Sweden, April 25–26, 2023

**Sourcing the European energy transition from domestic resources – vision or wishful thinking?** The one-day conference (April 25) questions Europe's raw materials supply security in the context of its economically valorizable raw material potential and of current geopolitics. It examines the existing and future framework conditions for mining projects and their downstream value chain (regulation, financing, permitting). The conference also focuses on the work of the European geological surveys for the territorial mapping of critical raw materials and highlights the potential for cooperation with Africa. On April 26th a site visit is offered to Bergby exploration project of United Lithium Ltd. In 2023 Sweden is taking over the EU Council Presidency. Sweden is one of the most important mining countries in Europe with great raw material potential for managing the energy and mobility transition and securing the raw material supply for future technologies. The conference is co-hosted by GREENPEG, the Swedish Mining Association SVEMIN and the European Technology Platform on Sustainable Mineral Resources (ETPSMR) and will take place in picturesque city of Uppsala, 20 minutes by train from Stockholm Airport. Participation is free of charge.

## GREENPEG toolset verification in Ontario, Canada, and GREENPEG-organized session at the joint GAC-MAC-SGA Meeting, Sudbury, May 24–27, 2023

GREENPEG partners have been invited by Lithium Americas Corp. to verify individual methods of the GREENPEG toolset at their exploration sites in Ontario, Canada. Of particular interest for both sites is to test the new method of the regional trace-element-in-quartz mapping to establish the province-scale chemical zoning of the Allison Lake pegmatite field to vector towards areas with lithium-mineralized pegmatites and to establish the genetic relationship to the nearby Allison Lake Batholith. The field campaign will follow the joint annual meeting of the Geological Association of Canada, Mineralogical Association of Canada, and Society for Geology Applied to Mineral Deposits held in Sudbury, Ontario, May 24–27, 2023, in which several GREENPEG partners will participate. In the frame of the conference, GREENPEG is organizing the session "Lithium in Pegmatites: Mineralogy, Petrogenesis and Classic to Innovative Exploration Techniques" together with Tania Martins from the Manitoba Geological Survey and Lee Groat from the University of British Columbia.

## Field studies on LCT pegmatites in tropical conditions in Mozambique

GREENPEG partners GKZ and University of Oslo (UiO) established a master student project cooperation with the Ministry of Mineral Resources and Energy of Mozambique and the Mining Academy Freiberg to study the applicability of GREENPEG exploration tools for pegmatites in tropical environments, i.e. in Mozambique. During the first stage of the cooperation, the master student Violeta Buzula applies for Erasmus scholarship to perform petrological studies of pegmatite ores at the UIO and the initial field inspection in Mozambique is planned for the second half of April 2023.

## GREENPEG Summer School, Tysfjord, Arctic Norway June 19–30, 2023

The GREENPEG Summer School aims at dual education giving advanced young careers strong practical insight into exploration for pegmatites, one of the most popular exploration targets in Europe now and in years to come. It will help students to familiarise themselves with the latest ground and airborne exploration technologies that meet the highest social and technical standards. Students will understand the economic aspects of mine development with a focus on exploration and investors' approach in financing mining projects. Besides the lectures and practical sessions, an open day with the local community, a day of outdoor social excursion and a barbecue evening will take place during the weekend. The programme language is English. In general, students will have indoor lectures in the mornings and practical sessions in the field during the afternoon. The programme covers topics including geochemical mapping of pegmatite fields, geophysical exploration methods, drone-borne hyper-spectral data acquisition, remote sensing exploration, satellite data interpretation, life cycle assessment for exploration and mining and Critical Raw Materials and circular economy.



## Editorial

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